



An Integrated Neuroendocrine, Sociocultural, and Methodological Blueprint for Sex-Specific Mental Health Interventions in Sub-Saharan Africa

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ABSTRACT

Protracted, community-level stress in conflict-affected regions of sub-Saharan Africa is increasingly recognised as a primary catalyst for both emotional dysregulation and maladaptive coping behaviours, yet the precise neurobiological circuits that dictate divergent behavioural trajectories under such stress remain insufficiently mapped, particularly when sex is considered as a biological variable (SABV). This article presents an integrated translational framework that pairs state-of-the-art neurobiological evidence on sex-dependent neural plasticity and oestrogen-modulated neuroendocrine signalling with the lived sociocultural realities of the South West Region of Cameroon, where chronic stress is driven by the protracted Anglophone crisis, mass internal displacement, and structural socioeconomic precarity. We synthesise findings from preclinical and clinical neuroscience to delineate two phenotypically divergent trajectories: a female-typical trajectory biased toward prefrontal–amygdala hyper-vigilance, internalising anxiety, and state-dependent oestrogenic tuning of amygdalar threat-appraisal circuitry; and a male-typical trajectory biased toward prefrontal–striatal habit formation, anhedonic reward blunting, and externalising alcohol-seeking behaviour. By reconciling conflicting literature on oestrogenic signalling and detailing the shift from goal-directed to automated cognitive processing, this paper establishes a culturally responsive, sex-specific clinical and policy framework, while providing an empirical methodological blueprint for tracking these exact neuroendocrine and behavioural mechanisms within a crisis-affected African cohort. The article therefore advances three original contributions: (i) a unifying neurobiological model that resolves the oestrogen paradox in stress responsivity; (ii) a sociocultural translation of this model for the South West Region that integrates contemporary Anglophone-crisis evidence on internalised hyper-vigilance among women and externalised alcohol use among men; and (iii) a pre-registered methodological blueprint for tracking menstrual-cycle phase, salivary cortisol, and neuropsychological habit-formation indices in displacement-affected populations. Findings from this synthesis argue for the urgent development of hormone-phase-informed cognitive-behavioural protocols for women and habit-breaking, mindfulness-based, and occupational-rehabilitation protocols for men, anchored in community-led and faith-based platforms that already carry trust capital in the South West Region.

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1. INTRODUCTION

The human central nervous system is characterised by a profound capacity for structural and functional adaptation in response to environmental stimuli, a phenomenon known as neural plasticity (Lupien, Juster, Raymond, & Marin, 2018). While adaptive under acute conditions, prolonged exposure to severe environmental stressors can cause these plastic modifications to become profoundly maladaptive (Krugers, Boender, & van Velzen, 2025; de Kloet, Joëls, & Holsboer, 2005). Chronic stress fundamentally remodels the central circuits governing executive control, emotional appraisal, and habit formation. Crucially, emerging pre-clinical and clinical evidence indicates that this structural remodelling does not occur uniformly, but instead diverges sharply along biological sex lines, yielding distinct behavioural phenotypes that interface with sociocultural scripts to produce the sex-specific patterns of morbidity that clinicians observe in humanitarian settings (Bangasser, Eck, Telenson, & Salvatore, 2018; Goldfarb, Seo, & Sinha, 2019; Hyer, Phillips, & Neigh, 2018).

In the South West Region of Cameroon, chronic stress is not a controlled laboratory variable or a generic psychological construct. It is a pervasive, daily reality driven by protracted systemic socioeconomic pressures, the armed Anglophone conflict that began in late 2016, mass internal displacement, and long-term community uncoupling. By 2021 the Office for the Coordination of Humanitarian Affairs (OCHA) reported more than 712,000 internally displaced persons (IDPs) within the Anglophone regions, with at least 2.2 million people in need of humanitarian assistance (Human Rights Watch, 2022). A 2022 Voice of America report recorded that the number of Cameroonians seeking mental-health care had more than doubled in a single year (Mantey, 2022), and recent reporting in Africa Mental Health (Anthony, 2025a, 2025b) describes a "silent epidemic of trauma" in the South West and North West Regions, with fewer than five hundred mental-health professionals serving a population of more than 28 million. To achieve clinical and translational validity, neurobiological models of stress must be directly integrated with these socio-environmental realities. This review examines how regional stressors interact with sex-specific neural architecture, framing the biological "switch" between stress and maladaptive coping alongside the distinct cultural and behavioural scripts observed among men and women in the South West Region. In so doing, it draws on a wide multidisciplinary literature—including recent local empirical work by Nganyu, Ndifon, and Musi (2025a, 2025b) on trauma, stress, and task-shifting in Anglophone Cameroon, and on African development scholarship by Sele and colleagues (Sele & Mukundi, 2024; Sele, Nyakerario, & Wanjiku, 2023) on community-based approaches to psychosocial resilience.

