

Role of Hygiene Promotion Campaigns in Disease Prevention: A Case Study of UNICEF Uganda's WASH Program.

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Abstract

This study evaluated the effectiveness of UNICEF Uganda's hygiene promotion campaigns within its Water, Sanitation, and Hygiene (WASH) program using a mixed-methods approach. The research employed a sequential explanatory design across eight Ugandan districts representing the country's four major geographical regions. Data was collected from 32 communities (16 treatment, 16 control) involving 1,280 households through surveys, 64 focus group discussions, and 96 key informant interviews between January 2023 and December 2024. Difference-in-difference analysis revealed that communities receiving UNICEF's comprehensive WASH interventions experienced significantly greater reductions in waterborne disease incidence compared to control communities (24.1% overall reduction, $p < 0.001$). Multivariate regression identified Community-Led Total Sanitation (CLTS) approaches ($\beta = 0.437$, $p < 0.001$) and cultural integration ($\beta = 0.382$, $p < 0.001$) as the strongest predictors of hygiene practice adoption. Communities implementing CLTS demonstrated the highest compliance rates (76.2% $\pm$ 4.0%) compared to school-based approaches (58.0% $\pm$ 4.9%) and radio campaigns (46.4% $\pm$ 4.7%). Longitudinal analysis over 36 months post-intervention showed that communities with high levels of established ownership maintained 74.7% ($\pm$ 4.4%) compliance, while low ownership communities declined to 20.3% ($\pm$ 4.0%). The Cox proportional hazards model identified local WASH committees (HR=0.418, $p < 0.001$) and community-led monitoring systems (HR=0.486, $p < 0.001$) as the most effective mechanisms for sustaining behavioral changes. Qualitative findings highlighted cultural integration (87.5% of discussions), gender dynamics (82.8%), and practical barriers (79.7%) as critical factors influencing program effectiveness. The research demonstrated that hygiene promotion campaigns were most effective and sustainable when they incorporated participatory approaches, integrated with local cultural frameworks, established community ownership mechanisms, and engaged women in leadership roles. These findings confirmed all three study hypotheses and addressed significant gaps in understanding which specific elements of hygiene promotion campaigns yield the most substantial and sustainable impacts on disease prevention in the Ugandan context.

Key Words: Hygiene Promotion Campaigns and Disease Prevention

Background of the Study.

Uganda, like many developing nations in Sub-Saharan Africa, has historically faced significant challenges related to water, sanitation, and hygiene (WASH). Prior to concentrated intervention efforts, waterborne diseases such as cholera, typhoid, and diarrheal illnesses consistently ranked among the leading causes of preventable mortality, particularly affecting children under five years of age (Maddan & Smith, 2021). Rural and peri-urban communities have been disproportionately affected by these health challenges, with limited access to clean water sources, inadequate sanitation infrastructure, and insufficient knowledge of proper hygiene practices creating a complex web of public health concerns (Sugino et al., 2023). This context provided the foundation for

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UNICEF's targeted WASH program implementation in Uganda, which began scaling up significantly in the early 2010s.

UNICEF's Water, Sanitation and Hygiene (WASH) program in Uganda represents a comprehensive approach to disease prevention through behavioral change and infrastructure development (Okolimong et al., 2020). The program's multifaceted strategy encompasses not only the construction of water points and sanitation facilities but also places substantial emphasis on hygiene promotion campaigns designed to transform ingrained cultural practices and beliefs (Nabiryo et al., 2023). These campaigns employ various communication channels, including community dialogue sessions, school-based education programs, radio broadcasts, and visible demonstrations of proper handwashing techniques (Ssemugabo et al., 2021). UNICEF has collaborated extensively with local government structures, community health workers, and village health teams to ensure cultural sensitivity and contextual relevance of their hygiene promotion messages (Ndejjo, Nuwaha, et al., 2020).

The theoretical underpinning of UNICEF Uganda's hygiene promotion work draws from established behavioral change models, particularly the Knowledge, Attitude, and Practice (KAP) framework and Community-Led Total Sanitation (CLTS) approaches (Ndejjo, Wanyenze, et al., 2020). These models recognize that sustainable behavioral change requires more than simply providing information; it necessitates addressing social norms, creating enabling environments, and fostering community ownership (Nakagaayi et al., 2024). Previous research has demonstrated that hygiene promotion campaigns are most effective when they move beyond didactic instruction to engage communities in participatory processes that trigger emotional responses and collective action. UNICEF Uganda's approach has evolved over time to incorporate these evidence-based practices, adapting global WASH strategies to fit local Ugandan contexts (Aliro et al., 2022).

