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Research article

Climate change and street children in Bulawayo: Perspectives on coping mechanisms and resilience building

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Abstract: In Sub-Saharan Africa, in general, and the City of Bulawayo, Zimbabwe, in particular, street children are among the most vulnerable populations facing the compounded impacts of climate change, including erratic rainfall, intensified heat, and prolonged drought. These environmental changes exacerbate pre-existing challenges such as homelessness, food insecurity, and limited access to health and social services. In this study, we assessed the coping mechanisms and strategies for resilience building by street children in Bulawayo in the face of climate change. A qualitative, interpretivist research design was adopted, utilizing semi-structured interviews, focus group discussions, key informant interviews, and unstructured observations. A total of thirty (30) respondents participated in this study, including twenty-five (25) street children aged ten (10) to eighteen (18) years and five (5) key stakeholders, who were selected through convenience and purposive sampling, respectively. Thematic analysis was conducted to identify core patterns in climate-related risks, adaptive behaviors, and the effectiveness of support systems. Our findings revealed that climate change manifests as unpredictable rainfall, extreme heat, and water scarcity, fundamentally disrupting daily survival strategies. Street children employ a range of coping mechanisms, including the construction of improvised shelters, adaptive clothing, peer support networks, and the acquisition of environmental knowledge. However, formal organizational support systems were fragmented and poorly synchronized with the urgent needs arising from climate emergencies, compelling children to rely primarily on informal peer networks.

Keywords: climate change; street children; coping mechanism; resilience; resilience building

1. Introduction

Globally, street children are among the most vulnerable individuals facing the severe consequences of climate change. According to the United Nations, there are one hundred and fifty million (150 m) street children worldwide who, for various reasons, spend most of their lives on the streets [1]. The global distribution of street children shows a disturbing trend, with forty million (40 m) in Latin America, thirty million (30 m) in Asia, ten million (10 m) in Africa, and the remaining twenty (20 m) in Europe, the United States, Canada, and Australia [2]. This number highlights a significant humanitarian issue related to the impacts of climate change, as it poses the greatest threat to the world's children and young people [3]. With increased frequency of climate related hazards such as cyclones, floods, cold waves, and heat waves, street children have been exposed to severe weather conditions. These individuals face significant climate risks, as research indicates that up to a billion children are at high risk of being impacted by climate change [4].

Within the African continent, children face higher climate-related risks compared to those in other parts of the world. The African Committee of Experts on the Rights and Welfare of the Child states that out of the thirty-three (33%) countries listed by UNICEF as having the greatest risk to children, seventy-five percent (75%) are in Africa [5]. This vulnerability is particularly problematic, as the top fifty (50%) of income earners are responsible for eighty-six (86%) of all global CO_2 emissions, with children in low- and middle-income countries suffering the most from loss and damage [6]. The combination of street life and climate change creates numerous problems, and children are among the most affected by climate change, especially in the African continent. Additionally, the interplay of climate change and child protection issues is particularly acute in Africa, where climate change has the greatest impact on children with disabilities, children on the street, poor children, and children separated from their families. Girls may also face increased risks due to climate change [7]. Not only are they more vulnerable than adults to extreme weather, toxic hazards and related diseases, but the world is becoming a more dangerous place to live [5].

Oyekale [8] described the problem of intergenerational justice, noting a seven-fold increase in the number of children displaced from their homes in Kenya between 2021 and 2022. Climate change has left one hundred and eighty-seven thousand (187,000) children without education or stable health, some ending up on the streets, according to an analysis of displacement by [9]. [4] obtained conflicting analyses that show how the lack of natural resources caused by the climate promotes inter-ethnic violence, displacing one million eight hundred and fifty thousand (1.85 m) children every year, with girls making up eighty percent (80%) of the children in eastern Chad who drop out of school and are forced to go to the street or do dangerous work to collect water during the prolonged drought.

Climate change in Southern Africa poses significant challenges for vulnerable populations. As researchers have documented, Sub-Saharan Africa (SSA) faces extreme weather events (EWES), including cyclones, floods, droughts, and heatwaves [10]. These events have adverse effects on the health and protection of children, especially those who have already been sidelined by street life. A global study on climate change revealed that the primary impacts of climate change on children include extreme weather and natural disasters, water scarcity, food scarcity, and air pollution [11].

Zimbabwe is not an exception to the problem of street children that is bedevilling the world. According to [12], Zimbabwe has an estimated number of street children ranging between ten thousand (10,000) and fifteen thousand (15,000). Zimbabwe exemplifies the challenges facing African nations in protecting vulnerable children from the impacts of climate change. Moreover, Zimbabwe is

also facing increased frequency of climate related hazards. The country is experiencing significant climate variability, characterized by highly variable rainfall patterns. These environmental stressors are compounded by socio-economic challenges that drive children to the streets when parents are failing to provide for their families. Research by [13] revealed several other variables contributing to Zimbabwe's notable street child population as a manifestation of the country's deep human factor deterioration, which is exacerbated by climate-related stress.

International organizations acknowledge this deficiency through the United Nations Convention on the Rights of the Child (1989), which binds countries to ensure children's rights to health, safety, and a safe environment [12]. However, the application of these rights to street children remains difficult, especially as climate-related risks increase the existing vulnerability. According to [14], the presence of street children has emerged as a significant characteristic of urban areas, particularly in developing nations, although it is not exclusive to these regions. The problem of the rise in street children in Zimbabwe, as postulated by [15], has further weakened urban resilience efforts by the Government, City Councils, and Non-Governmental Organizations (NGOs).

Available literature on street children by authors, including but not limited to [4,15,16], has gaps, prompting us to carry out this study. This study was necessitated, first by, lack of Bulawayo specific data, as no localized research has explored how the survival tactics of street children are affected by increasing climatic shocks, such as floods and incessant droughts. Second, there are ongoing institutional blind spots: Even with Bulawayo's 2025 Sustainability Monograph promoting climate-resilient infrastructure, street children are excluded from formal disaster response strategies. Last, the application of resilience theory in urban African settings is insufficiently detailed in the literature, which often focuses on household or community adaptation [11,15,17] but overlooks how the networks and mobility of street children influence resilience at the individual level. Therefore, our main objective of the study was to assess the coping mechanisms and strategies for resilience building by street children in Bulawayo in the face of climate change.

