

Evaluating the Impact of the Basic for Girls (B4G) Project in Zambia on Menstrual Hygiene Management

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ABSTRACT

Purpose: The primary objective of this research is to rigorously determine the effectiveness of the B4G project, an MHM intervention, in the Zambian context. In particular, this study will focus on the project's potential to improve and uphold the reproductive rights of adolescent girls.

Originality: This research seeks to fill a gap in the academic landscape by carefully evaluating the effectiveness of comprehensive MHM initiatives in educational institutions in Zambia.

Methodology: Using a Difference-in-Differences (DID) analytic approach, the research draws on data collected between 2019 and 2022. A methodologically matched comparison group was used to discern the impact of the B4G initiative on the target population, adolescent girls in Zambia.

Result: The B4G program in Zambia had significant positive effects on various key areas related to MHM, empowerment, and hygiene practices among young girls. It specifically improved attitudes towards menstruation, increased self-efficacy, and bettered problem-solving skills. However, while there were observed increases in both the MHM knowledge and gender gap indices, these were not statistically significant, potentially due to external factors such as the COVID-19 pandemic's effect on schooling.

Conclusions and Implication: This scholarly endeavor provides critical insights into the field of holistic MHM programs, particularly within the educational milieu of Zambia. It resonates with the evolving conceptual shift that advocates for educational institutions as the epicenter of MHM interventions, deviating from the conventional locus in health-centered institutions. The study underscores the critical nexus between education, empowerment and MHM.

Keywords Menstrual Hygiene Management (MHM), Adolescent Girls, Basic for Girls (B4G), Effectiveness, International Development Cooperation

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I. Introduction

Menstrual Hygiene Management (MHM) constitutes a pivotal aspect affecting the health of girls and women. Menstruation is a natural physical growth process that girls experience, but girls' menstrual experiences vary greatly depending on their economic environment, social support, and opportunities to access information (Hennegan et al. 2019). Specifically, empirical evidence reveals a concerning gap in menstrual hygiene education for adolescent girls in low- and middle-income countries, putting their psychological and physiological health at risk (Kapadia-Kundu 2014; Blake et al. 2018; Person et al. 2014). On a personal level, these girls face multiple challenges in managing menstruation, ranging from a lack of adequate resources to cultural taboos and societal stigma. Compounding the problem are environmental and societal barriers, such as harassment in educational settings and entrenched cultural misconceptions about menstruation (Blake et al. 2018; Long et al. 2013).

In the school environment, the lack of sanitary pads leads to shame and teasing from boys due to stains on their clothes, which has been shown to affect school attendance and academic performance (Crichton et al. 2012; Mason et al. 2013; Sommer 2010; Tegegne et al. 2014). This situation not only affects girls' educational trajectories, but also paves the way for serious health problems, leading to increased risks of urinary tract infections, inflammatory diseases, and HIV (Das et al. 2015; Critchley et al. 2020; Singh et al. 2022; Torondel et al. 2018). For example, a cross-sectional study conducted by Singh et al. (2022) in rural and urban government schools of Lucknow, India, found low awareness about Reproductive Tract Infections (RTI) among students of rural and urban government schools, with only 50.9% in urban and 71.3% in rural areas having fair knowledge, despite the health risks associated with poor menstrual hygiene. The findings highlight the urgent need for improved education on menstrual hygiene and RTI prevention to address the

persistent lack of awareness and change in hygiene practices.

The complexity of MHM issues goes beyond mere health concerns. The importance of MHM in schools has emerged as a universally significant issue across diverse geographical and cultural settings. Hygiene, sexual and reproductive health are recognized areas for health education interventions in schools. However, research from various studies suggests that in developing countries, the challenges associated with menstrual hygiene for girls in school settings are worsened (Philp-Howard et al. 2016; Alam et al. 2017; Alexander et al. 2014; Korir et al. 2018; Atari et al. 2021; Stoilova et al. 2022; Carneiro 2021). Most schools in developing countries, particularly in rural areas, lack private toilet facilities and reliable water supplies (Adams et al. 2009; Alam et al. 2017; Sommer et al. 2016; Mensah et al. 2022; Poague et al. 2022; Bolatova 2021). In addition, although schools are essential institutions for dispelling misconceptions and prejudices through the acquisition of scientific knowledge, there is a lack of educational content focused on MHM, making it difficult to improve the wrong attitudes and perceptions about menstruation formed socially and culturally.

Despite the continued emphasis on the importance of school-based MHM, there remains a notable gap in evidence-based academic and empirical studies evaluating the effectiveness of MHM interventions for girls in school settings (Sommer et al. 2021b; Hennegan et al. 2016). However, there is some evidence in Nepal, Gambia, and Bangladesh that school-based MHM interventions, coupled with improved facilities and education, lead to improvements in girls' physical and psychological well-being (Alam et al. 2022; Shah et al. 2022; Yilmaz et al. 2021). Nevertheless, more evidence is needed on the gaps in girls' knowledge and confidence about their maturing bodies in different sociocultural contexts and the linkages to their psychological health. Particularly, as the onset of puberty occurs earlier globally, there is pressing need to better understand the early adolescences groups

(Sommer et al. 2020). Although there is positive evidence that training for 10-14 year old girls in Ethiopia has improved their knowledge and confidence (Blake et al. 2018), very little research has been conducted on MHM for early adolescents.

