

2025 CHIPTS HIV NEXT GENERATION CONFERENCE



Impact of Water Insecurity and Extreme Weather Events on HIV Treatment Outcomes

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Zambia Study

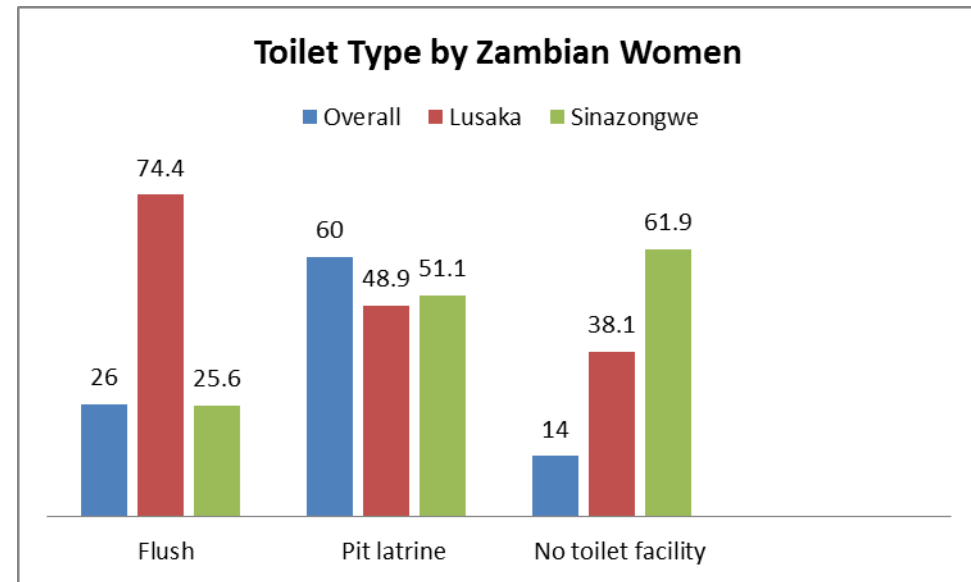
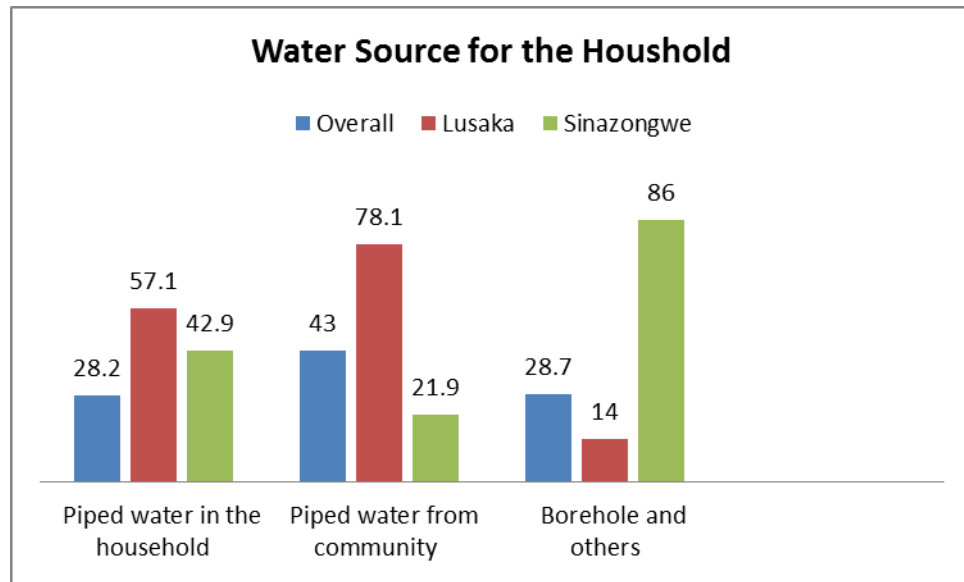
Impact of Water Access/ Water Insecurity on ART Adherence Intention
among Pregnant and Postpartum Women Living with HIV

Adherence intention

- There are two experts in provider–patient relationship
 - Nurse/provider is an expert of nursing or medicine
 - Patient who is the expert on his/her life
- Causes of non-adherence can be summarized as unintentional and intentional
 - Unintentional non-adherence: Patient intends to take the drug, but is prevented from doing so by limitations in their capacity and resources e.g., lack of water and toilet
 - Intentional non-adherence: Patient decides not to take medication as recommended
- Adherence Intention leads to Adherence

Findings

- Total sample (N) =150
- Lusaka (Urban) =81 (54%) and Sinazongwe (Rural) =69 (46%)



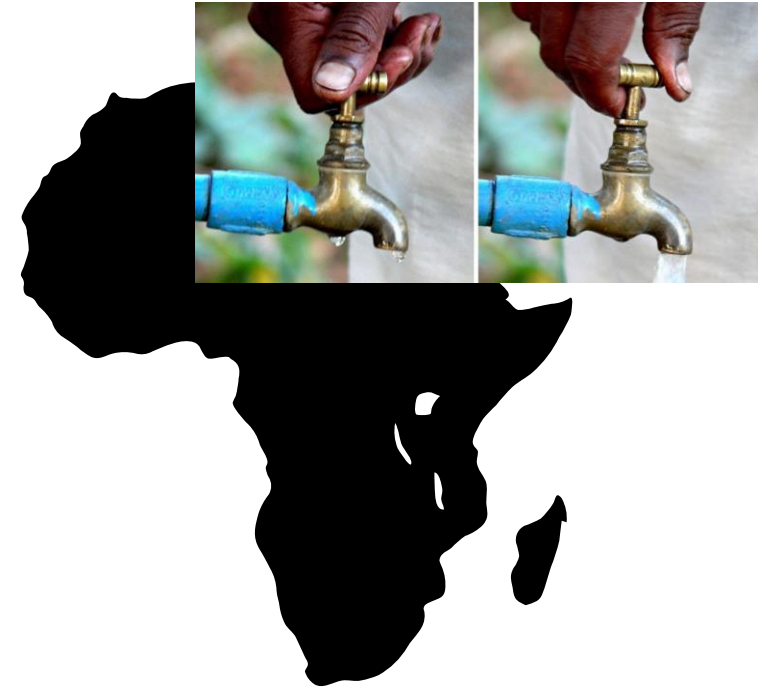
Outline

- Background
- Zambia study
- Ghana study among pregnant and postpartum women
- Ghana study 2 in the general population
- Summary
- Way forward
- Acknowledgment



Background

- ▶ Water insecurity (WI) is a major challenge in SSA; number of people living with HIV is disproportionately higher, and the worst impact of climate change
- ▶ WI is associated with emotional distress including fear of contamination and lack of safety, generalized anxiety, increased migration and thus HIV risk, as well as disruptions to health, care engagement, livelihoods, and relationships
- ▶ SSA will require dramatic efforts to improve current rates of water and sanitation services:
 - ▶ 418 million lack basic drinking water service
 - ▶ 779 million lack basic sanitation services
 - ▶ 839 million lack basic hygiene services



Background- cont'd ...