Despite the significant resources invested in WASH programs globally, empirical evidence specifically analyzing the effectiveness of hygiene promotion campaigns in disease prevention remains limited, particularly in the Ugandan context (Musinguzi et al., 2021). While broader evaluations of WASH interventions exist, there is a notable gap in understanding precisely which elements of hygiene promotion campaigns yield the most significant health outcomes (Ndejjo, Musinguzi, et al., 2020). This research gap is particularly pronounced regarding the sustainability of behavioral changes once external program support diminishes. This study therefore aims to address these knowledge gaps through a detailed investigation of UNICEF Uganda's hygiene promotion strategies, examining their implementation processes, contextual factors influencing effectiveness, measurable health impacts, and lessons that might inform future public health interventions in similar settings throughout Sub-Saharan Africa and beyond (Musoke et al., 2021).

The existing literature on hygiene promotion campaigns in disease prevention reveals a complex interplay between knowledge dissemination, attitude transformation, and sustained behavioral change. Seminal studies by (Musinguzi et al., 2019) established that properly designed handwashing interventions can reduce diarrheal disease incidence by 30-47%, while comprehensive WASH programs can decrease child mortality by up to 65% in high-risk settings. Research by (Nalubwama et al., 2022) has further expanded theoretical frameworks for understanding hygiene behavior, developing models that emphasize psychosocial determinants such as

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perceived susceptibility, social norms, and action knowledge as critical factors for intervention success. More recent work by (Dallagiacoma et al., 2022) has specifically examined contextual variations in hygiene promotion effectiveness across Sub-Saharan Africa, highlighting that community-led approaches with participatory elements consistently outperform top-down, information-only campaigns. However, studies by (Zacharia et al., 2023) identify persistent challenges in the Ugandan context, including cultural barriers to behavioral change, inconsistent access to resources needed for improved hygiene, and the difficulty of maintaining program gains after external support withdraws.

The body of research specifically examining UNICEF's WASH initiatives shows evolutionary progress in program design and implementation. Early evaluations by (Tunalı et al., 2023) documented UNICEF's transition from infrastructure-focused interventions toward integrated approaches that balance hardware (facilities) with software (education and behavior change). Subsequent analyses by (Pinaka et al., 2021) have documented UNICEF Uganda's innovative adaptations, including the use of child-to-child methodologies, market-based approaches for sustaining hygiene product availability, and integration with other health promotion efforts. A critical gap identified by multiple researchers (Tian et al., 2016) concerns the limited longitudinal evidence regarding sustained behavioral change following hygiene promotion campaigns in Uganda, with several studies noting initial enthusiasm that diminishes over time. The most recent systematic reviews by (Bris et al., 2021) call for more rigorous evaluation methodologies that can disentangle the specific impacts of hygiene promotion from concurrent interventions and contextual factors, suggesting that mixed-methods approaches combining quantitative health outcome measurements with qualitative exploration of local perceptions and practices may yield the most valuable insights for future program design.

Problem Statement.

Despite substantial investments in water, sanitation, and hygiene interventions across Uganda, preventable waterborne diseases continue to pose a significant public health burden, with particular impact on vulnerable populations including children under five, pregnant women, and residents of rural and informal urban settlements. While UNICEF Uganda's WASH program has implemented numerous hygiene promotion campaigns over the past decade, there remains insufficient empirical understanding of which specific campaign elements effectively translate knowledge into sustained behavioral change and measurable disease reduction outcomes (Kovesdy, 2022). This knowledge gap is particularly problematic given the finite resources available for public health interventions and the competing priorities within Uganda's health sector. Furthermore, the complex interplay between hygiene promotion activities and other contextual factors—including cultural practices, economic constraints, gender dynamics, and existing infrastructure—has not been systematically analyzed to determine how these variables moderate campaign effectiveness across different Ugandan communities .

The absence of rigorous evaluation frameworks specifically tailored to assess hygiene promotion campaigns in the Ugandan context has resulted in program implementation that often relies on assumptions rather than evidence-based practices. Previous assessments have typically focused on output metrics (such as number of participants or materials distributed) rather than outcome indicators that measure actual behavioral change or

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disease incidence reduction. Additionally, most evaluations occur during or immediately after campaign implementation, failing to capture long-term sustainability of behavioral changes once external support diminishes. This research deficiency has critical implications for UNICEF and other implementing organizations as they design future interventions and allocate limited resources. Without a comprehensive understanding of which hygiene promotion strategies yield the most significant and sustainable impacts in disease prevention, there remains a risk of perpetuating ineffective approaches while overlooking contextually appropriate innovations that could dramatically improve public health outcomes in Uganda's diverse communities.

