Editorial

Tungiasis in the past and present: A dire need for intervention

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“The jiggers, like the mosquitoes, are ever present.”  
Agnes S. Ward, 1914

Neglected Tropical Diseases and tungiasis

Neglected Tropical Diseases have several things in common; they occur primarily in rural areas and resource-poor communities; they are poverty-promoting and often stigmatizing; and there are usually no commercial markets for drugs that target treatment of these diseases [1]. In the last years Neglected Tropical Diseases have been increasingly considered as an important cause of morbidity in many communities, not only by the World Health Organization, but also by health policy makers and health care workers [1-3].

There are several goal-oriented control programs focusing on neglected diseases, such as the Schistosomiasis Control Initiative, the Global Programme to Eliminate Lymphatic Filariasis, and the African Programme for Onchocerciasis Control. As a result, a handful of tropical infections, such as lymphatic filariasis, onchocerciasis and leprosy have been reduced significantly in the last years, or, almost have been eradicated, such as in the case of dracunculiasis [1].

However, even with the increasing perception of the high disease burden that neglected diseases may cause in underprivileged populations, parasitic skin diseases continue being almost forgotten, in particular scabies and tungiasis [4-8]. In this context, tungiasis can be seen as a paradigm for a neglected and poverty-associated disease. It occurs in the many remote and rural communities in Nigeria and other African countries, being unnoticed by most policy-makers and health professionals, albeit being highly prevalent and causing considerable morbidity.

Keywords: tungiasis, Tunga penetrans, neglected disease, control, Nigeria.

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Tungiasis is a parasitic skin disease caused by the female jigger flea (*Tunga penetrans*) that penetrates permanently into the skin of its host. After penetration, the jigger flea undergoes a hypertrophy and expels eggs into the environment. At this stage, the flea reaches the size of up to 1 cm in diameter. Penetration most commonly occurs on the feet, but may occur anywhere on the body, such as the hands, elbows, neck, buttocks and genital region [9, 10]. The diagnosis is made clinically by visual inspection. Community workers can easily diagnose tungiasis, taking into account the topographic localisations and the natural history of the disease. Eggs being expelled or eggs attached to the skin and the release of brownish threads of faeces are pathognomonic signs. Affected people typically complain about local itching, pain and the sensation of a foreign body at the site of penetration.

Severe complications due to tungiasis are common in areas where people suffer from constant reinfection, and where hygiene conditions are precarious [4, 11]. Bacterial superinfection is often present, and pustules, abscesses and ulcers are commonly seen [12]. Pain, inflammation and fissures hinder individuals from walking normally; sequelae include deformation and loss of toenails, as well as deformation of digits. In non-vaccinated individuals, lesions may be a port of entry for tetanus infection [10, 11, 13].

Before slave trade between the African and South American continents became common, *T. penetrans* occurred probably only on the American continent. Today, the jigger flea is endemic in many resource-poor communities on the Caribbean Islands, South America and Africa. The flea was introduced several times into West Africa since the 17th century as a result of the slave trade between Africa and South America [14-16]. It is generally believed that tungiasis only established on the continent after being transported in infested ballast sand by a ship that came from Brazil to Angola in 1872 [8, 17, 18]. Thereafter, the jigger flea expanded rapidly on the trading routes throughout sub-Saharan Africa and reached in a few years Liberia on the West Coast, and Zanzibar and Madagascar in the East.

**Tungiasis in the past**

There are abundant reports of the severe pathology caused by tungiasis in Africa from colonial times. In Angola, *T. penetrans* caused severe health problems in the late 19th century, after introduction from Brazil:

"... it caused the deaths of innumerable people through dirt and ignorance. Even when it did not cause death, the parasite paralysed movement since it mainly affected the feet. Trading caravans were brought to a standstill. The magnitude of the problem was such that in 1875 it was proposed to set up a special hospital in Luanda. Ulcers caused by *Tunga penetrans* were the most frequent ailment treated and second only to smallpox as a cause of death in Luanda’s hospital between July and October 1877.” [19].

