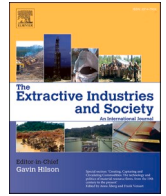


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Original article

Value addition for who? Challenges to local participation in downstream critical mineral ventures in Zambia

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ABSTRACT

The transition to low-carbon systems requires a secure supply of enabling technologies (e.g. renewables, batteries) and their components, which depend on various minerals. Governments are urgently seeking to secure these minerals by forming and augmenting strategic relationships with mineral-rich nations, particularly in Africa. Notably, the UK, EU and USA are encouraging value addition to take place within Africa, to balance their interests against China's dominating position in processing and manufacturing. In parallel, there is interest and debate as to how these mineral endowed countries can maximise the positive outcomes from harnessing value addition activities for the local economies. In this *viewpoint*, we argue that creating downstream high-value industry should be centred around prioritising local company participation. This is important since many African countries continue to experience unfavourable neocolonial impacts and dependencies, particularly in the extractives sectors. We draw on the case of Zambia, which is developing an agenda for local value addition to drive economic transformation and diversification goals. From discussions with in-country experts we highlight three key challenges, which have wider regional relevance: (1) a persisting dominance of foreign-owned entities in the upstream extractives sector; (2) an unfavourable landscape for local company participation; and (3) a lack of enabling environment for value addition activities. Based on these challenges, we offer some areas for policy reform and future research.

1. Introduction

The transition to a sustainable, low-carbon future necessitates a large-scale shift from fossil fuels to renewable energy. Various minerals are required as inputs for low-carbon technologies (e.g. cobalt, graphite, copper) and components (e.g. lithium-ion battery cathodes and anodes) (International Energy Agency, 2021; Scott Dunbar et al., 2020). These minerals are not easily replaceable, and their supply is geographically concentrated, leading them to be labelled 'critical' by many governments. The speed and scale of this shift is unprecedented, with critical mineral demand expected to double or quadruple by 2040 (International Energy Agency, 2021).

1.1. From extraction to value addition

Critical mineral reserves exist in various countries, but supply-chains are overwhelmingly dominated by China, which is the global leader in mineral processing and the manufacturing of battery, wind and solar components (International Energy Agency, 2023). China continues to exert influence and strategic reach in mineral-endowed nations, particularly in Africa (Vivoda, 2023; Wegenast et al., 2019). For example, by foreign direct investment (FDI) in mines, or through infrastructure development to facilitate trade (e.g., the Mombasa roads and ports or the Zambia-Tanzania railway) (Nogués, 2024). As a response, countries (e.g., UK, USA) and regions (e.g., EU, Middle East) are forming, and augmenting, strategic relationships with mineral-rich nations to

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reduce their exposure to China’s dominating position (Deberdt, 2024; Nakanwagi, 2023; Vivoda, 2023). In Africa, this dynamic is demonstrated by political and investor interest in mining, processing and enabling infrastructure. Notably, the USA, EU and UK are advocating for greater value addition and are funding infrastructure projects (e.g., US- and EU-funded DRC-Angola Lobito corridor railway (Economist Intelligence Unit, 2024)).

Value addition is often framed as an opportunity for mineral endowed countries to achieve sustainable economic growth by creating higher value downstream activities and backward linkages (i.e. manufacturing inputs and equipment for mining and value addition sectors) (African Union, 2009). This can support resource-based industrialisation goals to drive economic transformation. Diversifying from solely extraction to higher value activities provides opportunities to reach new markets, generate higher tax revenues, reduce exposure to commodity price fluctuations, and create employment prospects for the local population (African Union, 2009; Sokona et al., 2023). Thus, the Africa Mining Vision set out locally determined plans for beneficiation within Africa (African Union, 2009), and subsequently, individual countries are developing their own strategies (Mamina et al., 2020; Mavhunga, 2023). For example, there are battery manufacturing plans between the DRC and Zambia (Olan’g and Scurfield, 2023); cooperation on value addition activities between Zambia and China (FOCAC, 2023); ventures to conduct local nickel value addition in Tanzania (AFP news, 2024); and protectionist measures being implemented (e.g., Namibia’s ore export ban, and Nigeria’s local processing requirements (Anyago, 2024; Reuters, 2023)).