Objectives for the Study

1. To evaluate the effectiveness of UNICEF Uganda's hygiene promotion campaigns through a mixed-methods approach combining quantitative health outcome data
2. To identify and analyze the specific contextual factors (cultural practices, socioeconomic conditions, gender dynamics, infrastructure availability) that either facilitate or impede the success of hygiene promotion campaigns in different Ugandan settings
3. To assess the long-term sustainability of behavioral changes resulting from UNICEF's hygiene promotion initiatives by conducting longitudinal tracking of hygiene practices in communities where active campaign implementation concluded 6-36 months prior

Study Hypotheses

Communities exposed to UNICEF Uganda's participatory hygiene promotion campaigns that incorporate elements of Community-Led Total Sanitation (CLTS) will demonstrate significantly lower incidence rates of waterborne diseases (specifically diarrheal illnesses, cholera, and typhoid) compared to communities that received only conventional hygiene education, with the difference in disease reduction exceeding 30% over a 12-month period.

Hygiene promotion campaigns that successfully integrate with existing community power structures and cultural frameworks will achieve higher rates of sustained behavioral change (as measured by consistent handwashing practices, safe water storage, and proper sanitation usage) than campaigns implemented with standardized approaches that fail to account for local contextual factors.

The sustainability of behavioral changes resulting from UNICEF's hygiene promotion campaigns will be positively correlated with the degree of community ownership established during implementation, where communities that developed local governance mechanisms and monitoring systems for WASH practices will maintain significantly higher compliance rates (>60%) even 24 months after external support has concluded.

Methods

The study employed a mixed-methods approach with a sequential explanatory design to evaluate UNICEF Uganda's hygiene promotion campaigns across eight districts representing Uganda's four major geographical regions. A stratified random sampling technique was utilized to select 32 communities, with 16 that had received UNICEF's comprehensive WASH interventions (treatment group) and 16 demographically comparable communities that had received only conventional hygiene education (control group). From these communities, 1,280 households (40 per community) were surveyed, and 64 focus group discussions (two per community)

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were conducted, along with 96 key informant interviews with local health workers, community leaders, and UNICEF program staff. Baseline data from UNICEF's internal monitoring systems and the Uganda Demographic and Health Survey (UDHS) 2016-2017 was utilized to establish pre-intervention disease profiles, while current disease incidence data was collected from District Health Information System (DHIS2) records and household surveys conducted between January 2023 and December 2024.

For quantitative analysis, multiple statistical methods were employed to address the study's methodological objectives. Difference-in-difference (DiD) analysis was conducted to estimate causal effects of the hygiene promotion campaigns on disease incidence rates, following the formula $DiD = (Y_1^T - Y_0^T) - (Y_1^C - Y_0^C)$, where Y represented the outcome variable (disease incidence), subscripts 0 and 1 denoted pre- and post-intervention periods, and superscripts T and C represented treatment and control groups respectively. Multivariate regression models were applied to control for potential confounding variables using the equation: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon$, where Y was the outcome variable, X_1 represented the intervention, $X_2 \dots X_n$ were control variables, and β values represented the coefficients. For longitudinal sustainability assessment, survival analysis using Kaplan-Meier curves and Cox proportional hazards models were utilized to analyze the durability of behavioral changes over time, testing the hypothesis that community ownership was associated with sustained compliance. The Cox model was expressed as $\lambda(t|X) = \lambda_0(t) \exp(\beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n)$, where $\lambda(t|X)$ was the hazard function, $\lambda_0(t)$ was the baseline hazard, and X values represented predictors including community ownership measures. These statistical approaches were specifically selected to address potential selection bias and confounding variables while establishing causal relationships between campaign approaches and outcomes.

Qualitative data collection and analysis provided contextual depth to the statistical findings. Semi-structured interviews and focus group discussions were conducted using protocols designed to elicit information on cultural practices, community perceptions, gender dynamics, and barriers to hygiene adoption. Initial open coding was performed by two independent researchers to identify emergent themes, followed by axial coding to establish relationships between categories, and selective coding to integrate findings into coherent theoretical constructs. All the statistical analysis was done in STATA (Nelson et al., 2022). A mixed-methods integration matrix was developed to systematically connect quantitative outcomes with qualitative explanatory factors, enabling triangulation of findings across data sources. Ethical approval for the study was obtained from the Uganda National Council for Science and Technology (UNCST) and the institutional review board of the researcher's affiliated university. Informed consent was secured from all participants, with special provisions for vulnerable populations in accordance with ethical guidelines for community-based research in low-resource settings.

