ASSESSING THE IMPACT OF HEAVY METAL EXPOSURE AND E-WASTE EXPANSION ON TRYPANOSOMIASIS BURDEN IN NIGERIA: THE ROLE OF ENVIRONMENTAL AND SOCIAL WORK EDUCATION

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Abstract

This study investigates the correlation between heavy metal exposure due to electronic waste (e-waste) and the burden of trypanosomiasis in Nigeria, emphasizing the critical role of medical-social work and environmental education. The study explores how e-waste proliferation contributes to environmental contamination and its implications for public health, particularly in vulnerable populations. By integrating epidemiological data with insights from medical-social work and environmental education, the study highlights the necessity for enhanced training and awareness among healthcare professionals. The study posits a significant relationship between heavy metal exposure, e-waste expansion, and increased trypanosomiasis incidence, underscoring the need for educational initiatives to improve diagnostic and intervention strategies. Besides, a proposed framework for integrating environmental health education into medical-social work curricula.

Keywords: Heavy metals, E-waste, Trypanosomiasis, Environmental health, Epidemiology.

Introduction

The dual challenges of infectious diseases and environmental pollution have become critical public health concerns in Nigeria (Pona, Xiaoli, Ayantobo & Tetteh, 2021). Among these diseases, trypanosomiasis remains prevalent, especially in rural areas where vector-borne transmission is rampant (Muhammad, Abdulkareem, Chowdhury, 2017). The exponential growth of electronic waste (e-waste) has introduced a significant number of heavy metals into the environment, posing serious health risks (Parvez, Jahan, Brune, Gorman, Rahman, Carpenter, Islam, Rahman, Aich, Knibbs & Sly, 2021).

Heavy metals such as lead, cadmium, and mercury, commonly found in e-waste, can compromise immune function, thereby increasing susceptibility to infections like trypanosomiasis (Jain, Kumar, Chaudhary, Kumar, Sharma, Verma, 2023). As e-waste continues to accumulate in Nigeria, understanding its health impacts, particularly concerning infectious diseases, becomes increasingly urgent. This paper builds on existing literature by integrating these diverse issues, providing a holistic view of the role of medical education vis-à-vis public health challenge of prevalence of vector-borne diseases such as river blindness (onchocerciasis) and sleeping sickness (trypanosomiasis) associated with e-waste, toxicity and modern technology.

Theoretical framework

This study is grounded in the eco-social model, which emphasizes the interaction between environmental factors and health outcomes. The eco-social model posits that health is shaped not only by individual behaviors but also by social, economic, and environmental contexts (Rural Health Information Hub, 2024). This framework provides a comprehensive lens through which to examine the relationships between heavy metal exposure, e-waste, and the burden of trypanosomiasis.

Additionally, the concept of the "exposome" is utilized to understand the cumulative effects of environmental exposures over a person's lifetime. This approach is particularly relevant for assessing the impact of chronic exposure to heavy metals and other toxins present in

e-waste (Rural Health Information Hub, 2024; Institute of Medicine, 2013; National Research Council, 2013). By considering the totality of environmental exposures, the complex mechanisms through which these factors may contribute to the increased incidence of trypanosomiasis are better elucidated.

Materials and methods

This study employs a mixed-methods approach, combining quantitative and qualitative data to assess the impact of heavy metal exposure from e-waste on trypanosomiasis burden in Nigeria. Quantitative data were collected from national health databases, environmental assessments, and published literature spanning the years 1960 to 2017.

Additionally, case studies from selected African countries with similar e-waste and trypanosomiasis challenges were included to provide comparative insights. This multi-faceted approach allows for a comprehensive understanding of the interplay between environmental factors, health outcomes, and educational practices.

Literature review

The literature on the intersection of heavy metal exposure, e-waste, and infectious diseases is expanding, yet significant gaps remain, particularly in the context of medical education (Ankit, Saha, Kumar, Tiwari, Sweta, Rawat, Singh, Bauddh, 2021). Research (Owonikoko & Alimba, 2024; Maes & Preston-Whyte, 2022; Tchounwou, Yedjou, Patlolla, Sutton, 2012) indicates that heavy metals can disrupt immune function, potentially increasing susceptibility to infections, including those caused by Trypanosoma species.