1.2. The importance of locally-led value addition in Africa

The desire to develop downstream value chains within Africa is set against a challenging historical backdrop plagued with neocolonial legacies with prevailing structural injustices (Mavhunga, 2023). The concerns that countries fail to fully benefit from mineral endowment are persistent and well documented (Ross, 1999; Sachs and Warner, 2001). Evidence suggests that Africa has so-far failed to reap transformative and equitable impacts from their natural resources, but the increased focus on value addition has the potential to help overturn this dynamic (Sokona et al., 2023). Traditionally, the local population feels limited benefit from the mining sector whilst being highly exposed to its negative social and environmental impacts (Kolala and Bwalya Umar, 2019; Sovacool et al., 2020). Therefore, it is essential that the push for local value addition creates local, inclusive and just opportunities (Sokona et al., 2023). Local value addition aims to produce higher-value commodities, which theoretically allows for more profit retention and enhance local development. However, these pursuits come with additional challenges (e.g. skillsets, capital requirements) on top of grappling with the exploitative dynamic in the mining sector (Deberdt, 2024). Hence, there is a genuine risk that value addition projects could reinforce existing unfavourable dependencies that have limited benefit to the local population.

In this viewpoint, we draw upon insights from mineral-rich Zambia, where the Government has an ambitious agenda to scale-up value addition, including by encouraging downstream processing, local content, and even developing capabilities in electric vehicle battery manufacturing (Republic of Zambia, 2022). There are questions as to how this transformative economic approach can be achieved since, in the past, resource-based development in Zambia has only occurred to a limited extent (Aguirre Unceta, 2021; Shokrgozar et al., 2024). From discussions with in-country experts, we raise three persistent challenges that are perceived as obstacles to locally-led value addition: a dominance of foreign-owned businesses; an unfavourable landscape for local company participation; and a lack of enabling environment for value addition. These challenges were commonly identified during formal and informal discussions with Zambian experts (including industry representatives, policymakers, NGOs and associations) between September

2023 and March 2024. To advance the discussion, we present some pathways worthy of researcher, practitioner and policy attention. We stress that future pathways should be locally determined and led to ensure a self-reliant approach with transformative potential.

2. Zambia’s pursuit for economic transformation through value addition

Zambia is endowed with critical minerals, and mining is a major contributor to the economy. Fig. 1 highlights the importance of the mining sector for Zambia, including its ranking as 9th largest global producer of copper, contrasted against its limited value addition. Currently, the sector contributes 15 % to Zambia’s GDP and 72 % of export earnings. These high shares highlight an economic dependence on mining, thereby exposing Zambia to resource revenue volatility, rent-seeking, institutional weaknesses and corruption, and currency volatility (Mulder et al., 2024). On top of this, environmental concerns due to mining exist and relate to water management, waste disposal, and poor remediation of mining sites (Wambwa et al., 2023).

In recent history, Zambia’s mining sector has been dominated by copper extraction rather than developing downstream activities. For example, hardly any companies add any value beyond copper cathode with currently *only four* companies (namely ZAMEFA, Neelkanth, Uniflex and Doaba (Times of Zambia, 2024)) operating at scale to make higher value products, such as wires, cables and rods. This is disproportionately low when compared to how much ore is exported (see Fig. 1). In fact, Zambia’s mineral processing capabilities have reduced following a set of policy amendments starting in 2015 (e.g., reversal of