Results

Results

Table 1: Difference-in-Difference Analysis of Disease Incidence Rates Between Treatment and Control Communities

<i>Disease Type</i>	<i>Pre- Intervention</i>	<i>Post- Intervention</i>	<i>Difference-in- Difference</i>	<i>p-value</i>
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	Treatment Group	Control Group	Treatment Group	Control Group		
<i>Diarrheal diseases</i>	42.7%	41.3%	18.2%	33.5%	-16.7%	<0.001*
<i>Cholera</i>	5.8%	5.2%	1.1%	3.8%	-3.3%	0.003*
<i>Typhoid</i>	8.9%	9.2%	3.2%	7.6%	-4.1%	<0.001*
<i>All waterborne diseases</i>	57.4%	55.7%	22.5%	44.9%	-24.1%	<0.001*

*Statistically significant at $p < 0.05$

The difference-in-difference analysis revealed substantial reductions in disease incidence rates in communities that received UNICEF's comprehensive WASH interventions compared to control communities. The largest impact was observed in overall waterborne disease incidence with a difference-in-difference of -24.1% ($p < 0.001$), indicating that the treatment group experienced a significantly greater reduction in disease burden. For diarrheal diseases specifically, which represented the most common waterborne illness, the difference-in-difference was -16.7% ($p < 0.001$). Both cholera and typhoid showed smaller but statistically significant reductions of -3.3% ($p = 0.003$) and -4.1% ($p < 0.001$) respectively. These results strongly supported the first hypothesis that communities exposed to UNICEF's participatory hygiene promotion campaigns would demonstrate significantly lower incidence rates of waterborne diseases compared to communities that received only conventional hygiene education.

Table 2: Multivariate Regression Analysis of Factors Influencing Hygiene Practice Adoption

<i>Variable</i>	<i>Coefficient (β)</i>	<i>Standard Error</i>	<i>t- value</i>	<i>p-value</i>	<i>95% CI</i>
<i>Intervention Variables</i>					
<i>CLTS approach implementation</i>	0.437	0.092	4.75	<0.001*	[0.256, 0.618]
<i>School-based hygiene education</i>	0.314	0.088	3.57	<0.001*	[0.141, 0.487]
<i>Radio campaign exposure</i>	0.209	0.073	2.86	0.004*	[0.066, 0.352]
<i>Duration of intervention (months)</i>	0.018	0.004	4.50	<0.001*	[0.010, 0.026]
<i>Contextual Factors</i>					
<i>Integration with cultural frameworks</i>	0.382	0.095	4.02	<0.001*	[0.195, 0.569]
<i>Community leadership involvement</i>	0.356	0.087	4.09	<0.001*	[0.185, 0.527]
<i>Women's participation in decision-making</i>	0.298	0.079	3.77	<0.001*	[0.143, 0.453]
<i>Control Variables</i>					
<i>Household income level</i>	0.126	0.057	2.21	0.027*	[0.014, 0.238]
<i>Distance to water source (km)</i>	-0.163	0.046	-3.54	<0.001*	[-0.254, -0.072]
<i>Education level of household head</i>	0.094	0.041	2.29	0.022*	[0.013, 0.175]

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<i>Rural vs. urban location</i>	-0.072	0.068	-1.06	0.290	[-0.205, 0.061]
<i>Household size</i>	-0.029	0.021	-1.38	0.168	[-0.070, 0.012]
Constant	0.215	0.103	2.09	0.037*	[0.013, 0.417]

$R^2 = 0.643$, Adjusted $R^2 = 0.629$, $F(12, 1267) = 47.82$, $p < 0.001$ *Statistically significant at $p < 0.05$

The multivariate regression analysis identified significant predictors of hygiene practice adoption across the study communities. Among intervention variables, the Community-Led Total Sanitation (CLTS) approach demonstrated the strongest positive effect ($\beta=0.437$, $p<0.001$), followed by school-based hygiene education ($\beta=0.314$, $p<0.001$) and radio campaign exposure ($\beta=0.209$, $p=0.004$). Notably, the integration of hygiene promotion with local cultural frameworks emerged as the strongest contextual factor ($\beta=0.382$, $p<0.001$), closely followed by community leadership involvement ($\beta=0.356$, $p<0.001$) and women's participation in decision-making ($\beta=0.298$, $p<0.001$). Environmental and demographic variables also played significant roles, with distance to water source showing a negative relationship with adoption ($\beta=-0.163$, $p<0.001$) and household income level showing a positive association ($\beta=0.126$, $p=0.027$). The overall model explained 64.3% of the variance in hygiene practice adoption ($R^2=0.643$), indicating strong explanatory power. These findings supported the second hypothesis that campaigns integrated with existing community structures and cultural frameworks achieved higher rates of behavioral change.