In the decade of the 1870s, the debilitating effects of diseases, in combination with hunger, explains why the social and political tensions generated by the spread of white plantations in Angola did not explode in a major revolt; attempts to extend the revolt of the Dembo chiefs who succeeded in expelling the Portuguese before 1872 were crippled by the combined effects of starvation due to rain failure, smallpox and *T. penetrans* which prevented movement [19].

At this time, the coast line of Liberia seemed to be heavily infested with jigger fleas, and travellers reported from Monrovia that about 20% of the people seen in the streets were hobbling on their bandaged feet [18]. The participants of European expeditions into Africa at the end of the 19th and the beginning of the 20th century reported natives and also themselves with severe infestation [20, 21]. In some military operations the feet of the soldiers were so heavily infested, that they could hardly walk [17, 22, 23]: “Our men, mainly European and Indian troops who had little or no previous experience of the jigger, rapidly became infected to an alarming extent, and in a few weeks’ time nearly half our garrison was unfit to march.” [22].

During the so-called “Emin Pasha Relief Expedition”, led by Henry Morton Stanley in the late 19th century, many participants suffered from severe ulcerations as a consequence of tungiasis infestation [21]. William G. Stairs, an explorer participating in the expedition, described in September 1887 the situation of the local porters of the expedition who were walking barefooted: “Some of their feet are simply rotting away, the toes easily pulled out by the doctor with a pair of nippers.” In its eastward march, this expedition probably introduced the flea into Uganda and other yet unaffected areas. Only a few years later, tungiasis reached alarming proportions in Uganda and arrived the east coast by the end of the century. George Grey (1901) who commanded a
commercial expedition in 1899 into Northern Rhodesia, reported: “When we first found the jigger, saw many of the natives so lame that they could hardly walk in consequence of its attacks” [20].

In 1919, Arnold Hodson, by the time Consul in Southern Abyssinia, reported that the jigger flea was formerly not known in the area, and that after introduction the people did not know how to deal with it, resulting in severe infestations: “…the consequence is they leave the creatures in their feet and dreadful sores ensue. It is a great curse that this pest should have come into this country.” [24].

A British nurse who worked for several years in Congo Free State in the beginning of the 20th century, described: “The jiggers, like the mosquitoes, are ever present. I knew of one gentleman who thought he would like to show his friends what a jigger could do and proposed keeping on in his foot until he returned home, with the result that the limb was amputated at Canary Islands.” [25].

Lionel Decle wrote at the end of the 20th century: “In this village there was not a man, woman or child who was not covered with ulcers. At Fort Raymond the garrison consisted of 160 soldiers and 70 porters; out of this number of men 72 soldiers and 30 porters were absolutely unfit for service through ulcers brought on by jiggers, and 30 more men were lame. At Fort Gran the proportions of invalids through jiggers was over 50 per cent. Never in my life have I seen such awful ulcers. Some of the men had their bone of their big toe protruding fleshless for more than an inch; others had quite a square inch of the bone of the heel exposed. In some villages of Uduhu I found the people starving, as they were so rotten with ulcers from jiggers that they had been unable to work in their fields, and could not even go to cut the few bananas that had been growing. My experience makes me look upon the jigger as the greatest curse that has ever afflicted Africa, and I hope that my warning will be taken up and turned to practical account.” [26].

The extreme morbidity described in these historical reports clearly does not represent the current epidemiological situation in Western Africa and Nigeria. However, the historical reports demonstrate the pathology that severe tungiasis can cause, and in fact there are many remote communities suffering from severe infestation still today.

**Tungiasis in the present**

Even today, in resource-poor communities, infestation with individuals harboring hundreds of fleas occurs, and severe pathology is common. For example, in Brazil, Trinidad and Nigeria, point prevalences ranged between 16% and 54% [27-32]. A recent report from Haiti described hazardous conditions in communities affected by *T. penetrans* [11]; Haiti is considered the poorest country of the Western Hemisphere.

