Heat Exposure, Sleep, Cognition and MentAl Health: Mechanisms of Climate Change ImPacts on VulnErable Groups in Two Sub-Saharan Africa Countries – HEATSCAPE-Africa

IUSSP Webinar on Climate Change Research Ghana, 2026

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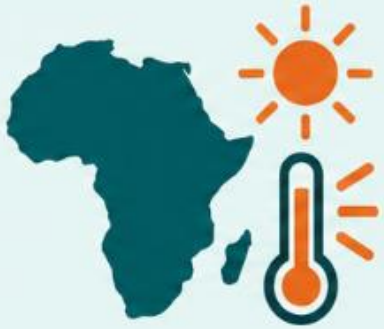
Motivation & Gaps

Why HEATSCAPE-Africa?

Growing need. Unequal risks. Critical evidence gaps.

Growing mental health burden

More people living with mental disorders globally since 1990



Escalating heat exposure

Sub-Saharan Africa faces increasing heat extremes

Unequal vulnerability

Heat risks vary by age, gender, health and living conditions

Limited local evidence

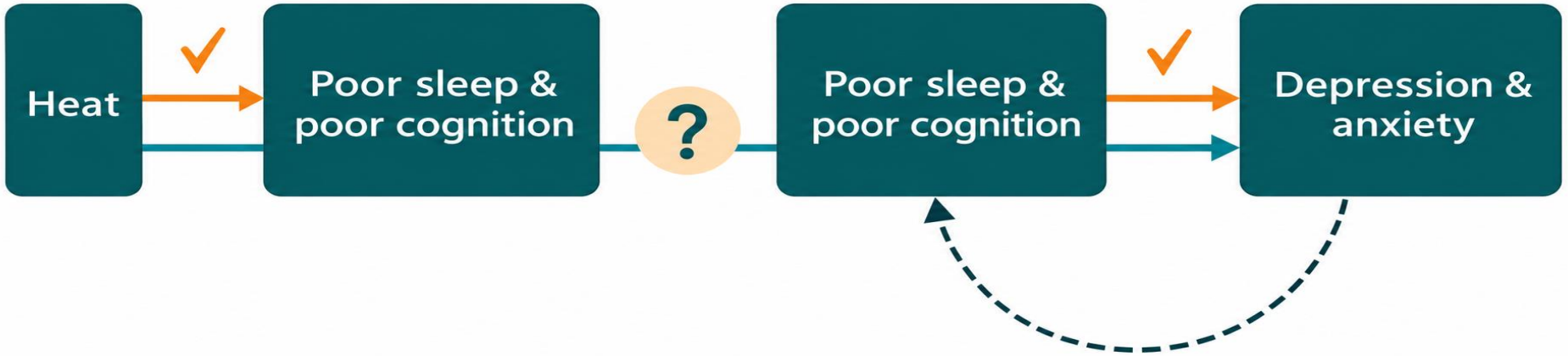
Heat–mental health research remains sparse in the Global South

Evidence Gaps & Our Response

Evidence gap	HEATSCAPE response
Few longitudinal studies Most evidence is cross-sectional	**8-round, 2-year cohort across dry and wet seasons**
Few mechanistic studies Causal pathways rarely tested explicitly	**Formal moderated-mediation analysis of sleep and cognition**
Little context-specific work Limited evidence from African settings and populations	**Four sites in Ghana & Zimbabwe; locally validated measures**

Next: review findings feed the Delphi core set of mediators & moderators and the measures we validate – and can inform climate adaptation, public health policy and culturally responsive mental health care.

Research Questions & Aims



RQ1 · Direct effect

Does exposure to climate-related heat, of any intensity, contribute to new-onset or persistent depression and/or anxiety?

RQ2 · Mechanisms

To what extent do poor sleep health and/or cognition influence and explain new-onset or persistent depression and/or anxiety?

