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Environmental degradation, climate change and health from the perspective of Brazilian Indigenous stakeholders: Qualitative interview study

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Introduction

The World Health Organization (WHO) points to climatic changes as the greatest challenge to global health systems. The Indigenous people, due to their way of life intrinsically linked to nature, are affected by these changes. This study has the objective of analyzing the understanding of Indigenous managers and Brazilian political actors about the climatic changes associated with the health of two Indigenous peoples.

Method

It is a descriptive study with a qualitative approach that has as a reference the theoretical guidelines of political ecology. The study participants are 22 Indigenous public managers. The data collection was carried out through an interview with the use of two vignette videos related to the environment and health situations. The data was analyzed according to thematic content analysis.

Results

The analytical process allowed the selection of 1101 citation excerpts, 21 codes, six subcategories grouped into three thematic macrocategories; Environmental degradation and climate change in the context of Indigenous peoples; Environment, vulnerability and impact on Indigenous mental health; Actions and public health policies for Indigenous peoples

Conclusion

It is necessary to implement the strengthening of public health policies aimed at the Indigenous peoples, to face the many challenges, especially suicide, and to represent the Indigenous voice in decision-making. A more sensitive approach to cultural, collaborative peculiarities that value or strengthens the connections with nature and the community, is essential to promote the integral health of the people.

Keywords: Indigenous, Climatic changes, Mental health, Community-based participatory research

Introduction

There are more than 1.65 million Indigenous people in Brazil, due to the number of counted in the last 2022 Census(1). This significant increase compared to previous Census is due to the average birth rate of the Indigenous communities being higher than that registered among non-Indigenous people (2).

We also observed significant changes in the health of the Indigenous population with a recognized condition of social vulnerability with precarious sanitation conditions, sometimes being common intestinal infections(3), as well as hepatitis and malaria that constitute important causes of morbidity and mortality(4).

Non-communicable chronic diseases, such as obesity, arterial hypertension, type II diabetes and psychiatric disorders(4–7) also impacts the Indigenous health. The emergence of this group of children as an important element in the profile of Indigenous morbidity and mortality is closely associated with changes in subsistence, food and physical activity patterns that result from the complex interaction between sociocultural and economic changes that have occurred(4,6).

In relation to cancer, the Indigenous population has low incidence, but cancer mortality rates are high due to late care(8). There is also a significant increase in deaths due to external causes, such as violence(9,10).

Another important question about the Indigenous people's health regards to the impacts of environmental changes. The degradation of the environment, of the ecosystem, the rise in global temperature and the increase in the frequency of two extreme climatic events, can be considered among the greatest threats against humanity(11,12).

The World Health Organization (WHO) points to climate change as the greatest challenge to global health systems(13,14). The Indigenous people, due to their way of life intrinsically linked to nature are affected in the manner of these changes(12). Recently, the unusual situation experienced by Indigenous peoples contaminated by mercury used in gold mines in the Amazon was reported(15).

The objective of this study was to analyze the understanding of Indigenous stakeholders/public managers about the climate changes associated with the health of Indigenous people.

Methods

Study type

It is a descriptive study with a qualitative approach that has as an enhancement the theoretical guidelines of political ecology, which allows to observe the proposed research object from the perspective of two events, conflicts and socio-environmental changes and their interrelationships with human societies(16–18).

The study respects the criteria for methodological consistency contained in the Consolidated Criteria for Qualitative Research Reports (COREQ), a checklist of 32 specific items to supervise writing in qualitative studies(19).

Setting

The present study was carried out in the municipality of Campo Grande, Mato Grosso do Sul state, however, due to the characteristics of the recruitment, two researchers collected data from six cities and three Brazilian states.

Participants

The study participants are 22 Indigenous stakeholders/public managers. The inclusion criteria were: a) Managers: over 18 years of age who are occupying a management position in the various spheres of the federated entity [municipal, state or federal] and our executive, legislative and judicial powers, and who exercise their function in Indigenous area. b) Indigenous: over 18 years of age, with self-declaration of ancestry who identifies and identifies as belonging to an ethnic group whose cultural characteristics or distinction from the national society(20).

Table 1 – Characterization of research participants.

Variables	n	%
Gender		
Female	12	54.54
Male	10	45.46
Age group		
20-29 years	5	22.72
30-39 years	8	36.36
40-49 years	7	31.81
50-59 years	2	9.11

Training		
Technical	2	9.11
Undergraduate	5	22.72
Post-graduate	15	68.17
Working time in Indigenous health/management		
Less than 1 year	1	4.55
Between 1 and 5 years	5	22.72
Between 6 and 10 years	7	31.82
Between 11 and 20 years	8	36.36
More than 20 years	1	4.55
I have another job		
No	17	77.28
Yes	5	22.72

Most participants are female 12 (54.54%), between 30-39 years 8 (36.36%), with post-graduation 15 (68.17), with experience between 11 and 20 years 8 (36.36), working exclusively in this job 17 (77.28).

Procedures for selecting participants

The participants who voluntarily agreed to participate in the research were recruited by means of the Snowball Technique(21). In this non-probabilistic sampling technique, the individual selected intentionally to participate in the study invites or indicates new participants from their social or professional network. The sample grow as the selected individuals invite new participants. The recruitment of the informant key took place through the announcement on social networks and e-mail contact between the two researchers involved. From an initial 30 interested participants, 22 participants filled in the inclusion criteria.

One of the participants indicated a new contact who, in turn, referred to others, and so on, until the 22nd participant, who opted for the cessation of data collection based on the saturation criteria, that is, when answers to the questions explained to the interviewees add little substantially or do not add anything new, considering each of the topics addressed(22).

Data collection

The data collection was carried out between August 2021 and April 2022, through a semi-structured interview with vignettes. The interviews lasted approximately 60 minutes and was carried out according to the availability of participants, using remote communication technology that makes available video/audio recording, for later transcription. The objective of the semi-structured interview is for the interviewee to discuss the proposed topic, without losing sight of the research objectives, following a script or previously elaborated structure(19)

The interviews initially had profile questions covering gender, age, length of time working with indigenous health/management and whether they have another job. The interviews were conducted in the online format.

During the interviews, there were opportunities for two vignettes in the form of video. The vignettes are real or fictitious situations before which the interviewees must position themselves(23). Before brief hypothetical situations on a certain domain of interest about people's lives (24); Or even a brief description that contains references that are proven to be the most important factors for the study participant to make a decision or make a judgment (25).

The first video illustrates a Brazilian Indigenous activist who participated in the official opening of the Climate Summit Conference (COP26) held in Glasgow in Scotland in 2021, she speaks about Indigenous people and their important role in maintaining climate change.

Video 1, presents a Brazilian Indigenous activist who participated in the official opening of the Climate Summit Conference (COP26) held in Glasgow in Scotland in 2021, and is available in the link: https://drive.google.com/file/d/1Z7IamEaseXEbk926PGPgzL20tncBjeBt/view

The second video shows mental health problems and access to health services for Indigenous people, the video narrates a case that occurred with a child, found available at the link: https://drive.google.com/file/d/1ZzYrHV-SXrqanGEmoXnPIR1gKrr5BdM1/view?usp=sharing

To support the research, we used the tools made available by the G-Suite package, from Google. The interviews were carried out virtually via google meet; The signing of the consent term and the completion of the profile questions will be answered via Google forms before the start of the interview; the recording of the interview and transcripts are

stored on google drive; Finally, the collaborative documents for transcription and analysis were used in google documents.

A summary of the device functionality and objective is described in the following Box.

Box 1 – Functionalities and objectives for the use of the G-Suite tools

Device	Functionality	Objective
Google Meet	Realization of synchronous interactions of audio, video, texts and projection of electronic content.	Perform interviews
Google Forms	Access and submission of the free and informed consent term.	Completion of questionnaires and signature of Informed Consent Form
Google Drive	Storage of electronic documents of various formats.	Storage of the recordings of the interviews and two transcription documents and data analysis.
Google Documentos	Collaborative creation and edition of two researchers of text documents.	Transcription of the recordings treatment, documentation and analysis of two data

Data analysis

The data analysis was carried out from the thematic content analysis(26). This type of analysis is based on operations of dismemberment of the text in registration units that allow the discovery of different nuclei of meaning that constitute communication and, later, the realization of their regrouping in classes or categories.

For data analysis, in an attempt to reach the manifest and latent meanings in the material, Content Analysis was carried out using the Atlas.ti Software, version 9, according to analytical precepts aimed at health(27), and was divided into three stages:

a) Pre-analysis: carried out by transcription, reading and prior organization of all material, with the objective of operationalizing and systematizing the initial records of the investigative object.
b) Exploration of the material: this stage consisted in the process of immersion in the subjects, from the selection of expressive passages converging to the objective of the research, creation of codes and groups in convergent themes.
c) Data treatment: the moment of inference consisted of two authors relating sections of the transcripts, codes, and group of codes for the formation of subcategories and categories. At this moment, two codes are the magnitude of the frequency, mining of words for the structuring of concepts related to the research object.

The results will be expressed by means of a table with the use of relative and absolute frequencies; network of words, which we emphasize the most expressive concepts in two selected passages; and excerpts of quotes, with examples of excerpts from interviews. For a better convergence of the views and understanding of the reader, linking theory and perception of the researchers, the extracts of representative citations will be inserted in the discussion section of this study.

Ethics

The research project was approved by the Research Ethics Committee of the University of Brasília (CEP/UNB) and by the National Research Ethics Commission (CONEP) under opinion no. 4,279,173, also respecting ethical standards established in Resolution CNS Resolution no. 510 of 2016 and Resolution CNS No. 466 of 2012 of CONEP (CAAE: 37321520.4.0000.5020).

The anonymity of the participants was preserved by the inclusion of an alphanumeric code composed of the letter P of participants followed by a cardinal number. For example: P1 referring to participant number 1 and so on.

Results

The analytical process allowed the selection of 1101 citation excerpts, 21 codes, six subcategories grouped into three thematic macrocategories (Table 2).

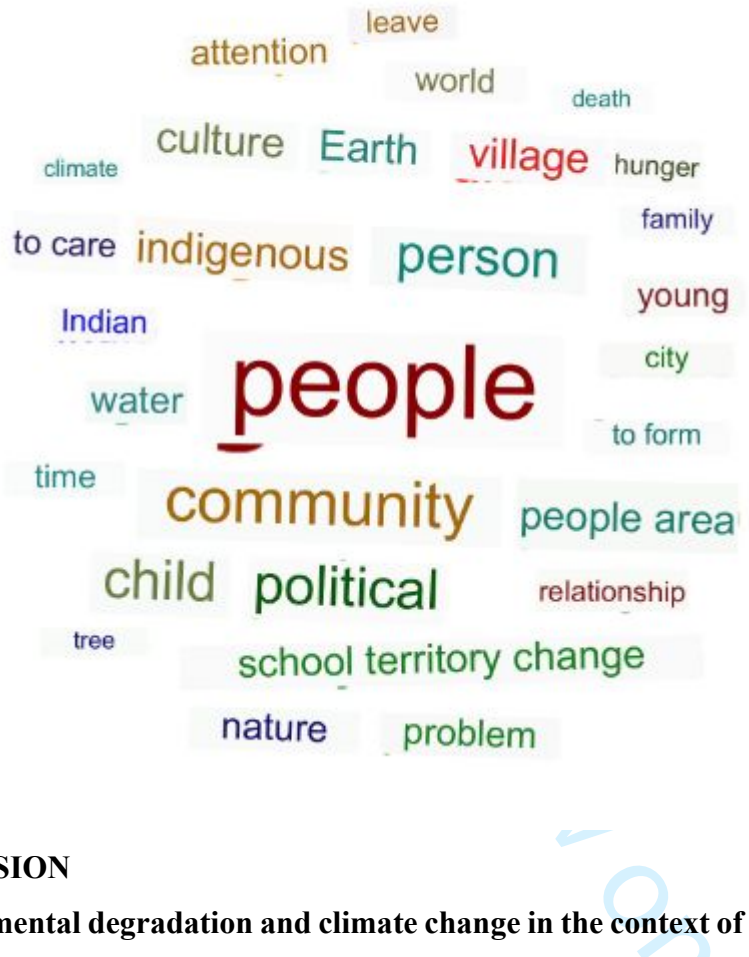
Table 2 - The number of quoted passages according to codes, subcategories and thematic categories on climate change and health in the Brazilian Indigenous context

Categories and subcategories	Codes	n	%
Environmental degradation and climate change in the context of Indigenous peoples (n= 727; 66%)			
Public politicy	Indigenous adolescents	389	53.5
	Demarcation of Indigenous lands	72	9.9
	Water	65	8.9
	Intersectorial actions articulated	25	3.4
Environment	Climatic changes and environmental degradation	68	9.4
	Environmental preservation	66	9.1
	Use of the forest	33	4.5
	Agriculture	9	1.2
Environment, vulnerability and Indigenous mental health (n=268; 24.3%)			
Problems of Indigenous peoples	Culture	76	10.5
	Lack of access	48	6.6
	Difficulty of insertion in society	26	3.6
mental health	Suicide	52	7.2
	Experiences	26	3.6
	Belonging	26	3.6
	Drugs and alcohol	14	1.9
Actions and public health policies for Indigenous peoples (n= 106; 9.7%)			
Highlights	Immediate actions	49	6.7
	Indigenous voice represented	28	3.9
	Don't come to reality	8	1.1
Suggestions	Communities	8	1.1
	Nature	7	1.0
	Family	6	0.8
	Total	**1101**	**100.0**

The category that prevailed in the study was environmental degradation and climate change in the context of Indigenous peoples (727; 66%), reinforcing the need for public policies for the Indigenous population with the adolescent age (389; 53.5%) and the impacts on climate changes and environmental degradation (68; 9.4%). The environment, vulnerability and Indigenous mental health (268; 24.3%) were also another analytical group, prevailing the difficulties of cultural maintenance (76; 10.5%) and mental health problems such as suicide (52; 7.2%). Finally, the need to promote public and health policies for Indigenous peoples (106; 9.7%) with highlights for immediate actions (49; 6.7%) and suggestions for improvements in the community (8; 1,1%)

The extracted concepts obtained by means of the relations between two passages of citations, codes and categories represent a synthesis of the proposed research object, connecting all the categories, subcategories and codes. The following figure illustrates the main concepts.

Figure 1 – Conceptual representation about climate change and health in the Brazilian Indigenous context



DISCUSSION

Environmental degradation and climate change in the context of Indigenous peoples

Environmental degradation and climate change arising from the global warming scenario are intrinsically related to the loss of quality of life and marked the statements of participants in this study, which classified the phenomenon as one of society's greatest challenges.

The impact is amplified in populations exposed to sensitive areas, close to rivers, slopes and forests, in addition to those who derive their livelihood from the land and who experience inequality, marginalization and colonization, as is the case of indigenous peoples. Thus constituting a threat to public health for the entire region of Latin America and the Caribbean (LAC), which contains many low-income countries with fragile economic systems and some with health systems with serious access difficulties. These

countries are home to more than 40 million indigenous people, whose health and well-being are closely related to the environment(28).

The process of long-term environmental degradation will be one of the main factors responsible for the genocide of indigenous peoples, whether due to violent conflicts or the unavailability of essential natural resources for the maintenance of their activities(14,29). For the indigenous peoples, remaining peoples of the forests, ecosystem conservation is of vital importance, as their culture, cosmovision and survival are strongly linked to nature. In addition to directly depending on a balanced functioning of the environment, they have in the signs of nature indicators for various events(12,30).

Indigenous subsistence practices have undergone transformations over the years and indigenous people incorporate different customs. But even so, they understand themselves as part of nature, establishing models of balanced and non-monetary exchanges, preserving biomes and maintaining biodiversity, as they use natural resources without putting the ecosystem at risk. That is, indigenous communities, although threatened and vulnerable, are fundamental for environmental preservation. The following excerpt from the interview illustrates this statement:

"... We Indigenous people do not understand this land and territory as something to be explored, as something to be devastated, as something to serve us, an idea that the environment is at the service of human beings. The Indigenous peoples have a much deeper, much more refined understanding, an understanding that the environment and we are so intertwined that if we destroy the environment, we also destroy the human being" (P15).

Participants argue that environmental degradation and climate change interfere with subsistence agriculture, forcing the change of traditional indigenous crops, which becomes a problem, as traditional plantations conserve nature, as they are part of the ecosystem(15,31).

Traditional knowledge, cultural practices, patterns of territorial occupation and systems of management of environmental resources adopted by indigenous peoples have historically promoted the conservation of biodiversity and hydrological cycles, the containment of deforestation, the maintenance of forest carbon stocks and the provision of a series of important environmental services for maintaining the stability of climatic conditions(32). The following excerpt represents this statement.