1.1. An overview of the challenge of street children in Bulawayo

The city is in the southwestern region of Zimbabwe, within an agro-ecological zone characterized by low to average annual rainfall, which leads to a propensity for droughts and water scarcity [18]. These climatic conditions create particular challenges for street children who lack adequate shelter and resources. Local climate impacts are intensifying, as during the rainy season, the country experiences four to five episodes of dry spells, followed by flash flooding and hailstorms, which are intensified by climate change and poor urban planning [19]. For street children in Bulawayo, these conditions are particularly hazardous as they live in makeshift shelters made of plastic, cardboard, and tents. These structures are particularly susceptible to damage from floods, further endangering the lives of street children who lack access to safe housing and necessities.

Bulawayo's social environment is characterized by a youthful demographic, widespread poverty, and extensive informal housing, which collectively influence the lived experiences of its inhabitants. Nearly half of the population is under eighteen years of age, accentuating the city's dependency burden and amplifying demands on social services [20]. The failure of the urban economy to offer adequate housing and jobs has left peri-urban spaces the only sanctuary for the urban poor to live in and eke out a living informally [21], resulting in over sixty percent (60%) of inhabitants residing in informal settlements where access to water, sanitation, and basic services is severely constrained [20]. High

unemployment and episodic economic shocks drive many into the informal sector, reinforcing cycles of vulnerability and social exclusion [22].

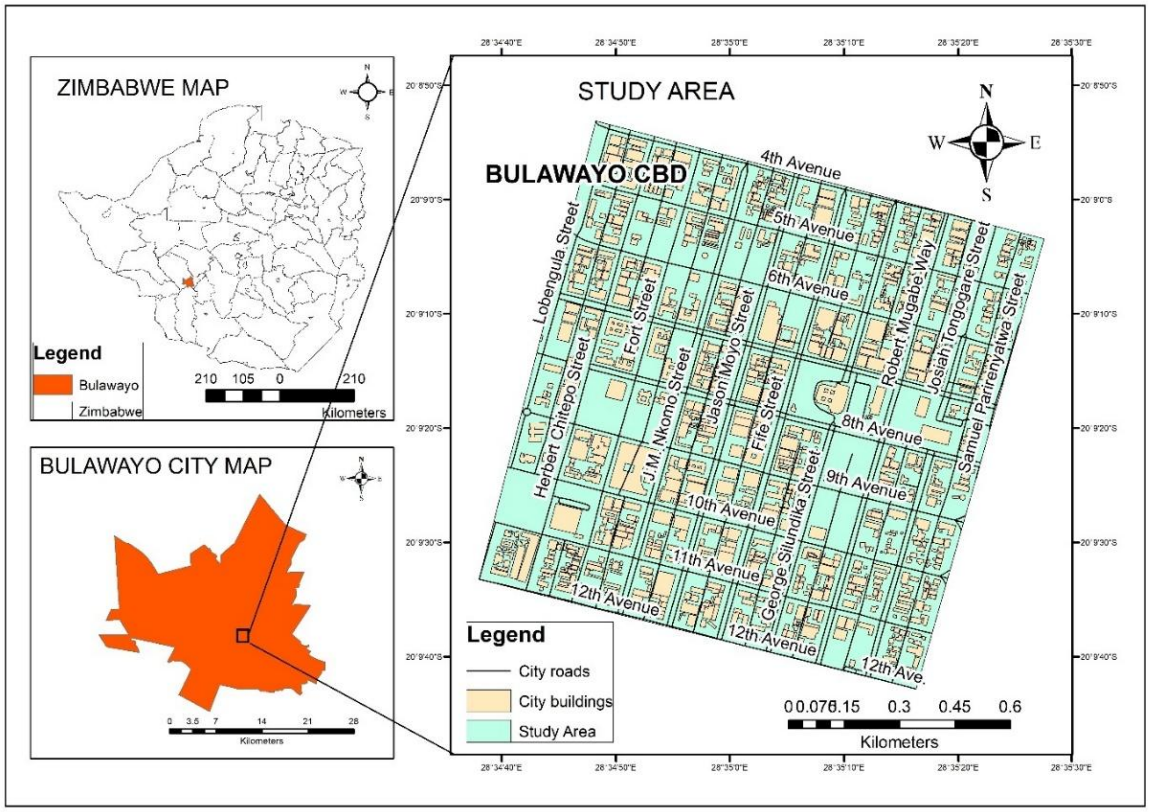


Figure 1. Map of study area. Source: Environmental Systems Research Institute (2023).

Over the past decade, climate change has worsened issues like homelessness, food insecurity, and the lack of clean water and sanitation generally in Zimbabwe and Bulawayo in particular. The street children in Bulawayo, who often live in unstable, flood-prone areas and rely on informal livelihoods, are especially impacted by climate change. Although Bulawayo's climate change plan, such as the 2025 Sustainability Monograph, focuses on improving urban infrastructure, street children are not included in the disaster management plan. Current interventions lack local knowledge of how climate risks interact with the unique economic conditions of street children, including their reliance on unsafe environments, survival mobility, and informal social networks. This disparity hampers the development of targeted strategies that aim to promote resilience, as existing policies do not adequately address the specific ways in which stressful climates increase the vulnerability of these populations. For example, when the floods occurred in February 2025, with only thirty millimeters (30 mm) of water falling on the city, the drainage system proved inadequate, and urban planning was insufficient, further exacerbating the impact on street children.

1.2. Resilience theory and street children

Resilience Theory was adopted in this study to understand how street children survive, innovate, and sometimes thrive in the face of adverse climate conditions. The theory was first articulated by

Holling (1973) in ecological systems, and the theory defines resilience as "the ability to absorb disturbance while retaining core functions", a definition later translated to human settings by [23]. Within social-ecological thinking, [24] reconceptualized resilience as a dynamic, multi-scalar process involving three inter-locking capacities: (1) resilience as the capacity to persist within critical thresholds, (2) adaptability as the capacity to adjust responses to changing drivers without shifting system identity, and (3) transformability as the capacity to cross thresholds into new development trajectories when current ones become untenable. These ideas are operationalized for street children by [11,25], who showed that even the most marginalized youth can mobilize individual assets (creativity, peer networks, environmental know-how) and collective resources (informal mutual-aid systems, micro-alliances with sympathetic adults) to buffer climate shocks. Consequently, Resilience Theory supplies the missing "response" dimension that Social Vulnerability Theory lacks: It captures the improvizational shelters, shared food strategies, weather-forecasting skills, and peer-to-peer teaching documented among Bulawayo's street children, thereby offering a fuller account of the constraints they face and the capacities they possess for climate adaptation.