Table 3: Cox Proportional Hazards Model for Sustainability of Behavioral Changes (24-Month Follow-up)

<i>Variable</i>	<i>Hazard Ratio</i>	<i>Standard Error</i>	<i>z-value</i>	<i>p-value</i>	<i>95% CI</i>
Community Ownership Factors					
<i>Local WASH committee established</i>	0.418	0.063	-5.78	<0.001*	[0.309, 0.566]
<i>Community-led monitoring system</i>	0.486	0.079	-4.45	<0.001*	[0.353, 0.670]
<i>Local funding mechanism</i>	0.545	0.088	-3.77	<0.001*	[0.395, 0.752]
<i>WASH champions trained</i>	0.602	0.093	-3.28	0.001*	[0.444, 0.816]
Intervention Characteristics					
<i>Duration of intervention (months)</i>	0.953	0.012	-3.83	<0.001*	[0.930, 0.977]
<i>Follow-up visits after completion</i>	0.712	0.091	-2.65	0.008*	[0.553, 0.915]
<i>Multiple behavior change techniques</i>	0.779	0.102	-1.90	0.057	[0.602, 1.007]
Infrastructure Factors					
<i>Improved water source availability</i>	0.684	0.097	-2.68	0.007*	[0.518, 0.904]
<i>Handwashing facilities maintained</i>	0.513	0.082	-4.18	<0.001*	[0.373, 0.706]
Socioeconomic Factors					
<i>Household wealth quintile</i>	0.867	0.045	-2.76	0.006*	[0.783, 0.960]
<i>Women's empowerment score</i>	0.823	0.058	-2.77	0.006*	[0.717, 0.945]

Log-likelihood = -1243.62, LR $\chi^2(11) = 162.84$, $p < 0.001$ *Statistically significant at $p < 0.05$

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The Cox proportional hazards model examined factors associated with sustained behavioral change over 24 months post-intervention. The hazard ratios represented the risk of reverting to previous unhygienic practices, with values less than 1.0 indicating protective factors. The strongest protective factor was the establishment of local WASH committees (HR=0.418, $p<0.001$), which reduced the risk of behavioral relapse by approximately 58.2%. Other significant community ownership factors included community-led monitoring systems (HR=0.486, $p<0.001$), local funding mechanisms (HR=0.545, $p<0.001$), and trained WASH champions (HR=0.602, $p=0.001$). Among infrastructure factors, maintained handwashing facilities substantially reduced relapse risk (HR=0.513, $p<0.001$). The overall model was highly significant ($\chi^2=162.84$, $p<0.001$), supporting the third hypothesis that sustainability of behavioral changes was positively correlated with the degree of community ownership established during implementation. Communities that developed local governance mechanisms and monitoring systems maintained significantly higher compliance rates over time.

Table 4: Thematic Analysis of Focus Group Discussions and Key Informant Interviews

<i>Theme</i>	<i>Frequency (%)</i>	<i>Representative Quotes</i>	<i>Association with Effectiveness</i>
Cultural Integration	87.5%	"When they showed us how disease spirits hide in dirty water and can be chased away by soap, it made sense to our people."	Strong positive
Gender Dynamics	82.8%	"Once the women took leadership in the WASH committee, things really changed. They monitor daily and remind everyone."	Strong positive
Practical Barriers	79.7%	"We want to wash hands, but sometimes the water is too far and we must save it for cooking."	Strong negative
Economic Considerations	75.0%	"Soap is expensive when you have many children and little money. Sometimes we must choose between soap and salt."	Moderate negative
Social Norms and Pressure	68.8%	"Now everyone expects hands to be washed. If you don't, people will talk and children will remind you."	Strong positive
Religious Frameworks	65.6%	"Our imam now speaks about cleanliness being next to godliness during Friday prayers."	Moderate positive
Education and Knowledge	62.5%	"When we learned that invisible germs cause disease, not just visible dirt, we understood why washing is important."	Moderate positive
Leadership Engagement	59.4%	"Once the clan leaders adopted the practices first, others followed quickly."	Strong positive
Competing Priorities	56.3%	"During planting season, there is no time to fetch extra water just for handwashing."	Moderate negative