"I think that where the indigenous people are, they preserve the river, the forest, the animals. They learned through the teachings of what was passed down by their ancestors... I think that if you preserve it, you will reverse this situation that it is today, that nobody knows anymore, nobody is 100% sure of what the climate, the now, the future will be like. tomorrow." (P13)

Indigenous lands contain unique elements to provide better living conditions for society as a whole, not only from an environmental point of view, but from an economic point of view as well. Traditional knowledge and Indigenous socio-biodiversity have an important potential to generate wealth from a series of products and services. The premise that it is possible to reconcile responsible environmental management with a new bioeconomy that brings ethnodevelopment, with respect for the rights of Indigenous peoples, is a way to think about new ways to face this problem(33).

Currently, the social phenomenon of migration of Indigenous peoples to urban centers throughout Latin America is observed, this phenomenon is related to a complex network of determinants. Among them, the loss of Indigenous territories and the destruction of the environment. This fact was addressed by the participants, as illustrated by the speech:

"Today it's quite complicated for our Indigenous people here in the village, many are no longer planting that swidden they planted before, it's not worth it anymore, so he's leaving to work in the city as a mason's servant, as a day laborer to be able to bring food to his house, for that if you depend on family farming you go hungry. (P14)

It is important to consider that groups moving to urban areas face different environmental risks than those experienced before migration. In addition, changes in the physical and cultural environment can alter the usual patterns of life of individuals in general, making the displaced population particularly vulnerable to the risks of becoming ill in their new environment(34).

It is estimated that more than 200 million people in the world will be forced to leave their regions due to climate change(35). This causes people or entire communities to be forced to abandon their territories, which unbalances living conditions, alters production systems and even threatens survival(36).

The impact of climate change and environmental degradation on Indigenous health was addressed by participants. According to them, culturally nature represents much more to the Indigenous people than a means of subsistence. Therefore, experiencing the current reality has deleterious effects that affect both the physical and mental health of Indigenous people.

"... climate change affects in every sense, it interferes physically, psychologically, mentally, culturally, because it is nothing separate, if there was a spring that no longer has drinking water for the Indigenous community, then it will affect the physical, there is no water, there are no forests, there are no animals..." (P5).

"[...] for example, when there are fires, because of the warming, this harms our territory, our health, our housing..." (P7).

Nature, in addition to representing the support of social life, is directly linked to the belief systems and knowledge of Indigenous peoples, so it is understandable that their mental health is affected by the environmental atrocities reported daily. The suffering and illness resulting from this was considerably mentioned in the interviews that the following category discusses on the subject.

Environment, vulnerability and impact on Indigenous mental health

In the context of Indigenous health in Brazil, the term mental health has been much debated and, in general, it is understood as individual, family, social or community well-being or good living(11,32).

Indigenous peoples are significantly more likely to experience some form of mental distress than majority populations and are influenced by the scars of the past, such as historical injustices, the legacy of colonialism, racism, slavery and land grabbing(37,38).

The Indigenous population of Brazil has some of the worst social indicators in the country, there are many Indigenous lands that do not have basic sanitation, water supply and are even difficult to access(39).

This leads to a series of transformations in their ways of life, such as the weakening of community ties and the disorganization of cultural practices, which directly

impacts the mental health of communities as a whole. In this sense, the participants referred to:

"Their mental health is also very affected by this lack of opportunity, work, income, support. Drought is a very serious problem here that I have noticed since last year, this year it is very complicated here. So they themselves, due to economic difficulties, also end up having a practice that contradicts their origin, their whole culture, this is very present here." (P14)

Brazilian Indigenous people face a substantial increase in land grabbing, wood theft, mining, invasions and even the implementation of subdivisions in their traditional territories, explaining that the growing dispute over these areas reaches a worrying level, since it puts at risk the very survival of several Indigenous communities in Brazil. And this has repercussions on mental health that can be harmed by factors such as social marginalization, lifestyle and work, and exposure to violence(40,41).

Violence against Indigenous peoples in Brazil" which registered an increase in mapped violence and the highest number of Indigenous suicides in recent years. Since the loss of territory and areas for planting, racism, poverty, social vulnerability and lack of assistance in the health area, are among the main causes identified for this increase in suicides(42).

The spread of alcohol and other drugs is a reality in many Indigenous villages. What has been related to different situations, but which may be especially linked to the lack of perspectives of Indigenous peoples.

"[...] it is precisely because of this extreme lack of perspective on life, of motivation to live, that alcohol and drugs finally become an escape from the miserable reality they live. The incidence of alcohol and drugs in the Indigenous community is very high, perhaps the most decimating agent of Indigenous culture. [...] Here [village] everything [drugs and drink] comes in. They become addicted, and they have to steal, find a way to get money to buy the drug. We had a recent case of death of a child whose mother was an alcoholic and left the child without food and ended up dying, very dramatic". (P3)

The Brazilian Ministry of Health recognizes the Indigenous population as vulnerable and with a high incidence of psychosocial problems, such as chemical dependence (alcohol and other drugs), abusive and inappropriate use of psychotropic medications, suicide and violence. This situation is linked to communities being unable to live their traditional way of life, with difficulty in guaranteeing economic subsistence, and facing conflicts, it introduces great suffering, which often leads to self-destructive processes(41,42).

The level of mental health deterioration among Indigenous peoples, including its most extreme form, suicide, is well above the national average. This scenario denotes a greater fragility to which this layer of the Brazilian population is subjected, with the evident denial of the most basic rights and public policies. The suicide mortality rate among Indigenous people in Brazil is 15.2/100,000, almost three times higher than that found among non-Indigenous people 5.7/100,000(36).

The marginalization and prejudice that Indigenous people are subjected to leads to intense psychic suffering. And the consequences of this practice culminate in worrying situations, such as the common record of suicides and the intensification of internal conflicts in the villages.:

"[...] many of the Indigenous people end up going into depression due to living in a culture strongly influenced by whites, losing their ethnic origins, being in an existential limbo that leads to suicide and they also have access to alcohol from a very early age and alcohol makes them also commit crimes, commit suicide...". (P8)

"Suicide is a reality [...] and among the Indigenous population it is gigantic, [...] there is this issue of land, of belonging, of not belonging, of how to deal with the problems, many times they somatize everything and then suicide is the only way that perhaps many of them believe to be the solution..." (P1)

In this context, suicide, alcoholism and drug addiction draw attention because they are reported in increasing numbers among ethnic groups and have a widespread impact on Indigenous communities, including young people and adults of both sexes27. Therefore, attention to Indigenous mental health must be linked to quality of life, the result of collective well-being promoted by social, emotional, spiritual and physical-biological factors(5,10).

Public health actions and policies for Indigenous peoples

The promotion of Indigenous health necessarily involves the protagonism of these populations, autonomy, the establishment of meaning and purpose in life, as well as the strengthening and rescue of their culture. Therefore, this must be contained in the proposition of Public Health Policies. This makes it necessary to critically reflect on the propositions that are intended to be developed in Indigenous communities, as it is something that cannot be seen in a compartmentalized way. The autonomy of these peoples is illustrated in the following excerpts:

"I understand that those who know what is best for the Indigenous people are the Indigenous people themselves, they have enough capacity to decide what is best for them. They have the ability to decide on health, education, social work, basic sanitation, the environment". (P1)

"In the first place, it is bringing those populations that are most affected, [...] bringing traditional peoples to occupy decision-making positions, we need to do that. Need these policies to be made by those who are affected and think about the direct consequences". (P21)

For this holistic view, intersectoral, inter and transdisciplinary, inter and transcultural dialogue is fundamental, so that integrated actions can be promoted in different instances of government and society, in the search for the improvement of the quality of life and, therefore, in the promotion of health and good living, capable of overcoming the dichotomies still present. This need for a comprehensive and interconnected view permeated the speech of the participants when addressing public health policies, most of which highlighted the guarantee of the right to Indigenous land as a sine qua non condition for the health and well-being of Indigenous people.

"Demarcation of Indigenous lands is the first point and from the demarcation of Indigenous lands, the development of public policies so that they can remain in these territories and have conditions for this, including public policies, so that they can manifest their language and culture anywhere". (P1)

"Before talking about public policy for Indigenous health, the first action must be to guarantee the right to land, with protection of their sacred territories because everything is interconnected. Secondly, the qualification of special Indigenous health teams to act in the prevention and promotion of mental health and network articulation for the treatment of more delicate cases". (P9)

One of the most controversial issues in Brazil is the demarcation of Indigenous Lands, defined as an area permanently inhabited by Indigenous Peoples, used for productive activities and for the preservation of culture and tradition. Therefore, more than simply the housing area, the Indigenous Land is a central element of the cultural and religious identity, which guarantees its survival and becomes its territory(34,37).

The concept of territory and its full clarification, contributed to a better organization of the Indigenous people, as it is understood as the totality of the regions that the Indigenous people occupy, in harmony with their cultures and spiritual values, for the protection, preservation, maintenance and development of this heritage culture, for the collective continuity of the people and its members, and for transmitting it to future generations(36).

In the same proportion to the Indigenous land, issues related to public policies that guarantee access to potable water were presented in the interviews.

"You walk in the village, you walk in the schools, you see dirty people, it's not because they are filthy, because they like dirt, it's because of the lack of water, which they don't even have to drink. So what public policies do I recommend? I recommend policies that guarantee human dignity, such as access to water, investments so that each residence can have a water tank, because sometimes there is and there is not enough for a long period". (P18)

"If you don't have potable water, ready to drink, you are subject to going to a dam sometimes and getting water that is unfit for consumption." (P12)

The scarcity of water in the world is aggravated due to social inequality and the lack of management and sustainable use of natural resources. The differences recorded between developed and developing countries are shocking and show that the world crisis of water resources is directly linked to social inequalities(43).

Water scarcity is now one of the world's main concerns and it would be no different for Indigenous communities. However, unlike the majority of the population, the Indigenous people seek to conserve springs that are still clean and to recover those that are already damaged, as they know that if this protection is not provided, the available water flow will be lower, the water courses water can dry up and the quality be impaired, affecting all living beings that depend on it to survive.

In addition to land and water, the participants addressed other issues related to public policies and government actions that can improve the quality of life of Indigenous people, from the perspective of access to health, education, sports, leisure, culture, infrastructure, among others. As well as reinforcing the importance of intersectoral actions and actions to protect the environment by tightening legislation that prevents mining and deforestation in Indigenous lands, as according to them these lands contain unique elements that can provide better living conditions for all Brazilian society, not only from an environmental point of view, but from an economic point of view as well.

Conclusion

Indigenous people face profound impacts of environmental degradation and climate change on their communities, difficulties related to the demarcation of Indigenous lands, which is fundamental to guarantee survival and cultural preservation. The promotion of articulated intersectoral actions that greatly reinforce environmental preservation is necessary to preserve water, the forest and promote sustainable agricultural practices, thus ensuring a better future for these communities.

Traditional experiences promote a sense of belonging and cultural rooting, but the lack of access to essential resources and the difficulty of insertion in the dominant society can lead to vulnerabilities. In addition, there is a converging relationship between the environment and Indigenous mental health, associated with the use of drugs and alcohol, which contribute to high suicide rates.

It is necessary to implement and strengthen public health policies aimed at Indigenous peoples, with a view to facing the numerous challenges, especially suicide and the representation of the Indigenous voice in decision-making. A more sensitive approach to cultural peculiarities, collaborative approach that values the strengthening of connections with nature and the community, is essential to promote the integral health of these peoples.

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Environmental degradation, climate change and health from the perspective of Brazilian Indigenous stakeholders: A qualitative study

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Introduction

The World Health Organization (WHO) identifies climate change as the most significant threat to global health systems. Indigenous peoples, with their lives deeply intertwined with nature, are particularly vulnerable to the impacts of these changes. This study aimed to understand the perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health.

Method

A qualitative study based on the perspectives of 22 Indigenous Indigenous stakeholders and public services managers on climate change and perceived impact on Indigenous health. Data was collected through interviews incorporating two vignette videos depicting environmental and health scenarios. Thematic content analysis was used to analyse the data.

Results

The analytical process yielded six subcategories that were further grouped into three overarching thematic macro-categories: Environmental Degradation and Climate Change in the Context of Indigenous Peoples; Environment, Vulnerability, and Impact on Indigenous Mental Health; and Actions and Public Health Policies for Indigenous Peoples.

Conclusion

The perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health were deeply entrenched in their lived experiences of loss of their Lands from deforestation and environmental degradation. They argued strongly for the strengthening of public health policies aimed at the Indigenous Peoples, to face the many challenges, especially suicide, and to have a voice in decision-making. A sensitive approach that value Indigenous People's connections with nature is fundamental to promote their health and well-being.

Keywords: Indigenous, Climatic changes, Mental health, Community-based participatory research

Strengths and limitations of this study

- The study used a novel methodological mix of culturally and environmentally appropriate vignettes coupled with interviews to elicit Indigenous perspectives on the interconnectedness of climate change and Indigenous health in Brazil.
- The perspectives reflected the immense knowledge and lived experiences of Indigenous communities and captured several priority actions across health and non-health sectors (e.g. mental health services, water security,) valuable for policy an programme development.
- Twenty-two Indigenous participants participated in this qualitative study and though their perspectives were conceptually cohesive and powerfully narrated, they cannot be generalised to all Indigenous communities.

Introduction

Brazil's Indigenous population, now over 1.65 million according to the 2022 Census, has seen a notable increase due to birth rates, which are higher than that of the non-Indigenous population(1), and to an increase in self-recognition of Indigeneity as a result of political participation of Indigenous peoples(2). As with Indigenous peoples globally, compared to non-Indigenous population in Brazil, the Indigenous population experiences poorer health and well-being(3). A recent report on mortality trends 200-2016 showed increasing mortality for both females and males for most age groups(4). The highest increases were observed for those aged >=60 years and 10 to 19 years. In children <5 years, the main causes of death were infectious and parasitic diseases, as well as respiratory diseases(5) . Between 5- 59 years, external causes ranked first and were responsible for more than half of all deaths among those 10-19 years(3). Circulatory diseases were most common cause of deaths for those >=60 years. These trends are linked to poor provision of basic social and health services including precarious sanitation conditions that make children vulnerable infections, conflicts between farmers and indigenous people and urban violence, and a general erosion of Indigenous traditions and customs in agriculture, hunting and fishing(7).

Environmental degradation pose a critical threat to Indigenous health. Ecosystem degradation, rising temperatures, and extreme weather events are major concerns, with the World Health Organization recognizing climate change as the greatest challenge to global health. Indigenous peoples, deeply connected to nature, are particularly vulnerable to these changes(8-10). A recent study found high levels of mercury in hair samples and mouth swabs among members of the Yanomami Indigenous group living in nine villages in the upper Mucajai river in the northern state of Roraima where illegal gold mining is common(6). Mercury consumption was high due to contaminated fish which is one of the Yanomami's main food sources. Cognitive deficits among children were observed in half of the children surveyed in 9 villages. There are also concerns that deforestation and degradation are linked to high rates of substance use and suicides among Brazil's Indigenous communities(7). Indigenous knowledge has been used for centuries for local adaptations for environmental sustainability. Indigenous scholars have long argued that their knowledge is critical for long-term sustainable solutions for biodiversity loss, water scarcity, pollution, sustainable livelihoods and general environmental resilience(8,9).

The Indigenous participants in this study are from South and Midwest Brazil. They strive to maintain their demarcated lands and spiritual connection to nature, possess a rich storytelling tradition that reinforces their identity and belonging(8). Their schools promote the retention of Indigenous knowledge and practices that can resolve local environmental challenges(10). For example, the Indigenous schools integrate growing and eating of cultural foods into the curriculum, oral learning methods, and participation in village activities with community leaders, shamans, parents, and elders.(11,12)

This study aimed to understand the perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health.

Methods

Theoretic framework

This qualitative study employed in-depth interviews to gather and analyze perspectives on the impacts of climate change on Indigenous health. Grounded in the principles of political ecology, which examines conflicts and socio-environmental changes, along with their interactions and relations with human societies, this theoretical lens guided both the study design and the subsequent development of analytical categories (13–14). Methodological rigor was ensured through adherence to the Consolidated Criteria for Qualitative Research Reports (COREQ) (15).

Trusting relationships

We collaborated with key Indigenous stakeholders in Mato Grosso do Sul, Brazil. Building upon long-established community-academic partnerships, our research team prioritised cultural integrity and agency by integrating Indigenous knowledge and values throughout the research process. The research question emerged organically from our ongoing collaborative work with this community since 2017.

Setting

While the study was based in Campo Grande, Mato Grosso do Sul, the snowball sampling method resulted in data collection across six cities (Brasilia, Campo Grande, Porto Alegre, Guarita, Dourados, and Terenos) and three Brazilian states (Mato Grosso do Sul, Federal District of Brasilia, and Rio Grande do Sul).