Among street children in Bulawayo, resilience is shaped by their unique social contexts, gendered experiences, and the specific challenges posed by climate change, including increased vulnerability to health risks, food insecurity, and the loss of support systems. According to [23], psychological resilience is characterized by the ability to cope with negative emotional experiences and by using flexible coping strategies to adapt to the changing demands of stressful situations. In Bulawayo, flexible coping strategies among street children include forming peer support groups, engaging in marginal work, and creatively accessing resources for survival [25].

In the context of street children in Bulawayo, resilience theory offers a valuable perspective for assessing how these children cope with and adapt to the complex impacts of climate change. Their resilience is not solely a reflection of individual strength but is also shaped by community-based adaptation strategies, social protection initiatives, and the larger social-ecological systems they are part of [11,26]. Understanding these dynamics is crucial for designing effective interventions that enhance coping strategies and foster resilience among this vulnerable group.

2. Materials and methods

This study was based on the interpretivist paradigm, which stresses qualitative methods to explore the complexities of human experience, emphasizing context, intentionality, and the evolving nature of social phenomena [24]. The researcher selected a qualitative research design as the most suitable approach for this study. The research was conducted following the scientific method of social work research. An exploratory study employing a qualitative approach enabled participants to express themselves in their own words. Additionally, qualitative research demonstrates its utility in exploring "why" rather than "how many" [15,27]. For this study, the target population comprised street children aged 10 to 18 years residing in Bulawayo Metropolitan Province, Zimbabwe, who have experienced climate-related stressors such as floods, droughts, or extreme temperatures for at least two consecutive years. While the exact population size was unknown, estimates indicated over one thousand two hundred (1,200) street children in Bulawayo's city center alone [28], which posed a challenge in determining a precise sample size. Convenience sampling was used to select participants for semi-structured interviews and Focus Group Discussions (FGDs), while purposive sampling was used to select participants for the Key Informant Interviews (KIIs). A total of thirty (30) respondents

participated in this study. A group of thirteen (13) participants who volunteered were recruited and participated in the semi-structured interviews. A total of two (2) FGDs were held. One (1) FGD comprised of the thirteen (13) street children who participated in the semi-structured interviews while the other FGD had twelve (12) other street children recruited within the Bulwayo Central Business District (CBD). The thirteen (13) participants for the semi-structured interviews, exceeded [29]'s threshold of twelve (12) participants required for reaching 90% thematic saturation in heterogeneous populations. The two (2) FGDs enabled exploration of group norms and consensus narratives without exceeding manageable group dynamics [30]. Additionally, 5 key informant interviews were targeted, namely; the District Development Coordinator (DDC) for ward 1, one Social worker from the Department of Social Development, one representative from the Thuthuka Children's Project organisation, one representative from Bulawayo City Council and one representative from the health department.

The data collection process was meticulously designed to comprehensively capture the lived experiences of street children regarding the impacts of climate change in Bulawayo. This was achieved through the employment of a triangulated qualitative approach, thereby ensuring methodological rigor and depth. Four complementary methods that is thirteen (13) semi-structured interviews of street children, two (2) Focus Group Discussions (FGDs), five (5) key informant interviews (KIIs), and unstructured observation were systematically implemented to address our objectives while aligning with its interpretivist paradigm. The interview guides and FGD guides were used, during which data was recorded by the research assistants in English, as participants used IsiNdebele and Shona languages. The participants were offered lunch which was not disclosed to them before the interviews and FDGs.

In this study, we employed thematic analysis, a method typically applied to a set of texts, such as interview transcripts [30]. The researcher closely examined the data using NVIvo software (version 2.0) to identify recurring themes, topics, ideas, and patterns of meaning from the semi-structured interviews and FGDs data. The codes were developed and saved in the NVIvo and nodes were also created to flag developed themes. Prolonged engagement with participants aided in extracting rich, dense data by utilizing repetitive statements from street children to form common themes that assisted with checking credibility and dependability of the participants.

This study on street children focused on minors, which required clearance from the Department of Social Services and was granted. The Institute of Development Studies-National University of Science and Technology (IDS-NUST) also cleared the study. Since the minors had no guardians in the streets, consent was obtained from the participants with the assistance of a Social worker.

3. Results and discussions

3.1. Coping strategies that street children use in response to climate-induced challenges

3.1.1. Immediate physical adaptation strategies

As the City of Bulawayo evidently reels under the effects of climate induced harsh conditions, in relation to devising and employing a range of rapid-response techniques to lessen their exposure to harsh weather, two participants stated that adaptations encompass makeshift shelter construction, creative use of clothing, and manipulation of the immediate environment to enhance comfort and safety.

By sharing materials and skills, they form informal networks that enable newcomers to learn essential survival tactics despite scarce resources and recurring disruptions.

Efforts to erect and reinforce shelters illustrate ingenuity and urgency. A 15-year-old boy described his approach: *"When heavy rains arrive, I scavenge plastic sheets and cardboard behind shops and bind them with wire scavenged from the streets. Although strong winds often tear the structure apart, I rebuild it immediately. On hot days, I rest on a shop veranda where the floor remains cooler, placing my cardboard there to shield myself from the sun's heat. Occasionally, police or security guards dismantle the shelter for 'dirtying the city,' but we have nowhere else to go"*.

A girl from the focus group discussions added by emphasizing the role of collaboration and gendered safety considerations: *"I like my shelter walls with soft materials—old clothes stuffed into plastic bags—and share blankets and newspapers with other girls to stay warm. We choose corners formed by two existing walls so that only two sides require covering. Floods pose the greatest threat, washing everything away and forcing us to rebuild with numb fingers in freezing water"*.

All these descriptions reveal that shelter construction or choice among street children functions not only as protection from rain, wind, and heat but also as a mechanism for peer-to-peer teaching and social cohesion. More experienced children mentor newcomers on material selection, joint reinforcement, and optimal location choice. During the rainy or cold seasons, they pooled resources to enable the construction of larger communal shelters, providing increased warmth and security, particularly for girls who fear isolation at night. However, competition for the driest spaces can provoke conflicts, underscoring the precarious balance between cooperation and rivalry in their informal support networks.

