HEALTH-DISEASE PROCESS IN THE AMAZON REGION: ENVIRONMENTAL FACTORS AND THE EMERGENCE OF DISEASES

REVIEW ARTICLE

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SUMMARY

Introduction: The Amazon has always been the object of numerous studies focusing on its environment, society and health. Guide question: What environmental factors

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contribute to the emergence of diseases in the Amazon region? Objective: To address the main environmental factors that contribute to the emergence of diseases in the Amazon region. Method: This is a review of the literature in the Scientific Electronic Library Online (SciELO), US National Library of Medicine National Institutes of Health (PubMed), Virtual Health Library (VHL) and National Institute of Space Research (INPE) databases. In all, 18 articles were used in the construction of the study, all of which went through the inclusion and exclusion criteria established in order to filter only journals with thematic approaches. Results: From the epidemiological point of view, the Amazonian space formed by the interaction of the socio-ecological system has different characteristics from other parts of the country. This difference is caused by the natural ecological foundation and its forms of occupation and development. Conclusion: The main environmental factors that contribute to the emergence of diseases in the Amazon region are deforestation, burning, river pollution, urbanization process and agribusiness.

Keywords: Health-disease, Amazon, Environmental factors.

1. INTRODUCTION

The Amazon has always been the subject of numerous studies focusing on its environment, society and development. Publications in recent decades have discussed important regional aspects such as biodiversity, land uses, science and technology, urban growth (BROWDER and GODFREY, 2017), sustainable development and deforestation-causing development projects (PERZ, 2002).

To understand the complexity of the Amazon in relation to the different regions of the world, it is important to remember that this complexity is not limited to its biological and environmental characteristics, but is related to the way the population that inhabits it differs in its way of life and in the way of acting and thinking (ROLIM, 2015).

The concept of health-disease can assume a regional dimension, since in this region there is an immense void of scientific information on social and environmental conditions, to meet the demands of society. It is worth mentioning that in this region

there is a high concentration of people fixed in urban centers, especially in the capitals, causing widespread problems in large centers such as: lack of treated water and basic sanitation, proliferation of insect vectors of diseases, unusually anopheline transmitting malaria, dengue among others (CAÑETE and RAVENA-CAÑETE, 2010).

The choice of this region as an object of analysis is justified by its environmental (climate, ecosystems and biodiversity) and demographic (social diversity with low population density and concentration in cities), which, in combination with economic processes such as extensive agriculture, livestock, mineral exploitation, hydroelectricity and industry impact the health of the population according to its development model. Based on this, the main question of the study is: which environmental factors contribute to the emergence of diseases in the Amazon region?

Thus, the aim of this study was to highlight the environmental factors that contribute to the emergence of diseases in the Amazon region, as well as to emphasize research directed to the region, enabling a larger bibliographic collection on the theme, besides highlighting the need for creation and reformulation of public health policies for the population living in this region.

2. METHODOLOGY

This work was carried out through a literature review in scientific journals, available on the websites and databases: Scielo, pubmed, Virtual Health Library and studies conducted by the national institute of space research. The articles were searched between August and November 2021, and 18 articles were collected and all of them selected for the construction of the study. The inclusion criteria were articles published from 2000 to 2021, in English, Spanish and Portuguese. On the other hand, the exclusion criteria were articles published prior to the year 2000, duplicates, editorials of the editor's letter, as well as journals in languages different from those mentioned in the inclusion criteria. The descriptors used to search the studies were: Health-disease; Amazon; Environmental factors.

Thus, this article is an analysis of the health-disease process in the Amazon region and the environmental factors that influence the emergence of diseases (social, economic, cultural and environmental factors, and other factors that affect the occurrence of health problems in the population), According to Sobral and Freitas (2010) using quantifiable variables (indicators) and literature review.

3. RESULTS

Table 1 - Top results of selected articles for research.