Participant selection

The recruitment of participants took place through the announcement on social networks and e-mail contacts of the authors. The participants voluntarily agreed to participate in the research and were recruited using snowballing(16). In this non-probabilistic sampling technique, the individual selected intentionally to participate in the study invites or indicates new participants from their social or professional network. Of an initial 30 interested participants, 22 participants met the inclusion criteria (see section on 'Participants'). One of the participants indicated a new contact who, in turn, referred to others, and so on, until the 22nd participant, by which time data saturation had been reached (17).

Participants

The study involved 22 Indigenous stakeholders/public service managers. Inclusion criteria were: a) Public service managers: individuals over 18 years old, holding management roles across municipal, state, or federal levels in executive, legislative, or judicial branches, operating in Indigenous areas. b) Indigenous peoples: individuals aged over 18 years old, self-identifying and recognised as belonging to an Indigenous ethnic group with distinct cultural characteristics from the national society.

Table 1 – Characterization of research participants.

Variables	**n**	**%**
Gender		
Female	12	54,5
Male	10	45,5
Age group		
20-29 years	5	22,7
30-39 years	8	36,4
40-49 years	7	31,8
50-59 years	2	9,1
Training		
Technical	2	9,1
Undergraduate	5	22,7
Post-graduate	15	68,2

Working time in Indigenous health/public service management		
Less than 1 year	1	4,5
Between 1 and 5 years	5	22,7
Between 6 and 10 years	7	31,9
Between 11 and 20 years	8	36,4
More than 20 years	1	4,5
I have another job		
No	17	77,3
Yes	5	22.7

Just over half of the participants were female, and two-thirds were between 30-49 years old, and had a post-graduate qualification. Two thirds had spent between 6-20 years working in Indigenous health or public service management from Terena and Kaingang ethnicity.

Data collection

The data collection process was developed by a university employed researcher, who was trained in qualitative methods. The interviewer worked in the same municipality as the data collection site, but in different services.

The data collection was carried out between August 2021 and April 2022, using vignettes and semi-structured interviews. The interviews lasted approximately 60 minutes and were carried out according to the availability of participants, using remote communication technology with audio and video recording, for later transcription. The aim of the interview was for the interviewee to discuss the proposed topic, without losing sight of the research objectives, following a script or previously elaborated structure(15) The interviews initially answered questions relating to their gender, age, length of time working with Indigenous health/management and whether they have another job. The interviews were conducted online. During the interviews, two vignettes in the form of video, were presented to the participants. Vignettes are known to: a) Enhance realism by considering various contextual factors and guiding participants' focus towards specific aspects of the research question; b) offer a standardised stimulus and improve reliability,; c) reduce social desirability bias and strengthen participant engagement (15) The first video illustrate a Brazilian Indigenous activist who participated in the official opening of

the Climate Summit Conference (COP26) held in Glasgow in Scotland in 2021, she speaks about Indigenous People and their important role in practices that are helping to mitigate or adapt to climate change. https://drive.google.com/file/d/1Z7IamEaseXEbk926PGP00gzL20tncBjeBt/5view

The second video shows mental health problems and access to health services for Indigenous People, the video narrates a case that occurred with a child, found available at the link: https://drive.google.com/file/d/1ZzYrHV-SXrqanGEmoXnPIR1gKrr5BdM1/view?usp=sharing

To support the research, we used the tools made available by the G-Suite package, from Google. The interviews were carried out virtually via Google Meet; The signing of the consent term and the completion of the profile questions will be answered via Google Forms before the start of the interview; the recording of the interview and transcripts are stored on google drive; Finally, the collaborative documents for transcription and analysis were used in google documents.

A summary of the device functionality and objective is described in the following Box 1.

Box 1 – Functionalities and objectives for the use of the G-Suite tools

Device	Functionality	Objective
Google Meet	Realization of synchronous interactions of audio, video, texts and projection of electronic content.	Perform interviews
Google Forms	Access and submission of the free and informed consent term.	Completion of questionnaires and signature of Informed Consent Form
Google Drive	Storage of electronic documents of various formats.	Storage of the recordings of the interviews and two transcription documents and data analysis.
Google Documentos	Collaborative creation and edition of two researchers of text documents.	Transcription of the recordings treatment, documentation and analysis of two data

Data analysis

Data analysis was conducted using thematic content analysis, a method that involved dissecting the text into units to uncover the underlying nuclei of meaning within the communication. These nuclei were then regrouped into distinct classes or categories(18). For data analysis, to reach the manifest and latent meanings in the material, Content Analysis was carried out using the Atlas.ti Software, version 9, according to analytical precepts aimed at health(27), and was divided into three stages:

a) Pre-analysis: carried out through transcription, reading, correction of language errors 0and prior organization of all interviews. After this organisation, the text documents were inserted into the software.

b) Exploration of the material: this stage consisted of the process of immersion in the subjects, from the selection of expressive excerpts converging to the research objective, creation of codes and groupings into converging themes.

c) Data processing: the moment of inference consisted of two authors relating excerpts from the transcriptions, codes and groupings of codes to form subcategories and categories. Rounds of evaluation were carried out by the study authors to establish consensus on the codes that would be in each grouping. The citation excerpts from the chosen codes were those that had greater frequencies, co-occurrence, that is, connections with other codes, and were more significant from the researcher's perspective, in order to more clearly represent the theme covered. The initial results were tabulated to show thenetwork of words which emphasised the most expressive concepts in two selected passages. Excerpts of quotes were then selected to bring together a coherent narrative across the interviews.

Ethics

The research project was approved by the Research Ethics Committee of the University of Brasília (CEP/UNB) and by the National Research Ethics Commission (CONEP) under opinion no. 4,279,173, also respecting ethical standards established in Resolution CNS Resolution no. 510 of 2016 and Resolution CNS No. 466 of 2012 of CONEP (CAAE: 37321520.4.0000.5020).

The anonymity of the participants was preserved by the inclusion of an alphanumeric code composed of the letter P of participants followed by a cardinal number. For example: P1 referring to participant number 1 and so on.

The recording audios were deleted after transcription and the transcriptions were saved on the external hard drive held by the study coordinator.

Results

The analytical process allowed the selection of 1101 citation excerpts, 21 codes, six subcategories grouped into three thematic macrocategories (Table 2).

Table 2 - The number of quoted passages according to codes, subcategories and thematic categories on climate change and health in the Brazilian Indigenous context

Categories and subcategories	Codes
Environmental degradation and climate change in the context of indigenous peoples	
Public policies	Indigenous adolescents
	Demarcation of Unworthy Lands
	Water
	Joint intersectoral actions
Environment	Climate change and environmental degradation
	Environmental preservation
	Forest use
	Agriculture
Environment, vulnerability and indigenous mental health	
Problems of indigenous peoples	Culture
	Lack of access
	Difficulty integrating into society
Mental health	Suicide
	Experiences
	Sense of belonging
	Drugs and alcohol
Public health actions and policies for indigenous peoples	
	Immediate actions
	Indigenous voices
	They haven't seen reality
Suggestions	Community
	Nature
	Dignity and health

The category that commonly identified was environmental degradation and climate change in the context of Indigenous Peoples, reinforcing the need for public policies that relate to Indigenous adolescents and the impacts of climate changes and environmental degradation. This intrinsic connection to the environment makes the

integration of the knowledge and experiences of Indigenous communities essential for environmental preservation. The following quotes represent this analytical category:

"... We Indigenous People do not understand this land and territory as something to be explored, as something to be devastated, as something to serve us, an idea that the environment is at the service of human beings. The Indigenous Peoples have a much deeper, much more refined understanding, an understanding that the environment and we are so intertwined that if we destroy the environment, we also destroy the human being" (P15).

"I think that where the Indigenous People are, they preserve the river, the forest, the animals. They learned through the teachings of what was passed down by their ancestors... I think that if you preserve it, you will reverse this situation that it is today, that nobody knows anymore, nobody is 100% sure of what the climate, the now, the future will be like. tomorrow." (P13)

"Today it's quite complicated for our Indigenous People here in the village, many are no longer planting that swidden they planted before, it's not worth it anymore, so he's leaving to work in the city as a mason's servant, as a day laborer to be able to bring food to his house, for that if you depend on family farming you go hungry. (P14)

"... climate change affects in every sense, it interferes physically, psychologically, mentally, culturally, because it is nothing separate, if there was a spring that no longer has drinking water for the Indigenous community, then it will affect the physical, there is no water, there are no forests, there are no animals..." (P5).

"[...] for example, when there are fires, because of the warming, this harms our territory, our health, our housing..." (P7).

The environment, vulnerability and Indigenous mental health were also another analytical group, prevailing the difficulties of cultural maintenance and mental health problems such as suicide. The following quotes represent this analytical category:

"Their mental health is also very affected by this lack of opportunity, work, income, support. Drought is a very serious problem here that I have noticed since last year, this year it is very complicated here. So they themselves, due to economic difficulties, also end up having a practice that contradicts their origin, their whole culture, this is very present here." (P14)

"[...] it is precisely because of this extreme lack of perspective on life, of motivation to live, that alcohol and drugs finally become an escape from the miserable reality they live. The incidence of alcohol and drugs in the Indigenous community is very high, perhaps the most decimating agent of Indigenous culture. [...] Here [village] everything [drugs and drink] comes in. They become addicted, and they have to steal, find a way to get money to buy the drug. We had a recent case of death of a child whose mother was an alcoholic and left the child without food and ended up dying, very dramatic". (P3)

"[...] many of the Indigenous People end up going into depression due to living in a culture strongly influenced by whites, losing their ethnic origins, being in an existential limbo that leads to suicide and they also have access to alcohol from a very early age and alcohol makes them also commit crimes, commit suicide...". (P8)

"Suicide is a reality [...] and among the Indigenous population it is gigantic, [...] there is this issue of land, of belonging, of not belonging, of how to deal with the problems, many times they somatize everything and then suicide is the only way that perhaps many of them believe to be the solution..." (P1)

Finally, the need to promote public and health policies for Indigenous Peoples with Indigenous People involved in the decisions made about them and their Lands. This will ensure that the interconnectedness between their communities, nature and their health is understood and protected. The following quotes represent this analytical category:

"I understand that those who know what is best for the Indigenous People are the Indigenous People themselves, they have enough capacity to decide what is best for them. They have the ability to decide on health, education, social work, basic sanitation, the environment". (P1)

"In the first place, it is bringing those populations that are most affected, [...] bringing traditional peoples to occupy decision-making positions, we need to do that. Need these policies to be made by those who are affected and think about the direct consequences". (P21)

"Demarcation of Indigenous lands is the first point and from the demarcation of Indigenous lands, the development of public policies so that they can remain in these territories and have conditions for this, including public policies, so that they can manifest their language and culture anywhere". (P1)

"Before talking about public policy for Indigenous health, the first action must be to guarantee the right to land, with protection of their sacred territories because everything is interconnected. Secondly, the qualification of special Indigenous health teams to act in the prevention and promotion of mental health and network articulation for the treatment of more delicate cases". (P9)

"You walk in the village, you walk in the schools, you see dirty people, it's not because they are filthy, because they like dirt, it's because of the lack of water, which they don't even have to drink. So what public policies do I recommend? I recommend policies that guarantee human dignity, such as access to water, investments so that each residence can have a water tank, because sometimes there is and there is not enough for a long period". (P18)

"If you don't have potable water, ready to drink, you are subject to going to a dam sometimes and getting water that is unfit for consumption." (P12)

The extracted concepts obtained by means of the relations between two passages of citations, codes and categories represent a synthesis of the proposed research object, connecting all the categories, subcategories and codes. The following figure illustrates the main concepts.

[insert figure 1]

Figure 1 – Conceptual representation about climate change and health in the Brazilian Indigenous context

DISCUSSION

The perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health Indigenous were deeply entrenched in their lived experiences of loss of their Lands from deforestation and environmental degradation and impacts on customs, livelihoods, and health of their communities. We highlight some salient points related to the key themes that emerged from the interviews.

Environmental degradation and climate change

Environmental degradation and climate change, fueled by global warming, have emerged as significant threats to quality of life, as highlighted by participants in this study. Indigenous peoples, recognised as stewards of the Earth, are disproportionately affected due to their close relationship with the environment and reliance on natural resources.

This impact is amplified for those residing in vulnerable areas near rivers, slopes, and forests, exacerbating existing inequalities, marginalization, and the enduring legacy of colonization. Consequently, climate change poses a public health crisis across Latin America and the Caribbean, a region with numerous low-income countries characterized by fragile economies and limited healthcare access. Home to over 40 million Indigenous people whose health and well-being are inextricably linked to the environment, the region faces unique challenges in mitigating the adverse effects of climate change on its most vulnerable populations.(19).

The ongoing process of environmental degradation poses a grave threat to the survival and cultural integrity of Indigenous Peoples. The depletion of natural resources essential for their traditional livelihoods, coupled with the potential for escalated conflicts over dwindling resources, could ultimately lead to devastating consequences, including the risk of cultural genocide. (20,21). Ecosystem conservation is paramount for Indigenous peoples, as their culture, worldview (cosmovision), and survival are intrinsically linked to nature. They not only depend on a balanced environment for their livelihoods but also interpret natural signs as indicators for various events, further

emphasizing the critical importance of preserving their ecosystems. (10,22).Indigenous subsistence practices have evolved over time, incorporating various customs. Despite these changes, Indigenous peoples maintain a deep understanding of themselves as an integral part of nature. They establish balanced, non-monetary exchange systems that preserve biomes and biodiversity, utilizing natural resources without jeopardizing the ecosystem.

Participants emphasised that environmental degradation and climate change disrupted subsistence agriculture, forcing the replacement of traditional Indigenous crops. This shift is problematic because traditional crops, as integral components of the ecosystem, play a crucial role in conserving nature.(23,24). The traditional knowledge, cultural practices, land-use patterns, and resource management systems employed by Indigenous Peoples have historically played a crucial role in safeguarding biodiversity, maintaining hydrological cycles, curbing deforestation, preserving forest carbon stocks, and providing vital environmental services that contribute to the stability of climatic conditions.(25). Indigenous lands harbor unique elements that contribute to improved living conditions for society, extending beyond environmental benefits to economic advantages as well. The wealth of traditional knowledge and Indigenous socio-biodiversity offers significant potential for generating income through a variety of products and services. The concept of a bioeconomy that promotes sustainable environmental management while respecting the rights of Indigenous Peoples and fostering their own development (ethnodevelopment) presents a promising avenue for addressing the challenges faced by these communities.(26).

The migration of Indigenous Peoples to urban centers across Latin America is a growing social phenomenon, driven by a complex network of factors. Among these, the loss of Indigenous territories and environmental destruction play a significant role. It is estimated that more than 200 million People in the world will be forced to leave their regions due to climate change(27). This displacement forces individuals and entire communities to abandon their territories, disrupting their livelihoods, altering production systems, and jeopardizing their very survival(4).

Environment, vulnerability and impact on Indigenous mental health

Within the Brazilian context, the concept of mental health among Indigenous populations has been widely debated. Generally, it is understood as encompassing individual, family, social, or community well-being, often referred to as "good living." (25,28). Indigenous

Peoples demonstrate a significantly higher prevalence of mental distress compared to majority populations. This heightened vulnerability is influenced by a complex interplay of historical traumas, including the enduring legacy of colonialism, racism, slavery, and land dispossession (29,30). Brazilian Indigenous Peoples are experiencing a dramatic escalation of land grabbing, illegal logging, mining, invasions, and even the establishment of unauthorized settlements within their traditional territories. This escalating conflict over Indigenous lands has reached alarming levels, threatening the very existence of numerous Indigenous communities in Brazil. The resulting social and environmental upheaval has severe repercussions on mental health, exacerbated by factors such as social marginalization, disrupted lifestyles and livelihoods, and exposure to violence(31,32).

The report "Violence Against Indigenous Peoples in Brazil" reveals a concerning rise in documented violence and the highest number of Indigenous suicides in recent years. The loss of territory and agricultural land, racism, poverty, social vulnerability, and inadequate healthcare access have been identified as key contributing factors to this alarming increase in suicides(7). The proliferation of alcohol and other drugs within numerous Indigenous villages is a growing concern. While attributed to various factors, this issue is particularly linked to the limited opportunities and lack of prospects faced by Indigenous Peoples.

The Brazilian Ministry of Health recognizes the Indigenous population as vulnerable and experiencing a high incidence of psychosocial issues, including chemical dependency (alcohol and other drugs), misuse of psychotropic medications, suicide, and violence. This alarming situation is attributed to the disruption of traditional ways of life, challenges in securing economic subsistence, and exposure to conflicts. These factors contribute to significant suffering within Indigenous communities, often leading to self-destructive behaviors (7,32). The alarming deterioration of mental health among Indigenous Peoples in Brazil, tragically culminating in a disproportionately high suicide rate, underscores the heightened vulnerability experienced by this marginalized population. This stark disparity reflects the systemic denial of fundamental rights and the inadequacy of existing public policies. The suicide mortality rate among Indigenous individuals in Brazil, at 15.2 per 100,000, is nearly three times that observed in the non-Indigenous population (5.7 per 100,000), highlighting the urgent need for targeted interventions and culturally sensitive mental health support.(4).