The shelter construction or choice strategies documented align closely with broader literature on spatial improvisation among vulnerable urban populations, particularly [31], who characterized street children's "spatial adaptation" in developing nations. The sophisticated drainage and cooling techniques described by participants mirror adaptive behaviors documented in similar urban contexts. However, the Bulawayo case reveals particular innovations shaped by local climate patterns and the availability of materials. The informal knowledge transfer systems observed resonate with Ndlovu 's documentation of collective learning among Bulawayo Street children, where practical skills become social capital and group membership criteria [28]. However, the findings extend this understanding by revealing how climate adaptation drives innovation and peer teaching, suggesting that environmental stressors may accelerate social learning processes within street communities.

The gendered dimensions of shelter construction strategies reflect broader patterns of differential vulnerability documented in street children literature, particularly the intersection of gender, safety, and survival documented by [32] in Ethiopian contexts. The emphasis on safety and privacy among female participants aligns with research highlighting how climate adaptation strategies must account for gender-specific risks, including sexual exploitation and violence. The gendered shelter strategies reveal that girls prioritize concealed, multi-layered structures, [32]'s research on safety-driven adaptations among female street populations is extended. The cyclical destruction-rebuilding pattern aligns with [33]'s documentation of institutional neglect in Bulawayo's climate planning, where street children remain excluded from municipal resilience programs. This pattern suggests that effective interventions must address not only immediate shelter needs but also the institutional and environmental factors that perpetuate cycles of displacement and reconstruction among street children's populations.

3.1.2. Adaptive clothing and personal protection

All participants acknowledged that extreme weather compels them to improvise garments and accessories that serve functional and protective purposes. Their ingenuity transforms discarded materials into layered outfits and makeshift footwear, enabling them to regulate their body temperature, shield against the sun and rain, and navigate social risks. These practices reveal not only an intuitive grasp of thermal physics but also a communal system of resource sharing that bolsters survival under precarious conditions.

A fourteen-year-old girl described her method for staying cool and dry: *"When the sun becomes unbearable, I wet my T-shirt and drape it over my head as a barrier against the heat just like construction workers do. In cold spells, I layer every piece of clothing I own, sometimes stacking five or six garments even if they are torn or soiled. During the rainy season, I slip plastic bags over my feet to keep them dry when my shoes have holes, though the bags start to smell terribly after a while"*.

A fifteen-year-old participant emphasized the dual role of clothing as protection and personal security: *"As a girl on the streets, I choose layers that let me adapt to weather changes while minimising attention to my body shape. When it's hot and I must remove layers, I seek out women's restrooms or crowded markets for privacy. On cold nights, my friends and I share the warmest coat, taking turns so that each of us stays insulated. Finding decent clothes is a constant struggle, and once we have something good, we hide it carefully to prevent theft"*.

According to the report, adaptive clothing serves as a lifeline and a form of social currency. The layering techniques manage thermal comfort, the repurposed plastics and fabrics avert immediate harm from rain and sun, and the communal sharing networks foster trust and reciprocity. Yet, the health department notes that prolonged wear of damp or unwashed layers can lead to skin infections and overheating, underlining the limitations of these stopgap measures. Ultimately, their creative strategies expose remarkable resilience and the urgent need for stable access to suitable clothing and shelter.

The clothing adaptation strategies documented align with broader research on material culture and survival among marginalized populations, particularly [28]'s observations about resource sharing and innovation among Bulawayo Street children. The sophisticated understanding of thermal regulation and weather protection demonstrated by participants reflects what [34] described as practical knowledge systems that emerge from sustained exposure to environmental stressors. The health implications of clothing strategies align with broader public health literature on environmental exposure among homeless populations, particularly the work of [35], which documented health risks associated with inadequate protection from weather elements. The psychological dimensions of clothing and dignity reflect broader research on identity and belonging among street children, where appearance affects self-concept and social access.

3.1.3. Peer networks and mutual aid systems

Street children regard one another as a de facto family, collectively sharing their limited resources during storms when daily survival becomes extraordinarily challenging. A fifteen-year-old boy articulated this solidarity: *"My friends on the streets are like my family now. When very bad storms arrive, we gather in the sturdiest building we can find and share whatever food and water we have. If one of us finds bread while another has water, we divide everything equally. We never leave anyone behind when the weather is dangerous"*.

Within these groups, the immediate response of street children to hazard awareness and safe havens creates effective crisis support systems. An officer from Thuthuka Children's Project mentioned what she observed: *"We observe that children's peer networks provide critical emotional and practical support that formal services often cannot match. The immediate response and intimate knowledge of each other's needs create effective crisis support systems. However, these networks can also perpetuate negative behaviours and create barriers to accessing formal services when group dynamics discourage engagement with adults or institutions"*.

The peer network's function revealed that it acts as a first responder and educator, enabling rapid information exchange and coordinated action. However, competition for scarce resources can strain relationships, and group dynamics sometimes deter engagement with formal services, leaving confident children isolated despite the strength of these grassroots support systems.

The peer support networks documented align closely with the literature on social capital formation among street children, particularly [28]'s observations about collective identity and mutual aid systems among street children in Bulawayo. The sophisticated organizational structures described reflect broader patterns identified by [32] in Ethiopian contexts, where street children develop parallel social institutions that provide functions typically associated with formal family and community structures. The reciprocity principles observed resonate with anthropological literature on gift economies and mutual aid, suggesting that street children create alternative economic systems based on sharing rather than accumulation. However, the Bulawayo findings reveal particular adaptations to climate stressors that drive specific forms of cooperation and resource pooling not documented in other contexts.

3.1.4. Community connections and adult support

Some participants mentioned that they navigate a complex web of adult relationships to secure aid during extreme weather, balancing the benefits of genuine assistance against the risks of exploitation. These community ties, ranging from local vendors to faith groups and civic officials, offer intermittent shelter, food, and guidance, but often entail conditions that clash with children's need for autonomy and safety.

A sixteen-year-old girl described how she discerns trustworthy helpers: *"A woman at the market, whom we call Mama Joyce, lets us take cover in her stall when storms strike. Yet I remain cautious, because some adults promise food or shelter only to demand favours in return. A friend suffered an infection after agreeing to such conditions. Over time, I have learned to distinguish those who truly care from those who pose danger"*.

A thirteen-year-old boy reflected on support from religious groups: *"Church members sometimes open their doors and share meals and water when we face severe hardship. However, many require that we attend their programs and follow strict rules, which is hard because I cannot leave at will. Others preach salvation but offer no practical relief when we urgently need food or a dry place to sleep"*.