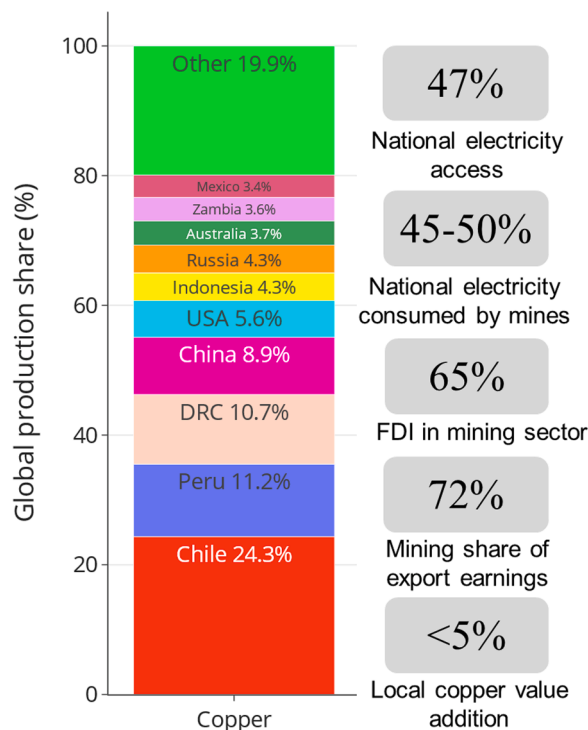


Fig. 1. Copper mining key facts for Zambia. Left: Copper production (2022) from USGS, 2024; Right: population with electricity access (2021) from (World Bank, 2024); shares of electricity from Integrated Resource Panel 2023 (consolidated base case demand in 2020 of 6569 GWh for Mining excluding losses and exports) (Ministry of Energy, 2023) and Copperbelt Energy Corporation (created for reliable electricity supply to mines) (Copperbelt Energy Corporation Plc, 2023); FDI as liability stock (2021) (The Balance of Payments Statistical Committee, 2022), Mining share of export earnings (2022) (EITI, 2021); local copper value addition shown as share of total copper production manufactured into a more refined product.

royalties being tax deductible - although this has now been altered). In parallel, the overreliance on copper has been intertwined with debates about diversification, including in the mining and manufacturing sub-sectors (Chitonge, 2016; Chikalipah and Makina, 2019). Nevertheless, there has been a continuous decline in the manufacturing sector, which is illustrated by its contribution to GDP plummeting from a share of 37 % (1992) to 7 % (2022) (Mutambo et al., 2022; Republic of Zambia, 2006, 2022).

The Government has developed policies to encourage greater value addition in the mining sector, as laid out in the Zambia 2030 Vision (Republic of Zambia, 2006) and subsequent National Plans (Republic of Zambia, 2022). Large mining operations are currently foreign owned and managed, aided by the lack of restrictions on foreign ownership (Zambia Development Agency, 2020). Many large-scale mining companies are listed on international stock exchanges whilst Zambian government-affiliated entities hold minority stakes. For example, Zambia's copper mines have a government-majority owned company (ZCCM Investment Holdings) holding stakes of between 10 and 49 % depending on the mine. Local participation in mining is currently supported for small- or artisanal-scale mining with licensing options specifically tailored towards citizen participation at this level (i.e. through a dedicated 'artisanal' license). More generally, high foreign ownership makes newcomer barriers high, as competing with large mines is unattainable for small-scale operations - possibly even more so when establishing value addition operations. For instance, an expert mentioned that small scale mining licenses have area limitations, yet refining operations require more land (personal communications, 2023).

From our discussions with in-country experts, there is appetite from Zambian enterprises to participate in the mining and mining-sub sectors, particularly at value addition level. The sentiment repeatedly led to questioning *why can't that be made in Zambia?*

3. Three key challenges to local participation in value addition activities in Zambia

In this section, we present three key interrelated challenges that are perceived as hindering locally driven value addition activities in Zambia.

3.1. A persistent dominance of large foreign-owned businesses in upstream activities

The mining sector in Zambia is dominated by large foreign-owned incumbents, which focus on extraction and rarely chose to expand downstream (Kragelund, 2020). This dynamic creates a difficult environment for newcomers to value addition businesses whilst limiting the economic benefits reaching the local population (Kragelund, 2020). The ownership structures and the resulting company listings on international stock exchanges lead to a large portion of economic benefit being realised outside of Zambia by international investors.

Traditionally, the main economic contribution from mining and value addition is through royalty and tax payments. This is a point of contention as many feel the government has lost out on capital gains from privatisation in the 1990s due to late participation in shareholding or the high costs paid for shares, which have not delivered the expected returns. The destructive practices of some large-scale foreign owned mines are a major concern amongst local experts and NGOs. The impacts of irresponsible corporate behaviours are both persistent and severe, such as social externalities relating to human rights abuses, land right conflicts, health problems and environmental issues relating to biodiversity loss, pollution and deforestation (personal communications, 2023; 2024). As such, some experts questioned whether downstream value addition activities would replay these negative impacts on the environment and society.