Public health actions and policies for Indigenous Peoples

Promoting Indigenous health necessitates a multi-sectoral collaboration that prioritises Indigenous voices and perspectives. Such collaborative efforts enable the implementation of integrated actions across various levels of government and society, ultimately striving to improve the quality of life and promote health and well-being for Indigenous communities. This need for a comprehensive and interconnected approach was a recurring theme in participant discussions regarding public health policies, with many emphasising the fundamental importance of guaranteeing the right to Indigenous Lands as a non-negotiable prerequisite for their health and well-being. One of the most contentious issues in Brazil revolves around the demarcation of Indigenous Lands, defined as areas inhabited by Indigenous Peoples for their productive activities, cultural preservation, and the continuation of their traditions. Indigenous Land is not merely a physical space; it is a fundamental component of cultural and religious identity, ensuring the survival of Indigenous communities and serving as their ancestral territory.(29,33). Indigenous Peoples maintain a harmonious relationship with their cultures and spirituality, actively engaging in the protection, preservation, and continued development of their traditions to ensure the transmission and flourishing of their collective identity for future generations(4).

Water scarcity has emerged as a pressing global concern. Indigenous communities, acutely aware of the consequences, actively seek to conserve uncontaminated springs and restore those that have been polluted or damaged. This proactive approach stems from the understanding that environmental degradation and water scarcity directly threaten their survival. Beyond land and water rights, participants highlighted the need for comprehensive public policies and government actions that improve the quality of life for Indigenous people across multiple domains, including access to healthcare, education, sports, leisure, culture, and infrastructure. They emphasized the importance of stricter legislation to prevent mining and deforestation on Indigenous lands.

Limitations of the study

A larger and diverse sample with a range of ethnicities, indigenous policymakers and young people from different villages, would have enhanced the study's interpretive value. Wider representation of Indigenous perspectives is important. The restoration of communal balance and harmony and collective well-being is a common perspective, but

the challenges from environmental degradation vary across ethnic groups due to historic geospatial contexts and traditions.

Conclusion

Indigenous communities are disproportionately affected by environmental degradation and climate change, further compounded by challenges related to the demarcation of Indigenous lands, essential for their survival and cultural preservation. To address these pressing issues, they argue strongly that it is imperative to implement and strengthen intersectoral actions that prioritise environmental preservation, including water conservation, forest protection, and sustainable agricultural practices, thereby ensuring a brighter future for these communities. Traditional practices and knowledge foster a sense of belonging and cultural rootedness, but the lack of access to essential resources and the challenges of integration into mainstream society can create vulnerabilities. Furthermore, a complex interplay exists between the environment and Indigenous mental health, often associated with substance abuse and contributing to alarmingly high suicide rates. Public health policies need to be developed with Indigenous Peoples to address these multifaceted challenges. A holistic approach to health, coupled with collaborative strategies that value the strengthening of connections with nature and community, are fundamental to promote the overall well-being of Indigenous peoples.

Data sharing statement

Data may be obtained from a third party and are not publicly available

Contributorship statement

AG, SH, PJ, ID, and AV coordinated the study, edited, and revised the manuscript. JS, MR, and LB analyzed the quantitative data and wrote the first draft of the manuscript with additions from XZ. All authors were involved in designing the study. All authors contributed to the article and approved the submitted version.

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Competing interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Figure 1

304x187mm (96 x 96 DPI)

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:
Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

YOU MUST PROVIDE A RESPONSE FOR ALL ITEMS. ENTER N/A IF NOT APPLICABLE

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Inter viewer/facilitator	Which author/s conducted the inter view or focus group?	Results
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	Methods
3. Occupation	What was their occupation at the time of the study?	Methods
4. Gender	Was the researcher male or female?	N/A
5. Experience and training	What experience or training did the researcher have?	Methods
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	N/A
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	N/A
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Methods
Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Methods
Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Methods
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Methods
12. Sample size	How many participants were in the study?	Results

13. Non-participation	How many people refused to participate or dropped out? Reasons?	Methods
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	Methods
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	Results
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	Results
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Methods
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	N/A
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Methods
20. Field notes	Were field notes made during and/or after the inter view or focus group?	Methods
21. Duration	What was the duration of the inter views or focus group?	Methods
22. Data saturation	Was data saturation discussed?	Methods
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	N/A
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	Methods
25. Description of the coding tree	Did authors provide a description of the coding tree?	N/A
26. Derivation of themes	Were themes identified in advance or derived from the data?	Methods
27. Software	What software, if applicable, was used to manage the data?	NVivo
28. Participant checking	Did participants provide feedback on the findings?	Strengths and limitations
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Results
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Relationship to existing knowledge
31. Clarity of major themes	Were major themes clearly presented in the findings?	Results
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Discussion

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Environmental degradation, climate change and health from the perspective of Brazilian Indigenous stakeholders: A qualitative study

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Environmental degradation, climate change and health from the perspective of Brazilian Indigenous stakeholders: A qualitative study

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Background

The World Health Organization (WHO) identifies climate change as the most significant threat to global health systems. Indigenous peoples, with their lives deeply intertwined with nature, are particularly vulnerable to the impacts of these changes

Objective

This study aimed to understand the perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health.

Design

A qualitative study with 22 Indigenous stakeholders and public services managers on climate change and perceived impact on Indigenous health

Setting and Participants

Indigenous stakeholders and public services managers on climate change and perceived impact on Indigenous health from Brazil. Data was collected through interviews incorporating two vignette videos depicting environmental and health scenarios. Thematic content analysis was used to analyse the data.

Results

The analytical process yielded six subcategories that were further grouped into three overarching thematic macro-categories: Environmental Degradation and Climate Change in the Context of Indigenous Peoples; Environment, Vulnerability, and Impact on Indigenous Mental Health; and Actions and Public Health Policies for Indigenous Peoples.

Conclusion

The perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health were deeply entrenched in their lived experiences of loss of their Lands from deforestation and environmental degradation. They argued strongly for the strengthening of public health policies aimed at the Indigenous Peoples, to face the many challenges, especially suicide, and to have a voice in decision-making. A sensitive approach that value Indigenous People's connections with nature is fundamental to promote their health and well-being.

Keywords: Indigenous, Climatic changes, Mental health, Community-based participatory research

Strengths and limitations of this study

- A novel methodological mix of culturally and environmentally vignettes and interviews were used.
- Indigenous highlighted mental health services and water security priority actions for policy and program development for their communities.
- Indigenous communities' perspectives were conceptually cohesive and powerfully narrated.
- A larger and diverse sample with a range of ethnicities from different villages would enhance the study's interpretive value

Introduction

Brazil's Indigenous population, now over 1.65 million according to the 2022 Census, has seen a notable increase due to birth rates, which are higher than that of the non-Indigenous population(1), and to an increase in self-recognition of Indigeneity as a result of political participation of Indigenous peoples(2). As with Indigenous peoples globally, compared to non-Indigenous population in Brazil, the Indigenous population experiences poorer health and well-being(3). A recent report on mortality trends 200-2016 showed increasing mortality for both females and males for most age groups(4). The highest increases were observed for those aged >=60 years and 10 to 19 years. In children <5 years, the main causes of death were infectious and parasitic diseases, as well as respiratory diseases(5) . Between 5- 59 years, external causes ranked first and were responsible for more than half of all deaths among those 10-19 years(3). Circulatory diseases were most common cause of deaths for those >=60 years. These trends are linked to poor provision of basic social and health services including precarious sanitation conditions that make children vulnerable infections, conflicts between farmers and indigenous people and urban violence, and a general erosion of Indigenous traditions and customs in agriculture, hunting and fishing(7).

Environmental degradation pose a critical threat to Indigenous health. Ecosystem degradation, rising temperatures, and extreme weather events are major concerns, with the World Health Organization recognizing climate change as the greatest challenge to global health. Indigenous peoples, deeply connected to nature, are particularly vulnerable to these changes(8-10). A recent study found high levels of mercury in hair samples and mouth swabs among members of the Yanomami Indigenous group living in nine villages in the upper Mucajai river in the northern state of Roraima where illegal gold mining is common(6). Mercury consumption was high due to contaminated fish which is one of the Yanomami's main food sources. Cognitive deficits among children were observed in half of the children surveyed in 9 villages. There are also concerns that deforestation and degradation are linked to high rates of substance use and suicides among Brazil's Indigenous communities(7). Indigenous knowledge has been used for centuries for local adaptations for environmental sustainability. Indigenous scholars have long argued that their knowledge is critical for long-term sustainable solutions for biodiversity loss, water scarcity, pollution, sustainable livelihoods and general environmental resilience(8,9).

The Indigenous participants in this study are from South and Midwest Brazil. They strive to maintain their demarcated lands and spiritual connection to nature, possess a rich storytelling tradition that reinforces their identity and belonging(8). Their schools promote the retention of Indigenous knowledge and practices that can resolve local environmental challenges(10). For example, the Indigenous schools integrate growing and eating of cultural foods into the curriculum, oral learning methods, and participation in village activities with community leaders, shamans, parents, and elders.(11,12)

This study aimed to understand the perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health.

Methods

Theoretic framework

This qualitative study employed in-depth interviews to gather and analyze perspectives on the impacts of climate change on Indigenous health. Grounded in the principles of political ecology, which examines conflicts and socio-environmental changes, along with their interactions and relations with human societies, this theoretical lens guided both the study design and the subsequent development of analytical categories (13–14). Methodological rigor was ensured through adherence to the Consolidated Criteria for Qualitative Research Reports (COREQ) (15).

Trusting relationships

We collaborated with key Indigenous stakeholders in Mato Grosso do Sul, Brazil. Building upon long-established community-academic partnerships, our research team prioritised cultural integrity and agency by integrating Indigenous knowledge and values throughout the research process. The research question emerged organically from our ongoing collaborative work with this community since 2017.

Setting

While the study was based in Campo Grande, Mato Grosso do Sul, the snowball sampling method resulted in data collection across six cities (Brasilia, Campo Grande, Porto Alegre, Guarita, Dourados, and Terenos) and three Brazilian states (Mato Grosso do Sul, Federal District of Brasilia, and Rio Grande do Sul).

Participant selection

The recruitment of participants took place through the announcement on social networks and e-mail contacts of the authors. The participants voluntarily agreed to participate in the research and were recruited using snowballing(16). In this non-probabilistic sampling technique, the individual selected intentionally to participate in the study invites or indicates new participants from their social or professional network. Of an initial 30 interested participants, 22 participants met the inclusion criteria (see section on 'Participants'). One of the participants indicated a new contact who, in turn, referred to others, and so on, until the 22nd participant, by which time data saturation had been reached (17).

Participants

The study involved 22 Indigenous stakeholders/public service managers. Inclusion criteria were: a) Public service managers: individuals over 18 years old, holding management roles across municipal, state, or federal levels in executive, legislative, or judicial branches, operating in Indigenous areas. b) Indigenous peoples: individuals aged over 18 years old, self-identifying and recognised as belonging to an Indigenous ethnic group with distinct cultural characteristics from the national society.

Table 1 – Characterization of research participants.

Variables	**n**	**%**
Gender		
Female	12	54,5
Male	10	45,5
Age group		
20-29 years	5	22,7
30-39 years	8	36,4
40-49 years	7	31,8
50-59 years	2	9,1
Training		
Technical	2	9,1
Undergraduate	5	22,7
Post-graduate	15	68,2

Working time in Indigenous health/public service management		
Less than 1 year	1	4,5
Between 1 and 5 years	5	22,7
Between 6 and 10 years	7	31,9
Between 11 and 20 years	8	36,4
More than 20 years	1	4,5
I have another job		
No	17	77,3
Yes	5	22.7

Just over half of the participants were female, and two-thirds were between 30-49 years old, and had a post-graduate qualification. Two thirds had spent between 6-20 years working in Indigenous health or public service management from Terena and Kaingang ethnicity.

Data collection

The data collection process was developed by a university employed researcher, who was trained in qualitative methods. The interviewer worked in the same municipality as the data collection site, but in different services.

The data collection was carried out between August 2021 and April 2022, using vignettes and semi-structured interviews. The interviews lasted approximately 60 minutes and were carried out according to the availability of participants, using remote communication technology with audio and video recording, for later transcription. The aim of the interview was for the interviewee to discuss the proposed topic, without losing sight of the research objectives, following a script or previously elaborated structure(15) The interviews initially answered questions relating to their gender, age, length of time working with Indigenous health/management and whether they have another job. The interviews were conducted online and it is available as supplementary file. During the interviews, two vignettes in the form of video, were presented to the participants. Vignettes are known to: a) Enhance realism by considering various contextual factors and guiding participants' focus towards specific aspects of the research question; b) offer a standardised stimulus and improve reliability,; c) reduce social desirability bias and strengthen participant engagement (15) The first video illustrate a Brazilian Indigenous

activist who participated in the official opening of the Climate Summit Conference (COP26) held in Glasgow in Scotland in 2021, she speaks about Indigenous People and their important role in practices that are helping to mitigate or adapt to climate change: https://bit.ly/3SwZsmq

The second video shows mental health problems and access to health services for Indigenous People, the video narrates a case that occurred with a child, found available at the link: https://bit.ly/3A6g6Tt

To support the research, we used the tools made available by the G-Suite package, from Google. The interviews were carried out virtually via Google Meet; The signing of the consent term and the completion of the profile questions will be answered via Google Forms before the start of the interview; the recording of the interview and transcripts are stored on google drive; Finally, the collaborative documents for transcription and analysis were used in google documents.

A summary of the device functionality and objective is described in the following Box 1.

Box 1 – Functionalities and objectives for the use of the G-Suite tools

Device	Functionality	Objective
Google Meet	Realization of synchronous interactions of audio, video, texts and projection of electronic content.	Perform interviews
Google Forms	Access and submission of the free and informed consent term.	Completion of questionnaires and signature of Informed Consent Form
Google Drive	Storage of electronic documents of various formats.	Storage of the recordings of the interviews and two transcription documents and data analysis.
Google Documentos	Collaborative creation and edition of two researchers of text documents.	Transcription of the recordings treatment, documentation and analysis of two data

Data analysis

Data analysis was conducted using thematic content analysis, a method that involved dissecting the text into units to uncover the underlying nuclei of meaning within the communication. These nuclei were then regrouped into distinct classes or categories(18). For data analysis, to reach the manifest and latent meanings in the material, Content Analysis was carried out using the Atlas.ti Software, version 9, according to analytical precepts aimed at health(27), and was divided into three stages:

a) Pre-analysis: carried out through transcription, reading, correction of language errors 0and prior organization of all interviews. After this organisation, the text documents were inserted into the software.

b) Exploration of the material: this stage consisted of the process of immersion in the subjects, from the selection of expressive excerpts converging to the research objective, creation of codes and groupings into converging themes.

c) Data processing: the moment of inference consisted of two authors relating excerpts from the transcriptions, codes and groupings of codes to form subcategories and categories. Rounds of evaluation were carried out by the study authors to establish consensus on the codes that would be in each grouping. The citation excerpts from the chosen codes were those that had greater frequencies, co-occurrence, that is, connections with other codes, and were more significant from the researcher's perspective, in order to more clearly represent the theme covered. The initial results were tabulated to show thenetwork of words which emphasised the most expressive concepts in two selected passages. Excerpts of quotes were then selected to bring together a coherent narrative across the interviews.

Ethics

The research project was approved by the Research Ethics Committee of the University of Brasília (CEP/UNB) and by the National Research Ethics Commission (CONEP) under opinion no. 4,279,173, also respecting ethical standards established in Resolution CNS Resolution no. 510 of 2016 and Resolution CNS No. 466 of 2012 of CONEP (CAAE: 37321520.4.0000.5020).

The anonymity of the participants was preserved by the inclusion of an alphanumeric code composed of the letter P of participants followed by a cardinal number. For example: P1 referring to participant number 1 and so on.

The recording audios were deleted after transcription and the transcriptions were saved on the external hard drive held by the study coordinator.

Patient and public involvement

The study design was co-developed in close collaboration with Indigenous community members and leaders, building upon established relationships from previous studies. This participatory approach ensured that the research questions, methodologies, and data collection methods were culturally relevant, respectful, and responsive to the unique needs and priorities identified by Indigenous communities. Upon publication, study results will be shared directly with all participants through culturally appropriate channels, including face-to-face meetings for local participants and online platforms for those residing further away, fostering ongoing dialogue and knowledge exchange.

Results

The analytical process allowed the selection of 1101 citation excerpts, 21 codes, six subcategories grouped into three thematic macrocategories (Table 2).