These testimonies illustrate how street children develop criteria for evaluating potential allies, observing past behavior, weighing demands against benefits, and sharing intelligence about reliable adults. Institutional offerings from businesses or faith-based organizations can provide valuable resources; however, the conditional nature of such support often conflicts with children's immediate need for freedom and security. Consequently, forging lasting, trustworthy connections demands time,

mutual respect, and a measure of risk, reflecting the resilience of these young survivors and the fragility of informal social protection in Bulawayo's changing climate.

The community support patterns documented align with broader research on social capital and community responses to vulnerable populations, particularly the work of [36], which highlights the role of religious and community organisations in supporting street children during crises. The trust-building processes described reflect broader literature on social relationships between marginalized youth and community members, where historical trauma and stigma create barriers to help-seeking behavior. The selective and conditional nature of community support aligns with research on social exclusion and belonging, where street children navigate complex negotiations for inclusion and acceptance. However, the Bulawayo findings reveal specific strategies for identifying and cultivating support relationships, suggesting local innovations in the development of social capital. The hierarchical support networks documented among peers for resource sharing and among adults for material aid exemplify what [28] identified as "fictive kinship systems", unique to Bulawayo's street communities. This aligns with [37]'s description of "child-led collectives" in Kenya, yet the exclusionary dynamics under scarcity mirror [38] findings on resource-based conflict.

The institutional support patterns observed are connected to the broader literature on faith-based and community responses to child welfare, particularly the documentation by [28] of community initiatives in Bulawayo. The tensions between conditional and unconditional support reflect broader debates in child welfare about approaches that prioritize immediate safety versus long-term behavioral change. The exploitation risks identified by participants align with the international literature on child protection, where vulnerability intersects with power imbalances to create opportunities for abuse. These findings suggest that effective community engagement strategies must balance immediate crisis response with long-term relationship building while addressing the structural factors that create and maintain street children's vulnerability and social exclusion.

3.1.5. Drug use and abuse

All participants acknowledged that drug use and abuse is a critical coping mechanism among some street children, reflecting attempts to manage emotional distress and the perils of addiction. The availability of inhalants and other inexpensive substances exposes young people to health hazards and impedes their capacity to navigate daily risks safely. Their narratives reveal how drug use alleviates immediate pain and contributes to new vulnerabilities, underscoring a need for targeted intervention and support.

A sixteen-year-old boy explained why he sometimes turns to inhalants: *"When the hunger pangs and cold become unbearable, sniffing glue numbs the pain for a few hours. It feels like the world stops spinning, and I can forget about my problems if only briefly. But afterwards, I wake up feeling worse, my head pounds, and I have no appetite. I know it is destroying me, yet I keep going back because at that moment nothing else can quiet my mind"*.

An eighteen-year-old girl recounted how peer pressure and shelter instability pushed her toward substances: *"Some older children told me glue would help me stay awake when guarding our makeshift shelter at night. At first, it seemed helpful, but I soon found myself needing more to function effectively. My friends laughed when I stumbled or slurred my words, and I began to avoid them because I was ashamed. The more I used it, the harder it became to focus on finding food or keeping safe, and I started feeling sick all the time"*.

These accounts demonstrate how drug abuse among street children begins as a way to reduce physical and psychological suffering, but quickly turns into a cycle of dependency that weakens survival skills. Immediate relief leads to impaired judgment, declining health, and social isolation. Tackling this issue requires integrated programs that combine medical care, mental health support, and alternatives for coping with trauma, ensuring that vulnerable youth can escape substance-driven habits and develop healthier, more sustainable ways to handle adversity.

The reliance on inhalants as a coping mechanism among street children reflects broader patterns identified in resource-constrained settings, where solvent use predominates due to its low cost and ready availability. Systematic reviews indicate that nearly half of street-living youth report a lifetime use of inhalants, underscoring the ubiquity of glue sniffing in their survival strategies [23]. This behavior frequently emerges as an immediate response to physical and emotional distress, offering temporary relief from hunger, cold, and trauma; yet, it accelerates health deterioration, impairs cognitive function, and undermines social integration [39]. Moreover, prolonged solvent exposure disrupts neural development and heightens vulnerability to mental illness, compounding pre-existing adversities faced by these children [25]. Peer influence further amplifies substance initiation and dependence, as young people emulate older street cohorts to gain social acceptance and emotional support [40]. These findings highlight the urgent need for integrated interventions that address the psychosocial drivers and the health consequences of inhalant abuse.

3.1.6. Environmental knowledge and weather prediction

Most of the street children demonstrated environmental knowledge and weather prediction as a coping mechanism against climate change-related challenges. A 16-year-old male participant said, *"When you live on the streets for many years like I have, you can read the sky, the wind, the clouds, and predict what's coming"*.

A male participant aged 17 years added that: *"My grandmother used to tell me traditional ways of predicting weather before I came to the streets, but living outside has taught me much more because I depend on this knowledge for survival every single day. I learned that certain plants and trees exhibit signs before weather changes, and their leaves change colours or curl up when drought is approaching, while some flowers close their petals before rain. I also observe how domestic animals behave, such as dogs and cats, who act differently before storms, and even street pigeons change their flying patterns. Sometimes I can predict weather changes two or three days before they happen, which gives me time to prepare shelter and find safe places"*.

The environmental knowledge acquisition documented among Bulawayo street children represents a sophisticated form of practical meteorology developed through sustained exposure to weather variability and the necessity of survival. The integration of traditional knowledge systems with direct observation and experimentation demonstrates a remarkable capacity for knowledge synthesis and adaptation among participants. The biological and sensory indicators described, from joint pain predicting storms to olfactory changes preceding rainfall, suggest that prolonged environmental exposure creates embodied knowledge systems where children's bodies become instruments for environmental monitoring. The knowledge transfer mechanisms operating through peer teaching networks reveal informal educational systems that preserve and disseminate survival-critical information across generations of street children, creating institutional memory that persists despite population turnover.

The urban ecological knowledge demonstrated by participants extends beyond simple weather prediction to encompass a sophisticated understanding of microclimate variations, urban geography, and interactions between the built environment and natural systems. The recognition of climate change's impacts on traditional prediction methods reveals an adaptive learning capacity that enables the real-time updating of knowledge systems as environmental conditions change. The documentation of seasonal changes and pattern disruptions indicates that street children serve as inadvertent climate monitors, developing a detailed understanding of local ecological trends through daily survival dependence. However, the practical focus of this knowledge, while highly functional for immediate survival, may limit broader environmental understanding and climate change adaptation planning, which require a longer-term perspective and systemic thinking.