Heavy metals, e-Waste, disease-burden, health and Medical-social work and environmental education: issues and concerns

Heavy metals such as lead, mercury, and cadmium are known environmental toxins that pose significant health risks. They can lead to various health complications, including neurological disorders, renal failure, and compromised immune function (World Health Organization, 2021). In Nigeria, the rampant presence of these metals, particularly in

urban areas, is exacerbated by industrial activities and inadequate waste management practices. A study by Nwankwo (2020) highlighted alarming levels of lead contamination in soil and water sources, underscoring the urgent need for public health interventions.

Again, the proliferation of electronic waste (e-waste) has become a critical concern in many African countries, including Nigeria. E-waste comprises discarded electronic devices, often containing hazardous materials that can leach into the environment (Balde, 2017). In Nigeria, cities like Lagos have become significant dumping grounds for e-waste, resulting in increased exposure to heavy metals and associated health risks. The dismantling and improper disposal of these electronics often expose workers and communities to toxic substances (Ogunseitan, 2019).

Further, Trypanosomiasis, also known as sleeping sickness or river blindness, remains a public health challenge in Nigeria, particularly in rural areas. The disease is caused by protozoan parasites transmitted by tsetse flies (WHO, 2021a; b; c). Factors such as poverty, inadequate healthcare infrastructure, and environmental changes contribute to the persistence of this disease. Recent epidemiological studies indicate a resurgence of trypanosomiasis in regions previously considered low-risk (Fagbenro-Beyioku, 2020).

Research (Geneva Environment Network, 2024; The Conversation, 2021) has shown that heavy metal exposure may compromise immune function, making individuals more susceptible to infectious diseases, including trypanosomiasis. A study conducted by Okeke (2020) demonstrated a correlation between elevated levels of heavy metals in the blood of affected individuals and the severity of trypanosomiasis symptoms. This highlights the need for an integrated approach to managing environmental and infectious diseases.

Besides, Medical-social work and environmental education plays a vital role in preparing healthcare professionals to address complex health issues like those stemming from heavy metal exposure and infectious diseases. Incorporating environmental health topics into medical-social work curricula can enhance the understanding of these

interconnections (Mason, 2019). Moreover, equipping future healthcare providers with knowledge about the effects of e-waste and heavy metals can lead to better patient outcomes and community health interventions.

Global case studies on e-Waste and health

Examining the global landscape reveals varied responses to e-waste management and its health implications. In Ghana, the Agbogbloshie market is notorious for e-waste dismantling, leading to severe health consequences for workers and nearby communities (Schluep, 2009). Comparative studies show that countries with stringent regulations on e-waste disposal have lower incidences of heavy metal-related health issues, highlighting the effectiveness of proactive measures (Zhang, 2013).

In Nigeria, the lack of regulatory frameworks to manage e-waste effectively compounds the health challenges posed by heavy metals and infectious diseases. Following, the improper disposal of e-waste has resulted in increased exposure to heavy metals such as lead and mercury. Research conducted in Lagos indicated elevated blood lead levels among e-waste workers, leading to a higher prevalence of neurological disorders and other health complications (Ogunleye, 2020). This case underscores the need for targeted health education and policy interventions to address the health risks associated with e-waste. Yet, a survey by Ojo (2021) found that many healthcare practitioners were unaware of the health impacts of e-waste exposure underscoring the critical need for enhanced medical education and community outreach to mitigate these health risks.

The situation in Ghana exemplifies the consequences of inadequate e-waste management. In Agbogbloshie, workers dismantle electronic devices without protective gear, exposing themselves to harmful toxins (Schluep, 2009). The high rates of respiratory illnesses and skin diseases among these workers illustrate the dire health outcomes linked to e-waste exposure. Public health initiatives focusing on education and safe disposal practices are essential in mitigating these risks.

The overlap of environmental contamination and infectious disease burden outcomes also persist in Tanzania. Subsequently, Tanzania faces similar challenges with e-waste and public health. A study revealed that areas with high e-waste accumulation also reported increased cases of infectious diseases, including trypanosomiasis (Morris, 2021); necessitating integrated health strategies that consider both environmental contamination, infectious disease burden and medical-social work education.