Table 2 - The number of quoted passages according to codes, subcategories and thematic categories on climate change and health in the Brazilian Indigenous context

Categories and subcategories	Codes
Environmental degradation and climate change in the context of indigenous peoples	
Public policies	Indigenous adolescents
	Demarcation of Unworthy Lands
	Water
	Joint intersectoral actions
Environment	Climate change and environmental degradation
	Environmental preservation
	Forest use
	Agriculture
Environment, vulnerability and indigenous mental health	
Problems of indigenous peoples	Culture
	Lack of access
	Difficulty integrating into society
Mental health	Suicide
	Experiences
	Sense of belonging
	Drugs and alcohol
Public health actions and policies for indigenous peoples	
	Immediate actions
	Indigenous voices
	They haven't seen reality
Suggestions	Community
	Nature

Dignity and health

The category that commonly identified was environmental degradation and climate change in the context of Indigenous Peoples, reinforcing the need for public policies that relate to Indigenous adolescents and the impacts of climate changes and environmental degradation. This intrinsic connection to the environment makes the integration of the knowledge and experiences of Indigenous communities essential for environmental preservation. The following quotes represent this analytical category:

"... We Indigenous People do not understand this land and territory as something to be explored, as something to be devastated, as something to serve us, an idea that the environment is at the service of human beings. The Indigenous Peoples have a much deeper, much more refined understanding, an understanding that the environment and we are so intertwined that if we destroy the environment, we also destroy the human being" (P15).

"I think that where the Indigenous People are, they preserve the river, the forest, the animals. They learned through the teachings of what was passed down by their ancestors... I think that if you preserve it, you will reverse this situation that it is today, that nobody knows anymore, nobody is 100% sure of what the climate, the now, the future will be like. tomorrow." (P13)

"Today it's quite complicated for our Indigenous People here in the village, many are no longer planting that swidden they planted before, it's not worth it anymore, so he's leaving to work in the city as a mason's servant, as a day laborer to be able to bring food to his house, for that if you depend on family farming you go hungry. (P14)

"... climate change affects in every sense, it interferes physically, psychologically, mentally, culturally, because it is nothing separate, if there was a spring that no longer has drinking water for the Indigenous community, then it will affect the physical, there is no water, there are no forests, there are no animals..." (P5).

"[...] for example, when there are fires, because of the warming, this harms our territory, our health, our housing..." (P7).

The environment, vulnerability and Indigenous mental health were also another analytical group, prevailing the difficulties of cultural maintenance and mental health problems such as suicide. The following quotes represent this analytical category:

"Their mental health is also very affected by this lack of opportunity, work, income, support. Drought is a very serious problem here that I have noticed since last year, this year it is very complicated here. So they themselves, due to economic difficulties, also end up having a practice that contradicts their origin, their whole culture, this is very present here." (P14)

"[...] it is precisely because of this extreme lack of perspective on life, of motivation to live, that alcohol and drugs finally become an escape from the miserable reality they live. The incidence of alcohol and drugs in the Indigenous community is very high, perhaps the most decimating agent of Indigenous culture. [...] Here [village] everything [drugs and drink] comes in. They become addicted, and they have to steal, find a way to get money to buy the drug. We had a recent case of death of a child whose mother was an alcoholic and left the child without food and ended up dying, very dramatic". (P3)

"[...] many of the Indigenous People end up going into depression due to living in a culture strongly influenced by whites, losing their ethnic origins, being in an existential limbo that leads to suicide and they also have access to alcohol from a very early age and alcohol makes them also commit crimes, commit suicide...". (P8)

"Suicide is a reality [...] and among the Indigenous population it is gigantic, [...] there is this issue of land, of belonging, of not belonging, of how to deal with the problems, many times they somatize everything and then suicide is the only way that perhaps many of them believe to be the solution..." (P1)

Finally, the need to promote public and health policies for Indigenous Peoples with Indigenous People involved in the decisions made about them and their Lands. This will ensure that the interconnectedness between their communities, nature and their health is understood and protected. The following quotes represent this analytical category:

"I understand that those who know what is best for the Indigenous People are the Indigenous People themselves, they have enough capacity to decide what is best for them. They have the ability to decide on health, education, social work, basic sanitation, the environment". (P1)

"In the first place, it is bringing those populations that are most affected, [...] bringing traditional peoples to occupy decision-making positions, we need to do that. Need these policies to be made by those who are affected and think about the direct consequences". (P21)

"Demarcation of Indigenous lands is the first point and from the demarcation of Indigenous lands, the development of public policies so that they can remain in these territories and have conditions for this, including public policies, so that they can manifest their language and culture anywhere". (P1)

"Before talking about public policy for Indigenous health, the first action must be to guarantee the right to land, with protection of their sacred territories because everything is interconnected. Secondly, the qualification of special Indigenous health teams to act in the prevention and promotion of mental health and network articulation for the treatment of more delicate cases". (P9)

"You walk in the village, you walk in the schools, you see dirty people, it's not because they are filthy, because they like dirt, it's because of the lack of water, which they don't even have to drink. So what public policies do I recommend? I recommend policies that guarantee human dignity, such as access to water, investments so that each residence can have a water tank, because sometimes there is and there is not enough for a long period". (P18)

"If you don't have potable water, ready to drink, you are subject to going to a dam sometimes and getting water that is unfit for consumption." (P12)

The extracted concepts obtained by means of the relations between two passages of citations, codes and categories represent a synthesis of the proposed research object, connecting all the categories, subcategories and codes. The following figure illustrates the main concepts.

[insert figure 1]

Figure 1 – Conceptual representation about climate change and health in the Brazilian Indigenous context

DISCUSSION

The perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health Indigenous were deeply entrenched in their lived experiences of loss of their Lands from deforestation and environmental degradation and impacts on customs, livelihoods, and health of their communities. We highlight some salient points related to the key themes that emerged from the interviews.

Environmental degradation and climate change

Environmental degradation and climate change, fueled by global warming, have emerged as significant threats to quality of life, as highlighted by participants in this study. Indigenous peoples, recognised as stewards of the Earth, are disproportionately affected due to their close relationship with the environment and reliance on natural resources.

This impact is amplified for those residing in vulnerable areas near rivers, slopes, and forests, exacerbating existing inequalities, marginalization, and the enduring legacy of colonization. Consequently, climate change poses a public health crisis across Latin America and the Caribbean, a region with numerous low-income countries characterized by fragile economies and limited healthcare access. Home to over 40 million Indigenous people whose health and well-being are inextricably linked to the environment, the region faces unique challenges in mitigating the adverse effects of climate change on its most vulnerable populations.(19).

The ongoing process of environmental degradation poses a grave threat to the survival and cultural integrity of Indigenous Peoples. The depletion of natural resources essential for their traditional livelihoods, coupled with the potential for escalated conflicts

over dwindling resources, could ultimately lead to devastating consequences, including the risk of cultural genocide. (20,21). Ecosystem conservation is paramount for Indigenous peoples, as their culture, worldview (cosmovision), and survival are intrinsically linked to nature. They not only depend on a balanced environment for their livelihoods but also interpret natural signs as indicators for various events, further emphasizing the critical importance of preserving their ecosystems. (10,22).Indigenous subsistence practices have evolved over time, incorporating various customs. Despite these changes, Indigenous peoples maintain a deep understanding of themselves as an integral part of nature. They establish balanced, non-monetary exchange systems that preserve biomes and biodiversity, utilizing natural resources without jeopardizing the ecosystem.

Participants emphasised that environmental degradation and climate change disrupted subsistence agriculture, forcing the replacement of traditional Indigenous crops. This shift is problematic because traditional crops, as integral components of the ecosystem, play a crucial role in conserving nature.(23,24). The traditional knowledge, cultural practices, land-use patterns, and resource management systems employed by Indigenous Peoples have historically played a crucial role in safeguarding biodiversity, maintaining hydrological cycles, curbing deforestation, preserving forest carbon stocks, and providing vital environmental services that contribute to the stability of climatic conditions.(25). Indigenous lands harbor unique elements that contribute to improved living conditions for society, extending beyond environmental benefits to economic advantages as well. The wealth of traditional knowledge and Indigenous socio-biodiversity offers significant potential for generating income through a variety of products and services. The concept of a bioeconomy that promotes sustainable environmental management while respecting the rights of Indigenous Peoples and fostering their own development (ethnodevelopment) presents a promising avenue for addressing the challenges faced by these communities.(26).

The migration of Indigenous Peoples to urban centers across Latin America is a growing social phenomenon, driven by a complex network of factors. Among these, the loss of Indigenous territories and environmental destruction play a significant role. It is estimated that more than 200 million People in the world will be forced to leave their regions due to climate change(27). This displacement forces individuals and entire communities to abandon their territories, disrupting their livelihoods, altering production systems, and jeopardizing their very survival(4).

Environment, vulnerability and impact on Indigenous mental health

Within the Brazilian context, the concept of mental health among Indigenous populations has been widely debated. Generally, it is understood as encompassing individual, family, social, or community well-being, often referred to as "good living." (25,28). Indigenous Peoples demonstrate a significantly higher prevalence of mental distress compared to majority populations. This heightened vulnerability is influenced by a complex interplay of historical traumas, including the enduring legacy of colonialism, racism, slavery, and land dispossession (29,30). Brazilian Indigenous Peoples are experiencing a dramatic escalation of land grabbing, illegal logging, mining, invasions, and even the establishment of unauthorized settlements within their traditional territories. This escalating conflict over Indigenous lands has reached alarming levels, threatening the very existence of numerous Indigenous communities in Brazil. The resulting social and environmental upheaval has severe repercussions on mental health, exacerbated by factors such as social marginalization, disrupted lifestyles and livelihoods, and exposure to violence(31,32).

The report "Violence Against Indigenous Peoples in Brazil" reveals a concerning rise in documented violence and the highest number of Indigenous suicides in recent years. The loss of territory and agricultural land, racism, poverty, social vulnerability, and inadequate healthcare access have been identified as key contributing factors to this alarming increase in suicides(7). The proliferation of alcohol and other drugs within numerous Indigenous villages is a growing concern. While attributed to various factors, this issue is particularly linked to the limited opportunities and lack of prospects faced by Indigenous Peoples.

The Brazilian Ministry of Health recognizes the Indigenous population as vulnerable and experiencing a high incidence of psychosocial issues, including chemical dependency (alcohol and other drugs), misuse of psychotropic medications, suicide, and violence. This alarming situation is attributed to the disruption of traditional ways of life, challenges in securing economic subsistence, and exposure to conflicts. These factors contribute to significant suffering within Indigenous communities, often leading to self-destructive behaviors (7,32). The alarming deterioration of mental health among Indigenous Peoples in Brazil, tragically culminating in a disproportionately high suicide rate, underscores the heightened vulnerability experienced by this marginalized population. This stark disparity reflects the systemic denial of fundamental rights and the inadequacy of existing public policies. The suicide mortality rate among Indigenous

individuals in Brazil, at 15.2 per 100,000, is nearly three times that observed in the non-Indigenous population (5.7 per 100,000), highlighting the urgent need for targeted interventions and culturally sensitive mental health support.(4).

Public health actions and policies for Indigenous Peoples

Promoting Indigenous health necessitates a multi-sectoral collaboration that prioritises Indigenous voices and perspectives. Such collaborative efforts enable the implementation of integrated actions across various levels of government and society, ultimately striving to improve the quality of life and promote health and well-being for Indigenous communities. This need for a comprehensive and interconnected approach was a recurring theme in participant discussions regarding public health policies, with many emphasising the fundamental importance of guaranteeing the right to Indigenous Lands as a non-negotiable prerequisite for their health and well-being. One of the most contentious issues in Brazil revolves around the demarcation of Indigenous Lands, defined as areas inhabited by Indigenous Peoples for their productive activities, cultural preservation, and the continuation of their traditions. Indigenous Land is not merely a physical space; it is a fundamental component of cultural and religious identity, ensuring the survival of Indigenous communities and serving as their ancestral territory.(29,33). Indigenous Peoples maintain a harmonious relationship with their cultures and spirituality, actively engaging in the protection, preservation, and continued development of their traditions to ensure the transmission and flourishing of their collective identity for future generations(4).

Water scarcity has emerged as a pressing global concern. Indigenous communities, acutely aware of the consequences, actively seek to conserve uncontaminated springs and restore those that have been polluted or damaged. This proactive approach stems from the understanding that environmental degradation and water scarcity directly threaten their survival. Beyond land and water rights, participants highlighted the need for comprehensive public policies and government actions that improve the quality of life for Indigenous people across multiple domains, including access to healthcare, education, sports, leisure, culture, and infrastructure. They emphasized the importance of stricter legislation to prevent mining and deforestation on Indigenous lands.

Strengths and limitations of the study

This study embraced a culturally sensitive and trust approach, Building trust and rapport with Indigenous participants. This grounding in the Brazilian context enhances the relevance and applicability of the findings.

Despite these strengths, the study has limitations. Expanding the sample size and diversity to include a broader range of ethnicities, indigenous policymakers, and young people from various villages would have enriched the study's interpretive value and ensured a wider representation of Indigenous perspectives.

Furthermore, acknowledging the diverse cultural practices and beliefs within different Indigenous communities is crucial. While the restoration of communal balance, harmony, and collective well-being is a shared concern, the specific challenges stemming from environmental degradation vary across ethnic groups due to distinct historical, geospatial, and cultural contexts.

Conclusion

Indigenous communities are disproportionately affected by environmental degradation and climate change, further compounded by challenges related to the demarcation of Indigenous lands, essential for their survival and cultural preservation. To address these pressing issues, they argue strongly that it is imperative to implement and strengthen intersectoral actions that prioritise environmental preservation, including water conservation, forest protection, and sustainable agricultural practices, thereby ensuring a brighter future for these communities. Traditional practices and knowledge foster a sense of belonging and cultural rootedness, but the lack of access to essential resources and the challenges of integration into mainstream society can create vulnerabilities. Furthermore, a complex interplay exists between the environment and Indigenous mental health, often associated with substance abuse and contributing to alarmingly high suicide rates. Public health policies need to be developed with Indigenous Peoples to address these multifaceted challenges. A holistic approach to health, coupled with collaborative strategies that value the strengthening of connections with nature and community, are fundamental to promote the overall well-being of Indigenous peoples.

Data sharing statement

Data may be obtained from a third party and are not publicly available

Contributorship statement

AG serves as guarantor and accepts full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. SH, PJ, ID, and AV coordinated the study, edited, and revised the manuscript. JS, MR, and LB analyzed the quantitative data and wrote the first draft of the manuscript with additions from XZ. All authors were involved in designing the study. All authors contributed to the article and approved the submitted version.

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Competing interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Figure 1

304x187mm (96 x 96 DPI)

Interview Script

Vignette 1

An indigenous Brazilian activist took part in the official opening of the Climate Summit Conference (COP26) in Glasgow, Scotland in 2021. In her speech, the 24-year-old spoke about climate change and indigenous peoples. I'm going to show an excerpt from this speech:

Show video - Vignette 1 (https://bit.ly/3SwZsmq)

Questions

1 - What did you think of the video? Comment on the subject

2 - What caught your attention in the video? Why?

3 - In your opinion, could climate change affect the lives of indigenous people? How? In what way?

4- Could you comment further on public policies and climate change in Brazil? Can you name some actions that could help improve existing problems?

Vignette 2

Mental health problems are common among people all over the world, and among the indigenous population too. The following video illustrates some of this problem

Show video - Vignette 2 (https://bit.ly/3A6g6Tt)

1 - What did you think of the video?

2 - Which part caught your attention the most?

3 - Do you think climate change could affect the physical or mental health of indigenous people? Why? In what way? How?

4 - How could the indigenous person's death have been avoided?

5 - Would you like to comment further on public policies related to the mental health of indigenous people in Brazil? Can you name some actions that could help improve the existing problems?

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:
Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

YOU MUST PROVIDE A RESPONSE FOR ALL ITEMS. ENTER N/A IF NOT APPLICABLE

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Inter viewer/facilitator	Which author/s conducted the inter view or focus group?	10
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	5
3. Occupation	What was their occupation at the time of the study?	5
4. Gender	Was the researcher male or female?	N/A
5. Experience and training	What experience or training did the researcher have?	6
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	5
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	7
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	6
Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	5
Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	6
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	6
12. Sample size	How many participants were in the study?	5

13. Non-participation	How many people refused to participate or dropped out? Reasons?	6
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	5
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	6
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	6
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	7
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	N/A
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	7
20. Field notes	Were field notes made during and/or after the inter view or focus group?	8
21. Duration	What was the duration of the inter views or focus group?	8
22. Data saturation	Was data saturation discussed?	8
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	N/A
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	9
25. Description of the coding tree	Did authors provide a description of the coding tree?	N/A
26. Derivation of themes	Were themes identified in advance or derived from the data?	10
27. Software	What software, if applicable, was used to manage the data?	10
28. Participant checking	Did participants provide feedback on the findings?	14
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	10-14
30. Data and findings consistent	Was there consistency between the data presented and the findings?	15
31. Clarity of major themes	Were major themes clearly presented in the findings?	15
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	15

Once you have completed this checklist, please save a copy and upload it as part of your submission. When requested to do so as part of the upload process, please select the file type: *Checklist*. You will NOT be able to proceed with

submission unless the checklist has been uploaded. Please DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

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Environmental degradation, climate change and health from the perspective of Brazilian Indigenous stakeholders: A qualitative study

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Environmental degradation, climate change and health from the perspective of Brazilian Indigenous stakeholders: A qualitative study

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Abstract

Background

The World Health Organization (WHO) identifies climate change as the most significant threat to global health systems. Indigenous peoples, with their lives deeply intertwined with nature, are particularly vulnerable to the impacts of these changes

Objective

This study aimed to understand the perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health.