The environmental knowledge systems documented align with broader literature on traditional ecological knowledge and indigenous weather prediction, particularly the integration of natural indicators and behavioral observations described by traditional farming communities. Children's weather-prediction skills, combining cloud reading, plant behavior, and animal signals, demonstrate what [8] called "embodied meteorology", a fusion of traditional knowledge and urban observation. The embodied knowledge aspects observed reflect anthropological research on sensory ways of knowing, where prolonged environmental exposure creates somatic knowledge systems that complement observational data. The peer teaching networks described resonate with research on informal education among marginalized populations, where survival knowledge becomes cultural capital transmitted through social relationships. However, the urban context of this knowledge development represents a unique adaptation of traditional ecological knowledge to city environments, which is not commonly documented in the literature.

The climate change adaptation aspects observed are connected to broader research on adaptive learning and environmental change, particularly the capacity of vulnerable populations to update their knowledge systems in response to shifting conditions. This aligns with [10]'s findings on child-led adaptation but extends them through microclimate awareness specific to Bulawayo's geography. These findings suggest that street children's environmental knowledge represents valuable local expertise that could inform broader urban climate adaptation efforts while highlighting the need for integration with formal climate science to enhance long-term planning capacity.

3.1.7. Technical skills and resource management

Three of the participants reported that they developed a wide array of practical abilities to cope with weather extremes and limited resources. Through observation and hands-on practice, they cultivated techniques, from fire making to water treatment, which enhanced their capacity to address immediate survival challenges. These skills also fostered a sense of agency, enabling children to manage scarce materials and adapt swiftly to environmental hazards.

A seventeen-year-old girl described how she transforms ordinary waste into survival tools: *"After four years on the streets, I have learned to start fires even when everything is soaked. I search for the driest bits of cardboard or bark, arrange them to allow airflow underneath, and ignite them with a spark from a bottle cap and a cotton wick. I also purify water by letting sediments settle in plastic bottles, filtering it through a cloth, and checking its clarity and smell before drinking. Using discarded bottles and bags, I construct small, waterproof containers to keep my belongings dry during downpours"*.

Members of a focus group highlighted the peer-taught nature of these innovations: *"Living on the streets is like a continuous training program. We observe each other and share designs for insulation, drainage channels, and collapsible shelters. One day, someone demonstrates how to convert scrap metal into a simple cooker; the next, we learn how to splice wire to reinforce cardboard shelters. Every challenge teaches us a new technical solution that we pass on to newcomers"*.

These narratives reveal an informal vocational education system rooted in collaboration and necessity. As children experiment and refine techniques, they build not only practical competencies but also informal teaching networks that transmit expertise across cohorts. Their ability to integrate traditional methods, such as using natural materials for insulation, with creative adaptations of urban detritus underscores a sophisticated understanding of resource management. Nonetheless, the lack of formal instruction in safety practices means that some of these solutions carry inherent risks. Structured training programs and access to proper tools could transform these emergent skills into sustainable livelihoods while reducing hazards associated with improvised technologies.

The technical skill development patterns observed align with broader literature on informal learning and skill acquisition among marginalized populations, particularly research on vocational learning through practice and peer mentorship. Technical innovations, such as fire-starting in wet conditions and water purification, reflect survival-embedded vocational learning [28]. However, the absence of safety protocols during construction, for example, unstable platforms, reveals gaps noted by [26]. The resource management expertise developed reflects literature on poverty and innovation, where scarcity drives technological adaptation and efficiency optimization. The collaborative learning mechanisms described align with research on communities of practice, where shared challenges foster collective learning systems that enhance individual and group capabilities. Peer-to-peer skill transmission exemplifies [38]'s resilience theory, in which knowledge becomes a form of cultural currency. However, the specific technical competencies developed by street children in urban environments represent a unique form of practical education not commonly documented in the literature.

The economic potential of street-acquired skills connects to broader research on the informal economy and human capital development, particularly the recognition that marginalized populations often develop valuable competencies through survival activities. The certification and recognition challenges identified align with the literature on barriers to economic mobility among vulnerable youth, where a lack of formal credentials limits access to opportunities despite demonstrated capabilities [28]. The safety concerns raised reflect broader issues in informal skill development, where learning occurs without institutional oversight or safety protocols. These findings suggest that effective interventions should focus on recognizing and building upon competencies rather than starting from deficit assumptions while addressing certification and safety gaps that limit economic advancement opportunities.

3.2. Support systems and resilience building

3.2.1. Formal organizational support

All participants reported that they have encountered a variety of formal organizations, such as non-governmental agencies, faith-based groups, and government departments; yet, these entities often fail to provide timely assistance when extreme weather strikes. Their programmed distributions of food, clothing, and basic necessities follow fixed schedules that rarely align with the unpredictable onset of

storms, heatwaves, or droughts. As a result, young people living on the streets remain exposed to climate-related hazards without the immediate aid they require.

A sixteen-year-old boy with four years of street experience reflected on the limited value of scheduled support: *"Some churches and NGOs visit us and hand out soap or meals when conditions are normal, but they vanish during floods or heatwaves. The city council drives us away from makeshift shelters in the rain without offering alternatives. When extreme weather arrives, we are entirely on our own"*.

A focus group participant described the frustration of delayed programs: *"Organisations run their distributions by calendar, yet storms do not announce themselves. When a downpour begins at night, waiting for the next scheduled food or clothing drop is impossible. We need relief that responds instantly to weather emergencies, but formal systems move too slowly"*.

Key informant interviews provided institutional perspectives on formal support systems. The District Development Coordinator explained: *"Our current social protection systems were not designed to address the specific vulnerabilities that street children face during climate extremes. Most NGOs and government programs focus on general child welfare, but there's a significant gap in climate-responsive emergency support for this population. The challenge is that street children are mobile and often avoid formal institutions, making it difficult to provide systematic support during weather emergencies"*.