Three aims

1 **Mechanisms:** heat → sleep/cognition → depression & anxiety

2 **Readiness:** of primary care & community structures to mitigate heat effects

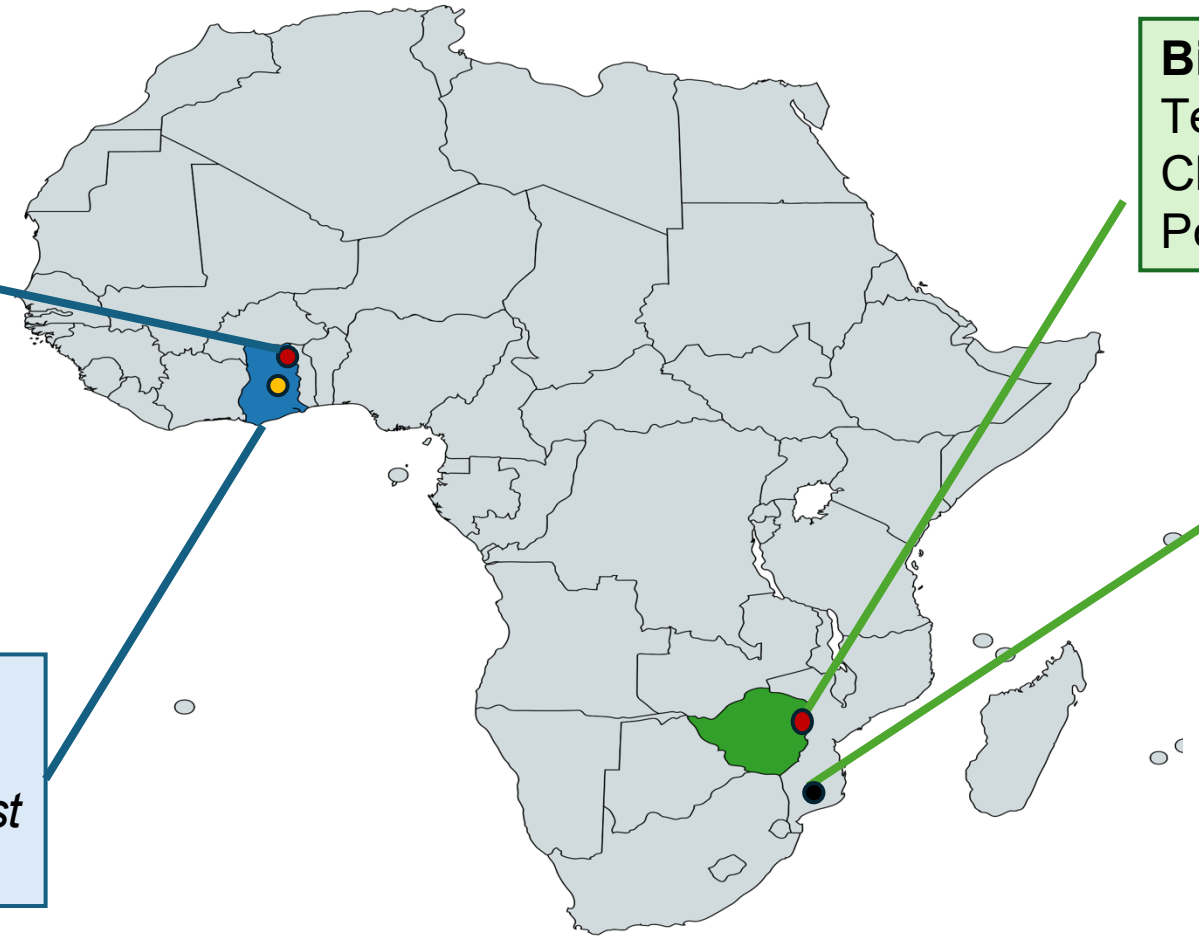
3 **Co-production:** lived-experience

Geographic Scope

Ghana

Navrongo:
Temp: *40°C*
Climate: *Tropical savanna*
Population: *rural/urban*

Kintampo:
Temp: *30°C*
Climate: *Tropical rainforest*
Population: *rural*