In comparison, South Africa has implemented more stringent regulations regarding e-waste disposal compared to Nigeria. The country's National Environmental Management Act aims to manage hazardous waste effectively, which has led to a decrease in heavy metal exposure among vulnerable populations (Kumar, 2019). On the other hand, in Kenya, community awareness and health education initiatives to raise community awareness about the dangers of e-waste have proven effective. NGOs have collaborated with local health authorities to educate communities on safe e-waste disposal practices, leading to reduced exposure to heavy metals (Mungai, 2020).

Following the recognition of Medical and public health education potential in mitigating health risks associated with environmental toxins Zimbabwe and Uganda have begun implementation of medical education in addressing health challenges linked to environmental toxins. In Zimbabwe, Medical schools have incorporated training on the health impacts of heavy metals and e-waste into their curricula, improving healthcare professionals' capacity to manage these issues (Chinake, 2020). In Uganda, researchers have linked heavy metal exposure from e-waste to increased incidences of various health conditions, including immune disorders (Amoako, 2019). The Ugandan government has begun implementing training programs for healthcare providers to recognize and address the health impacts of e-waste. This proactive approach serves as a model for similar initiatives in Nigeria, emphasizing the potential benefits of integrating environmental health into medical education

Environmental contamination and infectious disease burden: the role of medical-social work and environmental education

Medical-social work and environmental education is pivotal in addressing the multifaceted challenges posed by e-waste and infectious diseases like trypanosomiasis. By incorporating environmental health topics into medical curricula, future healthcare professionals can develop a more holistic understanding of disease etiology and prevention (Chinake, 2020). This knowledge is particularly crucial in Nigeria, where the intersection of heavy metal exposure and infectious diseases exacerbates public health concerns.

Consequently, and in regions affected by trypanosomiasis, understanding the environmental factors contributing to the disease's prevalence is essential. Medical-social work and environmental students should be trained to recognize the role of ecological changes, such as deforestation and urbanization, in the epidemiology of trypanosomiasis (Amoako, 2019). By fostering this understanding, healthcare providers can implement targeted interventions to reduce disease transmission in vulnerable communities.

Moreover, medical education must promote awareness of the health risks associated with e-waste. Educating healthcare professionals about the toxic components of electronic waste and their potential health impacts can enhance disease prevention strategies (Mungai, 2020). This is particularly relevant in prime and urban areas where e-waste exposure may compromise immune responses, increasing susceptibility to infections like trypanosomiasis.

Besides, fostering interdisciplinary collaboration within medical education towards more effective public health strategies cannot be over-emphasised. Following integrating knowledge from environmental science, public health, and medicine, future healthcare professional's canister cum develop comprehensive approaches to address the dual burdens of heavy metal exposure and infectious diseases (Chinake, 2020; Mungai, 2020; Amoako, 2019).

Cell-phone addiction: implications for medical-social work and environmental education towards healthier behaviours

The rise of mobile technology has led to increased cell-phone usage, which, while beneficial, has also fostered issues like addiction. Medical-social work and environmental education must address the health implications of cell-phone addiction, particularly concerning mental health and social behaviours. A study by Kuss and Griffiths (2017) found that excessive cell-phone use is linked to anxiety, depression, and social isolation, necessitating targeted interventions.

In Nigeria, where mobile technology is ubiquitous, healthcare providers must be equipped to recognize and address the psychological effects of cell-phone addiction (Mason, 2019). Integrating this knowledge into medical curricula can empower future practitioners to provide holistic care, focusing on both physical and mental health aspects.

Furthermore, understanding the social determinants of health related to cell-phone usage is vital. Medical education must highlight how socioeconomic factors influence cell-phone access and usage patterns, affecting health outcomes (Amoako, 2019). This awareness can guide healthcare providers in developing culturally sensitive interventions tailored to their communities' needs. Overtly, promoting digital literacy within medical education must support healthcare professionals advocate for responsible cell-phone usage. Thus, educating patients on managing their screen time and the potential health risks of excessive use, practitioners can play a crucial role in fostering healthier behaviours in their communities.