Design

A qualitative study with 22 Indigenous stakeholders and public services managers on climate change and perceived impact on Indigenous health

Setting and Participants

Indigenous stakeholders and public services managers on climate change and perceived impact on Indigenous health from Brazil. Data was collected through interviews incorporating two vignette videos depicting environmental and health scenarios. Thematic content analysis was used to analyse the data.

Results

The analytical process yielded six subcategories that were further grouped into three overarching thematic macro-categories: Environmental Degradation and Climate Change in the Context of Indigenous Peoples; Environment, Vulnerability, and Impact on Indigenous Mental Health; and Actions and Public Health Policies for Indigenous Peoples.

Conclusion

The perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health were deeply entrenched in their lived experiences of loss of their Lands from deforestation and environmental degradation. They argued strongly for the strengthening of public health policies aimed at the Indigenous Peoples, to face the many challenges, especially suicide, and to have a voice in decision-making. A sensitive approach that value Indigenous People's connections with nature is fundamental to promote their health and well-being.

Keywords: Indigenous, Climatic changes, Mental health, Community-based participatory research

Strengths and limitations of this study

- Mix of culturally and environmentally vignettes and interviews.
- Indigenous voices for policy and program development.
- Narrated interviews with community perspectives.

Introduction

Brazil's Indigenous population, now over 1.65 million according to the 2022 Census, has seen a notable increase due to birth rates, which are higher than that of the non-Indigenous population(1), and to an increase in self-recognition of Indigeneity as a result of political participation of Indigenous peoples(2). As with Indigenous peoples globally, compared to non-Indigenous population in Brazil, the Indigenous population experiences poorer health and well-being(3). A recent report on mortality trends 200-2016 showed increasing mortality for both females and males for most age groups(4). The highest increases were observed for those aged >=60 years and 10 to 19 years. In children <5 years, the main causes of death were infectious and parasitic diseases, as well as respiratory diseases(5) . Between 5- 59 years, external causes ranked first and were responsible for more than half of all deaths among those 10-19 years(3). Circulatory diseases were most common cause of deaths for those >=60 years(4-6). These trends are linked to poor provision of basic social and health services including precarious sanitation conditions that make children vulnerable infections, conflicts between farmers and indigenous people and urban violence, and a general erosion of Indigenous traditions and customs in agriculture, hunting and fishing(7).

Environmental degradation pose a critical threat to Indigenous health. Ecosystem degradation, rising temperatures, and extreme weather events are major concerns, with the World Health Organization recognizing climate change as the greatest challenge to global health. Indigenous peoples, deeply connected to nature, are particularly vulnerable to these changes(8-10). A recent study found high levels of mercury in hair samples and mouth swabs among members of the Yanomami Indigenous group living in nine villages in the upper Mucajai river in the northern state of Roraima where illegal gold mining is common(6). Mercury consumption was high due to contaminated fish which is one of the Yanomami's main food sources. Cognitive deficits among children were observed in half of the children surveyed in 9 villages. There are also concerns that deforestation and degradation are linked to high rates of substance use and suicides among Brazil's Indigenous communities(7). Indigenous knowledge has been used for centuries for local adaptations for environmental sustainability. Indigenous scholars have long argued that their knowledge is critical for long-term sustainable solutions for biodiversity loss, water scarcity, pollution, sustainable livelihoods and general environmental resilience(8,9).

The Indigenous participants in this study are from South and Midwest Brazil. They strive to maintain their demarcated lands and spiritual connection to nature, possess a rich storytelling tradition that reinforces their identity and belonging(8). Their schools promote the retention of Indigenous knowledge and practices that can resolve local environmental challenges(10). For example, the Indigenous schools integrate growing and eating of cultural foods into the curriculum, oral learning methods, and participation in village activities with community leaders, shamans, parents, and elders.(11,12)

This study aimed to understand the perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health.

Methods

Theoretic framework

This qualitative study employed in-depth interviews to gather and analyze perspectives on the impacts of climate change on Indigenous health. Grounded in the principles of political ecology, which examines conflicts and socio-environmental changes, along with their interactions and relations with human societies, this theoretical lens guided both the study design and the subsequent development of analytical categories (13–14). Methodological rigor was ensured through adherence to the Consolidated Criteria for Qualitative Research Reports (COREQ) (15).

Trusting relationships

We collaborated with key Indigenous stakeholders in Mato Grosso do Sul, Brazil. Building upon long-established community-academic partnerships, our research team prioritised cultural integrity and agency by integrating Indigenous knowledge and values throughout the research process. The research question emerged organically from our ongoing collaborative work with this community since 2017.

Setting

While the study was based in Campo Grande, Mato Grosso do Sul, the snowball sampling method resulted in data collection across six cities (Brasilia, Campo Grande, Porto Alegre, Guarita, Dourados, and Terenos) and three Brazilian states (Mato Grosso do Sul, Federal District of Brasilia, and Rio Grande do Sul).

Participant selection

The recruitment of participants took place through the announcement on social networks and e-mail contacts of the authors. The participants voluntarily agreed to participate in the research and were recruited using snowballing(16). In this non-probabilistic sampling technique, the individual selected intentionally to participate in the study invites or indicates new participants from their social or professional network. Of an initial 30 interested participants, 22 participants met the inclusion criteria (see section on 'Participants'). One of the participants indicated a new contact who, in turn, referred to others, and so on, until the 22nd participant, by which time data saturation had been reached (17).

Participants

The study involved 22 Indigenous stakeholders/public service managers. Inclusion criteria were: a) Public service managers: individuals over 18 years old, holding management roles across municipal, state, or federal levels in executive, legislative, or judicial branches, operating in Indigenous areas. b) Indigenous peoples: individuals aged over 18 years old, self-identifying and recognised as belonging to an Indigenous ethnic group with distinct cultural characteristics from the national society. The characterization of the research participants is presented in Table 1.

Table 1 – Characterization of research participants.

Variables	**n**	**%**
Gender		
Female	12	54,5
Male	10	45,5
Age group		
20-29 years	5	22,7
30-39 years	8	36,4
40-49 years	7	31,8
50-59 years	2	9,1
Training		
Technical	2	9,1
Undergraduate	5	22,7

Post-graduate	15	68,2
Working time in Indigenous health/public service management		
Less than 1 year	1	4,5
Between 1 and 5 years	5	22,7
Between 6 and 10 years	7	31,9
Between 11 and 20 years	8	36,4
More than 20 years	1	4,5
I have another job		
No	17	77,3
Yes	5	22.7

Just over half of the participants were female, and two-thirds were between 30-49 years old, and had a post-graduate qualification. Two thirds had spent between 6-20 years working in Indigenous health or public service management from Terena and Kaingang ethnicity.

Data collection

The data collection process was developed by a university employed researcher, who was trained in qualitative methods. The interviewer worked in the same municipality as the data collection site, but in different services.

The data collection was carried out between August 2021 and April 2022, using vignettes and semi-structured interviews. The interviews lasted approximately 60 minutes and were carried out according to the availability of participants, using remote communication technology with audio and video recording, for later transcription. The aim of the interview was for the interviewee to discuss the proposed topic, without losing sight of the research objectives, following a script or previously elaborated structure(15) The interviews initially answered questions relating to their gender, age, length of time working with Indigenous health/management and whether they have another job. The interviews were conducted online and it is available as supplementary file. During the interviews, two vignettes in the form of video, were presented to the participants. Vignettes are known to: a) Enhance realism by considering various contextual factors and guiding participants' focus towards specific aspects of the research question; b) offer a standardised stimulus and improve reliability,; c) reduce social desirability bias and

strengthen participant engagement (15) The first video illustrate a Brazilian Indigenous activist who participated in the official opening of the Climate Summit Conference (COP26) held in Glasgow in Scotland in 2021, she speaks about Indigenous People and their important role in practices that are helping to mitigate or adapt to climate change: https://bit.ly/3SwZsmq

The second video shows mental health problems and access to health services for Indigenous People, the video narrates a case that occurred with a child, found available at the link: https://bit.ly/3A6g6Tt

To support the research, we used the tools made available by the G-Suite package, from Google. The interviews were carried out virtually via Google Meet; The signing of the consent term and the completion of the profile questions will be answered via Google Forms before the start of the interview; the recording of the interview and transcripts are stored on google drive; Finally, the collaborative documents for transcription and analysis were used in google documents.

A summary of the device functionality and objective is described in the following Box 1.

Box 1 – Functionalities and objectives for the use of the G-Suite tools

Device	Functionality	Objective
Google Meet	Realization of synchronous interactions of audio, video, texts and projection of electronic content.	Perform interviews
Google Forms	Access and submission of the free and informed consent term.	Completion of questionnaires and signature of Informed Consent Form
Google Drive	Storage of electronic documents of various formats.	Storage of the recordings of the interviews and two transcription documents and data analysis.
Google Documentos	Collaborative creation and edition of two researchers of text documents.	Transcription of the recordings treatment, documentation and analysis of two data

Data analysis

Data analysis was conducted using thematic content analysis, a method that involved dissecting the text into units to uncover the underlying nuclei of meaning within the communication. These nuclei were then regrouped into distinct classes or categories(18). For data analysis, to reach the manifest and latent meanings in the material, Content Analysis was carried out using the Atlas.ti Software, version 9, according to analytical precepts aimed at health(19), and was divided into three stages:

a) Pre-analysis: carried out through transcription, reading, correction of language errors 0and prior organization of all interviews. After this organisation, the text documents were inserted into the software.

b) Exploration of the material: this stage consisted of the process of immersion in the subjects, from the selection of expressive excerpts converging to the research objective, creation of codes and groupings into converging themes.

c) Data processing: the moment of inference consisted of two authors relating excerpts from the transcriptions, codes and groupings of codes to form subcategories and categories. Rounds of evaluation were carried out by the study authors to establish consensus on the codes that would be in each grouping. The citation excerpts from the chosen codes were those that had greater frequencies, co-occurrence, that is, connections with other codes, and were more significant from the researcher's perspective, in order to more clearly represent the theme covered. The initial results were tabulated to show thenetwork of words which emphasised the most expressive concepts in two selected passages. Excerpts of quotes were then selected to bring together a coherent narrative across the interviews.

Ethics

The research project was approved by the Research Ethics Committee of the University of Brasília (CEP/UNB) and by the National Research Ethics Commission (CONEP) under opinion no. 4,279,173, also respecting ethical standards established in Resolution CNS Resolution no. 510 of 2016 and Resolution CNS No. 466 of 2012 of CONEP (CAAE: 37321520.4.0000.5020).

The anonymity of the participants was preserved by the inclusion of an alphanumeric code composed of the letter P of participants followed by a cardinal number. For example: P1 referring to participant number 1 and so on.

The recording audios were deleted after transcription and the transcriptions were saved on the external hard drive held by the study coordinator.

Patient and public involvement

The study design was co-developed in close collaboration with Indigenous community members and leaders, building upon established relationships from previous studies. This participatory approach ensured that the research questions, methodologies, and data collection methods were culturally relevant, respectful, and responsive to the unique needs and priorities identified by Indigenous communities. Upon publication, study results will be shared directly with all participants through culturally appropriate channels, including face-to-face meetings for local participants and online platforms for those residing further away, fostering ongoing dialogue and knowledge exchange.

Results

The analytical process allowed the selection of 1101 citation excerpts, 21 codes, six subcategories grouped into three thematic macrocategories is presented in table 2.

Table 2 - The number of quoted passages according to codes, subcategories and thematic categories on climate change and health in the Brazilian Indigenous context

Categories and subcategories	Codes
Environmental degradation and climate change in the context of indigenous peoples	
Public policies	Indigenous adolescents
	Demarcation of Unworthy Lands
	Water
	Joint intersectoral actions
Environment	Climate change and environmental degradation
	Environmental preservation
	Forest use
	Agriculture
Environment, vulnerability and indigenous mental health	
Problems of indigenous peoples	Culture
	Lack of access
	Difficulty integrating into society
Mental health	Suicide
	Experiences
	Sense of belonging
	Drugs and alcohol
Public health actions and policies for indigenous peoples	
	Immediate actions
	Indigenous voices

Suggestions

They haven't seen reality
Community
Nature
Dignity and health

The category that commonly identified was environmental degradation and climate change in the context of Indigenous Peoples, reinforcing the need for public policies that relate to Indigenous adolescents and the impacts of climate changes and environmental degradation. This intrinsic connection to the environment makes the integration of the knowledge and experiences of Indigenous communities essential for environmental preservation. The following quotes represent this analytical category:

"... We Indigenous People do not understand this land and territory as something to be explored, as something to be devastated, as something to serve us, an idea that the environment is at the service of human beings. The Indigenous Peoples have a much deeper, much more refined understanding, an understanding that the environment and we are so intertwined that if we destroy the environment, we also destroy the human being" (P15).

"I think that where the Indigenous People are, they preserve the river, the forest, the animals. They learned through the teachings of what was passed down by their ancestors... I think that if you preserve it, you will reverse this situation that it is today, that nobody knows anymore, nobody is 100% sure of what the climate, the now, the future will be like. tomorrow." (P13)

"Today it's quite complicated for our Indigenous People here in the village, many are no longer planting that swidden they planted before, it's not worth it anymore, so he's leaving to work in the city as a mason's servant, as a day laborer to be able to bring food to his house, for that if you depend on family farming you go hungry. (P14)

"... climate change affects in every sense, it interferes physically, psychologically, mentally, culturally, because it is nothing separate, if there was a spring that no longer has drinking water for the Indigenous community, then it will affect the physical, there is no water, there are no forests, there are no animals..." (P5).

"[...] for example, when there are fires, because of the warming, this harms our territory, our health, our housing..." (P7).

The environment, vulnerability and Indigenous mental health were also another analytical group, prevailing the difficulties of cultural maintenance and mental health problems such as suicide. The following quotes represent this analytical category:

"Their mental health is also very affected by this lack of opportunity, work, income, support. Drought is a very serious problem here that I have noticed since last year, this year it is very complicated here. So they themselves, due to economic difficulties, also end up having a practice that contradicts their origin, their whole culture, this is very present here." (P14)

"[...] it is precisely because of this extreme lack of perspective on life, of motivation to live, that alcohol and drugs finally become an escape from the miserable reality they live. The incidence of alcohol and drugs in the Indigenous community is very high, perhaps the most decimating agent of Indigenous culture. [...] Here [village] everything [drugs and drink] comes in. They become addicted, and they have to steal, find a way to get money to buy the drug. We had a recent case of death of a child whose mother was an alcoholic and left the child without food and ended up dying, very dramatic". (P3)

"[...] many of the Indigenous People end up going into depression due to living in a culture strongly influenced by whites, losing their ethnic origins, being in an existential limbo that leads to suicide and they also have access to alcohol from a very early age and alcohol makes them also commit crimes, commit suicide...". (P8)

"Suicide is a reality [...] and among the Indigenous population it is gigantic, [...] there is this issue of land, of belonging, of not belonging, of how to deal with the problems, many times they somatize everything and then suicide is the only way that perhaps many of them believe to be the solution..." (P1)

Finally, the need to promote public and health policies for Indigenous Peoples with Indigenous People involved in the decisions made about them and their Lands. This

will ensure that the interconnectedness between their communities, nature and their health is understood and protected. The following quotes represent this analytical category:

"I understand that those who know what is best for the Indigenous People are the Indigenous People themselves, they have enough capacity to decide what is best for them. They have the ability to decide on health, education, social work, basic sanitation, the environment". (P1)

"In the first place, it is bringing those populations that are most affected, [...] bringing traditional peoples to occupy decision-making positions, we need to do that. Need these policies to be made by those who are affected and think about the direct consequences". (P21)

"Demarcation of Indigenous lands is the first point and from the demarcation of Indigenous lands, the development of public policies so that they can remain in these territories and have conditions for this, including public policies, so that they can manifest their language and culture anywhere". (P1)

"Before talking about public policy for Indigenous health, the first action must be to guarantee the right to land, with protection of their sacred territories because everything is interconnected. Secondly, the qualification of special Indigenous health teams to act in the prevention and promotion of mental health and network articulation for the treatment of more delicate cases". (P9)

"You walk in the village, you walk in the schools, you see dirty people, it's not because they are filthy, because they like dirt, it's because of the lack of water, which they don't even have to drink. So what public policies do I recommend? I recommend policies that guarantee human dignity, such as access to water, investments so that each residence can have a water tank, because sometimes there is and there is not enough for a long period". (P18)

"If you don't have potable water, ready to drink, you are subject to going to a dam sometimes and getting water that is unfit for consumption." (P12)

The extracted concepts obtained by means of the relations between two passages of citations, codes and categories represent a synthesis of the proposed research object, connecting all the categories, subcategories and codes. Figure 1 illustrates the main conceptual representation about climate change and health in the Brazilian Indigenous context

[insert figure 1]

Figure 1 – Conceptual representation about climate change and health in the Brazilian Indigenous context

DISCUSSION

The perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health Indigenous were deeply entrenched in their lived experiences of loss of their Lands from deforestation and environmental degradation and impacts on customs, livelihoods, and health of their communities. We highlight some salient points related to the key themes that emerged from the interviews.