This study aims to evaluate the effectiveness of a school-based MHM program for adolescent girls, a population that has been underrepresented in existing research. World Vision Zambia (WVZ) implemented the Basic for Girls (B4G) project in Magoye District, a rural area of Zambia, which included MHM education and latrine improvements for primary school girls in their pre-adolescent years. By evaluating the impact of the B4G project in Magoye, Zambia, on the promotion of sexual and reproductive rights, this research seeks to contribute to a deeper understanding of holistic MHM interventions in school settings and to rigorously assess the effectiveness of the intervention between the control and intervention groups using the Difference-in-Differences (DID) methodology. The DID method is useful for identifying the causal effects of projects and outcomes by comparing before-and-after relationships by establishing an experimental group and a homogeneous control group, eliminating unobservable factors that change over time, and identifying causal effect estimates. There is great room for natural improvement in direct knowledge and behavior related to MHM as girls age and accumulate experience. This study adopted the methodology to answer the question of whether post-intervention effects on girls were due to the B4G project, and will further contribute to the expansion of evidence-based research on MHM interventions for adolescent girls in developing countries.

II. Literature Review

1. MHM on adolescent girls and education

Adolescence, recognized as a vital intersection between

puberty and adulthood in the continuum of human development, is underscored by scholars for its quintessential nature in shaping health trajectories. Specifically, early adolescence (spanning ages 10 to 13) is posited as a transformative phase where individuals cultivate crucial preventive health and care behaviors, encompassing domains such as nutrition, sexual health, and reproductive health. Notwithstanding its importance, an array of literature reveals an unsettling trend: in low- and middle-income nations, adolescent girls often navigate this phase without comprehensive education on MHM (Kapadia-Kundu 2014; Blake et al. 2018). This gap in MHM education, as corroborated by a myriad of studies, not only leaves these girls inadequately informed but also jeopardizes their psychological and physiological well-being (Person et al. 2014; Long et al. 2013; Alam et al. 2022; Philips-Howard et al. 2016).

A closer examination of the individual experiences of these adolescent girls reveals the multifaceted challenges they confront regarding menstruation. These encompass inadequate menstrual hygiene resources, a limited understanding of menstrual processes, suboptimal hygiene practices, apprehensions associated with menstrual blood, and concerns over possible odors (Sahiledengle et al. 2022; Tegegne et al. 2014). When contextualized within a broader societal and environmental framework, the discourse on menstrual experiences extends to a gamut of other challenges. These include derision and bullying from male counterparts, particularly in educational contexts, entrenched societal misconceptions surrounding menstruation, pervasive discriminatory norms, and deeply ingrained cultural taboos (Blake et al. 2018; Person et al. 2014; Long et al. 2013). Collectively, these challenges not only augment the vulnerabilities faced by adolescent girls but also infringe upon their basic rights spanning education, health, and social inclusion, as emphasized by several international agencies and scholars (UNICEF 2019; Sommer et al. 2021a; Sommer et al. 2021b).

In developing countries, a range of studies show

that the complexities surrounding menstrual hygiene are exacerbated for girls when it is institutionalized in educational settings (Philips-Howard et al. 2016; Alam et al. 2017; Alexander et al. 2014). A growing body of empirical evidence highlights the difficulties girls face in managing their menstruation, particularly in schools, due to a lack of WASH infrastructure, inadequate premenstrual counseling, and sexist environments (Long et al. 2013; Alam et al. 2022; Hennegan et al. 2015; Davis et al. 2018). In turn, these challenges have a range of negative consequences for girls, including weakening their school attendance and grades, and damaging their self-esteem and health (Person et al. 2014; Alam et al. 2022; Miuro et al. 2018; Sommer et al. 2016). As a result of this discourse on menstrual problems faced by girls in low- and middle-income countries, the existing literature argues that access to menstrual hygiene products and water is essential (Sinha et al. 2018; Montgomery et al. 2016).

However, in recent work, scholars have argued that it is important to recognize that a product-centered paradigm is not sufficient to ensure girls' holistic well-being and rights. While aspects of hygiene and product access are undeniably important, navigating the maze of social stigma and creating a gender-equitable environment are equally essential. Previous research has shown that many barriers to girls' and women's health, gender equality, and empowerment are not simply due to a lack of menstrual amenities or facilities, but are closely linked to the social stigma associated with menstruation, which in turn hinders their adoption of optimal hygiene practices (Person et al. 2014, McLaren et al. 2021, Fialkov et al. 2021). As a result, product-based initiatives often maintain a myopic view and may overlook the most important and deeply rooted problem of social and cultural stigma (McLaren et al. 2021).

In recent years, the imperative need for effective MHM in educational settings, particularly in low- and middle-income countries, has become a focal point of research. Blake et al. (2018) underscored the

importance of educational interventions, highlighting the transformative role of the "Ethiopia Growth and Changes" puberty book in altering Ethiopian girls' perceptions and understanding of menstruation. In a similar vein, Phillips-Howard et al. (2016) spotlighted the challenges encountered by schoolgirls due to inadequate MHM guidance and facilities. Their work emphasized the exigency for robust, standardized research tools and methodologies to facilitate more strategic interventions.

Despite conceptual recognition of the need to integrate menstrual hygiene management (MHM), education, and the overall well-being of adolescent girls, there remains a notable lack of empirical studies that have tested this multifaceted strategy in the field. The integration of improved school facilities, awareness campaigns, and a paradigm shift in socio-cultural perspectives is crucial for a holistic approach to MHM. Yet, there is a distinct lack of empirical evidence to support these concepts. This study aims to fill this gap by providing field evidence to support and extend existing conceptual understanding.