	Title	Authors, year of publication and country	Main results
ARTICLE I	A evolução do conhecimento sobre hepatites virais na região Amazônica: da epidemiologia e etiologia à prevenção.	Bensabath e Soares, 2016, Brasil.	The study seeks to demonstrate a disease similar to yellow fever, but considered as a new disease, occurs in areas of the valleys of the Juruá, Purus and Madeira Rivers. Feared by residents for high lethality, being clinically a hepatic encephalopathy of fulminant evolution (mean of 5 to 6 days).
ARTICLE II	Chagas disease and globalization of the Amazon.	Briceño-Léon, 2007, Brasil.	The article in question raises an increase in the number of autochthonous cases of Chagas disease in the Amazon since the 1970s, leading to fears that the

			disease will become a new public health problem in the region. This transformation in the epidemiological pattern of the disease in the Amazon can be explained by the environmental and social changes of the last 30 years.
ARTICLE III	Rainforest Cities. Urbanization, Development and Colonization of the Brazilian Amazon.	Browder e Godfrey, 2017, Estados Unidos.	The study demonstrated the reconciliation of environmental issues in the face of the current global urbanization considering the intense urban transition underway in the Amazon region.
ARTICLE IV	Populações Tradicionais Amazônicas: revisando conceitos.	Cañete e Ravena-Cañete, 2010, Brasil.	The work aimed to critically discuss the concept of traditional population within the Amazon context, verifying that the concept of traditional population, understood as a collective identity that has the specificity of developing ways of life of integration and intimacy with the environment.
ARTICLE V	O trabalho como determinante do processo saúde-doença.	Cardoso, 2015, Brasil.	The study analyzed how, in the current context, the organizational and physical conditions of work, situations and work relationships and

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			forms of management are determining and contributing to the illness of workers to understand such a complex relationship
ARTICLE VI	Determinante da saúde no Brasil: a procura da equidade na saúde.	Carrapato et al., 2017, Brasil.	The present study aimed to identify, through bibliometry, what are the determinants of health with the greatest impact on the health of the population in the face of the issue of quality of life is almost immediately associated with health.
ARTICLE VII	The Health of Indigenous Peoples in the Brazilian Amazon.	Confalonieri, 2000, Amsterdam.	The article sought to demonstrate the epidemic diseases and environmental destruction of many tribes that have gone from contact to displacement, decimation and extinction in a single generation, as well as the deculturation and construction of large development projects and how they had catastrophic effects on the native populations of the Amazon.
ARTICLE VIII	Saúde na Amazônia: um modelo conceitual para a análise de paisagens e doenças.	Confalonieri, 2005, Brasil.	The study reviewed the epidemiological profile of Amazonian populations in relation to the socio-

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			environmental dynamics of the region and developed a conceptual model of analysis that includes three major categories of landscapes in the Amazon: natural, anthropized and constructed.
ARTICLE IX	Indicadores de sustentabilidade ambiental e de saúde na Amazônia Legal.	Freitas e Giatti, 2009, Brasil.	The article demonstrated the current challenges of Public Health, which is mainly in structuring indicator systems that allow monitoring the conditions and trends of environmental and health sustainability. The article focused on showing how to face this challenge with the focus of analysis on the member states of the Legal Amazon Macroregion.
ARTICLE X	Custo das doenças atribuíveis a fatores ambientais na cidade de Manaus, Amazonas, Brasil.	Medeiros, 2014, Brasil.	The study presented the estimate of the cost of diseases attributable to environmental factors in the city of Manaus, between 1998 and 2009, showed the causes of hospitalization and how they were grouped based on the studies of Global Burden of Disease and comparative risk analysis of the World Health

			Organization.
ARTICLE XI	Recent Progress in Modeling Biome-Climate Interactions in Amazônia.	Nobre, 2004, Brasil.	The research aimed to investigate the relationship between historical deforestation and precipitation at different geographical scales in southern Brazil's Amazon (SBA). The impacts of deforestation policy scenarios on agriculture in the region were also evaluated.
ARTICLE XII	Population Growth and Net Migration in the Brazilian Legal Amazon, 1970- 1996, em WOOD e PORRO.	Perz, 2002, Estados Unidos.	The article was based on data from the Brazilian demographic census to show how populations grew in the Amazon between 1970 and 1996, which led to deforestation, with emphasis on how migration contributed to this growth. It was analyzed where population growth is concentrated for the region in general, as well as for its rural and urban components.
ARTICLE XIII	Estudo dos arbovirus na Amazônia Brasileira.	Rodrigues, 2004, Brasil.	The research sought to review the eco epidemiological aspects presented by St. Louis (SLE), East (EEA), West (WEE) and