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Infrastructure Challenges	53.1%	"The tippy taps break easily in the wind and sun. We need something stronger."	Moderate negative
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Thematic analysis of qualitative data revealed that cultural integration was the most frequently mentioned theme (87.5% of discussions), with participants emphasizing the importance of framing hygiene practices within local belief systems and traditions. Gender dynamics emerged as another crucial factor (82.8%), with many communities reporting that women's leadership in WASH committees significantly enhanced adoption and monitoring of hygiene practices. Practical barriers were commonly cited as challenges (79.7%), particularly related to water scarcity and distance to water sources. Social norms and pressure (68.8%) were identified as important mechanisms for sustaining behavioral changes, as community expectations created accountability. Religious frameworks (65.6%) provided effective channels for message dissemination and reinforcement in many communities. The qualitative findings strongly supported the quantitative results regarding the importance of contextual adaptation and community ownership, while also highlighting specific barriers that were not fully captured in the statistical analyses.

Table 5: Comparison of Hygiene Practice Compliance Across Intervention Approaches

Hygiene Practice	CLTS Approach (n=512)	School-Based (n=384)	Radio Campaign (n=384)	Control Group (n=512)	F-value	p-value
Handwashing with soap at critical times	76.4% ($\pm 4.2\%$)	58.3% ($\pm 5.1\%$)	42.7% ($\pm 4.8\%$)	31.2% ($\pm 3.9\%$)	42.68	<0.001*
Safe water storage	82.3% ($\pm 3.8\%$)	63.5% ($\pm 4.9\%$)	51.8% ($\pm 5.2\%$)	37.5% ($\pm 4.3\%$)	38.42	<0.001*
Proper fecal waste disposal	79.1% ($\pm 4.1\%$)	61.7% ($\pm 5.0\%$)	48.4% ($\pm 5.1\%$)	35.9% ($\pm 4.2\%$)	35.79	<0.001*
Food hygiene practices	73.8% ($\pm 4.3\%$)	54.9% ($\pm 5.2\%$)	45.3% ($\pm 5.0\%$)	33.6% ($\pm 4.1\%$)	31.15	<0.001*
Environmental cleanliness	69.5% ($\pm 4.4\%$)	51.3% ($\pm 5.3\%$)	43.8% ($\pm 5.1\%$)	28.9% ($\pm 3.8\%$)	29.74	<0.001*
Overall compliance score	76.2% ($\pm 4.0\%$)	58.0% ($\pm 4.9\%$)	46.4% ($\pm 4.7\%$)	33.4% ($\pm 3.8\%$)	45.23	<0.001*

Data presented as mean percentage ($\pm$ standard error) *Statistically significant at $p < 0.05$

Analysis of variance (ANOVA) revealed significant differences in hygiene practice compliance across different intervention approaches. Communities that received the Community-Led Total Sanitation (CLTS) approach consistently demonstrated the highest compliance rates across all measured practices, with an overall compliance score of 76.2% ($\pm 4.0\%$). School-based interventions showed moderate effectiveness with an overall compliance of 58.0% ($\pm 4.9\%$), while radio campaigns achieved 46.4% ($\pm 4.7\%$) compliance. The control group, which received only conventional hygiene education, demonstrated significantly lower compliance at 33.4% ($\pm 3.8\%$). The differences were most pronounced for handwashing with soap at critical times ($F=42.68$, $p < 0.001$)

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and safe water storage ($F=38.42$, $p<0.001$). Post-hoc Tukey tests (not shown) confirmed that all pairwise comparisons between intervention groups were statistically significant ($p<0.05$). These findings further supported the effectiveness of participatory, community-based approaches over conventional education methods, aligning with the study's first hypothesis.

Table 6: Longitudinal Analysis of Behavioral Change Sustainability (6-36 Months Post-Intervention)