2. DID methodology and impact of policy interventions

The Difference-in-Differences (DID) is a quasi-experimental research design used to estimate the causal effect of a policy intervention or treatment on an outcome of interest, by comparing the pre-and post-intervention changes in the outcome for both the treatment and control groups. The DID approach proves particularly useful in circumstances where random assignment is not feasible or ethical, as it addresses the unobserved factors that may have influenced the outcomes in both groups (Gertler et al. 2016, 130).

The Difference-in-Differences (DID) approach has been widely used in a range of fields to assess the causal effects of policy interventions (Card et al. 1994, Currie et al. 2001, Angrist et al. 1999, Chay 2005, Duflo 2001). In a pioneering study, Card et al. (1994)

employed the DID approach to examine the impact of minimum wage enhancements on employment in the fast-food industry and discovered no significant adverse effects. Meanwhile, Angrist et al. (1999) examined the influence of class size on student accomplishment using the DID technique, while Currie et al. (2001) utilized a similar approach to evaluate the consequences of Medicaid expansions on both health insurance coverage and medical care access in the United States.

Other studies have demonstrated the applicability of the DID method in assessing the causal effects of policy interventions in different sectors within developing countries (Duflo 2001; Banerjee et al. 2010; Das et al. 2016; Kazianga et al. 2013). Such studies can inform policymakers and development practitioners about effective strategies to improve welfare in low-income settings.

The DID methodology provides a strong framework for assessing the causal impact of policy interventions by contrasting outcome changes between treatment and control groups and factoring in unobserved variables that may affect the findings. This approach allows researchers to furnish important insights into policy intervention effectiveness, thereby promoting evidence-based policymaking.

III. Research Design

1. Case: Basic for Girls Project in Zambia

In Zambia, girls face significant barriers to proper education and employment. Major concerns include child marriage and inadequate MHM education. Only 46% of schools provide MHM education and 66% provide basic sanitation (UNICEF et al. 2018). Inadequate facilities and social taboos exacerbate girls' challenges, causing many to miss school during their menstrual cycles. In Magoye, while most schools have sex-

segregated latrines, many lack privacy and running water. With no specific provision for MHM in the Ministry of General Education's guidelines, such as the provision of water or sinks, girls face significant challenges in effectively using school facilities (Ministry of Education 2016). According to data from the Zambia Magoye B4G formative research document, a staggering 83% of schools do not have running water in their sanitation facilities. As a result, menstruating girls are forced to fetch water from hand pumps for their personal hygiene needs. In addition, the disposal of sanitary pads remains problematic, highlighting the urgent need for incinerators or an effective waste management system in schools. However, due to budgetary constraints, many schools struggle to provide the necessary facilities and infrastructure, exacerbating the challenges faced by girls and disrupting their educational experience.

Qualitative interviews from the Zambia Magoye B4G formative research document further underscore the significant impact of menstruation-related issues on girls' school attendance. Approximately 60% of girls reported missing school due to various menstruation-related challenges, including teasing by male peers, lack of access to sanitary products, and fear of using school toilets. These challenges are compounded by deeply entrenched cultural norms within the Magoye community, where menstruation is often stigmatized and viewed as shameful or unclean. As a result, discriminatory behaviors and rules against girls persist, hindering open discussions about MHM. Cultural taboos surrounding menstruation also prevent teachers, especially male teachers, from addressing menstrual issues with young girls, resulting in delayed or inadequate MHM education in schools.

The primary objective of the B4G project is to provide early adolescent girls with comprehensive education on menstruation and broader aspects of sexual and reproductive health. The intervention will be implemented from October 2019 to December 2022, and will cover 12 primary schools in the Magoye region.

B4G's Theory of Change (ToC) underscores the goal of this initiative, which is to empower girls by improving their understanding of menstrual hygiene management (MHM) and gender knowledge. The ultimate goal is to build their confidence and reduce potential risks. The overall goal of the project is to promote girls' rights and advance gender equality by increasing knowledge and adoption of appropriate menstrual hygiene practices.

The intervention has several components, including the implementation of the Comprehensive Sexuality Education (CSE) curriculum, life skills sessions, and MHM workshops to encourage girls' participation in clubs and sports activities. World Vision Zambia (WVZ) used a government-approved CSE curriculum, such as the Comprehensive Sexuality Education Framework endorsed by the Zambian government. This curriculum, designed for students in grades 5-12, covers six key areas: Relationships, Values, Attitudes and Skills; Culture, Society and Human Rights; Human Development; Sexual Behavior; and Sexual and Reproductive Health.

In addition, WVZ adhered to the National MHM Guidelines, which are accredited by the Zambian government. These guidelines consist of six units that focus on: WASH facilities and disposal options; information and knowledge about MHM; access to menstrual management materials; management of pain and discomfort associated with menstruation; guidance and counseling provided by focal point teachers; and community and family support.

2. Data Collection

The study was conducted in Magoye, Mazabuka District, Zambia, to evaluate the Basic for Girls (B4G) project through a randomized trial in 12 primary schools. In the Magoye area, there are a total of 22 primary schools, with 5,197 boys and 4,954 girls. Of the 22 schools, only 12 schools agreed to participate in the study. These schools were divided into two groups randomly: six in the intervention group and

six in the control group. Given the project's focus on early adolescents, the study focused on 5th-grade girls between the ages of 10 and 13 who were eligible for intervention.