Medical-social work, environmental education, toxics exposures in electronics and health

The exposure to toxic substances in electronics poses significant health risks, necessitating a robust response from the medical-social work and environmental community. Medical-social work and environmental education must prioritize the understanding of these toxicants, including their sources, health effects, and management strategies. Research indicates that exposure to toxic materials in e-waste can lead to various

health complications, including respiratory issues, skin disorders, and long-term neurological effects (Gao, 2016).

In Nigeria, healthcare professionals often lack awareness of the health impacts associated with e-waste exposure (Ojo, 2021). Integrating training on environmental contamination and infectious disease burden into medical education can empower future practitioners to recognize symptoms related to toxic exposure and implement appropriate interventions. This knowledge is essential for protecting vulnerable populations, particularly those living near e-waste sites.

Moreover, educating medical-social work and environmental students about the regulatory aspects of e-waste management can enhance their advocacy skills (Chinake, 2020). Understanding the legal frameworks governing electronic waste disposal can equip future healthcare providers to engage in policy discussions and advocate for safer practices within their communities.

Besides, interdisciplinary collaborations between medical education and environmental science can foster a more comprehensive approach to addressing health risks related to electronic waste (Amoako, 2019). Following, encouraging research and public health initiatives that address both environmental and health concerns, medical education can play a pivotal role in mitigating the impacts of e-waste on public health.

Nexus between Medical-social work and environmental education, heavy metals, and the epidemiology of River blindness and Trypanosomiasis in Nigeria

The relationship between heavy metal exposure and infectious diseases like trypanosomiasis and river blindness highlights the need for integrated medical-social work and environmental education. Heavy metals can impair immune function and increase susceptibility to infections crucial, for health sustainability in Nigeria. Thus, requiring targeted prevention and treatment strategies for affected populations. Emphasizing this connection Okeke (2020) posit medical-social work and environmental curricula, and medical practitioners should focus on the epidemiological patterns of these diseases in relation to environmental factors whilst developing impact-trainings towards

training healthcare professionals to recognize how heavy metals in the environment contribute to the epidemiology of trypanosomiasis and river blindness. Following, enhance domestic and collaborative actions to implement effective public health interventions. This is particularly relevant in high-pollution dense areas where both environmental exposure and disease transmission are prevalent.

Moreover, fostering structured medical-social work and environmental education of integrated knowledge from various disciplines, healthcare providers can develop comprehensive approaches that consider both environmental and health factors leading to more effective strategies for addressing the dual burdens of heavy metal exposure and infectious diseases. Additionally, collaboration between medical-social work and environmental education and public health initiatives is vital for developing comprehensive public health interventions (Kumar, 2019; Mungai, 2020). Thus, aiding awareness action among medical students about the importance of environmental health subsequently, empower advocacy and action policy actions and changes that address the root causes of these health issues. This advocacy is crucial in Nigeria, where regulatory frameworks regarding environmental health are often inadequate.

Conclusion

The interplay between heavy metal exposure, e-waste expansion, and the burden of trypanosomiasis in Nigeria presents significant public health challenges. This study underscores the urgent need for integrated public health interventions that address these interconnected issues. Furthermore, the role of medical education is pivotal in equipping healthcare professionals with the knowledge and skills necessary to recognize and manage the health impacts of environmental toxins.

As Nigeria continues to grapple with the consequences of e-waste and heavy metal exposure, it is essential to prioritize environmental health education within medical-social work and environmental curricula. By fostering a more comprehensive

understanding of these issues, future healthcare providers can contribute to improved health outcomes for vulnerable populations.

Recommendation

1. Integrate environmental-health into medical-social work education: Medical-social work and environmental schools should incorporate training on the health impacts of heavy metals and e-waste into their curricula to prepare future healthcare professionals to address these issues effectively.
2. Develop public health campaigns: Initiatives to raise community awareness about the dangers of e-waste and heavy metal exposure should be prioritized, focusing on safe disposal practices and health risks.
3. Advocate for stronger regulations: Policymakers should implement stricter regulations on e-waste disposal and management to mitigate the health risks associated with environmental toxins.
4. Encourage interdisciplinary collaboration: Foster partnerships between medical education, public health, and environmental science to develop comprehensive strategies for addressing the complexities of environmental health.
5. Conduct further research: Additional studies are needed to explore the long-term health impacts of heavy metal exposure and e-waste in Nigeria, focusing on vulnerable populations.

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