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Disregard of neurological impairments associated with neglected tropical diseases in Africa

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ABSTRACT

Neglected tropical diseases (NTDs) affect people in the bottom billion poorest in the world. These diseases are concentrated in rural areas, conflict zones and urban slums in Africa and other tropical areas. While the World Health Organization recognizes seventeen priority NTDs, the list of conditions present in Africa and elsewhere that are eligible to be classified as NTDs is much longer. Although NTDs are generally marginalized, their associated neurological burden has been almost completely disregarded. However, reports indicate that trichuriasis, schistosomiasis and hookworm infection, among others, cause impairments in memory and cognition, negatively affecting school attendance rates and educational performance particularly among children, as well as agricultural productivity among adults. Consequently, the neurological impairments have substantial influence on education and economic productivity, thus aggravating and perpetuating poverty in affected societies. However, inadequate research, policy and public health attention has been paid to the neurological burdens associated with NTDs. In order to appropriately address these burdens, we recommend the development of policy interventions that focus on the following areas: (i) the introduction of training programs to develop the capacity of scientists and clinicians in research, diagnostic and treatment approaches (ii) the establishment of competitive research grant schemes to fund cutting-edge research into these neurological impairments, and (iii) the development of public health interventions to improve community awareness of the NTD-associated neurological problems, possibly enhancing disease prevention and expediting treatment.

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1. Introduction

Neglected tropical diseases (NTDs) are a set of predominantly infectious diseases that are particularly prevalent in resource-poor populations, mostly in tropical areas. The World Health Organization (WHO) recognizes seventeen NTDs that disproportionately affect the world's poorest populations [1]. The WHO estimates that more than 1 billion of the world's poorest 2.7 billion people (living on less than US$ 2.00 a day) are affected by one or more NTDs [1]. These diseases do not only spread in poverty-stricken areas, but they also aggravate and perpetuate the poverty of affected societies [2,3]. NTDs cause considerable disfigurement, morbidity and mortality. Some of these diseases impair childhood growth and development, decrease economic productivity of young adults, and cause adverse pregnancy outcomes among infected individuals [4]. NTDs can be controlled and, in some cases, eradicated using low-cost strategic interventions [1]. However, although some local and international organizations have actively been contributing to the prevention and effective treatment of these illnesses, the impact has been less compared to diseases such as malaria, HIV/AIDS and tuberculosis [1]. A probable reason for the seeming neglect of NTDs is that the recorded mortality resulting from these diseases is low compared to mortality caused by diseases such as HIV/AIDS and malaria [5]. However, authorities should be cognizant of the fact that NTDs and their related burdens are often under-reported since the diseases are common in rural areas that are not adequately covered by health surveillance systems [4].

Several NTDs have known neurologic impairments (e.g. cysticercosis, leprosy, dengue, and rabies). However, the neurologic aspects of

Abbreviations: DALYs, disability adjusted life-years; DRC, Democratic Republic of Congo; GBD, Global Burden of Disease; NTDs, neglected tropical diseases; WHO, World Health Organization.

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these NTDs are given much less attention. Nonetheless, addressing the neurologic aspects of NTDs would be particularly important in supporting vulnerable populations and the establishment of the true health and socio-economic burdens of these diseases [6]. Here, we highlight the seemingly unrecognized burden of neurologic complications associated with NTDs, and advocate for improvements in the policy, research and public health attention paid to them.

2. NTD-related neurology: a burden requiring urgent attention in Africa

NTDs are given only limited attention by the public health community at both the national and international levels [3]. Most of these diseases are communicable, and may be classified by aggregating them according to their causative agents (viral, bacterial, protozoan etc.), biology (infectious or noninfectious) and clinical manifestations (primarily neurological, or not). NTDs like Konzo (prevalent in the Kahemba territory of the Democratic Republic of Congo (DRC) and other countries such as Mozambique, Cameroon, Tanzania, Central African Republic and Angola) that result from food poisoning are classified among the non-infectious disease group [7], while most others (listed in Table 1), are infectious in nature. The NTDs listed in Table 1 are endemic in, but not limited to, specific African countries. In particular, hookworm infections and schistosomiasis cause substantial neurological impairments and represent a significant burden in affected communities [5,8]. It is estimated that about 600–700 million people suffer from hookworm infections globally, with most of the infections occurring in Nigeria, the DRC and some Asian countries [5,8]. Remarkably, about 90% of the 207 million global cases of schistosomiasis occurs in sub-Saharan Africa, especially in Nigeria, Ghana, Tanzania and the DRC [9].