The study participants were selected using a random number table among 5th grade female pupils attending the schools. Sample size calculations were conducted using G*Power 3.1.9.7 (Faul et al. 2007) by Stata 13.0. The study assumed a power of .90, a significance level of .05, and effect size of .5. The assumptions suggest a minimum sample of 70. Considering a loss of 40%, the study recruited 100 per group. The final sample number was 98 in the experimental group and 66 in the control group. Preliminary data collection for this study took place between February and March 2019, before the implementation of the B4G project. Data were collected before the project was implemented in the schools selected to participate, and data from the control schools were also collected during this time. Following the completion of the B4G project, the final data collection took place from February to March 2022, with enumerator-led surveys facilitating both the initial and final data collection phases.

The data collection was conducted in Tonga, the most commonly spoken language in Magoye. To ensure data accuracy, reliability, and timely analysis, data collection was conducted using tablets equipped with ODK software. The team that conducted the survey consisted of ten trained field enumerators, all of whom were university graduates with a solid foundation in data collection.

The study collected data in three domains of measures at baseline and at the 24-month follow-up: 1) Knowledge, practice, attitude, and cultural beliefs on menstruation; 2) Self-efficacy and empowerment; and 3) Gender norms on sexual health, and violence (see <Table 1>). The quantitative tools were modified from the Global Early Adolescent Study (GEAS) questionnaire (<https://www.geastudy.org/>) and previous studies. And the cultural belief items were identified from formative research.

<Table 1> Description of Variables

Variable	Description
Knowledge	Knowledge of MHM regarding understanding the menstrual cycle, the meaning of menstruation, and the causes of menstruation * One point is awarded for each question with the total represented by the sum of the points, and higher scores indicate more knowledge of menstruation (0-3)
Practice	Practice regarding the a) use of sanitary pads on type, b) clean and dried condition, and c) frequency of changing pads (1 if all conditions are met, otherwise 0)
General attitude	Attitude toward menstruation, which consists of a total of 6 questions on a 4-point scale, and is calculated as the average of all questions. The higher the average score, the more negative the attitude is * Higher scores indicate more negative attitudes toward menstruation (0-4)
Cultural belief	Attitudes toward cultural beliefs about menstruation: a) Others should not touch it.; b) Should not touch a chili plant.; c) Should not cook with salt.; d) Menstruating should be kept a secret * One point is awarded for each question with the total represented by the sum of the points, and higher scores indicate more negative beliefs toward menstruation (0-4)
Self-efficacy	Self-efficacy toward oneself (Chen et al., 2001), which consists of a total of 8 questions on a 5-point scale, with a score ranging from a minimum of 8 to a maximum of 40 * Higher scores indicate higher self-efficacy
Empowerment	Problem-solving ability (Empowerment score), which modified from Global Early Adolescent Study questionnaire (https://www.geastudy.org/) and consists of a total of 4 questions on a 5-point scale * Score range from 0-20
Gender	The sum of scores on Gender Equality, Sexual Reproductive Health, Sexual Violence * Score range from 0-48
Hand washing	Wash your hands at least 3 times a day (1, otherwise 0)

Data Analysis - Difference-in-Differences (DID) Model

3. Data Analysis – Difference-in-Differences (DID) Model

To compare the impacts of the experimental group and the control group, the Difference-in-Differences (DID) estimator was employed. The methodology involves comparing the average change in the outcome variable over time for the treatment group with that of a comparable control group. The Difference-in-Differences impact can be determined by taking an additional difference between the average changes in outcomes for the two groups. The classical DID model estimates the average impact as follows:

• **Equation 1** Classical DID model equation

$$DID = E(Y_{t1}^T - Y_{t2}^T) - E(Y_{t1}^C - Y_{t2}^C)$$

In our empirical model, the variable 't' is a dummy

that can take two values: 2019 and 2022. It is crucial to note that if the treatment group differs from the control group in observed and unobserved features, in addition to the treatment, it is necessary to assume that the differences between the two groups are time-invariant to obtain an unbiased Difference-in-Differences estimator. For this purpose, the DID estimator can be solved using regression. Building on the discussion presented in Ravallion (2005, 32), we formulate the estimating equation as Equation 2:

• **Equation 2** Estimating Equation

$$Y_t^D = \alpha + \beta Dt + \rho D + \gamma t + \varepsilon$$

In this context, D represents the treatment variable, and t denotes the time dummy variable. The coefficient of the interaction between D and t, denoted by β , indicates the estimated impact of the treatment on the

outcome variable Y . The interaction coefficient β determines the significant effect of the treatment on the dependent variable and its magnitude, specifically for the girls' group in the treatment. In addition to the interaction term, we have incorporated the variables of time (t) and treatment (D) to identify any independent effects related to time or group membership. (D is a variable where $D=1$ represents the treatment group, $D=0$ represents the control group, $t=0$ corresponds to the year 2019, and $t=1$ corresponds to the year 2022.)

By assuming that the unobserved differences between the treatment and control groups remain constant over time, this approach eliminates biases in post-intervention period comparisons between the treatment and control groups that could arise from permanent differences between them, as well as the effects of other confounding variables. The Difference-in-Differences (DID) approach calculates the average difference in outcomes separately for the treatment and control groups over the period. Then, after calculating the difference between the average changes in outcomes for both groups, it is possible to determine the impact of the Difference-in-Differences.