			Venezuelan equine encephalitis, [subtipos III, Mucambo (MUC) e IV, Pixuna (PIX)] resulting from studies conducted in several areas of the Brazilian Amazon Region, especially along highways and development projects.
ARTICLE XIV	A pobreza e a riqueza na região amazônica e a contribuição da política de assistência social: o estado do Amazonas em foco.	Rolim, 2015, Brasil.	The article addressed the contradictions between poverty and wealth and the contribution of social assistance policy in the State of Amazonas. It showed as a result that the currently Manaus, capital of the State coexist with the contradictions of the new capitalist order where the juxtaposition between wealth and poverty is visualized.
ARTICLE XV	Modelo de organização de indicadores para operacionalização dos determinantes socioambientais da saúde.	Sobral e Freitas, 2010, Brasil.	The study verified the social determinants and their relationships with the health-disease process between different population groups and their great relevance to public health and how they are gaining more and more prominence. In this process, theoretical-conceptual

			models have been adopted to explain how social determinants generate health inequities.
ARTICLE XVI	Saúde ambiental e desenvolvimento na Amazônia legal: indicadores socioeconômicos, ambientais e sanitários, desafios e perspectivas.	Viana et al., 2016, Brasil.	The article sought to discuss the processes of socio-environmental determination in the states that make up the Legal Amazon, based on the analysis of socioeconomic, environmental and health indicators.
ARTICLE XVII	Saúde, ambiente e desenvolvimento econômico na Amazônia.	Vincentin e Minayo, 2003, Brasil.	The study analyzed the process of transforming the epidemiological pattern of an Amazonian population constituted to work in the development of Mineração Rio do Norte S.A. (MRN), in the municipality of Oriximiná (PA), in the locality of Porto Trombetas. The determination of the health-disease process was developed according to the particular conditions of social reproduction of the enterprise, quite different from those of the populations linked to the traditional socioeconomic development of the region.

ARTICLE XVIII	Deforestation, Hunting and the Ecology of Microbial Emergence	Wolfe, 2000, Estados Unidos.	The study sought to understand how new microbes enter the human population, how often microbes emerge according to the determination given by the diversity of microbes present in the environment, with also the level of contact between a potential host microbial diversity and the susceptibility of the new host to infection
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Source: own authors.

Among the articles chosen, the vast majority of studies showed that the environmental and sociological factors that contribute to the emergence of diseases in the Amazon region since 1970, as shown in the article "*Chagas disease and globalization of the Amazon*" by the author Briceño-Léon (2007), making this historical catchment. This change in the epidemiology of diseases in the Amazon region can be explained by environmental and social changes in the last 30 years, as explained by the author.

The authors Browder and Godfrey (2017), Browder and Godfrey (2017), Cardoso (2015), Carrapato et al. (2017), Confalonieri (2000), Confalonieri (2005), Medeiros (2014), Nobre (2004), Perz (2002), Sobral e Freitas (2010) and Viana et al. (2016) in its published research, in summary, showed the relationship of social and environmental determinants and their intrinsic connection with the health-disease process of different populations, their significant relevance to public health and how they became more prominent. In this process of years of stories that the Amazon has been facing social changes and physical and territorial space, and as consequences the aggravation of diseases concentrated in this region.

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4. LITERATURE REVIEW AND DISCUSSION

4.1 REGIONAL ASPECTS

A very important phenomenon in the Amazonian environment is the interaction between the atmosphere and forests, which play an important role in the production of rainfall in the region. The climate is generally hot and humid and the temperature does not change much, being an important regulator of biological processes, especially those related to infectious diseases (NOBRE, 2004).

Another related biophysical aspect involves biodiversity, especially animal diversity. Some processes of focal infection in this area, especially the processes of viral infection, depend on blood-sucking insects (vectors) for transmission (arbovirus). The greater the diversity of animal species (vertebrates and invertebrates) in a given area, the greater the risk of a new infection process Wolfe (2000). To exemplify this point, about 196 arboviruses were identified in the Amazon, 32 of which can infect humans (RODRIGUES, 2004).