Environmental degradation and climate change

Environmental degradation and climate change, fueled by global warming, have emerged as significant threats to quality of life, as highlighted by participants in this study. Indigenous peoples, recognised as stewards of the Earth, are disproportionately affected due to their close relationship with the environment and reliance on natural resources.

This impact is amplified for those residing in vulnerable areas near rivers, slopes, and forests, exacerbating existing inequalities, marginalization, and the enduring legacy of colonization. Consequently, climate change poses a public health crisis across Latin America and the Caribbean, a region with numerous low-income countries characterized by fragile economies and limited healthcare access. Home to over 40 million Indigenous people whose health and well-being are inextricably linked to the environment, the region faces unique challenges in mitigating the adverse effects of climate change on its most vulnerable populations.(19).

The ongoing process of environmental degradation poses a grave threat to the survival and cultural integrity of Indigenous Peoples. The depletion of natural resources essential for their traditional livelihoods, coupled with the potential for escalated conflicts over dwindling resources, could ultimately lead to devastating consequences, including the risk of cultural genocide. (20,21). Ecosystem conservation is paramount for Indigenous peoples, as their culture, worldview (cosmovision), and survival are intrinsically linked to nature. They not only depend on a balanced environment for their livelihoods but also interpret natural signs as indicators for various events, further emphasizing the critical importance of preserving their ecosystems. (10,22).Indigenous subsistence practices have evolved over time, incorporating various customs. Despite these changes, Indigenous peoples maintain a deep understanding of themselves as an integral part of nature. They establish balanced, non-monetary exchange systems that preserve biomes and biodiversity, utilizing natural resources without jeopardizing the ecosystem.

Participants emphasised that environmental degradation and climate change disrupted subsistence agriculture, forcing the replacement of traditional Indigenous crops. This shift is problematic because traditional crops, as integral components of the ecosystem, play a crucial role in conserving nature.(23,24). The traditional knowledge, cultural practices, land-use patterns, and resource management systems employed by Indigenous Peoples have historically played a crucial role in safeguarding biodiversity, maintaining hydrological cycles, curbing deforestation, preserving forest carbon stocks, and providing vital environmental services that contribute to the stability of climatic conditions.(25). Indigenous lands harbor unique elements that contribute to improved living conditions for society, extending beyond environmental benefits to economic advantages as well. The wealth of traditional knowledge and Indigenous socio-biodiversity offers significant potential for generating income through a variety of products and services. The concept of a bioeconomy that promotes sustainable environmental management while respecting the rights of Indigenous Peoples and fostering their own development (ethnodevelopment) presents a promising avenue for addressing the challenges faced by these communities.(26).

The migration of Indigenous Peoples to urban centers across Latin America is a growing social phenomenon, driven by a complex network of factors. Among these, the loss of Indigenous territories and environmental destruction play a significant role. It is estimated that more than 200 million People in the world will be forced to leave their

regions due to climate change(27). This displacement forces individuals and entire communities to abandon their territories, disrupting their livelihoods, altering production systems, and jeopardizing their very survival(4).

Environment, vulnerability and impact on Indigenous mental health

Within the Brazilian context, the concept of mental health among Indigenous populations has been widely debated. Generally, it is understood as encompassing individual, family, social, or community well-being, often referred to as "good living." (25,28). Indigenous Peoples demonstrate a significantly higher prevalence of mental distress compared to majority populations. This heightened vulnerability is influenced by a complex interplay of historical traumas, including the enduring legacy of colonialism, racism, slavery, and land dispossession (29,30). Brazilian Indigenous Peoples are experiencing a dramatic escalation of land grabbing, illegal logging, mining, invasions, and even the establishment of unauthorized settlements within their traditional territories. This escalating conflict over Indigenous lands has reached alarming levels, threatening the very existence of numerous Indigenous communities in Brazil. The resulting social and environmental upheaval has severe repercussions on mental health, exacerbated by factors such as social marginalization, disrupted lifestyles and livelihoods, and exposure to violence(31,32).

The report "Violence Against Indigenous Peoples in Brazil" reveals a concerning rise in documented violence and the highest number of Indigenous suicides in recent years. The loss of territory and agricultural land, racism, poverty, social vulnerability, and inadequate healthcare access have been identified as key contributing factors to this alarming increase in suicides(7). The proliferation of alcohol and other drugs within numerous Indigenous villages is a growing concern. While attributed to various factors, this issue is particularly linked to the limited opportunities and lack of prospects faced by Indigenous Peoples.

The Brazilian Ministry of Health recognizes the Indigenous population as vulnerable and experiencing a high incidence of psychosocial issues, including chemical dependency (alcohol and other drugs), misuse of psychotropic medications, suicide, and violence. This alarming situation is attributed to the disruption of traditional ways of life, challenges in securing economic subsistence, and exposure to conflicts. These factors contribute to significant suffering within Indigenous communities, often leading to self-destructive behaviors (7,32). The alarming deterioration of mental health among Indigenous Peoples in Brazil, tragically culminating in a disproportionately high suicide

rate, underscores the heightened vulnerability experienced by this marginalized population. This stark disparity reflects the systemic denial of fundamental rights and the inadequacy of existing public policies. The suicide mortality rate among Indigenous individuals in Brazil, at 15.2 per 100,000, is nearly three times that observed in the non-Indigenous population (5.7 per 100,000), highlighting the urgent need for targeted interventions and culturally sensitive mental health support.(4).

Public health actions and policies for Indigenous Peoples

Promoting Indigenous health necessitates a multi-sectoral collaboration that prioritises Indigenous voices and perspectives. Such collaborative efforts enable the implementation of integrated actions across various levels of government and society, ultimately striving to improve the quality of life and promote health and well-being for Indigenous communities. This need for a comprehensive and interconnected approach was a recurring theme in participant discussions regarding public health policies, with many emphasising the fundamental importance of guaranteeing the right to Indigenous Lands as a non-negotiable prerequisite for their health and well-being. One of the most contentious issues in Brazil revolves around the demarcation of Indigenous Lands, defined as areas inhabited by Indigenous Peoples for their productive activities, cultural preservation, and the continuation of their traditions. Indigenous Land is not merely a physical space; it is a fundamental component of cultural and religious identity, ensuring the survival of Indigenous communities and serving as their ancestral territory.(29,33). Indigenous Peoples maintain a harmonious relationship with their cultures and spirituality, actively engaging in the protection, preservation, and continued development of their traditions to ensure the transmission and flourishing of their collective identity for future generations(4).

Water scarcity has emerged as a pressing global concern. Indigenous communities, acutely aware of the consequences, actively seek to conserve uncontaminated springs and restore those that have been polluted or damaged. This proactive approach stems from the understanding that environmental degradation and water scarcity directly threaten their survival. Beyond land and water rights, participants highlighted the need for comprehensive public policies and government actions that improve the quality of life for Indigenous people across multiple domains, including access to healthcare, education, sports, leisure, culture, and infrastructure. They

emphasized the importance of stricter legislation to prevent mining and deforestation on Indigenous lands.

Strengths and limitations of the study

This study embraced a culturally sensitive and trust approach, Building trust and rapport with Indigenous participants. This grounding in the Brazilian context enhances the relevance and applicability of the findings.

Despite these strengths, the study has limitations. Expanding the sample size and diversity to include a broader range of ethnicities, indigenous policymakers, and young people from various villages would have enriched the study's interpretive value and ensured a wider representation of Indigenous perspectives.

Furthermore, acknowledging the diverse cultural practices and beliefs within different Indigenous communities is crucial. While the restoration of communal balance, harmony, and collective well-being is a shared concern, the specific challenges stemming from environmental degradation vary across ethnic groups due to distinct historical, geospatial, and cultural contexts.

Conclusion

Indigenous communities are disproportionately affected by environmental degradation and climate change, further compounded by challenges related to the demarcation of Indigenous lands, essential for their survival and cultural preservation. To address these pressing issues, they argue strongly that it is imperative to implement and strengthen intersectoral actions that prioritise environmental preservation, including water conservation, forest protection, and sustainable agricultural practices, thereby ensuring a brighter future for these communities. Traditional practices and knowledge foster a sense of belonging and cultural rootedness, but the lack of access to essential resources and the challenges of integration into mainstream society can create vulnerabilities. Furthermore, a complex interplay exists between the environment and Indigenous mental health, often associated with substance abuse and contributing to alarmingly high suicide rates. Public health policies need to be developed with Indigenous Peoples to address these multifaceted challenges. A holistic approach to health, coupled

with collaborative strategies that value the strengthening of connections with nature and community, are fundamental to promote the overall well-being of Indigenous peoples.

Data sharing statement

Data are available upon reasonable request

Contributorship statement

AG serves as guarantor and accepts full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. SH, PJ, ID, and AV coordinated the study, edited, and revised the manuscript. JS, MR, and LB analyzed the quantitative data and wrote the first draft of the manuscript with additions from XZ. All authors were involved in designing the study. All authors contributed to the article and approved the submitted version.

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Competing interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Figure 1

304x187mm (96 x 96 DPI)

Interview Script

Vignette 1

An indigenous Brazilian activist took part in the official opening of the Climate Summit Conference (COP26) in Glasgow, Scotland in 2021. In her speech, the 24-year-old spoke about climate change and indigenous peoples. I'm going to show an excerpt from this speech:

Show video - Vignette 1 (https://bit.ly/3SwZsmq)

Questions

1 - What did you think of the video? Comment on the subject

2 - What caught your attention in the video? Why?

3 - In your opinion, could climate change affect the lives of indigenous people? How? In what way?

4- Could you comment further on public policies and climate change in Brazil? Can you name some actions that could help improve existing problems?

Vignette 2

Mental health problems are common among people all over the world, and among the indigenous population too. The following video illustrates some of this problem

Show video - Vignette 2 (https://bit.ly/3A6g6Tt)

1 - What did you think of the video?

2 - Which part caught your attention the most?

3 - Do you think climate change could affect the physical or mental health of indigenous people? Why? In what way? How?

4 - How could the indigenous person's death have been avoided?

5 - Would you like to comment further on public policies related to the mental health of indigenous people in Brazil? Can you name some actions that could help improve the existing problems?

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:
Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

YOU MUST PROVIDE A RESPONSE FOR ALL ITEMS. ENTER N/A IF NOT APPLICABLE

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Inter viewer/facilitator	Which author/s conducted the inter view or focus group?	10
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	5
3. Occupation	What was their occupation at the time of the study?	5
4. Gender	Was the researcher male or female?	N/A
5. Experience and training	What experience or training did the researcher have?	6
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	5
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	7
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	6
Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	5
Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	6
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	6
12. Sample size	How many participants were in the study?	5

13. Non-participation	How many people refused to participate or dropped out? Reasons?	6
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	5
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	6
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	6
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	7
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	N/A
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	7
20. Field notes	Were field notes made during and/or after the inter view or focus group?	8
21. Duration	What was the duration of the inter views or focus group?	8
22. Data saturation	Was data saturation discussed?	8
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	N/A
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	9
25. Description of the coding tree	Did authors provide a description of the coding tree?	N/A
26. Derivation of themes	Were themes identified in advance or derived from the data?	10
27. Software	What software, if applicable, was used to manage the data?	10
28. Participant checking	Did participants provide feedback on the findings?	14
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	10-14
30. Data and findings consistent	Was there consistency between the data presented and the findings?	15
31. Clarity of major themes	Were major themes clearly presented in the findings?	15
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	15

Once you have completed this checklist, please save a copy and upload it as part of your submission. When requested to do so as part of the upload process, please select the file type: *Checklist*. You will NOT be able to proceed with

submission unless the checklist has been uploaded. Please DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

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Environmental degradation, climate change and health from the perspective of Brazilian Indigenous stakeholders: A qualitative study

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Environmental degradation, climate change and health from the perspective of Brazilian Indigenous stakeholders: A qualitative study

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Abstract

Background

The World Health Organization (WHO) identifies climate change as the most significant threat to global health systems. Indigenous peoples, with their lives deeply intertwined with nature, are particularly vulnerable to the impacts of these changes

Objective

This study aimed to understand the perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health.

Design

A qualitative study with 22 Indigenous stakeholders and public services managers on climate change and perceived impact on Indigenous health

Setting and Participants

Indigenous stakeholders and public services managers on climate change and perceived impact on Indigenous health from Brazil. Data was collected through interviews incorporating two vignette videos depicting environmental and health scenarios. Thematic content analysis was used to analyse the data.

Results

The analytical process yielded six subcategories that were further grouped into three overarching thematic macro-categories: Environmental Degradation and Climate Change in the Context of Indigenous Peoples; Environment, Vulnerability, and Impact on Indigenous Mental Health; and Actions and Public Health Policies for Indigenous Peoples.

Conclusion

The perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health were deeply entrenched in their lived experiences of loss of their Lands from deforestation and environmental degradation. They argued strongly for the strengthening of public health policies aimed at the Indigenous Peoples, to face the many challenges, especially suicide, and to have a voice in decision-making. A sensitive approach that value Indigenous People's connections with nature is fundamental to promote their health and well-being.

Keywords: Indigenous, Climatic changes, Mental health, Community-based participatory research

Strengths and limitations of this study

- A blend of culturally and environmentally focused vignettes and interviews.
- Inclusion of Indigenous voices in shaping policy and program development.
- Narrated interviews that offer community perspectives.
- Underrepresentation of various Indigenous ethnicities.
- Small sample size leading to less precise measurements.

Introduction

Brazil's Indigenous population, now over 1.65 million according to the 2022 Census, has seen a notable increase due to birth rates, which are higher than that of the non-Indigenous population(1), and to an increase in self-recognition of Indigeneity as a result of political participation of Indigenous peoples(2). As with Indigenous peoples globally, compared to non-Indigenous population in Brazil, the Indigenous population experiences poorer health and well-being(3). A recent report on mortality trends 200-2016 showed increasing mortality for both females and males for most age groups(4). The highest increases were observed for those aged >=60 years and 10 to 19 years. In children <5 years, the main causes of death were infectious and parasitic diseases, as well as respiratory diseases(5). Between 5- 59 years, external causes ranked first and were responsible for more than half of all deaths among those 10-19 years(3). Circulatory diseases were most common cause of deaths for those >=60 years(4-6). These trends are linked to poor provision of basic social and health services including precarious sanitation conditions that make children vulnerable infections, conflicts between farmers and indigenous people and urban violence, and a general erosion of Indigenous traditions and customs in agriculture, hunting and fishing(7).

Environmental degradation pose a critical threat to Indigenous health. Ecosystem degradation, rising temperatures, and extreme weather events are major concerns, with the World Health Organization recognizing climate change as the greatest challenge to global health. Indigenous peoples, deeply connected to nature, are particularly vulnerable to these changes(8-10). A recent study found high levels of mercury in hair samples and mouth swabs among members of the Yanomami Indigenous group living in nine villages in the upper Mucajai river in the northern state of Roraima where illegal gold mining is common(6). Mercury consumption was high due to contaminated fish which is one of the Yanomami's main food sources. Cognitive deficits among children were observed in half of the children surveyed in 9 villages. There are also concerns that deforestation and degradation are linked to high rates of substance use and suicides among Brazil's Indigenous communities(7). Indigenous knowledge has been used for centuries for local adaptations for environmental sustainability. Indigenous scholars have long argued that their knowledge is critical for long-term sustainable solutions for biodiversity loss, water scarcity, pollution, sustainable livelihoods and general environmental resilience(8,9).

The Indigenous participants in this study are from South and Midwest Brazil. They strive to maintain their demarcated lands and spiritual connection to nature, possess a rich storytelling tradition that reinforces their identity and belonging(8). Their schools promote the retention of Indigenous knowledge and practices that can resolve local environmental challenges(10). For example, the Indigenous schools integrate growing and eating of cultural foods into the curriculum, oral learning methods, and participation in village activities with community leaders, shamans, parents, and elders.(11,12)

This study aimed to understand the perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health.

Methods

Theoretic framework

This qualitative study employed in-depth interviews to gather and analyze perspectives on the impacts of climate change on Indigenous health. Grounded in the principles of political ecology, which examines conflicts and socio-environmental changes, along with their interactions and relations with human societies, this theoretical lens guided both the study design and the subsequent development of analytical categories (13–14). Methodological rigor was ensured through adherence to the Consolidated Criteria for Qualitative Research Reports (COREQ) (15).