- ▶ In Ghana, one of the most vulnerable countries to climate change in SSA, **flooding affects around 45,000 Ghanaians annually**
- ▶ Nearly half of Ghana's coastline is vulnerable to erosion and flooding because of sea-level rise and atypical rainfall
- ▶ An estimated 70% of all disease burden in Ghana is attributed to WI
- ▶ **There is an urgent need to explore and document the impact on WI on PLWH's health and in Ghana, specifically**



Sustainable Development Goals

In 2015, the new Sustainable Development Goals (SDGs) were released

17 goals in all with goal 6 focusing on water and sanitation

However, there are other goals which address water insecurity indirectly

End extreme poverty.

Fight inequality & injustice.

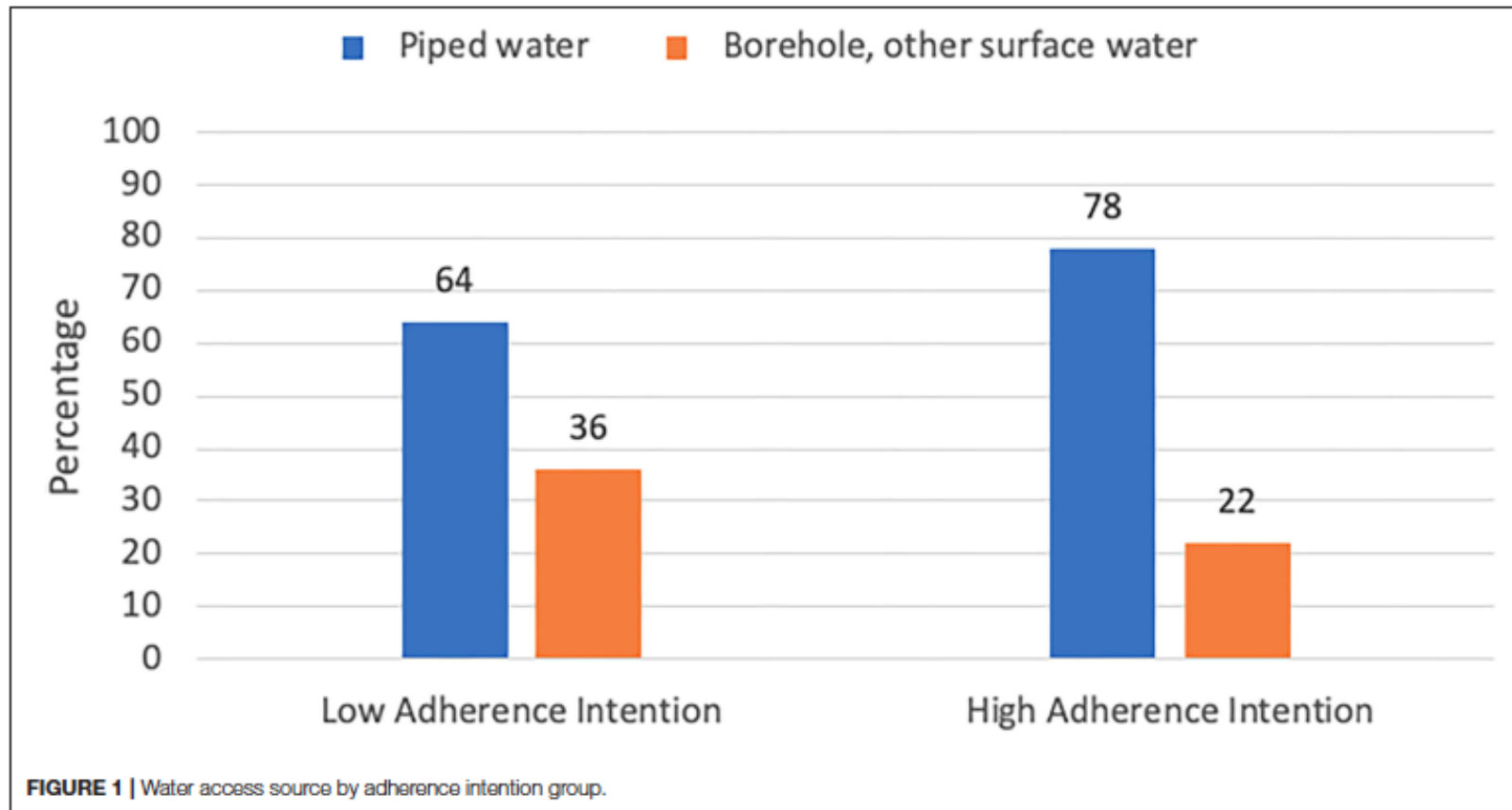
Fix climate change.



Water access source by adherence intention group

Nutor et al.

Water Access and Adherence Intention



Regression models for predictors of ART adherence intention (N = 148)

Nutor et al.

Water Access and Adherence Intention

TABLE 2 | Regression models for predictors of ART adherence intention (N = 148).

Characteristics	Model 1 PR (95% CI) ^a	Model 2 PR (95% CI) ^a	Model 3 PR (95% CI) ^a	Model 4 PR (95% CI) ^a
Water source				
Piped water	Referent	Referent	Referent	Referent
Borehole or surface water	0.73 (0.52–1.02)	0.77 (0.52–1.14)	0.80 (0.61–1.05)	1.06 (0.78, 1.45)
HIV transmission knowledge				
High (12–13)		Referent	Referent	Referent
Low (<12)		0.59 (0.49,0.70)*	0.62 (0.49–0.79)*	0.65 (0.50,0.84)*
Age				
18–30			Referent	Referent
Above 30			1.02 (0.65–1.60)	1.06 (0.67, 1.68)
Occupation				
Employed			Referent	Referent
Housewife			0.96 (0.80–1.15)	0.84 (0.58, 1.23)
Unskilled labor			1.01 (0.49, 2.06)	1.13 (0.61, 2.06)
Household monthly income				
≥3,000 Zambian Kwacha			Referent	Referent
<3,000 Zambian Kwacha			1.31 (1.08, 1.61)	1.18 (0.78, 1.78)
Place of residence				
Urban				Referent
Rural				0.53 (0.24–1.15)
Pearson's and Deviance goodness of fit tests both had P = 1.00 for all four models. ^b				

*p-value ≤ 0.05.

^aFrom mixed effects Poisson regression with robust variance estimate (i.e., log-linear model), including a random effect for clinic. PR, prevalence ratio.

^bFrom fixed effects Poisson regression model (with a fixed effect for clinic, since goodness of fit tests are not implemented for random effects models; model coefficients negligibly different).

Multiple regression models for association between toilet type and adherence intention stratified by district

Table 3. Multiple regression models for adherence intention by place of residence ($n = 150$).