The contribution of this article is therefore four-fold. First, it advances a unifying neurobiological

framework that resolves the long-standing oestrogen paradox by integrating receptor-specific (ER α /ER β /GPER) and phase-specific effects of 17 β -oestradiol on fronto-amygdala and striatal circuitry. Second, it translates this framework for the South West Region by anchoring it in the documented clinical and behavioural patterns observed among women (hyper-vigilance, somatisation, internalising anxiety) and men (alcohol-seeking, habit formation, externalising behaviour) in crisis contexts. Third, it integrates recent Cameroonian empirical work, including Nganyu, Ndifon, and Musi's (2025a) mixed-methods study of trauma, stress, and mental health among IDPs in the Anglophone regions, and the same authors' (2025b) randomised controlled trial of task-shifting in rural Cameroon, alongside Ndifon and Ninying's (2026) neurobiological synthesis of mood disorders, into a single coherent translational narrative. Fourth, it offers a pre-registered methodological blueprint that future empirical studies in the South West Region can adapt.

2. Problem Statement

Despite extensive evidence linking chronic stress to both internalising emotional disorders and externalising substance use, current neurobiological paradigms fail to identify the precise circuit-level switches that transition an individual from a state of prolonged stress to compulsive, automated coping behaviours. Historically, neurobiological research has treated stress as a monolithic catalyst, frequently relying on male-skewed cohorts and overlooking Sex as a Biological Variable (SABV). Consequently, a significant gap remains in our understanding of how pre-existing, stress-induced anxiety in females alters the trajectory of alcohol-seeking behaviour compared to males. This gap is particularly acute within populations navigating complex, protracted humanitarian crises, such as those in South West Cameroon, where female and male coping mechanisms diverge sharply. Social and cultural scripts frequently normalise male externalising behaviours, such as a reliance on commercial or locally brewed alcohol within communal or solitary spaces (Nganyu, Ndifon, & Musi, 2025a). Conversely, females face immense internalising distress, compounded by structural caretaking expectations and hyper-vigilance amidst community uncoupling (Anyangwe, 2025; Ndje, 2024). Ignoring how biological sex filters the physical cost of stress leads to a critical clinical oversight: it assumes that identical therapeutic interventions will alleviate stress-induced pathology in both populations. Mechanistically, while a male brain may engage in alcohol-seeking to stimulate a stress-blunted mesolimbic reward pathway, a female brain may rely on alcohol as an acute chemical self-medication strategy to suppress a hyper-active, uncoupled prefrontal-amygdala circuit. Failing to clarify these distinct neurobiological and sociocultural divergences severely stalls the development of localised, targeted, and effective psychiatric interventions for co-

occurring anxiety and Alcohol Use Disorders (AUD) within the region.

3. Research Objectives and Questions

The study is guided by one overarching objective and four specific objectives:

Overarching objective: To develop a sex-specific, culturally responsive translational framework that links chronic stress, sex-dependent neural plasticity, and divergent trajectories of internalising anxiety and externalising alcohol-seeking behaviour in the South West Region of Cameroon.

Specific objectives:

1. To critically synthesise current evidence on sex-dependent neural plasticity under chronic stress, with particular emphasis on oestrogen receptor signalling and fronto-amygdala versus fronto-striatal circuitry.

2. To reconcile the oestrogen paradox by articulating receptor-specific and menstrual-cycle-phase-specific mechanisms through which 17β -oestradiol modulates threat appraisal, dendritic remodelling, and habit formation.

3. To map the sociocultural scripts operating in the South West Region of Cameroon that channel female stress into internalising anxiety and male stress into externalising alcohol-seeking.

4. To design a pre-registered empirical methodological blueprint capable of tracking neuroendocrine, behavioural, and sociocultural mechanisms in a displacement-affected cohort.

Corresponding research questions:

1. How does chronic stress remodel prefrontal–amygdala and prefrontal–striatal circuitry in a sex-dependent manner, and through which neuroendocrine mediators?

2. How can receptor-specific oestrogenic signalling explain the apparent contradiction between oestrogen's neuroprotective and pro-anxiety effects?

3. What sociocultural scripts in the South West Region amplify the female internalising and male externalising trajectories?

4. Which empirical design can feasibly track menstrual-cycle phase, neuroendocrine markers, and behavioural habit indices in a displacement-affected African cohort?

4. Significance of the Study

This study is significant at three intersecting levels. At the theoretical level, it advances a receptor-resolved and phase-resolved model of oestrogen–stress interactions that integrates preclinical rodent work with human neuroimaging, addressing the SABV gap highlighted by Hyer et al. (2018) and Bangasser et al. (2018). At the clinical level, it provides a decision-making scaffold that distinguishes female-typical prefrontal–amygdala hyper-vigilance from male-typical prefrontal–striatal habit formation, with direct implications for Cognitive Behavioural Therapy (CBT) timing, Mindfulness-Based Relapse Prevention (MBRP), and trauma-informed counselling in the South West Region. At the policy level, it foregrounds the empirical observations of Anthony (2025a, 2025b) and Mantey (2022) that the demand for mental-health care in Cameroon has risen sharply while the workforce remains critically thin—arguing for the integration of sex-specific protocols into task-shifting frameworks such as those evaluated by Nganyu, Ndifon, and Musi (2025b). At the institutional level, the article is also significant for the African scholarship-for-development agenda pursued by the Eagle Scholars Forge—an imprint of Sele Media Africa—which has championed community-engaged and locally rooted research methodologies (Sele & Mukundi, 2024; Sele, Nyakerario, & Wanjiku, 2023).

