Hookworm Eradication in Brazil and Beyond

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Abstract

In the early-20th century, the Rockefeller Foundation's International Health Board (IHB) traveled to several areas around the world to tackle rural sanitation and hookworm disease. Yet, few historians have endeavored to evaluate the consequences of IHB-led interventions for local populations. This report describes research conducted at the Rockefeller Archive Center in order to evaluate the effectiveness of hookworm-eradication measures in Brazil (for my first book project) and worldwide (for a second major research project). I discuss the general content of the hookworm-eradication reports and offer insights into how this body of evidence could be used for scholars working outside of health- or medicine-related fields of inquiry. I argue that the content of the hookworm control reports could be better used by historians with a general interest in inequality.

Introduction

In the early-20th century, the Rockefeller Foundation's International Health Board (IHB)[1] traveled to several areas around the world to tackle rural sanitation and hookworm disease. Prior to Rockefeller-led interventions targeting rural sanitation, hookworm plagued roughly half of the population living in the US South. In 1909, the Rockefeller Sanitary Commission for the Eradication of Hookworm Disease (RSC) initiated rural health campaigns in the US South that involved a two-pronged approach of curative and prophylactic measures to de-worm the population and stop outdoor defecation. These methods would evolve as the newly-formed International Health Commission (IHC), later the International Health Board (IHB), went on to implement similar hookworm-eradication campaigns on an international scale; it conducted campaigns in the Federated Malay States and then in countries like Mexico and Brazil. There is a divide amongst how historians view the health efforts of the Rockefeller Foundation—some tout them as purely altruistic endeavors while many others see them as mechanisms of imperialist domination. Although a handful of studies on the work of the IHB have avoided these binaries altogether, few historians have endeavored to evaluate the consequences of IHB-led interventions for local populations. That is the goal of my two research projects on Brazil and in comparative perspective.

My research at the Rockefeller Archive Center (RAC) was focused in two areas. First, I deepened my doctoral research on rural hygiene and hookworm disease in Brazil and collected new information for my first book project. Second, I collected the entirety of the hookworm-related documents at the RAC in order to complete a second major project on the global history of hookworm and the IHB's efforts to eradicate it. This report provides an overview of the documentation I consulted and my preliminary findings.

Literature

While hookworm is not widespread in the present day, in the early-twentieth century, it was rampant in many warmer areas of the globe. Although the disease rarely results in death (and hence its burden is difficult to ascertain based on mortality statistics), hookworm severely debilitates those infected. One of several types of soil helminthic infections, hookworm disease, or ancylastomiasis, is caused by intestinal parasites. Two types of parasitic nematodes, *Necator americanus* and *Ancylostoma duodenale*, can cause infection with hookworm disease. In humans, hookworm infection can have devastating consequences. The worms feed on the blood of humans, thus decreasing the amount of iron and protein available for homeostasis and musculoskeletal development. By diverting nutrients away from "normal" physical growth and body functions, hookworm tends to both stunt growth and provoke immunodeficiency. Typical symptoms of hookworm infection include severe fatigue, loss of appetite, and iron-deficiency anemia. In addition to direct effects of nutritional malabsorption, hookworm in adolescents and children can also stunt growth, due to diarrhea in cases of severe infection.[2]

Scholarship on the public health work conducted by the IHB is generally limited to qualitative assessments by historians of medicine, economic historians, and epidemiologists conducting quantitative evaluations with semi-experimental research frameworks. Covering much more than hookworm, John Farley examines the work of the IHB in global perspective. According to him, it was decided that hookworm offered an excellent opportunity for the IHB to enter into foreign territories and conduct intensive campaigns in rural areas, thus illustrating to local governments the benefits of modern health institutions. Farley argues that the role of the IHB as a catalyst to spark increased health investments by local governments never came to fruition. The ample breadth of an analysis like Farley's would appear to gloss over a degree of minor details that a narrower focus on one disease can capture. Looking at hookworm disease in Brazil, as my study reveals, I argue that Wickliffe Rose's vision did indeed materialize, since Brazilian authorities prioritized hookworm and invested heavily in deworming and soil sanitation in the wake of the IHB's involvement.[3]

Due to this pervasiveness of the disease and the uneven roll-out of eradication campaigns, economic historians have been able to assess the consequences of the Rockefeller Foundation's health efforts, using quasi-experimental methods (by employing a control-treatment framework). For example, hookworm has received increasing attention from scholars working in the economic history field. Analyzing the long-term consequences of rural hygiene, Hoyt Bleakley finds, in contrast to many qualitative researchers, that the anti-hookworm services of the RSC in the US South significantly increased income and school enrollment.[4] My second project uses a similar framework in international perspective.