Characteristics	Urban			Rural		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
Toilet type						
Flush toilet	Referent	Referent	Referent	Referent	Referent	Referent
Pit latrine	1.12 (0.98-1.29)	1.25 (1.08-1.46)**	1.26 (1.08-1.47)*	0.91 (0.72-1.16)	0.83 (0.64-1.08)	0.84 (0.65-1.09)
No toilet facility	1.24 (0.99-1.55)	1.35 (1.07-1.70)*	1.32 (1.05-1.67)	0.77 (0.58-1.03)	0.65 (0.47-0.90)*	0.65 (0.47-0.89)*
Age						
18-25		Referent	Referent		Referent	Referent
26-30		0.90 (0.76-1.46)	0.91 (0.77-1.08)		0.75 (0.59-0.95)*	0.74 (0.59-0.94)*
31-35		0.97 (0.78-1.20)	0.98 (0.79-1.21)		0.83 (0.66-1.04)	0.85 (0.68-1.28)
36-44		1.17 (0.93-1.48)	1.14 (0.90-1.44)		0.79 (0.62-1.00)	0.83 (0.65-1.05)
Marital Status						
In a relationship living with partner		Referent	Referent		Referent	Referent
In a relationship, not living with partner		1.03 (0.80-1.34)	1.05 (0.82-1.37)		0.94 (0.74-1.21)	0.96 (0.76-1.23)
Educational Status						
Higher/College		Referent	Referent		Referent	Referent
Primary or no formal education		0.80 (0.56-1.37)	0.84 (0.59-1.20)		0.89 (0.65-1.21)	0.93 (0.68-1.28)
Secondary		0.91 (0.66-1.26)	0.93 (0.67-1.00)*		0.82 (0.60-1.03)	0.87 (0.64-1.17)
Occupation						
Employed		Referent	Referent		Referent	Referent
Housewife		1.06 (0.90-1.25)	1.06 (0.90-1.25)		0.92 (0.72-1.65)	0.96 (0.75-1.22)
Other		0.80 (0.63-1.01)	0.80 (0.63-1.04)		1.17 (0.92-1.48)	1.21 (0.96-1.53)
Household Monthly Income						
≥ 3000 Zambian Kwacha		Referent	Referent		Referent	Referent
< 3000 Zambian Kwacha		0.82 (0.69-0.99)	0.83 (0.69-1.00)*		1.21 (0.89-1.66)	1.19 (0.88-1.61)
HIV and MTCT transmission knowledge						
12-13			Referent			Referent
< 12			0.90 (0.77-1.04)			0.84 (0.68-1.03)
Goodness of fit test for urban						
Model 2 = 0.22						
Model 3 = 0.34						
Goodness of fit test for rural						
Model 2 = 0.34						
Model 3 = 0.18						

* p value $\leq .05$.

** p value $\leq .001$.

Low adherence group = 0.

High adherence group = 1.

Impact of toilet and water access on ART adherence intention in Zambia



Water Access and Adherence Intention Among HIV-Positive Pregnant Women and New Mothers Receiving Antiretroviral Therapy in Zambia

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Background: Mother-to-infant transmission of HIV is a major problem in Sub-Saharan Africa despite free or subsidized antiretroviral treatment (ART), but is significantly reduced when mothers adhere to ART. Because potable water access is limited in low-resource countries, we investigated water access and ART adherence intention among HIV-positive pregnant women and new mothers in Zambia.

Methods: Our convenience sample consisted of 150 pregnant or postpartum women receiving ART. Descriptive statistics compared type of water access by low and high levels of ART adherence intention.

Results: Most (71%) had access to piped water, but 36% of the low-adherence intention group obtained water from a well, borehole, lake or stream, compared to only 22% of the high-adherence intention group. The low-adherence intention group was more rural (62%) than urban (38%) women but not statistically significant [unadjusted Prevalence Ratio (PR) 0.73, 95% CI: 0.52–1.02; adjusted PR 1.06, 95% CI: 0.78–1.45].

Conclusion: Providing potable water may improve ART adherence. Assessing available water sources in both rural and urban locations is critical when educating women initiating ART.

Keywords: ARV, Sub-Saharan Africa, potable water, women, rural, borehole, well water, Theory of Planned Behavior



Influence of toilet access on antiretroviral adherence intention among pregnant and breastfeeding women who are HIV-positive and enrolled in Option B+

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ABSTRACT

We investigated the influence of toilet access on intention to adhere to antiretroviral therapy (ART) among women who are HIV-positive and enrolled in Option B+. A convenience sample of 150 women residing in Lusaka (urban) and Sinazongwe (rural) Districts of Zambia were recruited. If they were seeking pre- or post-natal care and were enrolled in Option B+, intention to adhere to ART was assessed using four questions based on the Theory of Planned Behavior; the median score was used to distinguish high intention from low intention. Descriptive statistics were used to characterize access to toilet facilities and ART adherence intention in the entire sample and by rural and urban districts in Zambia. There was no significant difference ($p = .19$) between rural and urban women's access to a flush toilet. After adjusting for toilet access, however, rural women were significantly less likely to be in the high adherence intention group (PR = 0.80, 95% CI 0.71–0.90, $p < .001$) but access to a flush toilet was associated with

ARTICLE HISTORY

Received 13 August 2019

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Ghana Study 1

Association between water insecurity and antiretroviral therapy adherence among pregnant and postpartum women in Greater Accra region of Ghana



Methods

To investigate the associations between food insecurity, water insecurity and ART adherence among HIV positive pregnant and postpartum women in Greater Accra region of Ghana

Cross-sectional study of 176 HIV-positive pregnant and postpartum women receiving ART in the Greater Accra region

Bivariate analysis was performed using chi-square test and univariate logistics regression models to identify potential factors associated with ART adherence

Description of the study population

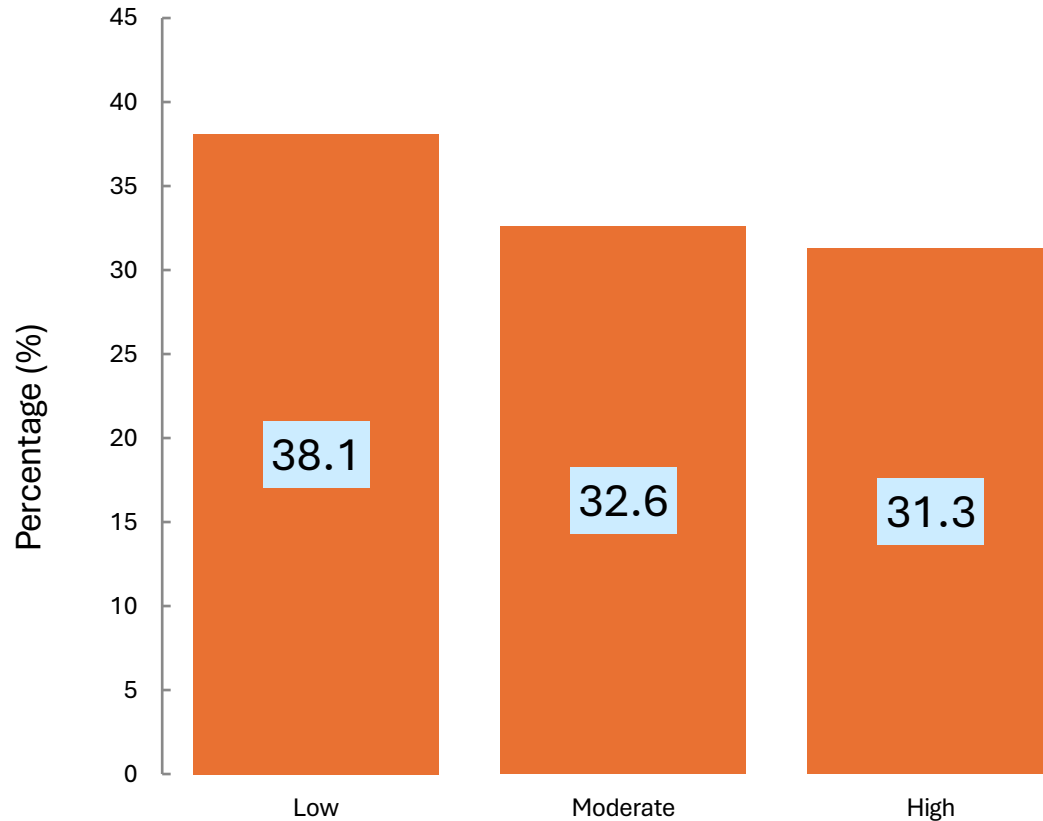
Characteristics	Category	Frequency (%)
Residence in Urban	Urban	140 (79.5)
Age	<30 years	54 (30.7)
	30-34	64 (36.4)
	>=35 years	56 (31.8)
	Missing	2 (1.1)
Partner's HIV status known	Yes	111 (63.1)
Fuel type mainly used	LPG or natural gas	112 (63.6)
Household Food Insecurity score	Low	63 (35.8)
	Moderate	57 (32.4)
	High	56 (31.8)