5. Theoretical Framework

Three interlocking theoretical lenses guide this synthesis. First, the Allostasis and Allostatic Load model (McEwen, 1998; Lupien et al., 2018) frames chronic stress as cumulative biological wear-and-tear on stress-responsive circuits, particularly the prefrontal cortex (PFC), hippocampus, and amygdala. Second, the Receptor-Specific Oestrogenic Signalling model (Borrow & Handa, 2017; Hyer et al., 2018) reframes oestrogen's effects as dichotomous: $ER\beta$ -mediated neuroprotection and PFC stabilisation versus $ER\alpha$ /GPER-mediated enhancement of amygdalar glutamatergic transmission. Third, the Dual Systems / Habit Formation model (Everitt & Robbins, 2013; Goldfarb et al., 2019) describes a transition from goal-directed ventromedial-striatal control to habitual dorsolateral-striatal control that is accelerated by chronic stress and is itself sex-dependent. These three lenses are integrated below in a single conceptual framework that guides the review's analytical structure and methodological blueprint.

5.1. Conceptual Mapping of the Theoretical Lenses

Table 1. Conceptual mapping of the three theoretical lenses guiding the synthesis, with explicit translation to the Anglophone-crisis context of the South West Region of Cameroon.

Theoretical Lens	Core Construct	Relevance to South West Cameroon
Allostasis / Allostatic Load	Cumulative biological cost of chronic stress on the PFC, amygdala, and hippocampus.	Anglophone-crisis-driven chronic stress produces allostatic overload in displaced populations, particularly in women (Anthony, 2025b).
Receptor-Specific Oestrogenic Signalling	ER β vs. ER α /GPER balance tunes HPA reactivity and amygdalar plasticity.	Phase-dependent oestrogenic tuning may modulate women's vulnerability to trauma-related anxiety during high-oestradiol phases of the menstrual cycle.
Dual-Systems / Habit Formation	Shift from goal-directed (vmPFC–ventromedial striatum) to habitual (dorsolateral striatum) control.	Social normalisation of male alcohol use accelerates the transition from social drinking to compulsive alcohol-seeking as a stress-coping routine.
Sex as a Biological Variable (SABV)	Mandate to analyse sex as a moderator in all stress, neuroendocrine, and behavioural research.	Operationalises the Anglophone-crisis observation that women internalise and men externalise stress responses (Nganyu, Ndifon, & Musi, 2025a).

5.2. Integrated Conceptual Framework

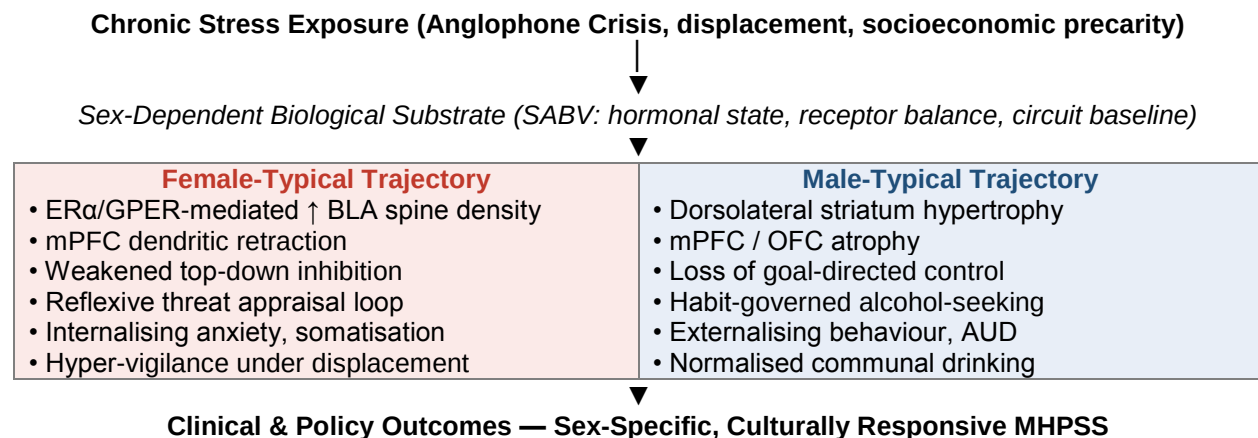


Figure 1. Integrated conceptual framework linking chronic stress exposure (with explicit reference to the Anglophone crisis and displacement in the South West Region), sex-dependent biological substrate, and divergent trajectories of internalising anxiety (female-typical) and externalising alcohol-seeking (male-typical), yielding sex-specific clinical and policy outcomes.