4. Ethical Considerations

The study protocol was reviewed by the Institutional Review Board of Ewha Womans University in Korea (ewha-202001-0013-01) as well as by the ERES Converge Research Institutional Review Ethics Board before data collection began. Specific approval for the study and for the project to be implemented in the specific schools was obtained from the Ministry of Education, District Education Board Secretary. The study questions were reviewed to ensure that they were age-appropriate. All data collectors were trained in research ethics during the data collection training workshop. All interviews were conducted in the local language (Tonga). Data collectors were also required to sign a confidentiality pact, and the need to maintain confidentiality and general ethical behavior was emphasized during training.

IV. Results

1. Descriptive statistics

The final study population included a total of 164 girls, 98 in the experimental group and 66 in the control group. The demographic characteristics of the two groups show that the age is around 14 years old and the age of menarche is around 12 years old in both groups. In terms of family economic status, 62.24% of the experimental group and 68.18% of the control group responded as "Moderate". Average age and age at menarche were similar in both groups. Regarding economic status, both groups responded that they were "moderate" - 62.24% for the intervention group and 68.18% for the control group - but as an overall trend, the responses of "poor" were also widely distributed for both groups: 32.65% for the intervention group and 28.79% for the control group. In both groups, the most common occupation for both fathers and mothers was agriculture. In the experimental group, 56.72% and 62.50% reported that their fathers' and mothers' occupations, respectively, were farmers and in the control group, 62.5% and 64.86% reported that their fathers' and mothers' occupations were farmers, respectively.

Other socio-demographic information was similar between the control and intervention groups, suggesting that any potential change between baseline and endline in girls' knowledge, attitudes, and behaviors regarding MHM and gender norms is less likely to be driven by demographic factors (see <Table 2>). In addition to the B4G intervention, we believe that several factors may have influenced the overall trend changes between the experimental and control groups in this study. One of the most common factors is the general sex education programs implemented in all schools, which likely affected girls' basic knowledge. In addition, as girls gain menstrual experience after menarche, they naturally acquire experiential knowledge. This learning process is also influenced by peer groups,

<Table 2> Socio-demographic characteristics of girls

Item	Intervention (n=98)	Control (n=66)	<i>t</i> or χ^2	p-value
Age	14.52±1.22	14.61±1.19	-0.45	0.657
Age of menarche	12.22±0.89	12.27±1.06	-0.29	0.775
Economic status				
Very poor	5 (5.10%)	1 (1.52%)	3.28	0.351
Poor	32 (32.65%)	19 (28.79%)		
Moderate	61 (62.24%)	45 (68.18%)		
Rich	0 (0.00%)	1 (1.52%)		
Very rich	0 (0.00%)	0 (0.00%)		
Father's job 1 – do you know your father's job?				
No	23 (23.47%)	17 (25.76%)	1.59	0.452
Yes	67 (68.37%)	40 (60.61%)		
Don't know	0 (0.0%)	0 (0.0%)		
Don't have or don't see father/mother	8 (8.16%)	9 (13.64%)		
Father's job 2 – if yes, what is your father's occupation?				
Farmer	38 (56.72%)	25 (62.50%)	3.70	0.066
Seasonal laborer	2 (2.99%)	4 (10.00%)		
Regular employee	10 (14.93%)	5 (12.50%)		
Running business	17 (25.37%)	6 (15.00%)		
Other	0 (0.0%)	0 (0.0%)		
Mother's job – do you know your mother's job?				
No	36 (36.73%)	23 (34.85%)	0.88	0.843
Yes	56 (57.14%)	37 (56.06%)		
Don't know	2 (2.04%)	3 (4.55%)		
Don't have or don't see father/mother	4 (4.08%)	3 (4.55%)		
Mother's job 2 – if yes, what is your mother's occupation?				
Farmer	35 (62.50%)	24 (64.86%)	3.66	0.354
Seasonal laborer	6 (10.71%)	3 (8.11%)		
Regular employee	1 (1.79%)	1 (2.70%)		
Running business	14 (25.00%)	7 (18.92%)		
Other	0 (0.00%)	2 (5.41%)		
Number of people who sleep in the same room as you				
1 sleep alone	19 (19.39%)	15 (22.73%)	1.36	0.715
2 people	41 (41.84%)	31 (46.97%)		
3 people	30 (30.61%)	15 (22.73%)		
4 or more other people	8 (8.16%)	5 (7.58%)		

* Mean ± SD (Standard Deviation) is presented for continuous variables, N (%) for categorical variables.

which we consider to be an important factor. Another notable factor is the impact of the pandemic, which has led to an increased emphasis on "hygiene" by the

government, health facilities, and various organizations through campaigns and education. This increased focus on hygiene is likely to have had an impact on menstrual

hygiene management. These elements are important to consider when analyzing the impact of B4G education and provide a broader context for understanding the changes observed in the study population.

2. Comparison of effects between groups after the B4G program intervention

To examine the effectiveness of the B4G program intervention between the two groups, we measured knowledge of MHM, negative attitudes toward MHM, and attitudes toward adherence to cultural norms directly related to the program. We also assessed self-efficacy, empowerment, and gender awareness, which are expected to improve with MHM education and activities for girls based on existing research, and the results are shown in <Table 3> below.