Most of the participants reside in Urban areas (79.5%)

Most of the participants were 30 and above years of age (68.2%)

Most participants knew their partners' HIV status (63.1%)

Household water insecurity in Greater Accra



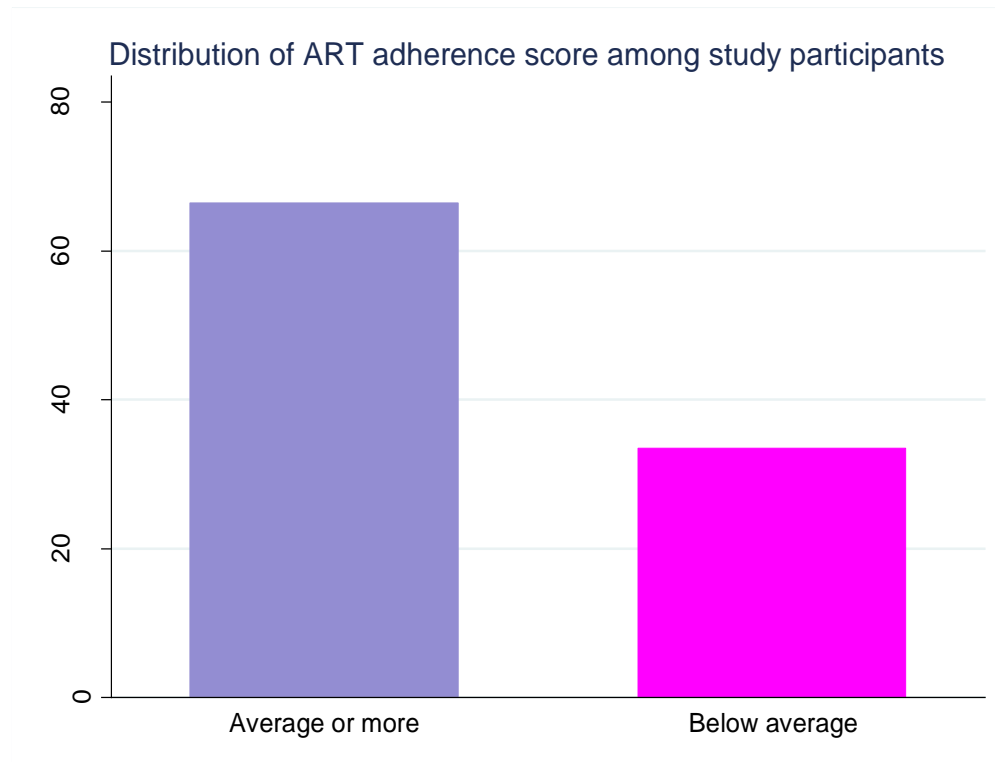
Household water insecurity were at least moderate (63.9%)

Main source of drinking water was Sachet water (70.0%)

Public tap/standpipe was the main source of water for other purposes such as cooking (35.2%)

ART adherence among women living with HIV

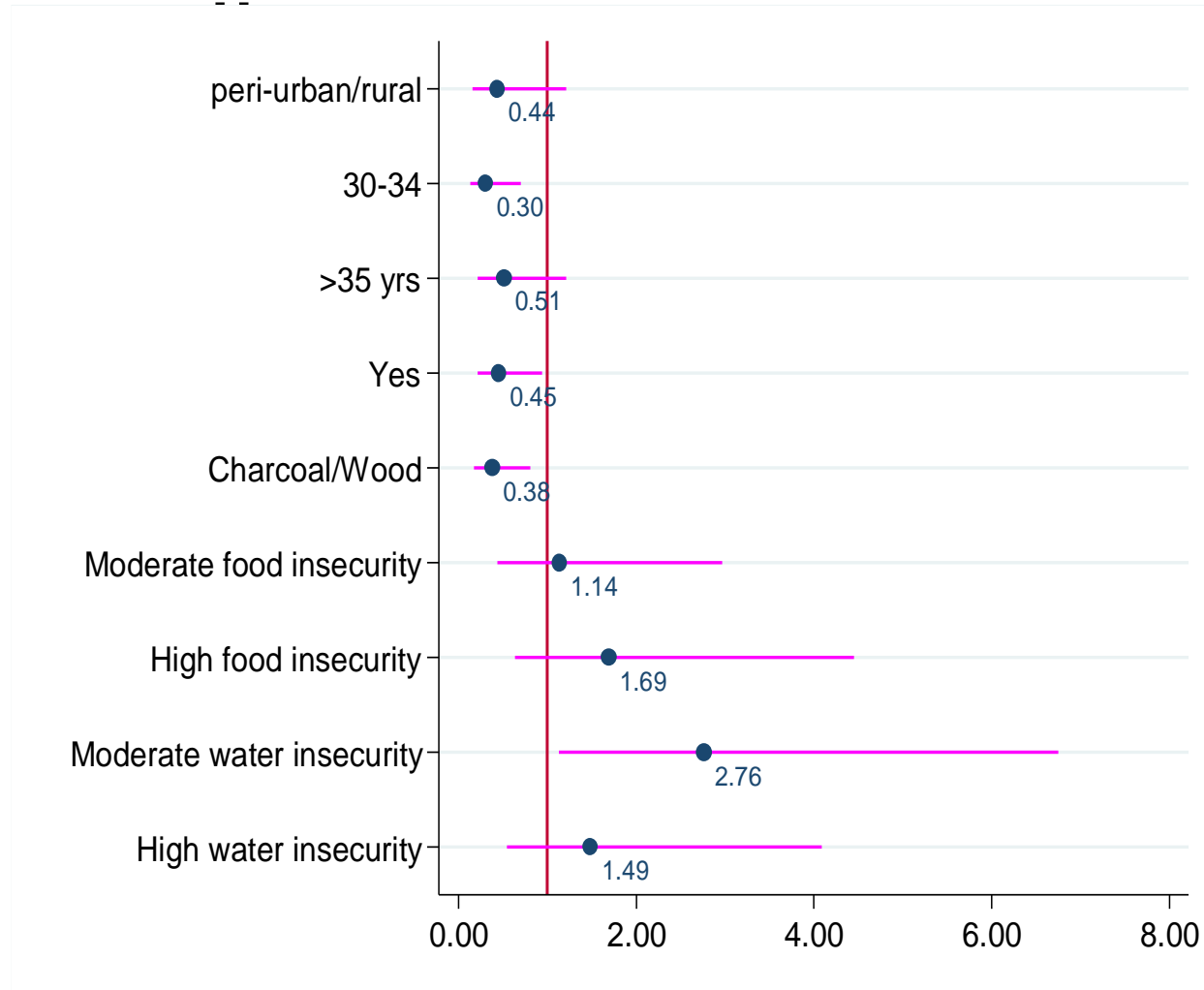
Most participants had a good ART adherence score (66.5% vs 33.5%)



Most participants with good ART adherence (n=117), had moderate and high water insecurity (53.8%) compared to those with low water insecurity (46.2%).