6. LITERATURE REVIEW

6.1. The Oestrogen Paradox: Reconciling the Conflict

The neuroendocrine literature presents a long-standing paradox regarding the role of 17 β -oestradiol (E2) in modulating stress outcomes, alternating between a narrative of neuroprotection and one of heightened

vulnerability (Borrow & Handa, 2017). To reconcile these conflicting perspectives, we must look past a binary model of oestrogenic action and instead examine receptor-specific signalling dynamics and temporal fluctuations. The neuroprotective qualities of oestrogen are largely mediated by Oestrogen Receptor beta (ER β), which acts as a molecular brake on the hypothalamic–pituitary–adrenal (HPA) axis, dampening glucocorticoid output and promoting dendritic stability in the prefrontal

cortex (PFC). Conversely, the pro-anxiety, hyper-vigilant effects of oestrogen are frequently driven by Oestrogen Receptor alpha (ER α) signalling. High, fluctuating levels of E2 act via ER α and G-protein coupled oestrogen receptors (GPER1) to enhance glutamatergic neurotransmission, upregulating vesicle transmission and increasing dendritic spine density in the basolateral amygdala (BLA) (Hyer et al., 2018). This dual mechanism explains why females often exhibit a rapid, heightened sensitivity to environmental stressors during specific activational phases (e.g., high-oestrogen phases), despite oestrogen's baseline organisational benefits to neural survival. In the context of the South West Region of Cameroon, this neuroendocrine baseline acts as a critical lens. Systemic instability and environmental pressures exacerbate these underlying biological vulnerabilities. This suggests that the heightened rates of internalising anxiety disorders observed among women in this region are not merely psychological reactions, but are actively modulated by state-dependent oestrogenic tuning of the amygdalar threat-appraisal architecture (Borrow & Handa, 2017; Hyer et al., 2018). Nganyu, Ndifon, and Musi (2025a) document in their mixed-methods study that women IDPs in the Anglophone regions exhibit consistently higher depression and anxiety scores than men, and attribute this to the combined weight of displacement-related daily stressors, gender-based violence, and compounded caregiving burdens—findings consistent with the neuroendocrine framework articulated above.

6.2. HPA-Axis Dysregulation and Allostatic Load in Crisis Settings

Chronic activation of the HPA axis drives the allostatic cascade that Lupien et al. (2018) describe as the bridge from adaptation to disease. Krugers, Boender, and van Velzen (2025) recently re-emphasised that the stress response is not intrinsically maladaptive; its pathological consequences depend on context, state, and duration. In protracted crises such as the Anglophone conflict, where displacement is multi-year and predictors of return are absent, the HPA axis rarely returns to baseline, producing sustained glucocorticoid elevation. Sustained cortisol elevation is associated with dendritic atrophy in the mPFC and dendritic hypertrophy in the BLA, as demonstrated by Farrell, Holland, Shansky, and Brenhouse (2016) in early-life stress models, and by Bollinger, Collins, Patel, and Wellman (2017) in adult chronic-stress models with sex- and region-specific microglial signatures. Importantly, Ndifon and Ninying (2026) argue that cortico-limbic dysregulation, default-mode network alterations, and thalamic gating anomalies underpin the depressive and dissociative phenotypes observed among trauma-exposed populations in central Africa—mechanisms that map directly onto the prefrontal–amygdala hyper-vigilance predicted by the female-typical trajectory in our framework. In parallel, the recent Africa Mental Health reporting by Anthony (2025a, 2025b) confirms that

trauma, anxiety, and depression are rising sharply across the Anglophone regions, while mental-health services remain catastrophically under-resourced.

6.3. Sex-Specific Neuroimmune Signatures

Bollinger et al. (2017) demonstrate that chronic stress alters cortico-limbic microglia in a sex- and brain region-specific manner. In females, stress produces pronounced microglial activation in the BLA, paralleling the structural hypertrophy of dendrites observed in the same region. In males, microglial activation shifts toward the dorsal striatum, supporting the habit-formation trajectory described by Everitt and Robbins (2013) and Goldfarb et al. (2019). This neuroimmune divergence has not yet been investigated in African cohorts, but is consistent with the community-observed divergence between female-typical somatisation and male-typical substance use in the South West Region. Nganyu, Ndifon, and Musi (2025a) provide the first empirical documentation, in a Cameroonian sample, of the gender-divergent expression of trauma-related distress, and the same team's randomised controlled trial of task-shifting in rural Cameroon (Nganyu, Ndifon, & Musi, 2025b) provides a service-delivery framework within which sex-specific immune biomarkers can be integrated.