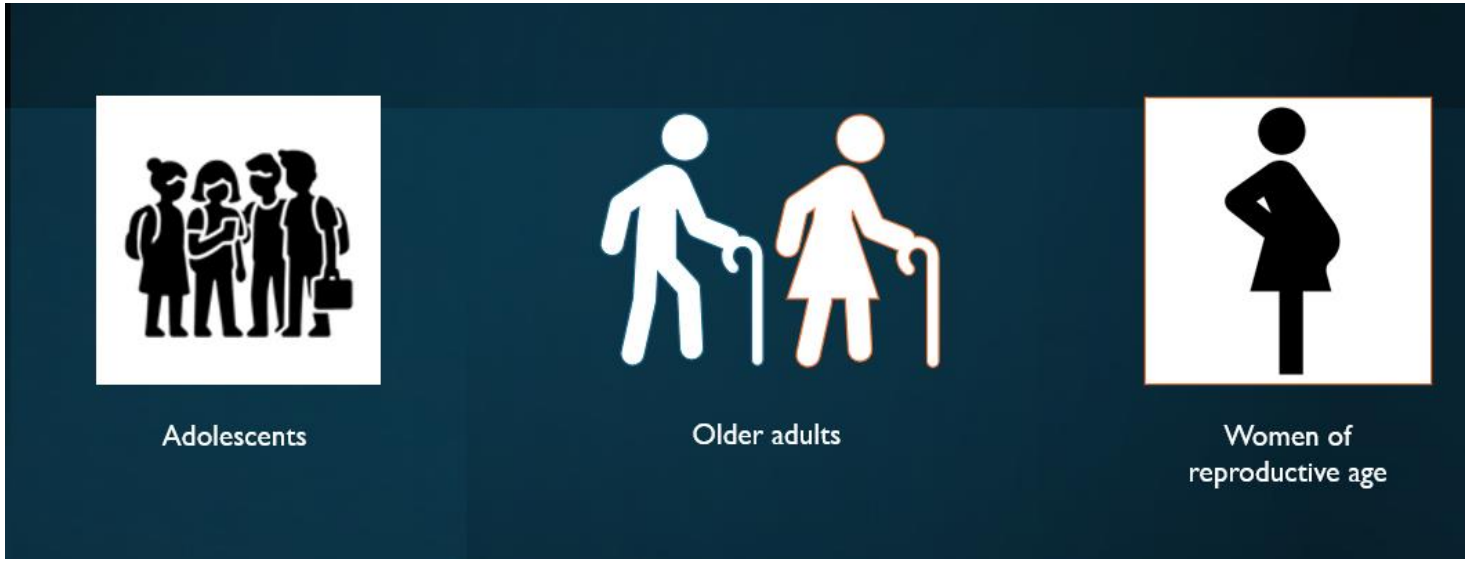


Zimbabwe

Binga:
Temp: *34°C*
Climate: *Sub-tropical*
Population: *rural*

Beitbridge:
Temp: *30°C*
Climate: *Sub-tropical*
Population: *rural/urban*

Populations & Thematic Scope



Why these groups?

Adolescents, women of reproductive age and older adults are already at higher risk of poor mental health, or have livelihoods and physiology that make them more sensitive to heat.