Most participants with poor ART adherence (n=59) had moderate and high water insecurity (78%) compared to those with low (22.0%)

Effect of water insecurity on ART



Respondents with moderate WI had greater odds of poor ART adherence scores (aOR=2.76, 95% CI: 1.13-6.75, p=0.026) as compared to those with low WI

Summary findings

Half of the respondents with good ART adherence scores reported moderate or high water insecurity (58.8%) compared to 78% of those with poor ART adherence scores

Participants with a moderate household water insecurity score had nearly 3 times greater odds of reporting poor ART adherence (aOR=2.76, 95% CI: 1.13-6.75, p=0.026) compared to those with low household water insecurity score

There was no association between household food insecurity and ART adherence at both bivariate and multivariate analysis

RESEARCH ARTICLE

Association between water insecurity and antiretroviral therapy adherence among pregnant and postpartum women in Greater Accra region of Ghana

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Abstract

Background

Adherence to antiretroviral therapy (ART) can substantially reduce morbidity and mortality among women living with HIV (WLWH) and prevent vertical transmission of HIV. However, in sub-Saharan Africa (SSA), more than 50% of new mothers discontinue ART and HIV care after childbirth. The role of water insecurity (WI) in ART adherence is not well-explored. We examined the relationship between WI and ART adherence among pregnant and postpartum WLWH in Greater Accra region of Ghana.

Methods

Using a cross-sectional survey, we recruited 176 pregnant and postpartum WLWH on ART across 11 health facilities. We examined the association between WI (measured using the Household Water Insecurity Experience Scale, and categorized as moderate and severe WI compared to low WI) and poor ART adherence (defined as scoring a below average observed CASE index score). Bivariate analysis was performed using chi-square test followed by multivariate logistic regression models. We included all variables with p-values less than 0.20 in the multivariate analysis.

Results

Most (79.5%) of the pregnant and postpartum WLWH enrolled on ART, were urban residents. Over 2/3 were aged 30 years and older. Overall, 33.5% of respondents had poor



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Data Availability Statement: All data used for this study are included in the study.

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Competing interests: The authors have declared that no competing interests exist.

A composite image featuring a globe of the Earth. The landmasses are depicted with a cracked, brown, parched texture, while the oceans are a deep blue. A chrome faucet is positioned on the left side of the globe, with a black microphone attached to its top. The text 'Ghana Study 2' is overlaid in white, sans-serif font in the center of the image.

Ghana Study 2

Identifying the mechanisms of water insecurity on HIV
treatment outcomes

Background

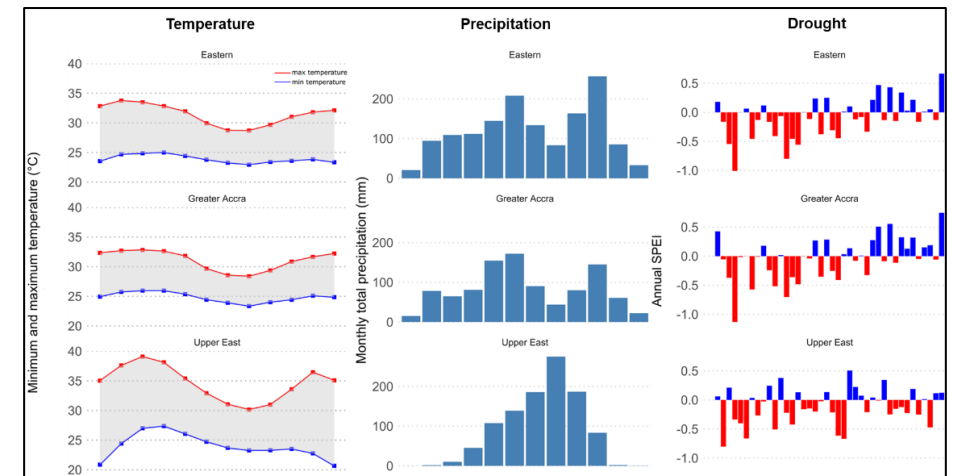
Convergent mixed-methods

A longitudinal cohort of 503 PLWH

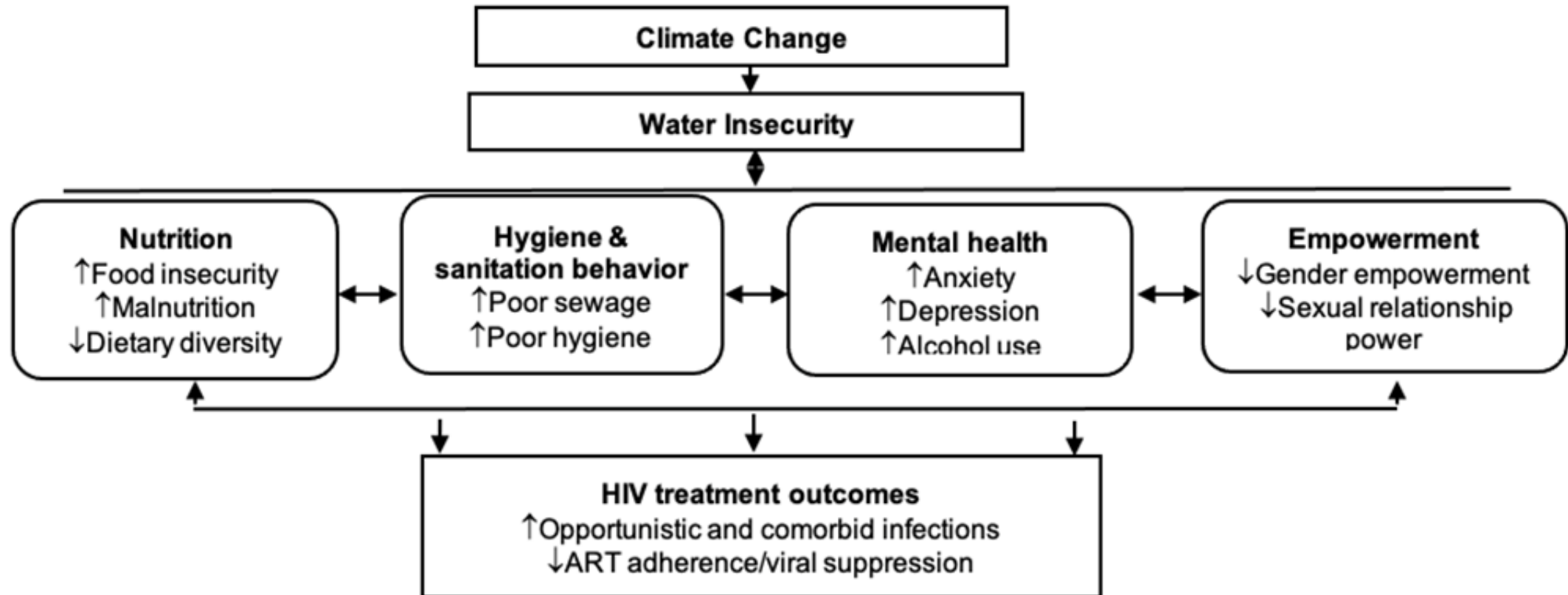
Three selected regions based on preliminary climate data

To quantify and elucidate the impact of water insecurity on HIV, related to climate-related drivers, infrastructure challenges, water accessibility.