<i>Time Intervention</i>	<i>Post-High Community Ownership (n=384)</i>	<i>Medium Community Ownership (n=512)</i>	<i>Low Community Ownership (n=384)</i>	<i>Chi-square</i>	<i>p-value</i>
6 months	92.7% ($\pm 2.7\%$)	78.5% ($\pm 3.8\%$)	61.3% ($\pm 4.9\%$)	74.32	<0.001*
12 months	87.5% ($\pm 3.3\%$)	67.2% ($\pm 4.1\%$)	43.8% ($\pm 5.0\%$)	108.67	<0.001*
18 months	83.1% ($\pm 3.8\%$)	58.6% ($\pm 4.3\%$)	32.5% ($\pm 4.7\%$)	156.24	<0.001*
24 months	79.4% ($\pm 4.1\%$)	52.3% ($\pm 4.4\%$)	25.8% ($\pm 4.4\%$)	189.50	<0.001*
30 months	76.8% ($\pm 4.3\%$)	47.5% ($\pm 4.4\%$)	22.4% ($\pm 4.2\%$)	204.36	<0.001*
36 months	74.7% ($\pm 4.4\%$)	45.1% ($\pm 4.4\%$)	20.3% ($\pm 4.0\%$)	212.83	<0.001*
Decay rate (% per month)	0.50%	0.93%	1.14%	--	--

Data presented as mean percentage compliance ($\pm$ standard error) *Statistically significant at $p<0.05$

The longitudinal analysis demonstrated clear differences in the sustainability of behavioral changes based on the level of community ownership established during the intervention. Communities classified as having high community ownership maintained 74.7% ($\pm 4.4\%$) compliance even 36 months after the intervention concluded, compared to 45.1% ($\pm 4.4\%$) for medium ownership communities and only 20.3% ($\pm 4.0\%$) for low ownership communities. The differences were highly significant at all time points ($p<0.001$). The monthly decay rates in compliance were also markedly different: 0.50% for high ownership communities versus 0.93% for medium and 1.14% for low ownership communities. These findings strongly supported the third hypothesis that sustainability was positively correlated with the degree of community ownership. Chi-square tests showed that the differences between groups became increasingly pronounced over time, suggesting that community ownership factors became more critical for long-term sustainability as the time since active intervention increased.

Discussion of Results

The results of this study provide compelling evidence regarding the effectiveness and sustainability of UNICEF Uganda's hygiene promotion campaigns within its broader WASH program. The significant reduction in waterborne disease incidence demonstrated through difference-in-difference analysis (24.1% overall reduction, $p<0.001$) aligns with seminal work by Curtis et al. (2011) and Freeman et al. (2014), who established that properly designed handwashing interventions can reduce diarrheal disease by 30–47%. However, our findings revealed slightly lower effectiveness rates than the upper bounds of these previous studies, potentially reflecting the real-world implementation challenges encountered in Uganda's diverse geographical and cultural contexts. The variation in effectiveness across different disease types—with diarrheal diseases showing the greatest reduction (16.7%, $p<0.001$)—corresponds with Pickering et al.'s (2019) findings that hygiene interventions

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demonstrate differential impacts across various waterborne illnesses depending on transmission pathways and local environmental factors.

Our multivariate regression analysis identified community-led total sanitation approaches ($\beta=0.437$, $p<0.001$) and cultural integration ($\beta=0.382$, $p<0.001$) as the strongest predictors of successful hygiene practice adoption. These findings strongly support Mosler's (2012) theoretical framework emphasizing psychosocial determinants of behavior change and Dreibelbis et al.'s (2013) integrated behavioral model that highlights the importance of contextual factors. Particularly noteworthy was the significant association between women's participation in decision-making ($\beta=0.298$, $p<0.001$) and hygiene practice adoption, echoing O'Reilly et al.'s (2017) work on gendered dimensions of WASH interventions. The substantial effect of community leadership involvement ($\beta=0.356$, $p<0.001$) mirrors Montgomery et al.'s (2012) findings on UNICEF's transition toward community engagement strategies, suggesting that the organization has successfully implemented this strategic shift in Uganda.

The longitudinal sustainability analysis provided perhaps the most significant contribution to existing knowledge. The marked differences in compliance decay rates—0.50% monthly for high ownership communities versus 1.14% for low ownership communities—extend the findings of Jiménez et al. (2018) regarding UNICEF Uganda's innovative adaptations for program sustainability. The Cox proportional hazards model revealed that establishing local WASH committees ($HR=0.418$, $p<0.001$) and implementing community-led monitoring systems ($HR=0.486$, $p<0.001$) were the most effective strategies for maintaining behavioral changes, addressing a critical gap identified by Tumwebaze et al. (2018) concerning limited longitudinal evidence of sustained behavior change. These findings closely align with the most recent systematic reviews by Wolf et al. (2022) and Chaudhuri et al. (2023), who advocated for mixed-methods approaches to disentangle specific impacts of hygiene promotion components.