A common tax loophole, used by large companies, involves discounting sales of minerals to affiliated companies overseas. In 2008, the

government pursued a strategy to limit such revenue loss by requiring companies to utilise publicly quoted benchmark prices (i.e. London Metals Exchange) to regulate the transactions between companies and their subsidiaries (Readhead, 2017). Yet, based on anecdotal discussions with local experts, large mines still conduct similar activities by "under-pricing [ores or concentrates] through third party reselling to their own subsidiary companies acting as seller agents abroad" (personal communication, 2024). Consequently, newcomers conducting value addition may struggle to compete. Government compliance monitoring on this matter is believed to be ineffective due to issues around mineral exports not being declared properly, and the government not having enough capacity to conduct tests and checks (personal communication, 2024).

3.2. An unfavourable landscape for small local enterprise participation

Given the push to scale downstream value addition, it is important – from a normative standpoint – that Zambians' can benefit from these activities by fostering local company and entrepreneurial participation (Sokona et al., 2023). Nevertheless, currently, none of the existing value-adding copper companies in Zambia have majority local ownership (personal communications, 2023; 2024).

A frequently discussed roadblock surrounds the difficulties local companies, especially small and medium enterprises (SMEs), have in joining and competing in the sector (personal communications, 2023; 2024). The dominance of foreign majority-owned mines (3.1.), combined with a sectoral status quo of using off-take agreements (selling contracts either before production begins or long into the future, anywhere from three to ten years) means local companies struggle to access inputs. An interconnected barrier is that the London Metal Exchange (LME) determines the prices of commodities. This is based on supply and demand dynamics, plus the cost for the commodity to reach the nearest LME-approved warehouse (for Zambia, the nearest is in Malaysia). This approach to pricing is the industry norm, and encouraged by the Zambian government through 2008 reforms to enhance transparency, yet high commodity prices can prevent local entrepreneurs from affordably accessing the required raw materials to develop businesses (personal communications, 2023; 2024). This is generally perceived as a frustrating, severe and unjust economic obstacle for locals, given copper is mined domestically, exported and then imported back as higher value products (personal communications, 2023). Large foreign-owned mining companies in Zambia generally have no financial incentive to sell to local companies, since they likely would demand small volumes. There is no policy in place to enable small, local companies to secure raw materials at a discount. The few copper value addition players that do exist in Zambia typically have direct arrangements with mining companies; some have negotiated minor price reductions based on discounting the intra-country transport cost. Nonetheless, according to some experts, the most viable way for local companies to legally access metals and minerals is to obtain a license to mine legacy tailings or to acquire post-consumer scrap (personal communications, 2023).

It was suggested that the current policy regime is more suited to foreign players, rather than fostering local, small business participation. There are no enacted legislations that have been successful at lowering these barriers for local players and there are sparse government backed schemes to support entrepreneurs (e.g. skills and capacity development, grants and business incubation). Hence, Zambians will continue to be priced out of participating in value addition business models, unless rectified. In parallel, opportunities to benefit from the sector through backward linkages are also underexploited with most mining companies relying on imported equipment and inputs. A Local Content Strategy (2018–2022) does exist (Kragelund, 2020), but the impact of this policy has thus far been underwhelming, and no subsequent local content act or statutory instrument has been implemented.

3.3. A Lack of enabling environment for value addition

Our discussions with experts suggested that the socio-economic landscape is unfavourable. Issues related to policy, finance, energy, human capital, and mineral availability exist. The combined issues create a suffocating landscape for local new entrants.

The regulatory environment has been fast changing (e.g. multiple amendments of the Mines and Minerals Development Act, the key legislation governing the extractives sector), causing volatility and uncertainty for companies and investors. It is also not clear which ministry will have ownership over the value addition agenda (personal communication, 2024: “*who takes the lead in this space of value addition?*”). For manufacturing in Zambia, the ongoing unfavourable macro-economic environment, has resulted in declines in the sector in the last thirty years (Fessehaie, 2012; Mutambo et al., 2022; Republic of Zambia, 2006). This also reflects the broader picture in Sub-Saharan Africa. The weak Zambian currency (Kwacha; depreciated 35 % against the US\$ in 2023 (Mpuku and Masilokwa, 2024)) and high borrowing rates offered by local banks (the Bank of Zambia policy rate is 13.5 % (Bank of Zambia, 2024)), but in practice optimal rates of 25–30 % are offered by local banks) (personal communication, 2024). Ultimately these economic factors mean start up costs and equipment are prohibitively expensive. Thus, local companies are not competing on an even basis with foreign-backed players who are able to obtain more favourable external financing terms.