N = 1,500 participants across the four sites

Thematic scope

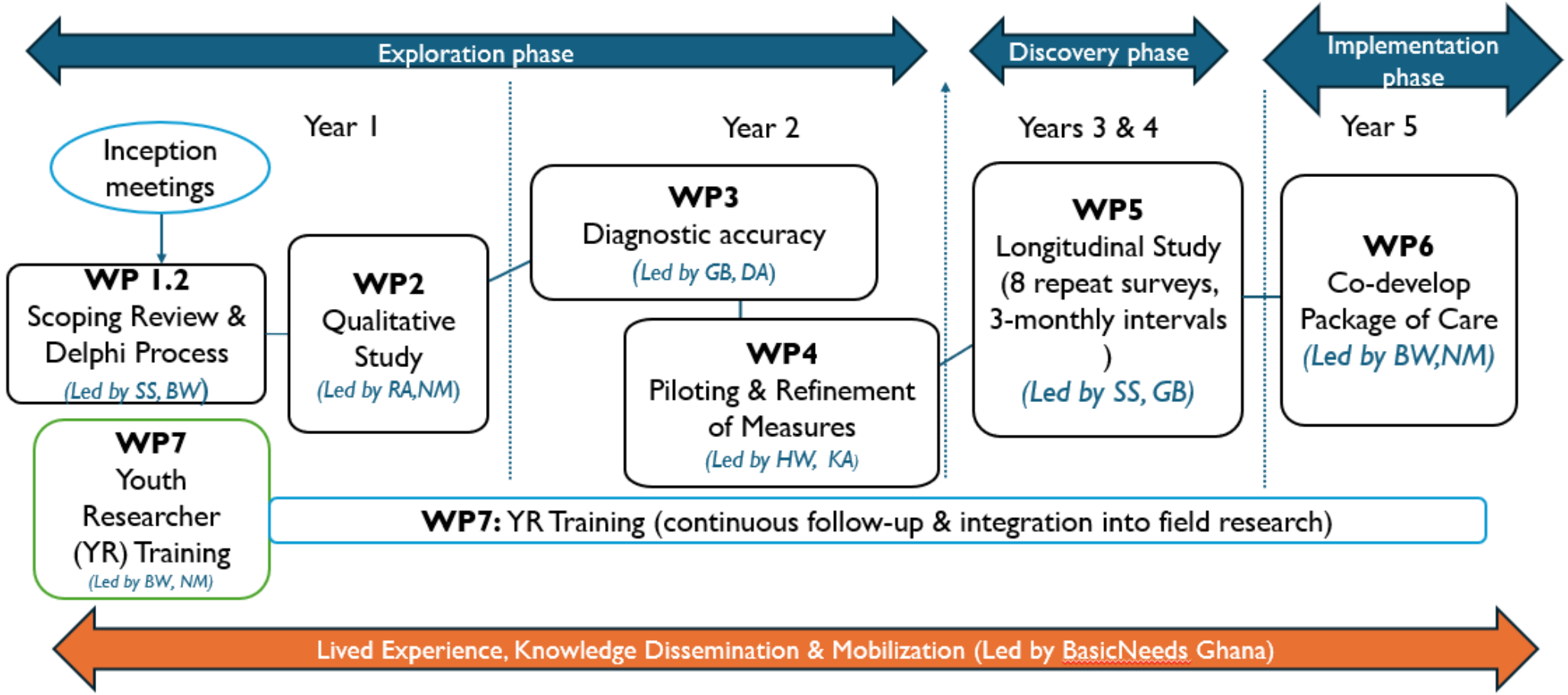
Exposure
Daytime & nighttime temperature; indoor and individual heat

Mediators
Sleep health (quality, quantity, timing) and cognitive function

Outcomes
Depression and anxiety – onset and persistence

Context
Gender, socioeconomic status, housing, cooling, humidity, substance use

Study Design Overview



BW: Benedict Weobong | **SS**: Seyi Soremekun | **RA**: Raymond Aborigo | **KA**: Kenneth Ae-Ngibise
DA: Dzifa Attah | **GB**: Godfred Boateng | **HW**: Helen Weiss | **NM**: Newton Matandirotya

Formative Phase: Measures First

1 Results in

Scoping review
WP1.1

What do we know about mediators & moderators of heat–mental health links in LMICs?

Output: Logic model; measures inventory

2

Qualitative study
WP2

How are heat and mental health understood and experienced locally? (25–30 people/site)

Output: Explanatory model

3

Delphi study
WP1.2

What is the expert & lived-experience consensus on core mediators and moderators?