Some international organizations have attempted to estimate the burden of NTDs globally. Data from the WHO's Global Burden of Disease (GBD) project indicate that a group of twelve NTDs (onchocerciasis, lymphatic filariasis, dengue, leprosy, leishmaniasis, schistosomiasis, human African trypanosomiasis, Japanese encephalitis, Chagas disease, and intestinal nematode infections such as trichuriasis, hookworm disease and ascariasis) accounted for about 177,000 deaths globally in 2002, and that these deaths mostly occurred in sub-Saharan Africa [10]. According to the WHO's GBD estimate, about 20 million disability adjusted life-years (DALYs) were lost due to these NTDs [10]. Recently-revised estimates, however, include a slightly different set of twelve NTDs (leprosy, leishmaniasis, human African trypanosomiasis, schistosomiasis, hookworm infection, trichuriasis, ascariasis, onchocerciasis, dracunculiasis, lymphatic filariasis, trachoma, and Chagas disease) that accounted for an even higher burden, including 56.6 million DALYs and 534,000 deaths [11]. Although NTDs have been given limited attention in comparison with malaria or HIV/AIDS, when the chronic morbidities of NTDs (particularly hookworm infection and schistosomiasis) are fully considered, they rank among the most important diseases in Africa [5]. Overall, NTDs account for 4.5–92 million DALYs annually, and the upper limit is greater than the DALYs resulting from HIV/AIDS or malaria [5]. Additionally, conservative estimates for food borne trematode infections (paragonimiasis, opisthorchiasis, fascioliasis, clonorchiasis, and intestinal fluke infections) alone caused an additional 665,352 DALYs and 7158 deaths [12].

These data indicate that the endemicity of NTDs in sub-Saharan Africa accounts for a considerable socio-economic burden. Surprisingly, the available disease-burden estimates do not take into account the NTD-associated neurological problems. Therefore, the actual burden of neurological problems arising from NTDs in Africa largely remains unknown.

Table 1
Neurologic impairments associated with neglected tropical diseases (NTDs) endemic in Africa.

Type of disease by cause	NTDs	Associated neurologic impairments
Protozoan infection	Human African trypanosomiasis*, leishmaniasis*	Neural axis affected: central, peripheral and autonomic nervous systems Suggested impairments: neuropathy, myelopathy, meningo-encephalitis, and stroke, as well as death in severe cases
Bacterial infection	Leprosy*, buruli ulcer*, trachoma*	
Viral infection	Rabies, dengue fever	
Helminth infection	Taeniasis/cysticercosis, schistosomiasis*, soil transmitted helminthiasis (ascariasis*, hookworm infection*, trichuriasis*), lymphatic filariasis*, onchocerciasis*, dracunculiasis*, foodborne trematodiasis: fascioliasis, paragonimiasis	

NTDs, neglected tropical diseases; *twelve core NTDs.

3. Challenges in assessing the burden of neurological impairments associated with NTDs in Africa

There are several inherent challenges involved in assessing the true burden of neurological impairments of NTDs. These challenges, among other things, do account for the under-appreciation and seeming 'neglect' of NTDs. The challenges include the following: (i) individuals suffering from NTD-associated neurological impairments are usually part of the poorest groups in their societies (possibly living in remote, impoverished communities) and may therefore not be adequately covered by national health interventions (ii) data utilized in disease assessment schemes are largely based on hospital records (owing to epidemiological challenges in many African communities) and are therefore limited to only those who get access to medical facilities. However, many people in rural Africa lack access to hospital facilities. (iii) the full disability and morbidity associated with a given NTD may be rather difficult to evaluate, as a 'syndromic' approach is often employed in assessing morbidity rather than a 'disease-specific' approach. Consequently, only striking symptoms are taken into account while the so-called 'subtle morbidity' is often not considered. (iv) finally, attributing the cause of death to a particular disease may be both challenging and inaccurate because co-infections are common i.e. individuals are often affected by more than one lethal condition (e.g. parasitic diseases such as hookworm or schistosomiasis complicate HIV/AIDS and tuberculosis) [4].

4. Why further attention should be paid to neurological impairments associated with NTDs

NTDs represent a potent reinforcement of poverty due to the huge socio-economic burden they present to endemic communities (Table 2). These burdens affect education, child health and survival, as well as economic and agricultural productivity. The bacterial and parasitic (protozoan and helminthic) tropical infections and dengue are collectively responsible for the highest burden of NTDs [5]. The soil-transmitted helminth infections (trichuriasis, hookworm, ascariasis), schistosomiasis, lymphatic filariasis, onchocerciasis (river blindness) and trachoma are also tropical diseases with high prevalence rates but are quite amenable to control [13]. About 600–800 million people, mostly children, are known to suffer from soil-transmitted helminthic infections [13]. Among these, hookworm infection, which causes maternal and childhood anemia, results in the greatest disability, and represents one of the highest burden of NTDs in Africa [8,13]. The neurologic impairments associated with schistosomes and soil-transmitted helminthes lead to detrimental effects on education, school attendance and performance, and future job prospects and earnings [14,15]. These effects are, at least in part, due to impairments in memory and cognition, as previously reported in individuals with chronic hookworm infection, schistosomiasis, and trichuriasis [14,15]. However, deworming programs have demonstrated that combating NTDs in childhood represent a cost-effective approach for improving education

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