Nobre (2004) points out that in relation to Amazonian society, the following important demographic aspects can be highlighted:

I. Low regional population density (approximately 20 million inhabitants in an area of 3.5 million square kilometers) (INPE, 2013; IBGE, 2013);

II. the high rate of growth provided by immigration over the past 30 years. There is also a strong interregional migration (PERZ, 2002);

III. cities are highly concentrated, especially in capitals. Approximately 70% of the Amazon population lives in cities large and small. The rapid, spontaneous and disorderly emergence of many of these small urban settlements without the necessary sanitation infrastructure is characteristic (BROWDER and GODFREY, 2017);

IV. there is a large number of traditional populations (Indians, riparians, rubber tappers, etc.). who live on extractivism and small agriculture (INPE, 2013; IBGE, 2013).

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Another important regional feature concerns land use practices and their environmental and social impacts. Some of these practices produce environmental changes that present health risks. This is the case of mercury pollution in mines; due to the lack of sanitation infrastructure in urban areas, water is contaminated by microorganisms; smoke from burning after deforestation causes respiratory problems; local changes in the hydrological cycle that produce mosquito breeding sites, to enumerate only a few more direct effects (CONFALONIERI, 2000).

It should also be remembered that social conflicts, for example, land tenure lead to violence and cultural conflicts, and the drastic impact of isolated indigenous peoples and the introduction of microbial agents previously unknown by these communities, providing the emergence of new diseases and increasing the number of cases of existing ones in the region (RODRIGUES, 2004).

The common background of these events is that resource development and use policies ignore regional potential, forgetting the environmental resilience and ecological sustainability of the Amazon, do not lead to traditional culture or income distribution and do not care about health risks (CONFALONIERI, 2000).

In practice, this is happening both at the initiative of the government, through the implementation of large infrastructure projects (highways, hydroelectric plants, etc.), and industry (commercial mining), encouraging livestock (and deforestation), as well as through spontaneous extractive activities such as mining, fishing, logging and others (BRICEÑO-LEÓN, 2007; VICENTIN and MINAYO, 2003; FREITAS and GIATTI, 2009).

4.2 SOCIO-ENVIRONMENTAL INDICATORS

In the space that surrounds the southern and eastern parts of the Amazon (states of Rondônia, Mato Grosso, Tocantins, Maranhão and Pará), outbreaks of fires, accumulated deforestation and construction of highways, as well as areas of cultivation and intensification of pesticide consumption have intensified in recent years (INPE, 2013; IBGE, 2013).

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These resources were called by Nobre (2004) "arc of fire". Regarding the consumption of pesticides, the rates achieved with these substances in the region were expressive, representing 18% of the national total. According to data published in 2009 by the Brazilian Institute of Geography and Statistics (IBGE), the state of Mato Grosso reached the highest national rate of pesticide use per hectare of cultivated area in the Legal Amazon (IBGE, 2013).

According to the indicators examined, the data of increase of arable land and pastures on natural areas and cumulative deforestation in the Amazon reached the highest rates in the same 'arc of fire', with clear convergence between the expansion of extensive agriculture and deforestation along with the occurrence of fires and the use of pesticides (CARDOSO, 2015).

Following the reasoning and rescue of Confalonieri (2005), it is possible to show how much Amazonian societies experience difficulties in accessing health and, consequently, lack of care and diseases. The author draws attention to factors such as: low regional demographic density, significant growth in migration, including interregional migrations, high concentration of cities, especially in capitals, with a lack of sanitary infrastructure and a large number of traditional populations, harms social determinants in the Amazon, causing serious health problems.

For the authors Medeiros et al. (2014) the situation of working conditions in the areas of natural and anthropic landscape of the Amazon was also discussed. This is because the conditions and the work environment are determinants of occupational health-diseases and are classified as non-communicable diseases. Therefore, the health of the worker is conceptualized as:

Um campo de saúde pública que tem como objeto de estudo e intervenção as relações produção-consumo e o processo saúde-doença. Neste campo, o trabalho é considerado como eixo organizador da vida social, espaço de dominação e resistência dos trabalhadores e determinantes das condições de vida e saúde das pessoas (BRASIL, 2018, p. 136).