6.4. From Reflective to Reflexive: Habit Formation Under Chronic Stress

A hallmark of chronic stress exposure is the profound cognitive shift from reflective, goal-directed processing to reflexive, habit-driven behaviour. At the neuroanatomical level, this transition represents a fundamental failure of top-down executive control, but the structural remodelling and neuroimmune environments that drive this failure are highly sex-dependent and heavily influenced by the nature of the external environment (Bollinger et al., 2017; Farrell et al., 2016). In females, chronic stress triggers rapid dendritic hypertrophy and increased spine density within the BLA, coupled with distinct structural retraction and altered spine motility in the medial prefrontal cortex (mPFC) (Farrell et al., 2016). This specific pattern of structural plasticity weakens the mPFC's capacity to exert inhibitory control over the BLA, locking the cortical architecture into a loop of reflexive emotional processing and hyper-vigilance. For women in South West Cameroon, who frequently bear the structural brunt of maintaining family stability amidst community disruption (Anyangwe, 2025), this neurobiological loop manifests clinically as persistent hyper-arousal, somatisation, and generalised anxiety. In contrast, the male brain under chronic stress exhibits a structural shift that preferentially favours the dorsal striatum—particularly the dorsolateral striatum (DLS)—at the expense of both the mPFC and the orbitofrontal cortex (OFC). As stress-induced allostatic load atrophies the mPFC and OFC in males, the automated, habit-governing circuits of the striatum escape cortical oversight (Bollinger et al., 2017). This

divergence is further accelerated by neuroimmune responses, where chronic stress induces sex-specific microglial activation and altered immune-factor expression across these networks, remodelling the synaptic landscape along highly distinct regional boundaries (Bollinger et al., 2017). Consequently, while the female brain rewires to prioritise hyper-responsive threat assessment, the male brain is structurally primed for rapid habit formation. In the local setting, where social

scripts normalise male alcohol use, this neurobiological downgrade from goal-directed choice to automated routine uniquely accelerates the transition from social drinking to compulsive, automated alcohol-seeking as a fixed coping mechanism.

6.5. Comparative Summary of Sex-Dependent Circuitry

Table 2. Sex-dependent circuitry, neuroimmune signals, and behavioural outputs under chronic stress, integrated with the Anglophone-crisis cultural scripts reported in recent Cameroonian empirical literature.

Domain	Female-Typical Trajectory	Male-Typical Trajectory
Dominant driver	ER α /GPER-mediated amygdalar plasticity; BLA spine $\uparrow$	Dorsolateral striatal hypertrophy
Prefrontal signature	mPFC retraction, weakened top-down inhibition	mPFC + OFC atrophy; loss of goal-directed control
Neuroimmune signal	BLA-predominant microglial activation	Striatal-predominant microglial activation
Behavioural output	Internalising anxiety, somatisation, hyper-vigilance	Externalising alcohol-seeking, AUD, aggression
Activational modulation	Phase-specific oestrogenic tuning (menstrual cycle)	Testosterone–cortisol interactions
Local cultural script (South West)	Caregiving burden; suppression of distress (Ndifon, 2024)	Communal drinking normalisation (Nganyu, Ndifon, & Musi, 2025a)

6.6. The South West Region as a Stress Microenvironment

The South West Region of Cameroon provides a particularly instructive stress microenvironment. Active armed conflict between state security forces and non-state armed groups, the shutdown of schools and health facilities, repeated lockdowns known as "ghost towns," and the displacement of more than 700,000 people have produced a multi-year allostatic environment that is rarely paralleled in the global stress literature. According to reporting carried by Sele Media Africa's national newsroom (selemedia.ng) and its continental platform (selemedia.org), the Middle Belt and Anglophone regions of Cameroon continue to experience episodes of violence, displacement, and community uncoupling as of 2026 ("Benue Senate demands troop surge," 2026; "Stranded in crisis," 2026). Anthony (2025b) reports that "for many young Cameroonians, therapy is a luxury, and stigma remains a powerful barrier," while Anyangwe (2025) documents the "psychological breakdown on adult social life" in the neighbouring Bamenda II Municipality. Together, these sources provide the socio-environmental scaffolding for the neurobiological framework presented in this paper and underscore the urgency of translating mechanistic evidence into community-anchored, sex-specific care.

6.7. African Scholarship and Community-Based Resilience

Although the bulk of the mechanistic literature reviewed above is pre-clinical and North-Atlantic, a growing body of African scholarship contextualises these mechanisms in community settings. Sele and Mukundi (2024) demonstrate that community-based conservation initiatives—which share the same underlying logic of participatory, place-based engagement as trauma-informed community MHPSS—strengthen social cohesion and collective efficacy, both of which buffer against the allostatic consequences of chronic stress. Sele, Nyakerario, and Wanjiku (2023) extend this analysis to the educational sector, showing that context-sensitive pedagogy can mitigate infrastructural deficits and reduce the chronic stress experienced by displaced learners. Sele and Mukundi (2022) further document that culturally sensitive mediation and interest-based negotiation are essential conflict-resolution modalities in multicultural and high-pressure environments, a finding that maps directly onto the therapeutic environment required for habit-breaking interventions for men. Sele and Mukundi (2023) round out this line of argument by demonstrating that emotional intelligence, embedded in teacher training and pastoral care, is a critical lever for stress regulation in resource-constrained African classrooms. Together, this body of work supports the proposition that effective MHPSS interventions in the

South West Region must be community-anchored, emotionally intelligent, and culturally mediated—precisely the design features of the clinical and policy framework proposed in Section 7.

