

Tunga Penetrans Inflict Morbidity in Visitors and Inhabitants in Endemic Countries

Kristen L. Biddle

North Carolina State University

Abstract

This literature review observes and synthesizes research conducted on the affects, severity and results of Tungiasis in the health of impoverish countries and travelers. Tungiasis has recently become more prevalent due to an increase in travel both internationally and locally, which has brought more research on the female sand flea (or Tunga Penetran). Tungiasis is prevalent in areas of South America, the Caribbean and Sub-Saharan Africa¹. Belaz et. Al. and Hakeem et. Al. studied case reports on travelers affected by Tungiasis returning from Madagascar, Asia and South America^{2,7}. In all cases, people returned with painful lesions, mostly on the feet, but also on the hands and other areas. In Brazil and Nigeria, ten different villages were used in a rapid assessment conducted by L. Ariza et. Al. on the prevalence of Tungiasis in endemic communities². It was found that prevalence of lesions ranged from 21.1% to 54.4% where some of the subjects had up to 200 sand flea infestations. Lesions and infected areas resulting from Tungiasis causes significant morbidity, disabled walking, mutilated features and sometimes fatal secondary diseases. Thielecke et. Al. conducted experiments testing the effects of a repellent called Zanzarin as well as dimeticone, a non-toxic chemical mostly used in treating head lice^{8,9}. Results in both experiments found that the treatments significantly lessened symptoms or prevented infestations compared to other means of prevention. Since the largest

population inflicted by Tungiasis live in poor, endemic countries, access to adequate healthcare or prevention, such as repellents, treatments and shoes is unavailable³.

Key Words: Tungiasis, Tunga Penetrans, Jiggers, Epidermal Skin Disease

Introduction

Tungiasis, an epidermal skin disease caused by the sand flea (also known as a jigger or Tunga Penetran), was originally present in only the Americas. The disease was spread to Africa by ship in the late 1800s through sailors and possibly rats⁴. Tungiasis has become a prevalent disease among poor countries in South America, the Caribbean and sub-Saharan Africa¹. Infestations happen when people walk bare-footed on soil or sand where adult fleas live until attaching to a host⁵. The female sand flea is able to jump up to 20 to 30 centimeters onto its host where burrows into the skin and eventually dies⁶. While on its host, the flea will reach the size of a pea and leave a small opening in the skin in order to breathe, excrete and expel eggs. The disease becomes harmful when multiple infestations are present or the fleas are not removed properly which may lead to superinfections such as gangrene and tetanus. The risk factors that impact the spread and prevalence of Tungiasis are mainly economic status, the debilitating nature of the disease and lack of awareness⁶. Since most endemic areas are characterized by low economic status and inadequate living conditions and education, Tungiasis can become a means for more serious issues such as poverty and fatal diseases. Many endemic areas have animal reservoirs where the female sand fleas live and are spread. Rapid assessment methods have been taken in order to measure the true prevalence of Tungiasis in areas of Brazil and Nigeria in order to “plan and monitor control measures aimed at the reduction of Tungiasis in affected

communities”³. While Tungiasis is a self-limiting, it has the potential to contribute to more severe health problems, especially in resource-poor areas.

Methods

Case Reports

Belaz et. Al. analyzed a case report on sixteen travelers returning from a 14-day backpacking trip in Madagascar². Data was taken on thirteen of the travelers, seven of which were affected by sand fleas. While symptoms included itching and pain, the seven infected travelers did not experience anything more severe. All travelers walked barefoot at some point in their trip and half of them wore open toed shoes. It is not known exactly how much time was spent barefoot or wearing open toed shoes. None of travelers used repellent on their feet or had prior knowledge of Tunga Penetrans. Hakeem et. Al. found that a 39-year-old man returned from travelling through areas of Asia and South America returned with five .5 cm lesions on his feet⁷. The only symptoms experienced were tenderness and painful walking. All of the travelers observed by Belaz et. Al. and Hakeem et. Al. recovered without any other complications^{2,7}.

Rapid Assessment

In the community assessment of the prevalence of Tungiasis, Ariza et. Al. studied 7,121 individuals in Brazil and Nigeria³. The experiment was conducted in fishing villages, urban slums and rural communities. All areas showed low economic status with low literacy rate as well as unpaved roads. Surveys were taken from July, 2001 to March, 2008 in different parts of the rainy and dry seasons, since Tungiasis is known to vary seasonally⁴. Data was collected by clinically examining participants for sand flea lesions. Signs of manipulations in past attempts to extract fleas were also documented. Estimations of the prevalence of Tungiasis were found

using observations of six different areas of the feet. The estimations were compared to the true prevalence of the different areas, which were based on the presence of *Tungiasis* on the feet of participants³.

Experimentation

The experiments in this literature review attempt to measure the effectiveness of plant-based repellents and dimeticones. In order to prevent or treat sand flea infestations, people living in endemic communities will attempt to wear shoes, extract, or soak their feet in a solution^{1,4,9}.