Work is an important determinant of people's lives and health. Knowing that there are many different activities, relationships and service conditions in the Amazon region, it is important that health professionals promote, prevent and diagnose disease related to the tasks that are performed in the Amazon region (CARDOSO, 2015).

In these very specific professional activities of the Amazon, which are rare in other parts of Brazil, it can be mentioned: plant extractivism - profession, which includes, among others extractive açai, rubber compactor, brazil nut collector, Pilots of passenger transport boats, prospectors, fishermen and many more. It is also perceived that highly degrading labor relations, which in many places can be considered analogous to slavery, are quite evident in the region due to the difficulty of controlling the great expansion of land in the Amazon.

Because it is an area rich in ore, prospectors settle in this region and in protected areas where mining is prohibited. As a result of entering forest areas, both prospectors and extractors of brazil nuts and rubber tappers are affected by bacterial diseases transmitted by vectors or non-communicable and protozoa that exist in the forest.

Among them, one can mention Chagas disease, malaria, leishmaniasis and many viral diseases in the region. Therefore, given the large number of these professionals and the risks they face, the health system should direct actions so that diseases directly or indirectly related to work do not become a factor of increased morbidity and mortality in the Amazon region (CARDOSO, 2015).

It is important to highlight that the debate about the work of the Amazon and its scope is very rich, as it also shows that the Amazon is a place that is still a recent of specific research and public health policies on living conditions, health-disease and work in the region (BENSABATH and SOARES, 2016).

4.3 REGIONAL EPIDEMIOLOGICAL INDICATORS

In relation to regional epidemiological indicators, there are some important differences between the Amazon region and the rest of the country. In 1996, the rate of hospitalizations for infectious and parasitic diseases was very high (12.7%), much

higher than the national average (8.3%). Although the incidence of these lesions has decreased in the Amazon, the mortality rate from these diseases has not been the same (SUDAM, 2000).

This region is home to the vast majority of malaria cases in the country (98%), approximately 35% of leprosy cases in 2016, and the second highest incidence of tuberculosis among all regions of the country. It is also a highly endemic area of viral hepatitis with frequent outbreaks, especially in the Western Amazon (BENSABATH and SOARES, 2016).

It is noteworthy that due to the geographical conditions of the region, as well as the process of urbanization and lack of basic sanitation contributed to the process of diseases that reemerged in the Amazon, such as cholera in 1991 and dengue in the mid-1990s, in addition to these, other diseases also cause large numbers of deaths in the population of the region such as malaria, Leishmaniasis tegumentary american parasitic infections and especially tuberculosis (VIANA et al., 2016).

The literature also reveals the disproportionate relationship between improved quality of life and environmental degradation, that is, development advances in an unsustainable way, and highlights the importance of considering the cost of diseases caused by environmental factors, which has increased in the Amazon region (MEDEIROS et al., 2014).

Carrapato; Correa and Garcia (2017) immediately linked quality of life to health. The authors emphasize that, in addition to biomedical models, there are some decisive factors that have decisively affected or will affect personal health. Therefore, these determinants currently have a greater impact on health than those currently covered by medicine. They emphasized the existence of three determinants: environment, economy and society, for them social determinants are largely responsible for the injustice of access to health care.

5. CONCLUSION

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Based on the leading question of the study, it is possible to infer that the main environmental factors that contribute to the emergence of diseases in the Amazon region are deforestation, burning, river pollution, urbanization process and agribusiness, thus concluding that the discussion about the study finally identified some issues that are responsible for the number of diseases in the Amazon, where one should, for example, consider the geographical, ethnic, cultural and political aspects of health in the Amazon region. It is denoted that there is a lack of public policies that meet the demand for health-diseases related to the socio-environmental indicators of the region, as well as the need to conduct further studies and research in order to know the adversities faced by these populations.

It is also note point that the main environmental factors that contribute to the emergence of diseases in the Amazon region are deforestation, burning, river pollution, urbanization process and agribusiness, that is, all from the action of man

However, the study also shows that from the perspective of environmental indicators of health and disease, the Amazonian space formed by the interaction of the socioecological system has distinct characteristics from other parts of the country. This difference is caused by the natural ecological foundation and its forms of occupation and development.

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