In Latin America in particular, Anne-Emanuelle Birn studies the work of the IHB in Mexico. While a carefully researched contribution to the IHB's historiography in Latin America, Birn does not provide any indications as to the effectiveness of the public-health work for the Mexican population. She also speculates that the IHB was so deeply influenced by its relationship with Mexico that it set the tone for future medical interventions throughout the world.[5] While a worthy contribution to the history of public health institutions in Latin America, Birn's analysis fails to examine the outcomes of public-health endeavors for the local population.

A Global Comparative Assessment: Preliminary Findings of the Field Survey Reports

General Content

Country-level studies of the IHB, and in particular of hookworm eradication, have received ample scholarly attention, but there are few general comparative studies. Farley's (2003) seminal work provides an excellent general overview of the IHB's activities, but a work of such breadth inevitably fails to capture a degree of nuance.

Focusing on one disease in a comparative fashion enables the researcher to more adequately examine population health outcomes, as my second project will do. One of the main issues in constructing a globally comparative dataset of hookworm infection rates lies in the comparability of the survey methods used across different localities. Most campaigns involved a series of surveys along with treatment, but others were shorter and intended only to document the level of infection. Often, while these smaller reports contain data on hookworm infection rates, severe sample selection biases call into question their inclusion amongst other reports that followed methods more akin to the randomized-controlled trials that we would see in a clinical setting today.

The larger field surveys generated the most common type of report on hookworm control, which contain a first section with general information on a country or territory's history, government, geography and climate, population, education, and transport and communication networks. The survey of Barbados conducted in 1916 follows a similar format with some minor deviations, delving into more detail about the colonial period (one speculates because it was no longer a Crown possession). [6] A second narrative section provides a general overview on population health and the public health activities of local authorities. I would argue that the content of the local reports, and more specifically that of these health-related sections, could be better used by historians with a general interest in inequality—not just those interested in the history of medicine, disease, and health. One stands much to gain from reading between the lines of the general observations of the IHB personnel on the ground. Concerns with utilizing a foreigner's account in historical research abound, but with these caveats in mind, the hookworm reports offer an in-depth window into daily life in the early-20th century in a number of locations.

Social historians, for instance, might uncover new insights from the sections dedicated to describing the housing situation of a locality. In the northeastern state of Pernambuco, Brazil, for example, one observer remarked that a "family living in a thatch roofed mud hut cannot be made to see the wisdom of installing a sanitary latrine, costing perhaps three of four times what their home costs. The same is true of piped water, electricity and decent furniture."[7] Other reports

document public health activities such as milk inspections—public health activities that had become rather standard in many countries and cities in the early 1900s. At times, these sections can provide an extra dimension in our glimpse of daily life and policy formation in the early-20th century and the general implementation of law in practice. For example, the 1916 report on Barbados laments that laws controlling the milk supply have been discussed but never passed and that there was a high degree of urban overcrowding.[8]

Campaign Activities

In general, the goal of the campaigns was to select towns of small population in order to examine a large percentage of the inhabitants and avoid the error which might arise in larger towns by the examining an unintentionally selected group, as could occur if only those with anemic symptoms presented themselves for examination and free treatment.[9] Moving from one town to the next, one nurse would have a small lab to demonstrate hookworm prevalence with microscopes. These lantern presentations were announced before arrival of the IHB personnel and then carried out on the first day of operations. A physician showed slides of hookworms, their ova, and the manner of infection. Then, the presenter would speak of the IHB, why and how the work was done for free, hookworm disease itself, and the value of exams to the Brazilian people. The speaker would conclude by offering free treatment to all found to be infected.[10]