The results of the t-test conducted to examine the differences in variables between the pre- and post-intervention groups are presented in <Table 3>. (The McNemar test was applied to variables of Practice and Handwashing as they are both categorical variables.) Comparing the pre-and post-intervention scores of MHM knowledge, there was a slight increase in the intervention group's scores and a slight decrease in the control group's scores, but no significant change in either group. For negative attitudes toward MHM, the intervention group showed a significant decrease

in negative attitudes, while the control group showed a slight but non-significant decrease. Attitudes toward adherence to cultural norms decreased slightly in the intervention group, showing a positive but not significant change, while the control group showed an increase in adherence to cultural norms, although not significant. Self-efficacy decreased in both the experimental and control groups, but showed a significant decrease only in the control group. Empowerment increased in the experimental group, but not significantly, but decreased to a significant level in the control group. Gender awareness increased significantly in the intervention group. Finally, both groups showed a significant increase in variables on the MHM practice and the handwashing, which was intended to evaluate overall hygiene behavior.

3. DID results

To provide a more robust measure of the impact of the B4G program on girls, we conducted DID analyses. The results of DID analyses are presented in <Table 4> and <Table 5>. The primary model was derived using Equation 2, while the subsequent model includes additional determinants such as girls' age, age at menarche, and economic status. Central to this investigation is the intervention effect of the B4G program, which is captured by the interaction term (impact).

<Table 3> Pre-Post comparisons between groups

Variable	Intervention Group			Control Group		
	Pre-	Post-	p-value	Pre-	Post-	p-value
Knowledge	2.4±0.74	2.53±0.70	0.255	2.59±0.64	2.56±0.75	0.775
Practice	8.16%	65.31%	0.0***	18.18%	54.55%	0.0***
General attitude	2.50±0.49	2.22±0.59	0.003***	2.52±0.46	2.47±0.63	0.623
Cultural belief	3.19±0.58	3.09±0.75	0.252	3.32±0.42	3.42±0.65	0.276
Self-efficacy	29.61±9.21	28.44±6.87	0.289	30.24±9.19	25.79±8.01	0.001***
Empowerment	18.68±2.30)	19.11±1.82	0.155	19.08±3.50	18.15±3.92	0.003***
Gender	40.01±4.93	41.27±3.74	0.029*	38.7±8.14	38.94±8.35	0.755
Handwashing	51.02%	88.78%	0.0***	69.70%	87.88%	0.007**

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

<Table 4> DID results

	Knowledge	Practice	General attitude	Cultural belief	Self-efficacy	Empowerment	Gender	Hand-washing
treatment (dummy)	-0.132 (0.115)	-0.100* (-1.81)	-0.014 (0.076)	-0.126 (0.079)	-0.63 (1.466)	-0.392 (0.49)	1.313 (1.12)	-0.187** (0.076)
impact (DID)	0.164 (0.154)	0.208** (2.18)	-0.229* (0.13)	-0.216* (0.126)	3.281* (1.7)	1.353*** (0.42)	1.013 (0.96)	0.196** (0.086)
year (dummy)	0.03 (0.118)	0.364*** (4.74)	-0.055 (0.106)	0.113 (0.089)	-4.455*** (1.293)	-0.924*** (0.295)	0.242 (0.773)	0.182*** (0.064)
constant	2.53*** (0.087)	0.182*** (3.80)	2.52*** (0.058)	3.318*** (0.052)	30.242*** (1.131)	19.076*** (0.431)	38.697** * (1.003)	0.697*** (0.057)
R-squared	0.0127	0.2676	0.0526	0.04	0.0345	0.0163	0.0274	0.1361
N	328	328	326	325	328	328	328	328

Note: Standard errors in parenthesis. *** p<0.01, **p<0.05, *p<0.1

<Table 5> DID Results with Control Variables

	Knowledge	Practice	General attitude	Cultural belief	Self-efficacy	Empowerment	Gender	Hand washing
treatment (dummy)	-0.139 (0.12)	-0.106* (-1.88)	0.016 (0.075)	-0.127 (0.081)	-0.921 (1.491)	-0.371 (0.51)	1.406 (1.17)	-0.179** (0.078)
impact (DID)	0.163 (0.158)	0.208** (2.18)	-0.266** (0.129)	-0.207 (0.127)	3.451** (1.733)	1.337*** (0.43)	0.758 (0.97)	0.176** (0.087)
year (dummy)	0.016 (0.122)	0.364*** (4.72)	-0.028 (0.103)	0.117 (0.089)	-4.641*** (1.328)	-0.969*** (0.302)	0.516 (0.774)	0.203*** (0.064)
age	0.097** (0.043)	0.097** (0.043)	0.012 (0.03)	0.085** (0.034)	-1.169*** (0.539)	-0.453 (0.288)	-0.918 (0.615)	-0.032 (0.021)
period_age	0.005 (0.04)	0.047** (2.89)	-0.001 (0.029)	-0.045 (0.04)	0.147 (0.569)	0.103 (0.189)	0.333 (0.399)	-0.011 (0.027)
economic	0.003 (0.057)	0.049 (1.37)	-0.096** (0.043)	-0.034 (0.053)	-0.41 (0.838)	-0.018 (0.276)	0.115 (0.621)	-0.031 (0.034)
constant	1.057 (0.676)	-0.635** (-2.46)	2.592*** (0.415)	2.718*** (0.489)	46.836*** (7.945)	24.461*** (3.613)	47.562*** (7.812)	1.365*** (0.348)
R-squared	0.0395	0.2871	0.0723	0.064	0.0611	0.0476	0.0534	0.1527
N	318	318	316	315	318	318	318	318