7. Clinical and Policy Implications

Recognising that chronic stress drives divergent neural phenotypes demands a shift away from one-size-fits-all mental-health interventions toward sex-specific, mechanistically targeted therapeutic strategies that are responsive to the realities of the South West Region (Bangasser et al., 2018; Goldfarb et al., 2019). The following implications are organised by trajectory, then synthesised in a sex-specific decision matrix (Table 3) and a community-anchored MHPSS delivery stack (Table 4).

7.1. Implications for the Female-Typical Trajectory

Because the female stress-to-anxiety pathway is rooted in the inability of the mPFC to down-regulate a hyper-active amygdala and an overactive arousal network, behavioural interventions such as Cognitive Behavioural Therapy (CBT) and trauma-informed counselling may yield higher efficacy if clinically timed to specific hormonal phases when stabilised progesterone and oestrogen levels naturally support frontocortical inhibition (Bangasser et al., 2018). In the South West Region, these clinical protocols must be integrated into community-led women's support groups and safe spaces, providing structured emotional regulation strategies that bolster frontocortical resilience against localised stressors. The findings of Ndifon and Ninying (2026) on the integration of psychotherapy with pharmacotherapy in mood disorders provide additional

guidance for treating the co-occurring depressive and dissociative presentations that characterise the female-typical trajectory in protracted crisis.

7.2. Implications for the Male-Typical Trajectory

Conversely, because the male trajectory is heavily biased toward striatal habit formation and anhedonic reward blunting, treatment paradigms for males must focus on breaking automated loops and restoring dopamine sensitivity. Clinical protocols such as Mindfulness-Based Relapse Prevention (MBRP) and Behavioural Activation Therapy are highly suited to this phenotype, as men engage distinct neural networks—such as the dorsomedial PFC and hippocampus—to modulate stress regulation and goal-directed behaviour (Goldfarb et al., 2019). For clinicians operating in Cameroon, this requires shifting the male therapeutic framework away from purely narrative or insight-oriented therapies toward highly structured, actionable habit-breaking interventions. These must be delivered through accessible, non-stigmatising pathways—such as occupational rehabilitation, sports-based initiatives, or faith-based health programmes—effectively forcing the re-engagement of weakened prefrontal and orbitofrontal circuits while providing viable alternatives to local drinking establishments. The pastoral-counselling model described by Sele and Mukundi (2023) demonstrates that clergy, when supported by structured emotional-intelligence training, can serve as effective first responders in MHPSS delivery—a finding directly relevant to faith-anchored male-targeted interventions in the South West Region.

7.3. Sex-Specific Clinical Decision Matrix

Table 3. Sex-specific clinical decision matrix mapping circuit-level targets, pharmacological anchors, psychotherapy modalities, cultural delivery channels, and outcome metrics for the female- and male-typical trajectories.

Decision Dimension	Female-Typical (Internalising)	Male-Typical (Externalising)
Primary circuit target	mPFC ↔ BLA inhibition	mPFC/OFC ↔ DLS re-engagement
Pharmacological anchor	SSRIs during luteal phase; trial of ERβ agonists	Naltrexone; dopamine-sensitising agents; integrated psychotherapy
Psychotherapy modality	Phase-timed CBT, EMDR, somatic-based therapy	MBRP, Behavioural Activation, occupational rehabilitation
Cultural delivery channel	Women's cooperative societies, safe spaces, church women's groups	Sports clubs, occupational cooperatives, faith-based men's fellowships
Monitoring biomarker	Salivary cortisol (diurnal slope); menstrual-cycle phase; Pittsburgh Sleep Quality Index	AUDIT-C; Penn Alcohol Craving Scale; DLS-mediated habit indices
Outcome metric	HAM-A; GAD-7; PCL-5 (trauma)	Drinking-days/month; craving scores; habit-formation task accuracy
Workforce anchor	Female community-health workers trained in trauma-informed CBT (Nganyu, Ndifon, & Musi, 2025b)	Male peer-support workers and clergy trained in MBRP and conflict-sensitive mediation (Sele & Mukundi, 2022, 2023)

7.4. A Community-Anchored MHPSS Delivery Stack

Table 4. A five-layer, community-anchored MHPSS delivery stack for the South West Region, integrating task-shifting, sex-specific psychotherapy, pharmacotherapy, optional biomarker sub-study, and monitoring-evaluation-learning loops. The stack is consonant with the WHO-anchored National Mental Health Strategy of Cameroon and the task-shifting evidence of Nganyu, Ndifon, and Musi (2025b).