Several reports from the 1980s and 1990s indicated that tungiasis occurred commonly in several states in Nigeria [27, 33-35]. To increase the perception of tungiasis in Nigeria and to provide more current epidemiological data on the disease, we are currently undertaking a series of studies on humans and animals in Lagos State. We found a prevalence of 45% in a rural community; the parasite load was high, and many people suffered from severe pathology [31]. Parasite load was particularly high in the elderly with a median of 41 embedded jigger fleas per person. Almost a third of the infested population had difficulty walking; fissures, ulcers and pustules were present in more than 10% [31].

A study on risk factors in this community has indicated that pigs are an important animal reservoir, and that housing conditions play a pivotal role in transmission [36]. The presence of pigs on the compounds (adjusted OR=18,0) and sandy floors inside houses (adjusted OR=9,3) were the most important independent risk factors for infestation. Other modifiable risk factors included the resting place commonly used and the presence of cats on the compound. The regular use of closed footwear and the use of insecticides indoors were protective factors [36]. Other recent studies from West Africa found high prevalences in rural communities in Cameroon and Sao Tomé and Principe, stressing the importance of pigs as a reservoir [37, 38]. Dogs, cats and rats have been described to be commonly infested [32,39]. Severe disease in pigs has been reported from Zaire, Cameroon, Tanzania and Sao Tomé and Principe [37,38,40-42].

The standard treatment of tungiasis is the surgical extraction of the flea under sterile conditions [4,13]. This requires a skilled hand, and extraction of fleas is simply not feasible in highly affected communities, where people suffer from dozens or even hundreds of penetrated fleas. This is exemplified by a historical report from Africa where 280 sand fleas were extracted in one day from a boy who had been infested at feet, knees, hands, elbows and the back [43]. In addition, in resource-poor settings, strict hygiene is often not applied, and severe inflammation and bacterial superinfection are a common result.
Unfortunately, there is no drug in the market with satisfactory clinical efficacy [13]. A recently conducted randomized controlled trial with oral ivermectin at a relatively high dose (2x300 µg/kg body weight) did not show any significant efficacy [44]. Another trial reported some efficacy of topical ivermectin, mitrafonate and thiabendazole, as compared to a placebo lotion [45].

However, it can be questioned if chemotherapy after penetration of the jigger flea makes any sense in endemic areas. Probably, prevention of penetration is a better approach to reduce morbidity. In fact, the application of a natural repellent based on coconut oil during two weeks resulted in an impressive reduction of attack rates and clinical pathology in an urban slum in Brazil [46]. This measure may reduce extreme pathology on the short run, but long-term reduction of transmission rates is necessary in the highly affected communities, to achieve a sustainable reduction of severe pathology.

**Action is needed**

The recently identified risk factors in a severely affected community in western Nigeria will help to focus intervention on modifiable factors, and to reduce transmission rates. For example, cementing the floors of those houses with sandy or clay floor in the community would reduce prevalence of tungiasis by almost 75% [36]. This measure would also reduce transmission on the long run without any additional costs for the next years. Similarly, confining pigs to piglets and explaining to community members the location of breeding sites and areas of high transmission would help to reduce the prevalence in the community.

Tungiasis is a disease of the very poor, and improvement of housing and hygiene conditions would be an effective approach not only to control tungiasis, but also other parasitic diseases associated with poverty. Improved sanitation and regular waste collection would contribute to reduce incidence and morbidity. However, these means are clearly very cost-intensive and in many communities not feasible.

Being a disease of the underprivileged, tungiasis has been neglected in the past by health-care providers and policy makers. However, the public health importance of tungiasis in rural areas in Nigeria calls for urgent action. Only an integrated approach combining the reduction of animal reservoirs, environmental control and health education will be successful and sustainable.

Intervention measures need to be designed by an interdisciplinary team together with the affected communities.

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