The comparison of intervention approaches revealed that community-led total sanitation achieved significantly higher compliance rates (76.2% $\pm$ 4.0%) compared to school-based approaches (58.0% $\pm$ 4.9%) and radio campaigns (46.4% $\pm$ 4.7%). These findings support Ejemot-Nwadiaro et al.'s (2021) conclusion that community-led approaches with participatory elements consistently outperform top-down, information-only campaigns. However, our research extends their work by quantifying the differential effectiveness across specific hygiene practices, with handwashing showing the largest disparity between intervention approaches. This granular analysis addresses Wolf et al.'s (2022) call for more nuanced evaluation methodologies that can identify the specific impacts of different hygiene promotion components.

One unanticipated finding was the substantial role of religious frameworks (mentioned in 65.6% of qualitative discussions) in facilitating hygiene promotion effectiveness. While not extensively documented in previous literature on UNICEF's WASH programs, this finding suggests potential untapped opportunities for strategic partnerships with religious institutions to enhance message dissemination and norm setting. This insight extends beyond the observations of Jiménez et al. (2018) regarding UNICEF Uganda's innovative adaptations and points toward additional implementation pathways that merit further exploration.

The decay patterns observed in our longitudinal analysis partially contradict the findings of Chaudhuri et al. (2023), who suggested that decay rates typically accelerate over time. Instead, our data showed relatively constant monthly decay rates within each community ownership category, with the differences between categories becoming more pronounced over time. This finding has significant implications for program design and follow-up strategies, suggesting that intensive investment in community ownership mechanisms during initial implementation may yield compounding benefits for sustainability.

Conclusion.

The findings of this study provide compelling evidence that behavior-centered interventions, grounded in established behavioral change theories such as the Knowledge, Attitude, and Practice (KAP) model and the Community-Led Total Sanitation (CLTS) approach, are crucial for the success of hygiene promotion campaigns. The significant reduction in waterborne diseases in communities exposed to UNICEF Uganda's WASH program reaffirms the effectiveness of participatory engagement strategies in driving long-term behavioral change. Unlike infrastructure-focused interventions that assume improved facilities automatically translate into better hygiene practices, this study demonstrates that fostering community ownership, integrating local cultural frameworks, and employing interactive hygiene education methods are far more effective in ensuring sustained improvements. This aligns with the broader consensus in public health literature that sustainable hygiene behavior change is achieved when interventions are contextually relevant and actively involve community members in the decision-making process.

The study further underscores the importance of cultural integration and gender inclusivity as key determinants of hygiene behavior adoption and sustainability. The alignment of hygiene messages with existing cultural norms was found to enhance program effectiveness, as communities were more receptive to practices that resonated with their traditional beliefs. This supports the argument that interventions designed without regard for local values often struggle to gain acceptance and fail to achieve long-term impact. Additionally, the study highlights the significant role of women in sustaining hygiene practices, particularly when they are actively involved in leadership and decision-making structures. Given their central role in household hygiene management, increasing women's participation in WASH governance contributes to stronger program outcomes and greater compliance. These findings suggest that future hygiene promotion efforts should prioritize culturally sensitive approaches and gender-responsive strategies to maximize their effectiveness and sustainability.

The study also emphasizes the role of social norms and economic factors in influencing hygiene behavior adoption. Social expectations and peer influence were found to be powerful motivators for sustaining hygiene practices, reinforcing previous research that highlights the importance of community-driven accountability mechanisms. Moreover, the study revealed that economic constraints, such as the affordability of soap and accessibility of clean water, remain significant barriers to consistent hygiene practices. These insights highlight the need for complementary interventions that address economic challenges, such as subsidies for hygiene products or microfinance initiatives that support community-led sanitation improvements. By tackling both behavioral and economic barriers, policymakers and organizations can enhance the effectiveness of hygiene promotion campaigns and ensure that improved hygiene practices are sustained over time.

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Finally, the study's longitudinal findings highlight the necessity of establishing strong community ownership structures to sustain hygiene behavior beyond the intervention period. Communities with well-established WASH committees and monitoring systems demonstrated significantly lower rates of behavioral relapse, reinforcing the argument that decentralized governance and continuous engagement are essential for maintaining hygiene improvements.

Recommendations.

Enhance Community Ownership: UNICEF and other WASH stakeholders should strengthen local governance structures by establishing and training community-led WASH committees to sustain hygiene practices beyond external interventions.

Integrate Cultural and Gender-Sensitive Approaches: Hygiene promotion campaigns should align with local cultural beliefs and actively involve women in leadership roles to improve acceptance and long-term compliance.

Address Economic Barriers: Governments and development partners should introduce subsidies or community financing programs to make essential hygiene products like soap and clean water more affordable for low-income households.

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