Output: Core set; causal diagrams (DAGs)

4

Diagnostic accuracy
WP3

How culturally valid and reliable are our measures? (N = 300; CFA)

Output: Validated measures

5

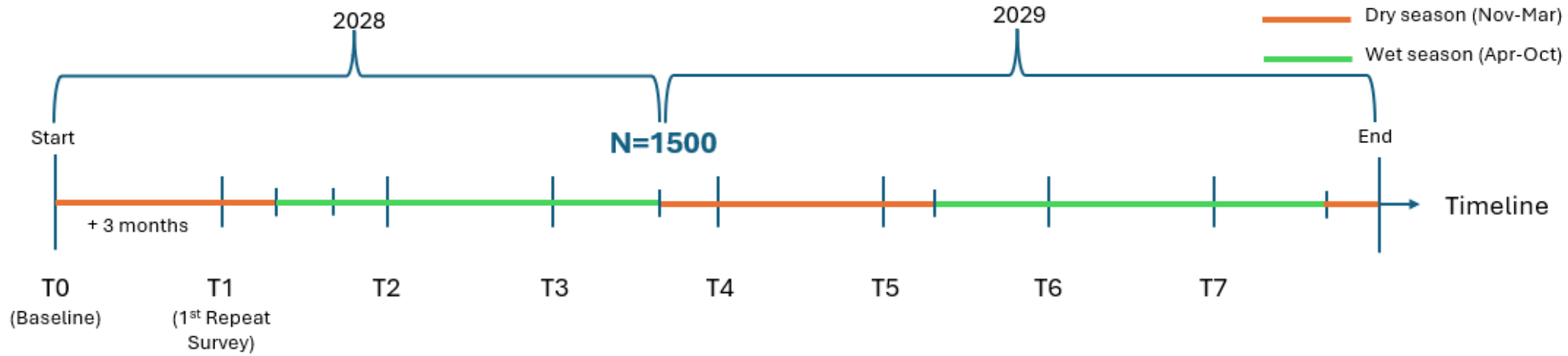
Pilot study
WP4

How feasible and acceptable are wearables and sleep diaries?

Output: Protocol & SOPs

Why front-load? Tools and constructs developed in the Global North cannot be assumed valid in Ghana and Zimbabwe – the cohort is only as good as its measures.

Longitudinal Cohort Study



- Consent & enrolment
- Socio-demographics
- GPS coordinates
- Install indoor digital temperature gauge
- Provide sleep wearable device

+

Measure depression, anxiety and cognition

Measure depression, anxiety, sleep, cognition

Analysis: causal mediation – how much of the day/night heat effect on depression & anxiety runs through sleep and cognition, and does this differ by group, gender, SES or housing?

Innovative Methods & Tools

Heat: indoor iButton loggers + gridded climate data **Sleep:** actigraphy, sleep diary, Ru-SATED, ISI-7 **Cognition:** MoCA **Mood:** PHQ-9, GAD-7

Objective Measurements

Actigraphy Watch

I-Buttons

Self-reports

Sleep Diary

Exact times are not necessary. Estimates are all you need.

SLEEP SCHEDULE	Bedtime:
	Rise Time:

DAY OF THE WEEK							
DATE							
Q1 What time did you get into bed?							
Q2 What time did you try to go to sleep?							
Q3 How long did it take you to fall asleep?							
Q4 How many times did you wake up, not counting your final awakening?							
Q5 In total, how long did these awakenings last?							
Q6 What time was your final awakening?							
Q7 What time did you get out of bed for the day?							
Q8 How would you rate the quality of your sleep?	○ Very poor ○ Poor ○ Fair ○ Good ○ Very good	○ Very poor ○ Poor ○ Fair ○ Good ○ Very good	○ Very poor ○ Poor ○ Fair ○ Good ○ Very good	○ Very poor ○ Poor ○ Fair ○ Good ○ Very good	○ Very poor ○ Poor ○ Fair ○ Good ○ Very good	○ Very poor ○ Poor ○ Fair ○ Good ○ Very good	○ Very poor ○ Poor ○ Fair ○ Good ○ Very good
Q9 Note anything that interfered with your sleep.							