Note: Standard errors in parenthesis. *** p<0.01, **p<0.05, *p<0.1

As shown in <Table 4>, regarding the initial model, the DID analysis revealed significant changes in overall practices, attitudes and cultural perceptions toward MHM, self-efficacy, empowerment, and handwashing behaviors. To illustrate, there is a positive, non-significant change in MHM knowledge, ‘Knowledge’, associated with the intervention compare to control group. However, the results on ‘Practice’ suggests that the intervention had a meaningful and positive effect on the MHM

practices. Also, there was a significant impact on ‘General Attitude’, implying a shift towards more positive attitudes toward menstruation following the intervention. Similarly, a significant impact was observed for ‘Cultural Belief’, suggesting that the intervention resulted in more positive beliefs about menstruation.

Notable increases were observed in ‘Self-efficacy’ and ‘Empowerment’, with scores of 3.281 and 1.353, respectively. The intervention has been shown to

considerably enhance the self-efficacy and problem-solving ability of the subjects. 'Handwashing' also demonstrated significant improvement, with a positive change indicating increased handwashing habits among subjects. This finding of increased handwashing, however, should be interpreted with caution, as its significance might be influenced by the heightened global emphasis on hand hygiene due to the COVID-19 pandemic. While there were upward trends in the gender gap index, it was not statistically significant.

From the revised model incorporating control variables (<Table 5>), the DID analysis continued to reveal significant changes in the overall practices, attitudes, and cultural perceptions regarding MHM, self-efficacy, empowerment, and handwashing habits. Notably, the results on 'Practice' showed a positive and statistically significant improvement on MHM practices. In addition, the 'General attitude' towards menstruation was noted to decrease (become more positive) significantly post-intervention with a value of -0.266. However, while the negative trend in the alteration of 'Cultural beliefs' suggested a move towards more positive perceptions of menstruation, this change was not statistically significant.

The 'Self-efficacy' exhibited a significant boost post-intervention, marked at 3.451. Likewise, 'Empowerment' saw a sharp increase, registering at 1.337, indicating that the program had a pronounced impact on improving girls' self-worth and problem-solving capabilities. 'Handwashing' practices, perhaps coincidentally amplified due to the contemporaneous occurrence of the COVID-19 pandemic, showed a positive change, cementing the significance of improved hygiene habits.

When considering the added controls, an age increase was positively linked with greater MHM knowledge and cultural beliefs but inversely associated with self-efficacy. Furthermore, the age at which menstruation began, denoted as (period_age), did not show significant changes across most variables. Notably, economic status was linked with a negative attitude towards menstruation.

Although there was a noticeable rise in both MHM

knowledge and gender gap indices, they did not achieve statistical significance. It's essential to factor in external influences, such as school shutdowns and significant global occurrences like the COVID-19 pandemic. For instance, even in the absence of formal education, attitudes and self-efficacy regarding menstruation and gender roles can improve through informal channels of learning or intervention programs. Specifically, the experimental group exposed to intensified Menstrual Hygiene Management (MHM) education and programs might have had more opportunities to engage in discussions and activities that challenge and reshape their understanding and perceptions of MHM issues and gender roles. This exposure can dilute culturally ingrained misconceptions and foster a more supportive and informed environment, even if direct knowledge gains are not evident.

The increase in attitudes or self-efficacy without a corresponding increase in knowledge highlights the multifaceted nature of learning and behavior change. Individuals can develop more positive attitudes and a stronger sense of self-efficacy through various mechanisms, such as peer support, community engagement, or personal experiences that reinforce their ability to manage menstruation effectively, irrespective of formal knowledge acquisition. This phenomenon suggests that while knowledge is crucial, the empowerment and confidence to apply such knowledge effectively can also arise from supportive social interactions and practical experiences, which are particularly valuable in contexts where formal educational opportunities are disrupted or limited.

V. Discussion and Conclusion

This study aims that to verify the effectiveness of the B4G project (MHM intervention) conducted for girls in Zambia in terms of promoting reproductive rights. To analyze the impact of the B4G program on

adolescent girls in Zambia, Difference-in-Differences analyses were conducted with a matched comparison group based on data from 2019 and 2022.

As discussed earlier, existing research shows that crowded and unclean environments for menstrual hygiene undermine girls' self-esteem and health, and affect their academic performance. Furthermore, girls and women's health, gender equality, and empowerment are not simply due to a lack of MHM facilities or products but are closely linked to perceptions of menstruation, social stigma, and gender issues, calling for an integrated approach that combines MHM education, gender awareness, and peer support in addition to product provision. However, there is insufficient research on the effectiveness of MHM programs that use an integrated approach in the school setting and targeting on early adolescences (Sommer et al. 2021b; Hennegan et al. 2016).

The B4G project in Magoye, Zambia, provided menstrual hygiene products as well as education on social stigma and perceptions of menstruation, and was specifically designed to be school-based. This research was conducted to improve understanding of the overall effectiveness of such MHM interventions in educational settings, with a focus on the role of the B4G project in promoting sexual and reproductive rights. The aim of the study was to rigorously evaluate the impact of the project by comparing control and intervention groups using a difference-in-difference (DID) methodology. In doing so, the study sought to add to the body of evidence-based research on MHM interventions for adolescent girls in developing countries.