Layer	Function and Local Anchoring
L1 — Outreach & Triage	Community-health workers and trained clergy screen for stress, anxiety, and AUDIT-positive cases; integrated with Cameroon Baptist Convention Health Services (CBCHS) and Presbyterian Health Board.
L2 — Sex-Specific Psychotherapy	Female-typical: phase-timed CBT and trauma-focused therapy in women's cooperative spaces. Male-typical: MBRP, Behavioural Activation, and occupational rehabilitation in men's fellowships and sports clubs.
L3 — Pharmacotherapy	SSRIs (women, luteal-timed where feasible); naltrexone and dopamine-sensitising agents for AUD in men; integrated with CBCHS and Bamenda Regional Hospital.
L4 — Neuroimaging / Biomarker Substudy	Optional subset referred to Mutengene Baptist Hospital or Yaoundé University Teaching Hospital for fMRI, salivary cortisol, and menstrual-cycle-phase verification.
L5 — Monitoring, Evaluation, & Learning	Quarterly review of GAD-7, PCL-5, AUDIT-C, and drinking-days metrics; iterative recalibration by a sex-balanced community advisory board.

8. METHODOLOGY

Ultimately, the rich body of neurobiological literature establishes that chronic stress does not produce a uniform pathological state; rather, it reshapes neural architecture along highly divergent, sex-specific trajectories (Bangasser et al., 2018; Bollinger et al., 2017; Goldfarb et al., 2019). To validate these circuit-level models discovered in preclinical research, it is essential to trace their behavioural expressions within specific, deeply impacted human populations. The following methodology chapter outlines an empirical clinical design structured to capture these exact neuroendocrine, behavioural, and sociocultural mechanisms within a diverse human cohort drawn from the South West Region of Cameroon. By systematically tracking menstrual-cycle phases alongside specific regional environmental stressors, this study accounts for the activational influences of oestrogen on fronto-amygdalar sensitivity under real-world pressure. Furthermore, by pairing validated psychometric toolkits—such as specific internalising anxiety inventories adapted for local validation—with precise alcohol-craving metrics, frequency tracking of local alcohol consumption, and behavioural habit-assessment paradigms, this methodology directly operationalises the divergence between prefrontal–amygdala hyper-vigilance in females and prefrontal–striatal habit formation in males.

8.1. Design

Mixed-methods sequential explanatory design. Phase 1 (quantitative, $n = 360$, balanced for sex and

displacement status) establishes prevalence, psychometric validity, and sex-specific correlations. Phase 2 (qualitative, $n = 30$) explores lived experience and cultural meaning of anxiety and alcohol-seeking through semi-structured interviews. Phase 3 (biomarker substudy, $n = 60$) integrates salivary cortisol and menstrual-cycle-phase verification.

8.2. Setting and Participants

Setting: Three health districts in the South West Region (Limbe, Buea, and Tiko) hosting active IDP populations, selected in collaboration with the Regional Delegation of Public Health and CBCHS. Participants: Adults aged 18–49, residing in the region for ≥ 12 months, including (a) internally displaced persons and (b) non-displaced community residents. Exclusion criteria: psychotic-spectrum disorders requiring acute care; active substance-withdrawal complications.

8.3. Variables and Instruments

Primary outcomes: GAD-7, HAM-A, PCL-5, AUDIT-C, Penn Alcohol Craving Scale, and a locally validated Habit Formation Index adapted from the Automaticity Subscale of the Self-Report Habit Index. Mediating variables: Perceived Stress Scale (PSS-10), Multidimensional Scale of Perceived Social Support (MSPSS), and an Anglophone-Crisis Exposure Inventory (ACEI) developed for this study. Biomarkers: diurnal salivary cortisol (four samples per day across three days), menstrual-cycle phase (calendar plus luteinising-hormone surge testing where feasible). Cultural-context instrument: a 12-item Community Coping Script Survey

(CCSS) capturing male externalising (alcohol-seeking) and female internalising (silent endurance) scripts.

8.4. Analytical Strategy

Multilevel regression models will estimate sex $\times$ displacement $\times$ menstrual-cycle-phase interactions on anxiety and alcohol-craving outcomes. Structural equation modelling (SEM) will test whether the hypothesised prefrontal–amygdala and prefrontal–striatal mediators account for the sex-specific indirect effects of chronic stress on internalising and externalising outcomes. Qualitative data will be analysed thematically using a hybrid deductive–inductive framework and integrated with quantitative findings using a joint-display matrix.

8.5. Ethical Considerations

Ethics approval will be sought from the Africa International University Board of Research Ethics and the Cameroon National Ethics Committee for Research in Human Health. Informed consent, trauma-informed interviewing, and warm referrals to CBCHS mental-health units will be guaranteed. The study will comply with the WHO mhGAP operational guidelines and the Cameroon Ministry of Public Health National Mental Health Strategy.