To help identify and prioritize intervention development to address WI among PLWH





Study conceptual framework





Methods

- Convergent mixed-methods
- A longitudinal cohort of 503 people living with HIV (PLWH)
- Three regions based on preliminary climate data
- Remote sensing data

 **Precipitation:** Total precipitation accumulated over each exposure period- converted into precipitation anomalies.

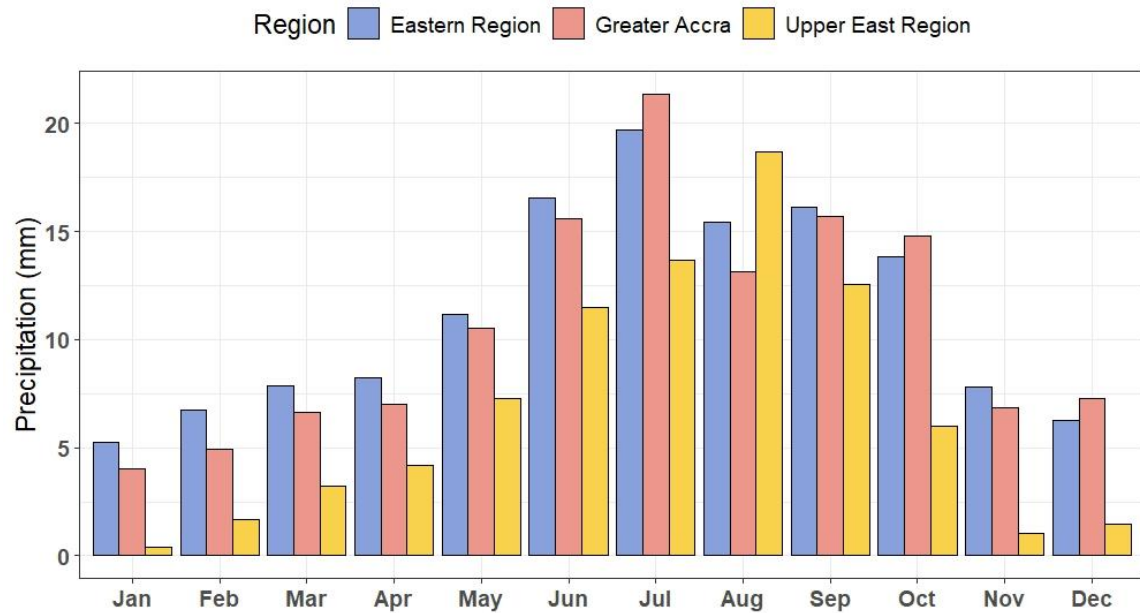
 **Drought:** Standardized Precipitation Evapotranspiration Index (SPEI), a multi-scalar drought index of gridded climate data on monthly precipitation and evapotranspiration.

 **Temperature:** Daily temperature means based on the maximum and minimum temperature values, averaged for the same windows of exposure.

 **Floods:** exposure to floods for each participant/wave.

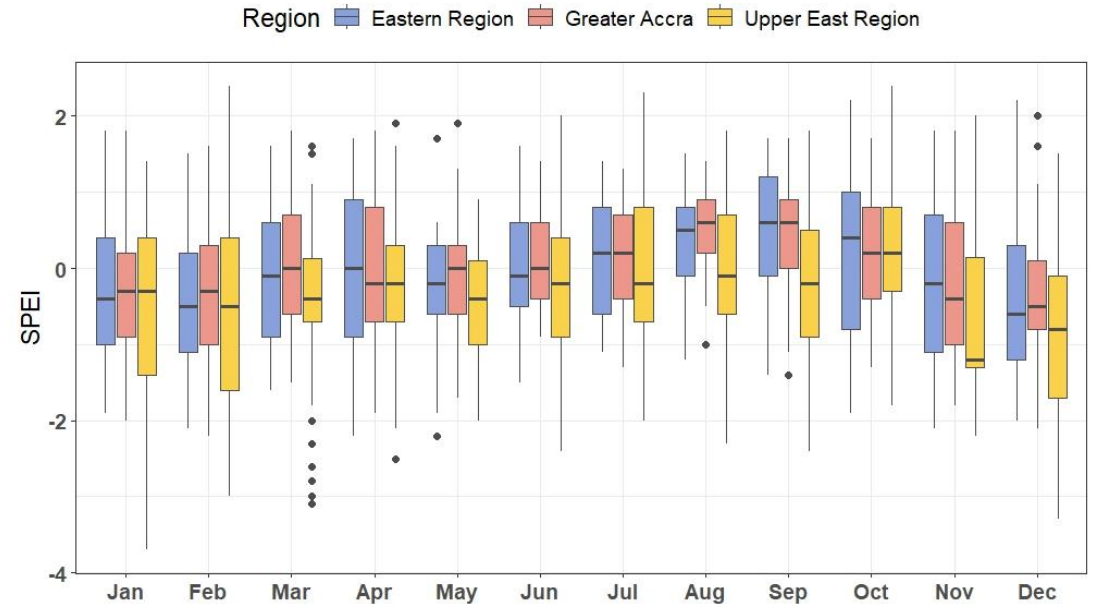
Mean Monthly Precipitation

Mean Monthly Precipitation*
(1993-2023)



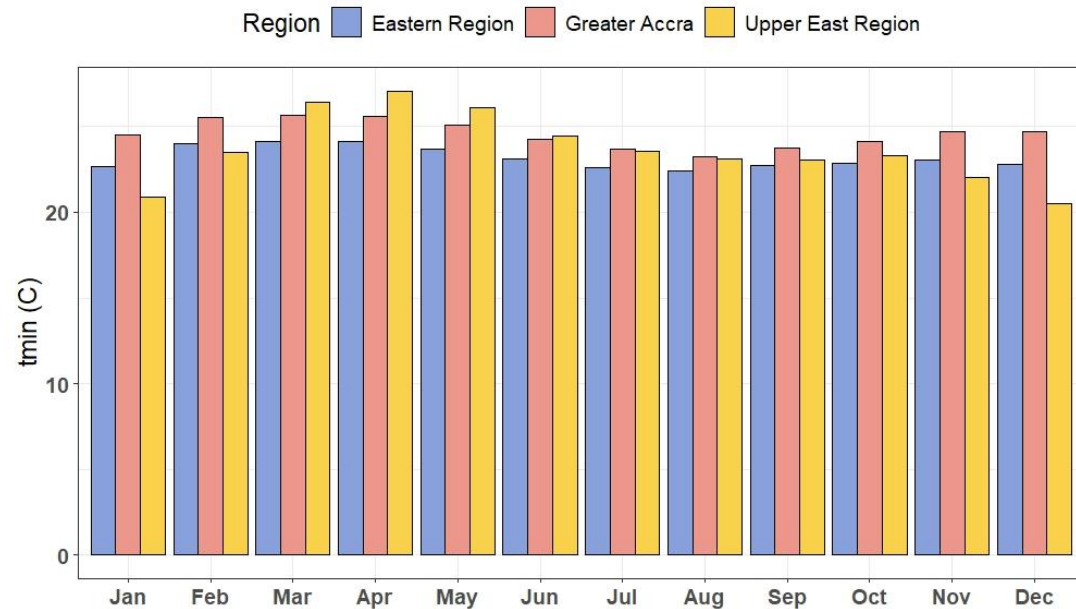
*averaged when daily precipitation > 0 mm