Since areas with a high prevalence of *Tungiasis* are impoverished, adequate means of treatment are unavailable. While wearing shoes does help to prevent infestations, most people are unable to afford them or are simply inconsistent in wearing them. A sharp and sterile tool is needed to extract embedded sand fleas; however, if not done properly, extractions can cause more harm, leading to severe morbidity. In areas where *Tungiasis* is prevalent people often use unsterile objects such as needles, scissors or even sticks⁴. Instruments used for extraction are also commonly shared among a household or even a community which can lead to the transmission of infections such as hepatitis B and HIV⁴. In order to treat an embedded flea, some people are advised to soak the feet and infected areas in solutions of potassium permanganate (KMnO₄) or antihelminthic compounds, which have not yet been proven to be effective⁹.

In the experiments conducted by Thielecke et. Al. a new method of prevention or treatment was compared to a method that was currently being used^{8,9}. In 2011, a randomized controlled field study was conducted from May to August with 219 participants in two villages in central Madagascar to test the effectiveness of Zanzarin, a plant-based repellent containing

coconut oil. The villages had houses made of wood on stilts and unpaved roads; the average age of the participants was 26.3. Subjects were randomized into three groups: a control group, a shoe group and a repellent group. The control group was not given repellent or shoes, and if there were already existing shoes it was not documented. The shoe group was given shoes and encouraged to wear them regularly; if participants were inconsistent in wearing shoes, it was documented as well. Repellent was applied daily by the experimenters, using the same procedures for every application. Intensity of infestation and attack rates were measured over 10 weeks of using using the specified treatment. In order to get adequate data, criteria were set in order to diagnose Tungiasis. At the end of the 10 weeks, the repellent group showed significantly less infestations than both the shoe group and the control group⁸.

In Central Kenya Thielecke et. Al. compared the use of dimeticones versus potassium permanganate (KMnO_4) in order to treat Tungiasis⁹. Dimeticones are often used to treat head lice; the non-toxic chemical lethally asphyxiates lice. Potassium permanganate is a common treatment, but has not been proven to be effective. 47 people participated in the experiment, all of them were at least five years old. Participants received both treatments, one on each foot; a coin toss was done in order to see which foot received which treatment. Over the course of 7 days, treatments involved soaking one foot in dimeticone and .05% KMnO_4 for 10 minutes. Efficacy of the treatment was measured by visible signs and documented. The dimeticone group showed significantly better results than the KMnO_4 ⁹.

Results

In all of the case reports studied in the literature review, the subjects healed without any further complications. Embedded sand fleas died in the epidermis and were discarded, causing no other harm⁴. For travelers returning from endemic areas, embedded sand fleas are more irritating than harmful, an “exotic souvenir”, since most have access to adequate health care¹. Contrasting that are people living in endemic areas where Tungiasis can have many complications leading to hazardous health problems.

The rapid community assessments conducted by Ariza et. Al. found prevalence of Tungiasis in resource-poor communities ranging from 21.1% to 54.4%³. The prevalence of severe Tungiasis (presence of over 20 lesions) ranged from 0.8% to 10.2%. Ariza et. Al. found that through rapid community assessment, it allows researchers to identify communities at risk in order to take action against Tungiasis in a time and cost effective manor³.

Through experimentation of new products used to find more effective ways of treatment and prevention, zanzarin and dimeticone are significantly more effective than previously used treatments^{8,9}. It was found that zanzarin significantly reduced attack rates and intensity of infestations compared to people who wore shoes. Dimeticones reduced inflammation significantly more than KMnO₄.

Discussion

According to the case studies that analyze travelers returning with embedded fleas, Tungiasis is not life threatening or extremely hazardous in countries with access to treatment and care^{2,7}. Lesions made by Tunga Penetrans can be tender, irritating and cause painful walking; however,

if treated correctly, do not include any further implications. In order for travelers to return from endemic areas without embedded sand fleas, they should become knowledgeable of diseases in the area and how to prevent treat and spot symptoms of Tungiasis. In order to prevent Tungiasis, travelers should wear close-toed shoes and wear repellent.

People living in endemic communities with multiple infestations do not always have the luxury of adequate treatment. Without proper healthcare or knowledge, Tungiasis can lead to hazardous superinfection, loss of digits, mutilated features and painful or even disabled walking⁶. Poverty and Tungiasis are closely linked due to the lack of healthcare and prevention of sand flea infestations. Tungiasis could possibly contribute to poverty as well due to its debilitating nature. People who lose their ability to walk are unable to perform activities needed for daily life. Tungiasis has the potential to lessen the quality of life for people with a large number of infestations. According to the experiments reviewed, treatments and means of prevention have been discovered and tested^{8,9}. In order for them to be affective, they must be able to distribute them to endemic areas, as well as educate the people on how to use the products and how to treat and spot symptoms of Tungiasis.

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