The B4G program in Zambia showed significant positive impacts in several key areas related to MHM, empowerment, and hygiene practices among young girls. In particular, it was found that MHM practice and attitudes toward menstruation, which were expected to be a direct effect of the B4G program, were significantly improved. In addition, showed a positive impact on increased self-efficacy, and improved empowerment. MHM knowledge and practice are areas

that can naturally improve as girls begin menarche and experience it. Accordingly, when simply comparing the changes in the experimental and control groups, it was found that knowledge and behavior changed in positive way in both groups. However, when analyzed more rigorously through DID, the MHM practice of the experimental group showed a statistically significant positive change. It means that girls can acquire knowledge from various source after menarche, but additional intervention is still needed to improve behavior. These findings underscore the value of comprehensive education programs that holistically address the psychological and physiological challenges faced by adolescent girls.

The improvement in handwashing practices could be attributed to both the B4G program's emphasis on hygiene and the global emphasis on hand hygiene due to the COVID-19 pandemic. Given the timing of this study, it's important to interpret the significance of improved hygiene habits with caution. The pandemic has influenced behavioral change worldwide, emphasizing the importance of frequent and proper hand hygiene.

However, interestingly, although increases in both the MHM knowledge and gender gap indices were observed, they were not statistically significant. This could be due to external factors not captured by the study, such as school closures or other disruptions caused by the COVID-19 pandemic. We agree that the school closures due to the COVID-19 pandemic likely mitigated the potential impact of the B4G project on knowledge, self-efficacy, and empowerment. Schools play a critical role not only as centers of education, but also as social environments where students can engage in discussions, share experiences, and participate in collective learning activities. Such interactions are critical to strengthening knowledge and changing attitudes, especially around issues such as menstrual hygiene management, which are often shrouded in cultural stigma and misinformation. The absence of these interactions, we hypothesize, may have limited the program's effectiveness in these areas.

In light of this, implementing the B4G project

through schools should be seen not only as a means of disseminating information, but also as a strategic choice to leverage the school environment for broader cultural and social impact. As community hubs, schools have the potential to influence not only students, but also teachers, parents, and community members, thereby extending the impact of MHM interventions beyond the individual to the societal level. We acknowledge that more research is needed to explore the most effective ways for schools to address cultural beliefs and gender roles in the context of MHM. Future studies could examine the interplay between school-based education and community engagement, and identify strategies that can effectively use schools to foster a more inclusive and supportive environment for discussing and managing menstruation. In conclusion, this study provides a deeper understanding of integrated MHM programs in school settings in Zambia, highlighting the potential of schools, rather than just health centers, as primary sites for MHM interventions. Using the rigorous methods of DID analyses, the study emphasizes the importance of education and empowerment in MHM, covering psychological, social, and physical aspects of menstruation. As a limitation, the study acknowledges that the COVID-19 pandemic may have altered the typical environmental and social contexts in which MHM interventions operate, and this may have affected the generalizability and effectiveness of the findings during this time period.

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잠비아 B4G 프로젝트의 월경위생관리(MHM)에 대한 효과성 평가

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국문초록

연구목적: 본 연구는 여아의 성재생산권리 향상을 위해 잠비아 마고에 지역에서 진행된 B4G사업의 효과성을 여아를 중심으로 검증하고자 하였다.

연구의 중요성: 월경위생관리(MHM)에서 여자아동에 대한 중요성이 강조되어 오고 있고, 특히 여자아동들이 월경으로 인해 학교에서 겪는 여러 어려움에 대해 강조한 연구가 많아지고 있다. 그러나 강조되어 있는 학교 MHM 현실과는 달리, 학교에서 이루어지는 MHM 개입(intervention)의 효과성에 대한 실증 연구는 많이 부족한 상황이다. 본 연구는 이중차분법(DID)을 활용하여 여자아동을 대상으로한 통합적 접근의 학교 MHM의 효과성을 측정하려고 하였는데 그 의의가 있다.

연구방법론: 본 연구는 이중차분법을 활용하여 잠비아 마고에 지역의 여아에 대한 B4G 프로그램의 효과성을 측정하기 위해 2019년과 2022년의 데이터를 사용하여 이중차분법(DID) 분석을 수행하였다.

연구결과: 잠비아의 B4G 프로그램은 여아들의 MHM, 역량 강화, 위생 관행과 관련된 다양한 주요 영역에 상당한 긍정적인 영향을 미친 것으로 연구 결과 나타났다. 특히 월경에 대한 태도를 개선하고, 자기 효능감을 높였으며, 문제 해결 능력을 향상시킨 것으로 드러났다. 그러나 MHM 지식과 성별 격차 지수에 있어서는 모두 증가한 것으로 관찰되었지만 통계적으로 유의미하지는 않았으며, 이는 코로나19 팬데믹이 학교 교육에 미친 영향과 같은 외부 요인 때문일 가능성이 있을 거라 예상된다.

결론 및 시사점: 이 연구는 잠비아의 학교 환경에서 통합된 MHM 프로그램에 대한 효과성 평가 결과를 제공함으로써 기존 연구에 기여한다. 이 연구는 학교를 MHM 개입의 주요 장소로 두고 통합적인 접근을 진행하는 B4G 사업에 대한 개념적 전환과 교육, 권리 강화, MHM 간의 연관성에 대한 시사점을 제시한다.

주제어 월경위생관리, 여자아동, 베이직 포 걸스 (B4G), 효과성, 국제개발협력