Education and awareness were major components of the eradication efforts. The "Hookworm Catechism" was one example of educational literature that was repeatedly employed for hookworm awareness. Frequently, doctors and nurses would use this document or parts of it in presentations or in informational leaflets. The Catechism and its various iterations stressed making the scientific knowledge of hookworm translatable into actionable information. The Catechism reminded readers that the most common mode of transmission is penetration of the skin. The hookworm eggs are released into favorable soil conditions (with ample humidity, moderate warmth, and some shade), they grow and hatch into larvae and, soon after, they are capable of entering a human host. Upon entering

a host, the larvae travel through the bloodstream and enter the digestive tract to feed on the individual's bloodstream. Adult females daily release thousands of ova via the feces, allowing ample opportunity for proliferation and re-infection, thereby restarting the hookworm cycle.[11] The Catechism stressed the importance of soil sanitation and de-worming, and many of the physicians commented on its effectiveness.

Survey Results and Infection Rates

Assessing how to deal with small sample sizes displaying high infection rates will be the subject of future scrutiny. In some instances, the IHB surveyed particular farms or plantations, or otherwise conducted surveys in areas in which 100% of those surveyed were found infected. For example, in the 1920 survey of Puerto Rico, one sample from the sugar-producing district of Maraguez was found to be 100% infected, but there were only 68 persons surveyed. In another instance, in the Barranquitas coffee district, 100% were found infected out of a sample of 159 persons. Statistically speaking, some of these surveys with limited samples sizes should not be given the same weight as those with larger samples. With larger samples, other coffee districts were between 96.2 and 97.5% infected, pointing to the more prolific environment for the hookworm ova provided by coffee plantation soils. In general, localities with less sandy and less absorbent soils had lower infection rates. The type of agriculture predominating in key areas also influenced the degree of infection. Coffee plantations, it was suggested, were especially propitious because they provided a good deal of shade, allowing soils to maintain their moisture and facilitate maturation of the hookworm ova. [12] In another instance, a small study was carried out at a "coolie" depot in southern India. Male "coolies" at the Negapatam depot were 98.4% infected in the 1916 survey (carried out by M. S. Mhaskar from Oct 1916 to March 1917). Although the study had a large sample size (n>7,000), it captured a targeted population drawn from various districts of the Madras Presidency.[13]

Social and regional inequalities in the degree of infection were one main target across the reports. For instance, in Barbados, severe heterogeneity of infection

was apparent, with the parish of St James with 20% infection to roughly 84% in St. Joseph.[14] In Australia, in the more developed regions of South Australia and Victoria, no infection of hookworm was detected at all in the 1921 report. In areas with hookworm, 22.3% of the general population was infected. The Aboriginal population displayed an infection rate of 80.9%, pointing to the tradition of segregation that relegated the Native Australian population to less desirable terrain. The report notes that infection rates were substantially higher in areas that received over 50 inches of rainfall per year.[15] The urban-rural divide was stark in Puerto Rico, as only 21% were infected in urban San Juan (as compared with over 90% in some rural areas).[16]

The table below provides a sense of how other countries and regions experienced a divide between rural and urban infection rates.

Hookworm Infection Rates Worldwide

	Rural	Town	Total	Year	Source
Guatemala	65.1	60.9	61.4	1915	RG 5 3_319 B140 F1653
India	80.96		60.99	1917	RG 5 3_464 B204 F2499
Papua	87	63	60.9	1917	RG 5 3_472 B210 F2589
Colombia	96	76.4	88	1921	RG 5 3_311 B133 F1563
Suriname			83.6	1915	RG 5 3_659 B229 F2837
Egypt	51.1	24.9	51%	1915	RG 5 3_485 B213 F2627
Seychelles			85.43	1924	RG 5 2_477 B51 F322
Panama	97	54.75		1920	RG 5 2_327 B35 F210
Malaysia	80.1	59.2	73.3	1925	RG 5 2_473 B50 F316
Dominican Republic			57	1920	RG 5 3_339 B160 F1946
Siam (Thailand)	85	40	59.39	1917	RG 5 2_617 B56 F358