The findings reveal a substantial disconnect between formal organisational mandates and the climate-specific needs of street children in Bulawayo. The data indicates that while organizations claim to support street children, their interventions are poorly synchronized with the temporal and urgent nature of climate-related crises. The participants' accounts consistently highlight the absence of immediate, weather-responsive support systems, suggesting that organizational frameworks operate on predetermined schedules that fail to accommodate the unpredictable timing of climate emergencies. This temporal mismatch creates critical protection gaps when street children are most vulnerable, such as during flash floods, prolonged heat waves, or severe drought periods.

These findings align with the broader literature on child protection systems in developing countries, particularly regarding their limited capacity to address climate-related vulnerabilities among marginalized populations. [36] emphasized that while the UN Convention on the Rights of the Child establishes states' obligations to ensure children's rights to health, safety, and a safe environment, the practical application of these rights to street children remains challenging, especially as climate-related risks intensify existing vulnerabilities. The gap between policy frameworks and implementation identified in this study reflects what [37] described as persistent implementation challenges in Zimbabwe's child protection system, particularly for street children who remain marginalized from formal protection systems.

The temporal mismatch between organizational support and climate emergency needs to be documented in this study, which resonates with global research on climate adaptation for vulnerable children. The African Committee of Experts on the Rights and Welfare of the Child [25] notes that climate change has the most significant impact on children with disabilities, children on the street, poor children, and children separated from their families, yet formal support systems often fail to provide timely, climate-responsive interventions. This is particularly problematic given that the emergency response protocols identified in this study do not adequately account for street children's specific vulnerabilities during climate events, reflecting broader systemic failures in inclusive disaster risk

reduction approaches that international frameworks like those promoted by Mercy Corps and Save the Children advocate for incorporating street children into climate adaptation initiatives.

3.2.2. Informal social networks and peer support

All participants agreed that they depend on informal alliances when formal aid proves too slow or absent during extreme weather events. These self-organized networks provide vital assistance, combining practical resource sharing with emotional solidarity and function as the first line of defence against climate hazards. By pooling scarce resources, disseminating timely warnings, and offering reassurance, peers create a responsive safety net that reflects a deep collective understanding of local conditions. Although these systems enhance immediate survival, they also reveal a troubling reliance on children to protect one another in life-threatening situations, underscoring the need for adult-led interventions that reinforce rather than replace grassroots support.

A fifteen-year-old boy with three years on the streets explained how older peers guide newcomers: *"When storms strike or the heat becomes unbearable, only our group stands between us and harm. The older boys show us hidden shelters, teach us how to shield ourselves from the sun, and insist that we look out for one another because nobody else will"*.

A focus group participant described the practical sharing that sustains them: *"In an emergency, we merge whatever we have: A tarp from one child, food from another, and the location knowledge of a third. The eldest always makes sure the youngest is safe first. Together we have endured floods, droughts, and heatwaves by combining our strengths when the weather turns against us"*.

The findings illustrate how peer networks deliver rapid, context-specific responses, issuing early warnings, pooling tools and provisions, and offering comfort during frightening events; yet, entrusting children with each other's safety places heavy emotional and physical burdens on already vulnerable youth. Strengthening these peer systems through targeted adult support and formal protection mechanisms is essential to ensure that resilience emerges from cooperation, not necessity.

The prominence of informal social networks in providing climate-related support aligns with the emphasis of resilience theory on social capital and collective adaptive capacity. [28] documented similar peer support systems among street children in Bulawayo, noting that street identity is acquired through shared presence during times when other city residents retreat to their homes. It is in these shared spaces that they forge links and friendships that sustain their survival on the streets through collective effort and initiative. The findings extend this understanding by demonstrating how these social bonds specifically function during climate emergencies, providing practical survival resources and emotional support mechanisms.

The knowledge-sharing aspects of peer networks identified in this study align with [32]'s findings in Addis Ababa, Ethiopia, where female street children heavily relied on peer networks for survival. Specifically, 16% of the children sought help from peers to solve problems, including seeking medical assistance when they fell ill due to extreme weather conditions. Our study's findings on gender-specific support networks particularly resonate with this literature, highlighting how peer relationships serve as crucial survival mechanisms in the absence of formal support systems. However, the findings also reveal a concerning reality: Children are forced to assume adult responsibilities for protecting other children during climate emergencies, a situation that, while demonstrating resilience, fundamentally violates principles of child protection and highlights systemic failures in formal protection systems.

3.3. Future outlook and adaptive capacity

3.3.1. Long-term survival strategies and aspirations

All participants envisage futures that extend far beyond day-to-day survival, demonstrating a nuanced understanding of how personal growth, collective effort, and strategic planning intersect with climate resilience. Many express a desire to transform current hardships into foundations for meaningful roles in their communities while seeking partnerships that can amplify their impact. Their reflections reveal that adaptation is not a one-time response, but a lifelong process that requires education, skill development, and ongoing support networks.

A sixteen-year-old boy described his vision of turning survival strategies into community assets*: "Rather than just getting through each day, I want to learn skills that help me live well under a changing climate. Perhaps I could teach other street children how to build shelters that withstand storms or grow vegetables during droughts. I hope to move from mere survival to thriving—and to assist my community in becoming stronger against future climate threats"*.

A seventeen-year-old girl highlighted the importance of collaboration and external support: *"No one can face climate change alone. I believe street children must join forces with neighbours, civil society groups, and even local authorities who understand environmental risks. By forging these connections now, we can create networks that endure and help us adapt together in the years ahead"*.

The long-term resilience for street children, as reported, depends on combining individual skill acquisition with collective action and institutional partnerships. The children's aspirations reflect confidence in their resourcefulness and recognition of the need for sustained educational opportunities and formal support systems. Fostering these ambitions will require programs that bridge immediate relief with vocational training, community engagement, and pathways to leadership in climate adaptation initiatives.

The long-term adaptation strategies and aspirations expressed by street children mirror transformational climate adaptation paradigms that prioritize building adaptive capacity and empowering marginalized groups as agents of change [9]. Resilience theory's emphasis on the ability to cross thresholds into new development trajectories aligns closely with the children's vision of moving beyond mere survival toward thriving and bolstering community resilience [10]. Their ambition to harness their survival experiences as a springboard for future contributions exemplifies the concept of transformability, defined by [6] as the capacity for small–scale innovations to catalyse broader system-level resilience.

Moreover, the collective nature of street children's future aspirations resonates with community-based adaptation frameworks that underscore the critical role of social capital and collective action in fostering climate resilience [28,32]. By maintaining strong ties within their street networks while pursuing individual advancement, they demonstrate a sophisticated grasp of the interdependence between personal resilience and communal well-being. This communal orientation is consistent with documented cases in which marginalized communities have successfully transitioned from vulnerability to leadership roles in climate adaptation efforts [28].