Standardized Precipitation-Evapotranspiration Index (SPEI)
(1993-2023)

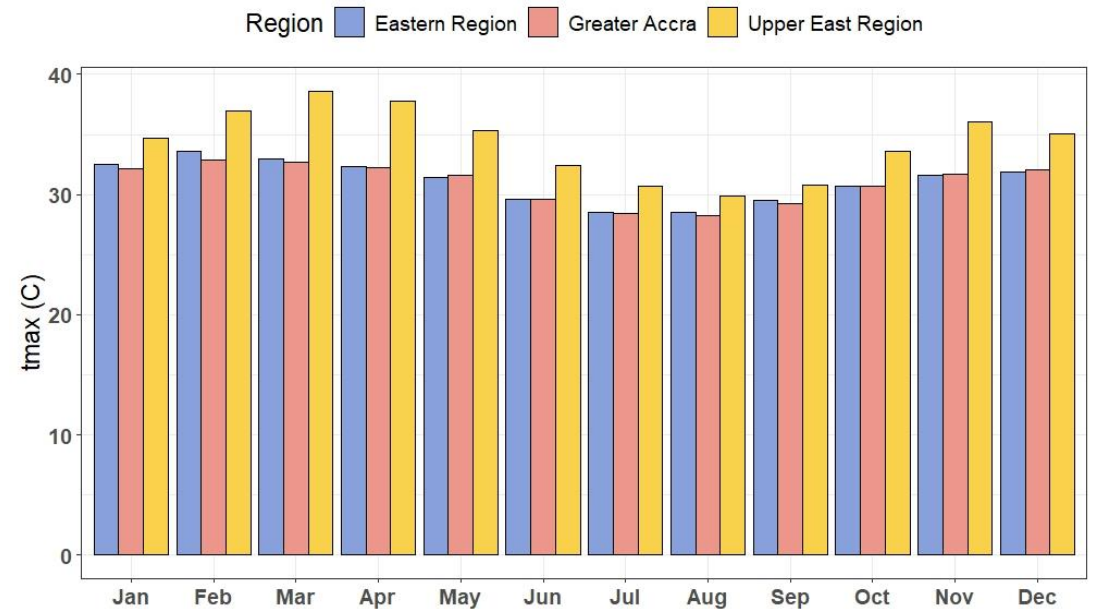


Mean Monthly Max. and Min. Temperature

Mean Monthly Minimum Temperature
(1993-2023)



Mean Monthly Maximum Temperature
(1993-2023)



Baseline Findings

- Those who experienced water insecurity (WI) was 66.2%
- More than half (54.1%) reported ART non-adherence
- 18.1% of the participants were virally unsuppressed
- 16.7% of the participants who had experienced WI were unsuppressed
- Non-adherence among those who experienced WI was 57.1%

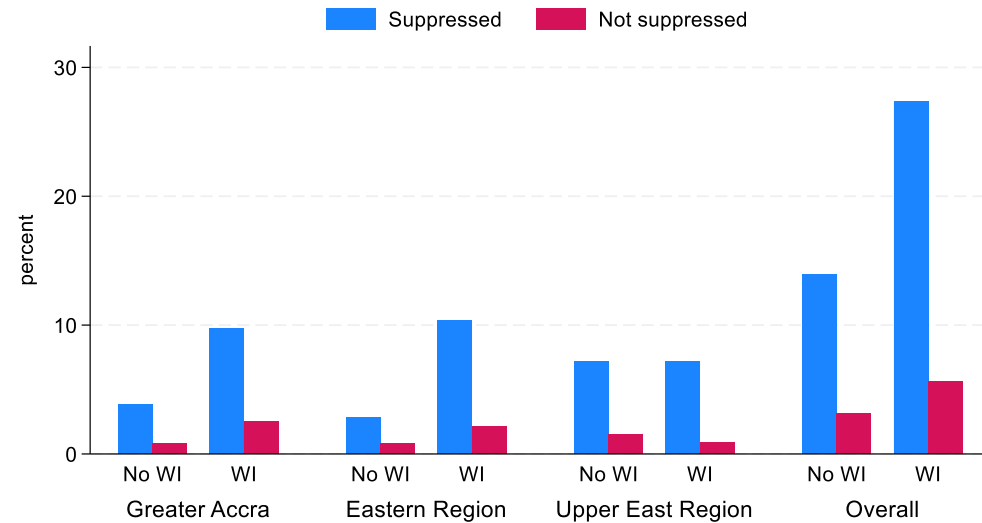
Baseline selected characteristics by region (N=503)

Characteristic	Greater Accra (N=171) n(%)	Eastern Region (N=166) n(%)	Upper East Region (N=166) n(%)	Overall (N=503) n(%)
Age in years (Mean, SD)	42.89 (±11.47)	46.55 (±12.71)	47.54 (±11.54)	45.63 (±12.06)
Gender				
Male	54 (31.6)	42 (25.3)	61 (36.7)	157 (31.2)
Female	117 (68.4)	124 (74.7)	105 (63.3)	346 (68.8)
Experience of water insecurity	124 (72.5)	129 (77.7)	80 (48.2)	333 (66.2)
Experience of food insecurity	140 (81.9)	150 (90.4)	146 (88.0)	436 (86.7)
ART non-adherence (urine test)	55 (32.2)	41 (24.7)	9 (5.4)	105 (20.9)
ART non-adherence (Visual Analog)*	100 (58.5)	95 (57.2)	77 (46.4)	272 (54.1)
Viral load	(N=169)	(N=163)	(N=166)	(N=498)
Suppressed	134 (79.3)	132 (81.0)	142 (85.5)	408 (81.9)
Not suppressed	35 (20.7)	31 (19.0)	24 (14.5)	90 (18.1)

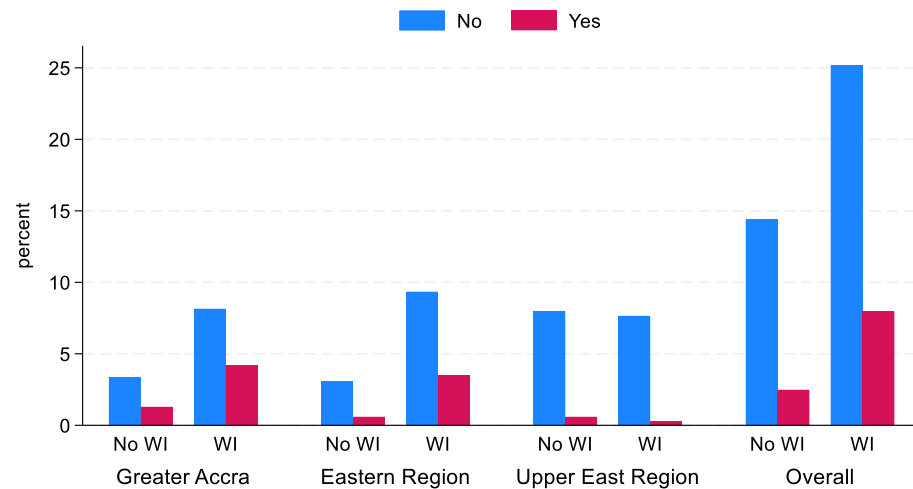
*Non-adherence on visual analog scale (VAS) is < 95%

Baseline findings cont'd...