Energy costs, and stability of supply, are hugely influential to the viability of downstream activities (Magno and Guzman, 2021). Zambia has a challenging energy situation, characterised by high costs and unstable supply, which has impacted the grid-reliant mining sector (Luk and Mfula, 2024). Once again, in early 2024, prolonged droughts disrupted the hydro-heavy mix, leading to daily loadshedding (Lusaka Times, 2024). Our discussions suggested that industrial electricity tariffs were circa 9.3 USD cent/kWh (this then means they refer to the highest commercial tariff which is 2.28 Kwacha/KWh or ~8.7 USD cent/kWh in 2024 (Energy Regulation Board, 2024)), but would have to be around 30 % less at 7 USD cent/kWh for processing viability (personal communication, 2023).

Questions around labour for value addition activities surfaced. It is unclear whether value addition would create better quality, safer and well-paid employment compared to existing mining jobs. Human rights abuses and inadequate safety could persist in downstream activities (personal communications, 2023). There may be different pollutant management challenges, as well as health and safety risks. From a practical perspective, a skills mismatch may exist given value addition activities require skilled and semi-skilled workers on top of manual labour (personal communications, 2023). Reiterating observations of Kragelund (2020), certain technical skillsets are limited in Zambia, and unlikely to be available in the near-term (personal communications, 2023). Foreign workers may then be prioritised over local labour for certain roles - a common practice in the mining sector (Wegenast et al., 2019). This risk is clearest when foreign companies are developing value-addition activities, and heightened when it comes to producing more advanced products (e.g. battery components) as local skills may not be readily available. This concern is shared by Deberdt (2024) in relation to the DRC's current skill profile, and their appropriateness for battery manufacturing. Hence, decent and improved employment prospects are not guaranteed.

On top of this, the plans for the joint Zambia-DRC lithium battery manufacturing plant are raising questions around the feasibility of accessing needed minerals in appropriate forms (Olan'g and Scurfield, 2023). Notably, nickel production quantities may be lower than required whilst manganese is associated with environmental, social and governance concerns due to high involvement of artisanal and small scale miners (Olan'g and Scurfield, 2023) who sell it to ferromanganese producers, where processing does not lead to battery precursor forms. Further, lithium exploration is beginning, but production has not started

(personal communication – 2024).

4. Proposed ways forward and research needs for Zambia and beyond

The three challenges raised reflect the complexities surrounding the value addition discussion. The challenges are connected and sometimes mutually-reinforcing, exacerbating the slow uptake of local participation in the mining and value addition sectors. Here, we outline some priorities for Zambia based on expert insights.

Zambia has a vision to scale-up value addition, outlined in key policies (e.g. Vision 2030, Eighth National Development Plan). So far, there have been some enacted and proposed regulatory additions and amendments to support downstream value-added industries, and there is growing interest in collaborating for regional strategies. Examples of this include a Local Content strategy framework, which encourages mining companies to prioritise the use of local goods and services in the mining sector; a bill passed through parliament regarding the establishment of a Minerals Regulation Commission (Parliament of Zambia, 2024); and the creation of a joint Battery Council between Zambia and DRC to engage in dialogue relating to battery manufacturing at the border. Despite such progress and ambition, these changes will take time to achieve desired results. We propose exploring the following points to prioritise in future policy, practice and research.

4.1. Plan for future opportunities via enabling and stable policies

There is a need to create an operationalisable pathway and detailed plan for local value addition for copper and other minerals in Zambia. This requires clearly defined roles and responsibilities amongst ministries and coordinating bodies, as well as a stable policy environment. The growing importance of the African Continental Free Trade Area also presents opportunities for regional collaboration, but exactly as to how so requires further research.