The IHB in Brazil

The intensive hookworm eradication campaigns spearheaded by the IHB consisted of the same curative and prophylactic measures that were employed before, but over the course of the campaigns in Brazil, a modification to the intensive method took place. Remedial techniques involved treatment with a de-

worming agent. In the early stages of the hookworm eradication campaigns in the US, the most commonly used anti-parasitic was beta-naphtol. Subsequently, physicians commonly used other deworming agents, such as thymol and oil of chenopodium. The latter of these, which was consequently the cheapest, was most frequently deployed in the Brazilian campaigns. Depending on the age and worm-load of the infected patient, a series of de-worming treatments were used, followed by a dose of Epsom salts as a purgative. In terms of prevention, the IHB advocated for increased use of footwear and soil sanitation, encouraging heads of family and land- and business owners to construct latrines.[17]

Although in the outset the IHB maintained pre-existing hookworm eradication methods, the vast territorial expanse, difficult topography, and lack of transportation infrastructure encountered in Brazil require several modifications to the intensive method. Further, innovations in medical knowledge regarding the identification of the disease, compounded with a lack of laboratory equipment and properly trained microscopists, prompted the use of alternative methods to determine the extent of hookworm infection. In his 1917 report on the IHB's progress in Brazil, Lewis Hackett stated: "Up to the end of the year the intensive method has been strictly adhered to, although the conditions for its employment are much less favorable, owing to the sparseness of the population, than those in the countries where the method was evolved."[18] It became apparent that changes would have to be made in order to reach the sparsely distributed rural population of Brazil.

The following modifications were made to cope with these obstacles. First, as beta-naphtol was prohibitively expensive in Brazil, oil of chenopodium was the de-worming treatment of choice. Second, in addition to being costly, in 1919, Dr. Wilson G. Smillie discovered that margins of error in determining the degree of infection by microscopic stool examination was on the order of 15%. Thus, patients with very low worm loads could go unnoticed, even by the most expert microscopists. Clinicians in Brazil also took hemoglobin levels using the Talquist scale. However, even when accounting for comorbidity of malaria, Smillie revealed that the number of hookworms in Brazilian patients had very little bearing on the hemoglobin levels determined by the Talquist scale. (The normal error of which is itself normally superior to 10%). The IHB reports have several

mentions of a "low normal" hemoglobin level in Brazilian patients, pointing to enduring problems with micronutrient consumption. Lastly, rather than monitor patients until worm loads reached zero, medications were distributed to patients directly. In areas in which initial microscopic exams indicated infection rates superior to 85%, the microscope was abandoned under the presumption of near-universal infection.[19]

While hookworm ravaged the rural population throughout the Brazilian territory, infection rates in the North and Northeast were extremely high, on par with the most infected areas ever surveyed by the IHB. In contrast to inferences made in the existing historiography on the public health work of the Rockefeller Foundation, I argue that the IHB activities catalyzed a tremendous expansion of public expenditures in sanitary and health institutions in Brazil. Although de-worming initiatives improved the health status of the Brazilian population, administrative inefficiencies and persistent poverty continued to plague the nation by limiting public- and household-level investments in sewage and clean-water technologies.

Contrary to what has been suggested by previous authors, the involvement of the IHB in Brazil did spur a substantial amount of investment in public health work. By 1919, 8 out of 21 states were already cooperating with IHB. In addition, the federal government and individual states invested significant amounts themselves, independent of the IHB monies. Brazilian policymakers were so awakened to the necessity to sanitize rural areas that the vice consul in Rio stated that Brazil had perhaps done more than any country in the world to address the grave hookworm problem. The vice consul indicated that Brazil spent some $1,150,000 in just 1919 alone, speculating it was "perhaps more, in proportion to the population, than any other country in the world is doing at present."[20]

Final Considerations

There is a divide amongst how historians view the health efforts of the Rockefeller Foundation, with some touting them purely altruistic endeavors while many

others see them as mechanisms of imperialism. Few historians have endeavored to evaluate the consequences of IHB-led interventions for local populations. This report describes research conducted at the RAC in order to evaluate the effectiveness of hookworm-eradication measures in Brazil (for my first book project) and worldwide (for a second major research project). As a body of historical evidence, the relevance of the hookworm eradication documents goes beyond that of population health. Historians with a general interest in inequality stand much to gain from reading between the lines of the health talk surrounding hookworm disease prevalence. The general content of the hookworm eradication reports offers important insights for historians with an interest in inequality.