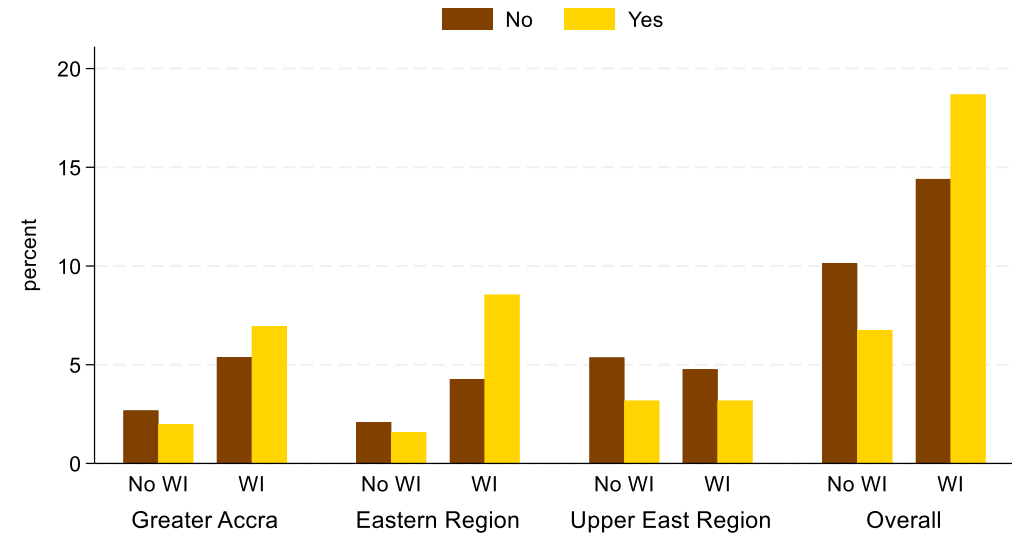
Viral suppression by water insecurity in 3 region of Ghana



Non-ART adherence by water insecurity in 3 region of Ghana



Opportunistic infections by water insecurity in 3 region of Ghana



Association of water insecurity with non-ART adherence, Viral suppression, and opportunistic infection

Outcome measures	Univariable		Multivariable*	
	Unadjusted OR (95%CI)	P	Adjusted OR (95%CI)	P
ART Adherence	Reference*	-	Reference*	-
	1.63 (1.04-2.56)	0.032	1.22 (0.77-1.95)	0.396
Viral suppression	Reference*	-	Reference*	-
	0.97 (0.63-1.50)	0.887	0.92 (0.59-1.42)	0.710
Opportunistic infection	Reference*	-	Reference*	-
	1.41 (1.07-1.86)	0.015	1.31 (0.98-1.76)	0.067

Baseline findings cont'd...

- At univariable analysis, water insecurity was associated with greater odds of both non-ART adherence and having opportunistic infections
- Similarly, this was observed in the multivariable analysis although not statistically significant.
- We found that the study regions exhibit significant climate variability, impacting rainfall patterns, drought severity, and extreme heat exposure
- ART adherence, opportunistic infections and viral load suppression all seems varied by regional pattern along climate variability.
- More to come soon

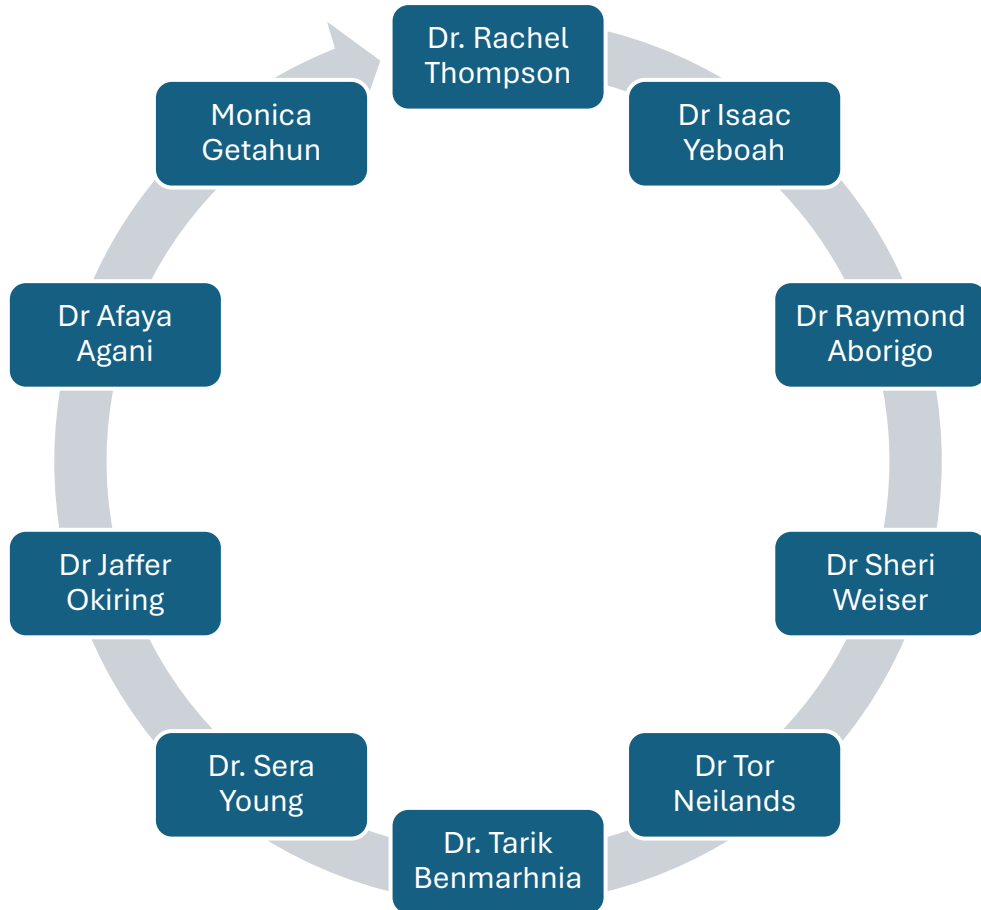
Quotes from in-depth interviews

- “We get access at times, but during this dry season, you have to wake up early to get water. That’s why I said I wake up at 3 AM to go and fetch water... The water I collect lasts for four days before I go again”
- “When I don’t have money to buy water, it worries me a lot because you can’t drink the borehole water since it’s salty, and sometimes it’s difficult to use it to wash clothes.”
- “A borehole at home would greatly improve my situation. Carrying water from afar causes chest pains and affects my waist. Sometimes, there is no medication to take, and it affects me a lot.”
- “I take the drugs as prescribed and instructed. I take it every evening at six; if there is no water, I have to buy sachet water to take it.”

Summary

- Water insecurity and exposure to extreme weather events may influence ART adherence, viral load suppression and opportunistic infections among PLWH
- More data needed to draw conclusion

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Thank you

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