End-of-week calculations
Easy calculations at mysleepwell.ca/calculator

SLEEP NUMBERS	1 Sleep window:	3 Time asleep:
	2 Time awake:	4 Sleep efficiency: %

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Participant's feedback

FGD

IDI

Lived Experience Strategy

Co-production and stakeholder engagement, built in from Year 1

HAYRA: 10 young people per country with lived experience of anxiety/depression, trained and paid as research interns
Advisory groups: guide sampling, recruitment and design through quarterly feedback
Governance: lived-experience representation in project decision-making

Emerging Findings: Scoping Review

Heat exposure and mental health in LMIC / Global South settings, with a focus on mediating and moderating factors

Heat exposure

Mediating factors

- Physiological stress
- **Sleep disruption**
- Economic strain
- Disrupted daily functioning

Associated outcomes

- Psychological distress
- Anxiety and depression
- Sleep disturbances
- Reduced wellbeing

Moderators of vulnerability: gender · age · socioeconomic status · housing conditions · occupation, especially outdoor labor

Synthesis of peer-reviewed and grey literature; dual-reviewer screening; pathways mapped iteratively.

Challenges & Opportunities

Context & culture

Measures must fit local realities.

→ **Local explanatory models of heat and distress**

Participant retention

Sustaining engagement and device wear over 8 rounds.

→ **Youth researchers and advisory groups build trust**

Adaptable tools

Instruments need adapting, not just transplanting.

→ **Validated tools reusable across LMICs**

Remote locations

Access, logistics and infrastructure constraints.

→ **Established field platforms and community ties**

Multiple languages

Translation and consistency across sites.

→ **Cross-language validation evidence (WP3)**

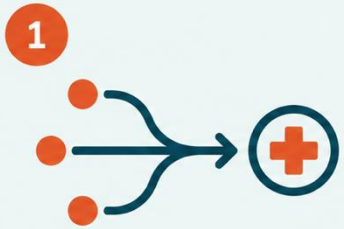
Local vs global

Local relevance with global comparability.

→ **A core mediator/moderator set for LMIC studies**

Expected Outputs, Outcomes & Impact

1



Path to interventions

Evidence-based framework linking heat to depression and anxiety

2

Ready for care

Community and health system readiness for a package of care

3

Next-generation researchers

Build a critical mass of young researchers with lived experience

Reaching people & policy

Community radio · theatre & drama · annual policy workshops with ministries · website, blogs & publications

Key outputs

- Core mediator/moderator set and causal diagrams for heat–mental health studies in LMICs
- Culturally validated sleep, cognition and mood measures for Ghana and Zimbabwe
- Explanatory model of heat and mental health grounded in lived experience
- Longitudinal dataset (N = 1,500) linking individual heat exposure, sleep, cognition and mood
- Co-developed heat action package of care, with feasibility data for a future trial
- A cohort of trained youth researchers with lived experience

Lessons So Far

1

Formative work protects causal claims

Front-loading measurement and concept work is what makes a mechanistic cohort credible in new settings.

2

Measure heat where people live and sleep

Station data miss indoor and night-time heat; low-cost loggers make individual exposure feasible.

3

Treat seasonality as a design variable

Repeat rounds across dry and wet seasons help separate heat from seasonal livelihood stress.

4

Resource co-production properly

Paid youth researchers and seats in governance – not one-off consultations.

Why mechanisms matter: knowing how heat harms mental health tells us where to intervene – sleep environments, cooling, and primary care.

Project leadership

Leadership

Dr. Benedict Weobong

Global Mental Health Epidemiologist

Lived Experience

Mr. Maxwell Sapak

LEE Coordinator

Planetary Health

Dr. Newton Matandirotya

Climate Scientist

Mr. Tonderai Dangare

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Mental Health

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Mental Health Systems Specialist

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Thank you!

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