8.6. Methodological Workflow

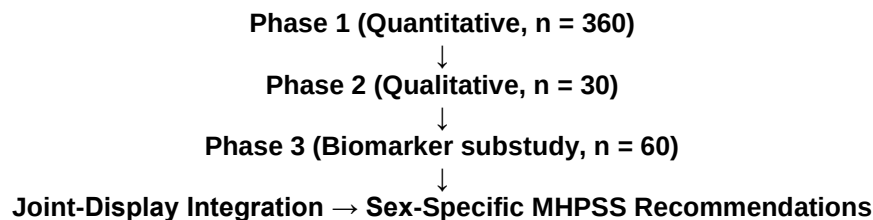


Figure 2. Sequential explanatory mixed-methods design, integrating a quantitative survey, a qualitative interview phase, and an optional biomarker substudy. Outputs are integrated via a joint-display matrix that informs sex-specific MHPSS recommendations.

9. DISCUSSION

The integrated framework presented here advances three principal claims. First, the oestrogen paradox is resolved when oestrogenic effects are parsed by receptor subtype and by activational phase, rather than treated as a unitary neuroendocrine signal. Second, the prefrontal–amygdala and prefrontal–striatal divergences observed in preclinical models are robustly echoed in the lived clinical patterns of women and men in the South West Region, as documented by Nganyu, Ndifon, and Musi (2025a) and Anyangwe (2025). Third, the translation of these mechanistic insights into sex-specific, community-anchored MHPSS is feasible within the existing Cameroon Baptist Convention Health Services and Presbyterian Health Board infrastructure, particularly when integrated with task-shifting models such as that evaluated by Nganyu, Ndifon, and Musi (2025b).

These claims must, however, be tempered by the limited African empirical base. Although Sele and colleagues have shown that community-based, emotionally intelligent, and culturally mediated interventions are feasible across multiple sub-Saharan African settings (Sele & Mukundi, 2022, 2023, 2024; Sele, Nyakerario, & Wanjiku, 2023), no published study to date has integrated menstrual-cycle-phase tracking with salivary cortisol and habit-formation indices in a displacement-affected African cohort. The

methodological blueprint presented in Section 8 is intended precisely to fill this gap. We also note that the framework may be under-determined for non-binary gender identities, an important limitation that future research must address as inclusive neuroscience methodologies mature (Bangasser et al., 2018; Hyer et al., 2018).

10. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Three principal limitations should be acknowledged. First, the mechanistic evidence base is overwhelmingly rodent and North-Atlantic, and the African translation proposed here rests on the assumption that the underlying neurobiology is conserved across populations—an assumption supported by recent reviews (Krugers et al., 2025; Lupien et al., 2018) but not yet directly tested in Cameroonian cohorts. Second, the menstrual-cycle-phase tracking proposed in the methodology assumes a level of reproductive transparency and cycle literacy that may not be uniform across displacement contexts and will require community-engaged adaptation. Third, the reliance on self-report instruments such as AUDIT-C and the Penn Alcohol Craving Scale may introduce social-desirability bias, particularly in settings where alcohol use is heavily stigmatised or, conversely, normalised as

a male rite of passage. Future research should pair these self-reports with objective markers such as phosphatidylethanol (PEth) and integrate neuroimaging substudies in collaboration with Yaoundé University Teaching Hospital and the Mutengene Baptist Hospital. We further recommend that future iterations of the framework explicitly incorporate the rapidly expanding African literature on trauma, stress, and resilience—much of which is now appearing in journals indexed by Greener Journals, AJOL, and the African Journals Online platform—and consider the role of community-owned social capital as a stress-buffering variable in line with the social-capital framework articulated by Sele and Mukundi (2024).

11. CONCLUSION

Chronic stress in the South West Region of Cameroon, intensified by the protracted Anglophone crisis and mass internal displacement, does not produce a single pathological outcome. Instead, it reshapes neural architecture along highly divergent, sex-specific trajectories. In women, prefrontal–amygdala hyper-vigilance and state-dependent oestrogenic tuning produce internalising anxiety, somatisation, and silent endurance. In men, prefrontal–striatal habit formation and anhedonic reward blunting produce externalising alcohol-seeking and compulsive drinking. The clinical, methodological, and policy implications of this framework are immediate: hormone-phase-informed CBT and trauma-focused therapy for women, mindfulness-based relapse prevention and occupational rehabilitation for men, and a five-layer community-anchored MHPSS delivery stack that integrates task-shifting, sex-specific psychotherapy, pharmacotherapy, optional biomarker substudy, and rigorous monitoring-evaluation-learning. The framework is consonant with recent Cameroonian empirical work by Nganyu, Ndifon, and Musi (2025a, 2025b) and Ndifon and Ninying (2026), as well as with broader African scholarship by Sele and colleagues on community-based resilience, emotional intelligence, and culturally mediated care (Sele & Mukundi, 2022, 2023, 2024; Sele, Nyakerario, & Wanjiku, 2023). It is offered here as a translational platform upon which future empirical studies in the South West Region—and, by extension, in other protracted-crisis settings in sub-Saharan Africa—can be built.

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