Finally, the entrepreneurial and innovation ambitions articulated by participants reflect a growing recognition that climate challenges can generate locally appropriate opportunities for solution development rooted in a lived experience [32]. However, realizing these aspirations will require enabling policy environments, robust institutional support, and strategic investments in capacity-

building elements that have been repeatedly identified as prerequisites for the meaningful participation of marginalized groups in adaptation planning and implementation [5].

3.3.2. Resilience building and empowerment strategies

All participants regarded resilience building and empowerment as important in their ability to adapt to the ongoing challenges presented by climate change. Their perspectives reveal a layered understanding of personal and collective strength, emphasizing the importance of learning from experience, supporting one another, and seeking broader alliances. These strategies are not limited to coping with immediate adversity but extend to advocating for systemic changes that can enhance protection and participation for all vulnerable groups. The children's reflections highlight a movement from basic survival toward proactive engagement in shaping their futures and contributing to community resilience.

A fifteen-year-old boy explained his approach to personal resilience, highlighting the importance of learning and sharing knowledge: *"Building resilience means becoming stronger and smarter about surviving climate challenges, but also becoming someone who can help others become resilient too. I want to learn from every climate emergency we face so I can be better prepared for the next one and teach other street children what I've learned"*.

In addition to individual efforts, the value of collective empowerment is evident in the way children seek to form connections beyond their immediate peer group. A sixteen-year-old girl described the need for broader collaboration*: "We become stronger when we work together and support each other, but we also need to connect with other groups who care about climate change. We can contribute our knowledge and experience while learning from others who have resources and influence that we lack. Together, we can create changes that help all vulnerable people, not just street children"*.

These insights demonstrate that resilience for street children is a dynamic process involving personal growth, mutual aid, and advocacy for systemic change. Their strategies include peer-to-peer teaching, alliance building with supportive groups, and a willingness to engage in broader community and institutional efforts. The findings suggest that, while street children are adept at leveraging their strengths, genuine empowerment also depends on opportunities to participate in decision-making and on the willingness of institutions to share power and resources. This approach points toward the potential for innovative partnerships that not only address immediate needs but also foster long-term resilience and leadership among marginalized youth.

The resilience-building and empowerment strategies articulated by street children align closely with participatory development and climate adaptation frameworks that prioritize leveraging existing capacities while advocating for systemic transformation [4,9]. Their conception of resilience as encompassing individual agency and collective adaptive capacity mirrors core tenets of Resilience Theory, which emphasizes the interconnectedness of personal and community strengths in responding to disturbances [37]. [35] further highlighted that resilience theory shifts focus from deficits to strengths, underscoring how adaptive capacities emerge from lived experiences and survival skills learned in stressful environments.

The participatory empowerment strategies described by street children reflect principles embedded in child participation frameworks and climate justice approaches, which stress the inclusion of marginalized voices in decision-making processes [5,6]. Their assertion that genuine empowerment

necessitates individual capacity building and systemic change resonates with transformational adaptation literature, which calls for addressing symptoms and root causes of vulnerability [23]. The peer-to-peer empowerment mechanisms recounted by participants also echo findings in other contexts where marginalized youth have forged collective advocacy networks to influence social change [28,32]. However, the broader child participation literature cautions that realizing such empowerment requires committed adult allies and institutional structures that recognize and act upon children's insights, ensuring meaningful participation in climate adaptation planning and implementation [6,40].

4. Conclusions

This study has demonstrated that street children in Bulawayo face severe and intensifying climate-related risks that compound their vulnerabilities while developing remarkable adaptive capacities that could contribute to broader urban climate resilience efforts.

Immediate physical adaptation strategies included sophisticated shelter construction and modification techniques, where children demonstrated remarkable innovation in using salvaged materials to create weather-resistant structures. Street children developed complex systems for drainage, insulation, and rapid reconstruction in response to weather-related destruction. Adaptive clothing and personal protection strategies revealed a sophisticated understanding of thermal regulation, with children employing multi-layering techniques, water-cooling methods, and material modification to manage extreme temperatures.

Social support networks emerged as critical survival mechanisms, with peer networks providing immediate response capabilities during climate emergencies through resource sharing, emotional support, and collective shelter strategies. Community connections, while limited and often conditional, provided essential assistance from sympathetic adults and institutions during extreme weather events. However, these relationships required careful navigation due to risks of exploitation and the unreliable nature of informal support systems.

Adaptive learning and skill development demonstrated a remarkable capacity for acquiring environmental knowledge and developing technical competency. Street children developed sophisticated weather prediction abilities by combining traditional ecological knowledge with urban observations, enabling them to anticipate climate events and prepare accordingly. Technical skills in areas such as construction, water purification, and resource management emerged through peer teaching networks and the necessity of survival.

The study revealed significant gaps in the support systems' capacity to enhance the resilience of street children to the impacts of climate change. Formal organizational support systems, including government agencies and non-governmental organizations, demonstrated substantial limitations in providing climate-responsive assistance. The research identified a critical temporal mismatch between organizational support schedules and the urgent, unpredictable nature of climate-related emergencies.

Street children consistently reported that formal organizations are absent during actual climate emergencies, assisting only during normal weather conditions when needs are less acute. Government agencies, particularly city council services, were described as primarily focused on removing children from public spaces rather than providing protection during extreme weather events. The fragmentation of formal support systems means that different organizations address isolated aspects of children's needs without comprehensive climate adaptation programming.

In contrast, informal social networks and peer support systems demonstrated greater effectiveness in responding to immediate climate emergencies. These networks provided rapid response capabilities, resource pooling, and emotional support that surpassed formal interventions in terms of speed and contextual appropriateness. However, the reliance on peer support places an inappropriate responsibility on vulnerable children to protect other children during life-threatening situations.

The evaluation revealed that while street children possess remarkable adaptive capacity and have developed sophisticated coping mechanisms, support systems fail to complement and strengthen these capabilities. The absence of climate-responsive programming specifically designed for street children represents a critical gap in child protection frameworks.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Conflict of interest

The authors declare that there is no conflict of interest in this article.

Author contributions

Tshuma Mlamuleli contributed to this article through conceptualization, methodology, data analysis and manuscript writing whilst Moyo Selina contributed by carrying out data collection, curation and analysis.

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