The health-related content of the reports and the hookworm infection rates constitutes a treasure trove of evidence for the historian interested in population health. Ongoing research examines if countries that received any support from the Rockefeller Foundation experienced any lasting economic benefit.

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[1] Referred here throughout as the IHB for simplicity. The organization was variably known as the International Health Commission (1913-1916); the International Health Board (1916-1927); and thereafter the International Health Division (IHD) until 1951.
2 John Ettling, "Hookworm Disease," in Kiple, Kenneth F. (ed.) *The Cambridge World History of Human Disease* (Cambridge Histories Online), 784-788.
3 John Farley, *To Cast Out Disease: A History of the International Health Division of the Rockefeller Foundation, 1913-1951* (USA: Oxford University Press, 2003).
4 See Hoyt Bleakley, "Disease and Development: Evidence from Hookworm Eradication in the American South." *Quarterly Journal of Economics,* 122:1 (2007): 73-117.
5 Anne-Emanuelle Birn, *Marriage of Convenience: Rockefeller International Health and Revolutionary Mexico* (Boydell & Brewer, 2006).
[6] George P. Paul, "No. 7239, Report on Ankylostomiasis Infection Survey of Barbados, From Sept. 4 to Nov. 16, 1916." IHB, 1917. RAC RG5_2 435 B43 F260.
[7] Fred L. Daper, "Report on Hookworm Infection Survey of the State of Pernambuco, Brazil, From May 17, 1920 to Aug. 31, 1920." p14. RAC RG5 2_305 B25 F149.
[8] George P. Paul, "No. 7239, Report on Ankylostomiasis Infection Survey of Barbados, From Sept. 4 to Nov. 16, 1916." IHB, 1917. RAC RG5_2 435 B43 F260.
9 L. W. Hackett, M.D., "Hookworm Infection Survey of the State of Rio de Janeiro, Brazil." IHB, 1918. RAC RG5 3_305, B111, F1432, p.10.
10 J. L. Hydrick, M.D., "Report No. 7468 Hookworm Infection Survey of the State of Sao Paulo, Brazil." (International Health Board: New York, 1919). RAC RG 5 2_305, B23 F139, p 15.

[11] George P. Paul, "No. 7239, Report on Ankylostomiasis Infection Survey of Barbados, From Sept. 4 to Nov. 16, 1916." IHB, 1917. RAC RG5_2 435 B43 F260.
[12] John B. Grant, "No. 7525, Report on Hookworm Infection and Malaria Survey of Porto Rico, From December 26 1919 to January 28, 1920." IHB, 1920. RAC RG5 243_3 B73 F895.
[13] J.F. Kendrick, Rev. J. F.Caius, K.S. Mhaskar, "Anti-Hookworm Campaign in Southern India," Archival Copy. Rockefeller Foundation, 1922. Table II. RAC RG5 464_2 B49 F307.
[14] George P. Paul, "No. 7239, Report on Ankylostomiasis Infection Survey of Barbados, From Sept. 4 to Nov. 16, 1916." IHB, 1917. RAC RG5_2 435 B43 F260.
[15] W.A. Sawyer, "No. 7699, Report on Work for the Relief and Control of Hookworm Disease in Australia; From April 17, 1918, to Dec. 31, 1920." IHB, 1921. RAC RG5 410_2 B39 F233.
[16] John B. Grant, "No. 7525, Report on Hookworm Infection and Malaria Survey of Porto Rico, From December 26, 1919 to January 28, 1920." IHB, 1920. RAC RG5 243_3 B73 F895.
17 Wickliffe Rose, "No. 7302, Observations on Public Health Situation and Work of the International Health Board in Brazil." IHB, 1920. RAC RG5 3_305 B107 F1401, p22.
[18] L.W. Hackett, "Relief and control of uncinariasis in Brazil for the year ending December 31, 1917." IHB, 1918. RAC RG 5 2_305, B23 F139.
[19] Wickliffe Rose, "No. 7302, Observations on Public Health Situation and Work of the International Health Board in Brazil." IHB, 1920. RAC RG5 3_305 B107 F1401.
[20] Wickliffe Rose, "No. 7302, Observations on Public Health Situation and Work of the International Health Board in Brazil." IHB, 1920. RAC RG5 3_305 B107 F1401, p22.