Policies designed to be enabling for local companies across the value chain are necessary, such as fully operationalising local content policies through legal mechanisms (Kragelund, 2020). Policy monitoring may ensure that interventions produce the intended outcomes, otherwise unintended or undesirable consequences may emerge (Ba and Jacquet, 2022). Importantly, the pathway should be locally determined and inclusive, rather than prescribed by external donors and multinationals. Similar calls for local empowerment and continuous monitoring have been highlighted in other contexts, such as Tanzania (Kinyondo, 2024).

4.2. Reduce financial barriers

A supportive finance landscape is required for local businesses, especially SMEs. Alongside government grants and small-business loans at competitive rates, more innovative instruments informed by other countries' policies could be explored. For example, experts suggested a need for greater government participation in negotiating and/or acquiring larger unrefined minerals and then carefully designing mechanisms for local companies to access these minerals. There is also potential to examine comparable instruments used by other jurisdictions to overcome the pricing hurdles faced by local companies. For example, Chile can serve as a case for policy learning as mining companies are required to allocate 25 % of lithium (and other critical mineral) output to local enterprises at a preferential price (Hailes, 2022). This type of innovative dual pricing approach may create a more level playing field between local small companies and the dominating large-scale players by enabling smaller, local companies to access raw materials at a more affordable cost than the externally determined LME price.

4.3. Energy reliability

Stable energy supply, at competitive prices, is indispensable for

value addition business' viability. Energy supply is a cross-cutting sectoral and national matter, and potential solutions involve diversification, increased financing and investments, and setting energy access priorities which balance energy needs of the population with the mining and manufacturing sectors. For value addition activities to align with sustainability goals (e.g. climate targets), scaling up renewable energy can be prioritised whilst also reducing reliance on hydropower.

4.4. Enhance skillsets

Value addition activities that can also provide decent employment prospects (i.e. fairly paid, quality and safe) are most aligned with inclusive development (Olan'g and Scurfield, 2023). Investments in specialist vocational training and higher education degrees can help align the future labour requirements with Zambia's vision. Without skillsets, value addition policies will fall short, as evidenced by Zimbabwe (see Mamina et al., 2020). We are aware of nascent discussions regarding curriculum development at local universities (e.g. University of Zambia) and the establishment of new multistakeholder players (e.g. Zambian Electric Mobility Innovation Alliance), which represent locally determined approaches. Bottom-up efforts can be supported with strong top-down reinforcement (i.e., through labour, industrial and trade support).

4.4. Improve government capacity

Local experts also recommended reinforcing and expanding government capacity to improve governance of the sector.

Importantly, ministries and implementing agencies require adequate facilities, resources, skills and capacities to carry out their mandates. For example, if the Ministry of Mines and Mineral Development had increased geographical and/or digital reach, then this could support a more inclusive licencing process, especially for smaller players without presence in Lusaka. Additionally, if the Zambia Environmental Management Agency had more capacity across the country, then this could improve social and environmental compliance.

Moreover, looking forward, relevant and responsible ministries may need new skills and training to equip personnel to deal with emerging issues relating to value addition opportunities (e.g. battery manufacturing). Coalitions and cross-country training programmes can help government stakeholders to acquire knowhow and best practice. Moreover, a focus on intra-Africa partnerships and policy initiatives can help create more equal collaborations, as scholars have noted the risks of perpetuating unequal (e.g. North-South) relations in critical minerals issues (Deberdt, 2024).

4.5. Bolster environmental and social governance

It is imperative that value addition pursuits are environmentally and socially sustainable. This requires a conscientious and deliberate effort to balance increased industrial activity with sustainability goals. Although legislations to protect the environment exist, compliance and enforcement fall short. Therefore, the Government can improve existing instruments (e.g. Environmental Impact Assessments and Environmental Protection Fund) so their intended goals are achieved whilst dedicating more resources to monitoring and enforcement (Wambwa et al., 2023).

Value addition projects will inevitably come with different environmental and social complexities than the mining sector. Hence, systematically understanding these emerging challenges presents an area in need of more research.

CRediT authorship contribution statement

Karla Cervantes Barron: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation,

Funding acquisition, Conceptualization. **Rebecca K.M. Clube:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Roseta Chabala:** Writing – review & editing, Investigation, Data curation. **Mwansa Matokwani:** Writing – review & editing, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Mulenga Joseph Chikwamo:** Writing – review & editing.

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