Trusting relationships

We collaborated with key Indigenous stakeholders in Mato Grosso do Sul, Brazil. Building upon long-established community-academic partnerships, our research team prioritised cultural integrity and agency by integrating Indigenous knowledge and values throughout the research process. The research question emerged organically from our ongoing collaborative work with this community since 2017.

Setting

While the study was based in Campo Grande, Mato Grosso do Sul, the snowball sampling method resulted in data collection across six cities (Brasilia, Campo Grande, Porto Alegre, Guarita, Dourados, and Terenos) and three Brazilian states (Mato Grosso do Sul, Federal District of Brasilia, and Rio Grande do Sul).

Participant selection

The recruitment of participants took place through the announcement on social networks and e-mail contacts of the authors. The participants voluntarily agreed to participate in the research and were recruited using snowballing(16). In this non-probabilistic sampling technique, the individual selected intentionally to participate in the study invites or indicates new participants from their social or professional network. Of an initial 30 interested participants, 22 participants met the inclusion criteria (see section on 'Participants'). One of the participants indicated a new contact who, in turn, referred to others, and so on, until the 22nd participant, by which time data saturation had been reached (17).

Participants

The study involved 22 Indigenous stakeholders/public service managers. Inclusion criteria were: a) Public service managers: individuals over 18 years old, holding management roles across municipal, state, or federal levels in executive, legislative, or judicial branches, operating in Indigenous areas. b) Indigenous peoples: individuals aged over 18 years old, self-identifying and recognised as belonging to an Indigenous ethnic group with distinct cultural characteristics from the national society. The characterization of the research participants is presented in Table 1.

Table 1 – Characterization of research participants.

Variables	**n**	**%**
Gender		
Female	12	54,5
Male	10	45,5
Age group		
20-29 years	5	22,7
30-39 years	8	36,4
40-49 years	7	31,8
50-59 years	2	9,1
Training		
Technical	2	9,1
Undergraduate	5	22,7

Post-graduate	15	68,2
Working time in Indigenous health/public service management		
Less than 1 year	1	4,5
Between 1 and 5 years	5	22,7
Between 6 and 10 years	7	31,9
Between 11 and 20 years	8	36,4
More than 20 years	1	4,5
I have another job		
No	17	77,3
Yes	5	22.7

Just over half of the participants were female, and two-thirds were between 30-49 years old, and had a post-graduate qualification. Two thirds had spent between 6-20 years working in Indigenous health or public service management from Terena and Kaingang ethnicity.

Data collection

The data collection process was developed by a university employed researcher, who was trained in qualitative methods. The interviewer worked in the same municipality as the data collection site, but in different services.

The data collection was carried out between August 2021 and April 2022, using vignettes and semi-structured interviews. The interviews lasted approximately 60 minutes and were carried out according to the availability of participants, using remote communication technology with audio and video recording, for later transcription. The aim of the interview was for the interviewee to discuss the proposed topic, without losing sight of the research objectives, following a script or previously elaborated structure(15) The interviews initially answered questions relating to their gender, age, length of time working with Indigenous health/management and whether they have another job. The interviews were conducted online and it is available as supplementary file. During the interviews, two vignettes in the form of video, were presented to the participants. Vignettes are known to: a) Enhance realism by considering various contextual factors and guiding participants' focus towards specific aspects of the research question; b) offer a standardised stimulus and improve reliability,; c) reduce social desirability bias and

strengthen participant engagement (15) The first video illustrate a Brazilian Indigenous activist who participated in the official opening of the Climate Summit Conference (COP26) held in Glasgow in Scotland in 2021, she speaks about Indigenous People and their important role in practices that are helping to mitigate or adapt to climate change: https://bit.ly/3SwZsmq

The second video shows mental health problems and access to health services for Indigenous People, the video narrates a case that occurred with a child, found available at the link: https://bit.ly/3A6g6Tt

To support the research, we used the tools made available by the G-Suite package, from Google. The interviews were carried out virtually via Google Meet; The signing of the consent term and the completion of the profile questions will be answered via Google Forms before the start of the interview; the recording of the interview and transcripts are stored on google drive; Finally, the collaborative documents for transcription and analysis were used in google documents.

A summary of the device functionality and objective is described in the following Box 1.

Box 1 – Functionalities and objectives for the use of the G-Suite tools

Device	Functionality	Objective
Google Meet	Realization of synchronous interactions of audio, video, texts and projection of electronic content.	Perform interviews
Google Forms	Access and submission of the free and informed consent term.	Completion of questionnaires and signature of Informed Consent Form
Google Drive	Storage of electronic documents of various formats.	Storage of the recordings of the interviews and two transcription documents and data analysis.
Google Documentos	Collaborative creation and edition of two researchers of text documents.	Transcription of the recordings treatment, documentation and analysis of two data

Data analysis

Data analysis was conducted using thematic content analysis, a method that involved dissecting the text into units to uncover the underlying nuclei of meaning within the communication. These nuclei were then regrouped into distinct classes or categories(18). For data analysis, to reach the manifest and latent meanings in the material, Content Analysis was carried out using the Atlas.ti Software, version 9, according to analytical precepts aimed at health(19), and was divided into three stages:

a) Pre-analysis: carried out through transcription, reading, correction of language errors 0and prior organization of all interviews. After this organisation, the text documents were inserted into the software.

b) Exploration of the material: this stage consisted of the process of immersion in the subjects, from the selection of expressive excerpts converging to the research objective, creation of codes and groupings into converging themes.

c) Data processing: the moment of inference consisted of two authors relating excerpts from the transcriptions, codes and groupings of codes to form subcategories and categories. Rounds of evaluation were carried out by the study authors to establish consensus on the codes that would be in each grouping. The citation excerpts from the chosen codes were those that had greater frequencies, co-occurrence, that is, connections with other codes, and were more significant from the researcher's perspective, in order to more clearly represent the theme covered. The initial results were tabulated to show thenetwork of words which emphasised the most expressive concepts in two selected passages. Excerpts of quotes were then selected to bring together a coherent narrative across the interviews.

Ethics

The research project was approved by the Research Ethics Committee of the University of Brasília (CEP/UNB) and by the National Research Ethics Commission (CONEP) under opinion no. 4,279,173, also respecting ethical standards established in Resolution CNS Resolution no. 510 of 2016 and Resolution CNS No. 466 of 2012 of CONEP (CAAE: 37321520.4.0000.5020).

The anonymity of the participants was preserved by the inclusion of an alphanumeric code composed of the letter P of participants followed by a cardinal number. For example: P1 referring to participant number 1 and so on.

The recording audios were deleted after transcription and the transcriptions were saved on the external hard drive held by the study coordinator.

Patient and public involvement

The study design was co-developed in close collaboration with Indigenous community members and leaders, building upon established relationships from previous studies. This participatory approach ensured that the research questions, methodologies, and data collection methods were culturally relevant, respectful, and responsive to the unique needs and priorities identified by Indigenous communities. Upon publication, study results will be shared directly with all participants through culturally appropriate channels, including face-to-face meetings for local participants and online platforms for those residing further away, fostering ongoing dialogue and knowledge exchange.

Results

The analytical process allowed the selection of 1101 citation excerpts, 21 codes, six subcategories grouped into three thematic macrocategories is presented in Table 2.

Table 2 - The number of quoted passages according to codes, subcategories and thematic categories on climate change and health in the Brazilian Indigenous context

Categories and subcategories	Codes
Environmental degradation and climate change in the context of indigenous peoples	
Public policies	Indigenous adolescents
	Demarcation of Unworthy Lands
	Water
	Joint intersectoral actions
Environment	Climate change and environmental degradation
	Environmental preservation
	Forest use
	Agriculture
Environment, vulnerability and indigenous mental health	
Problems of indigenous peoples	Culture
	Lack of access
	Difficulty integrating into society
Mental health	Suicide
	Experiences
	Sense of belonging
	Drugs and alcohol
Public health actions and policies for indigenous peoples	
	Immediate actions
	Indigenous voices

Suggestions

They haven't seen reality
Community
Nature
Dignity and health

The category that commonly identified was environmental degradation and climate change in the context of Indigenous Peoples, reinforcing the need for public policies that relate to Indigenous adolescents and the impacts of climate changes and environmental degradation. This intrinsic connection to the environment makes the integration of the knowledge and experiences of Indigenous communities essential for environmental preservation. The following quotes represent this analytical category:

"... We Indigenous People do not understand this land and territory as something to be explored, as something to be devastated, as something to serve us, an idea that the environment is at the service of human beings. The Indigenous Peoples have a much deeper, much more refined understanding, an understanding that the environment and we are so intertwined that if we destroy the environment, we also destroy the human being" (P15).

"I think that where the Indigenous People are, they preserve the river, the forest, the animals. They learned through the teachings of what was passed down by their ancestors... I think that if you preserve it, you will reverse this situation that it is today, that nobody knows anymore, nobody is 100% sure of what the climate, the now, the future will be like. tomorrow." (P13)

"Today it's quite complicated for our Indigenous People here in the village, many are no longer planting that swidden they planted before, it's not worth it anymore, so he's leaving to work in the city as a mason's servant, as a day laborer to be able to bring food to his house, for that if you depend on family farming you go hungry. (P14)

"... climate change affects in every sense, it interferes physically, psychologically, mentally, culturally, because it is nothing separate, if there was a spring that no longer has drinking water for the Indigenous community, then it will affect the physical, there is no water, there are no forests, there are no animals..." (P5).

"[...] for example, when there are fires, because of the warming, this harms our territory, our health, our housing..." (P7).

The environment, vulnerability and Indigenous mental health were also another analytical group, prevailing the difficulties of cultural maintenance and mental health problems such as suicide. The following quotes represent this analytical category:

"Their mental health is also very affected by this lack of opportunity, work, income, support. Drought is a very serious problem here that I have noticed since last year, this year it is very complicated here. So they themselves, due to economic difficulties, also end up having a practice that contradicts their origin, their whole culture, this is very present here." (P14)

"[...] it is precisely because of this extreme lack of perspective on life, of motivation to live, that alcohol and drugs finally become an escape from the miserable reality they live. The incidence of alcohol and drugs in the Indigenous community is very high, perhaps the most decimating agent of Indigenous culture. [...] Here [village] everything [drugs and drink] comes in. They become addicted, and they have to steal, find a way to get money to buy the drug. We had a recent case of death of a child whose mother was an alcoholic and left the child without food and ended up dying, very dramatic". (P3)

"[...] many of the Indigenous People end up going into depression due to living in a culture strongly influenced by whites, losing their ethnic origins, being in an existential limbo that leads to suicide and they also have access to alcohol from a very early age and alcohol makes them also commit crimes, commit suicide...". (P8)

"Suicide is a reality [...] and among the Indigenous population it is gigantic, [...] there is this issue of land, of belonging, of not belonging, of how to deal with the problems, many times they somatize everything and then suicide is the only way that perhaps many of them believe to be the solution..." (P1)

Finally, the need to promote public and health policies for Indigenous Peoples with Indigenous People involved in the decisions made about them and their Lands. This

will ensure that the interconnectedness between their communities, nature and their health is understood and protected. The following quotes represent this analytical category:

"I understand that those who know what is best for the Indigenous People are the Indigenous People themselves, they have enough capacity to decide what is best for them. They have the ability to decide on health, education, social work, basic sanitation, the environment". (P1)

"In the first place, it is bringing those populations that are most affected, [...] bringing traditional peoples to occupy decision-making positions, we need to do that. Need these policies to be made by those who are affected and think about the direct consequences". (P21)

"Demarcation of Indigenous lands is the first point and from the demarcation of Indigenous lands, the development of public policies so that they can remain in these territories and have conditions for this, including public policies, so that they can manifest their language and culture anywhere". (P1)

"Before talking about public policy for Indigenous health, the first action must be to guarantee the right to land, with protection of their sacred territories because everything is interconnected. Secondly, the qualification of special Indigenous health teams to act in the prevention and promotion of mental health and network articulation for the treatment of more delicate cases". (P9)

"You walk in the village, you walk in the schools, you see dirty people, it's not because they are filthy, because they like dirt, it's because of the lack of water, which they don't even have to drink. So what public policies do I recommend? I recommend policies that guarantee human dignity, such as access to water, investments so that each residence can have a water tank, because sometimes there is and there is not enough for a long period". (P18)

"If you don't have potable water, ready to drink, you are subject to going to a dam sometimes and getting water that is unfit for consumption." (P12)

The extracted concepts obtained by means of the relations between two passages of citations, codes and categories represent a synthesis of the proposed research object, connecting all the categories, subcategories and codes. Figure 1 illustrates the main conceptual representation about climate change and health in the Brazilian Indigenous context

[insert figure 1]

Figure 1 – Conceptual representation about climate change and health in the Brazilian Indigenous context

DISCUSSION

The perspectives of Indigenous stakeholders and public services managers on the interconnectedness of climate change and Indigenous health Indigenous were deeply entrenched in their lived experiences of loss of their Lands from deforestation and environmental degradation and impacts on customs, livelihoods, and health of their communities. We highlight some salient points related to the key themes that emerged from the interviews.

Environmental degradation and climate change

Environmental degradation and climate change, fueled by global warming, have emerged as significant threats to quality of life, as highlighted by participants in this study. Indigenous peoples, recognised as stewards of the Earth, are disproportionately affected due to their close relationship with the environment and reliance on natural resources.

This impact is amplified for those residing in vulnerable areas near rivers, slopes, and forests, exacerbating existing inequalities, marginalization, and the enduring legacy of colonization. Consequently, climate change poses a public health crisis across Latin America and the Caribbean, a region with numerous low-income countries characterized by fragile economies and limited healthcare access. Home to over 40 million Indigenous people whose health and well-being are inextricably linked to the environment, the region faces unique challenges in mitigating the adverse effects of climate change on its most vulnerable populations.(19).

The ongoing process of environmental degradation poses a grave threat to the survival and cultural integrity of Indigenous Peoples. The depletion of natural resources essential for their traditional livelihoods, coupled with the potential for escalated conflicts over dwindling resources, could ultimately lead to devastating consequences, including the risk of cultural genocide. (20,21). Ecosystem conservation is paramount for Indigenous peoples, as their culture, worldview (cosmovision), and survival are intrinsically linked to nature. They not only depend on a balanced environment for their livelihoods but also interpret natural signs as indicators for various events, further emphasizing the critical importance of preserving their ecosystems(10,22).Indigenous subsistence practices have evolved over time, incorporating various customs. Despite these changes, Indigenous peoples maintain a deep understanding of themselves as an integral part of nature. They establish balanced, non-monetary exchange systems that preserve biomes and biodiversity, utilizing natural resources without jeopardizing the ecosystem.

Participants emphasised that environmental degradation and climate change disrupted subsistence agriculture, forcing the replacement of traditional Indigenous crops. This shift is problematic because traditional crops, as integral components of the ecosystem, play a crucial role in conserving nature(23,24). The traditional knowledge, cultural practices, land-use patterns, and resource management systems employed by Indigenous Peoples have historically played a crucial role in safeguarding biodiversity, maintaining hydrological cycles, curbing deforestation, preserving forest carbon stocks, and providing vital environmental services that contribute to the stability of climatic conditions.(25). Indigenous lands harbor unique elements that contribute to improved living conditions for society, extending beyond environmental benefits to economic advantages as well. The wealth of traditional knowledge and Indigenous socio-biodiversity offers significant potential for generating income through a variety of products and services. The concept of a bioeconomy that promotes sustainable environmental management while respecting the rights of Indigenous Peoples and fostering their own development (ethnodevelopment) presents a promising avenue for addressing the challenges faced by these communities.(26).

The migration of Indigenous Peoples to urban centers across Latin America is a growing social phenomenon, driven by a complex network of factors. Among these, the loss of Indigenous territories and environmental destruction play a significant role. It is estimated that more than 200 million People in the world will be forced to leave their

regions due to climate change(27). This displacement forces individuals and entire communities to abandon their territories, disrupting their livelihoods, altering production systems, and jeopardizing their very survival(4).

Environment, vulnerability and impact on Indigenous mental health

Within the Brazilian context, the concept of mental health among Indigenous populations has been widely debated. Generally, it is understood as encompassing individual, family, social, or community well-being, often referred to as "good living." (25,28). Indigenous Peoples demonstrate a significantly higher prevalence of mental distress compared to majority populations. This heightened vulnerability is influenced by a complex interplay of historical traumas, including the enduring legacy of colonialism, racism, slavery, and land dispossession (29,30). Brazilian Indigenous Peoples are experiencing a dramatic escalation of land grabbing, illegal logging, mining, invasions, and even the establishment of unauthorized settlements within their traditional territories. This escalating conflict over Indigenous lands has reached alarming levels, threatening the very existence of numerous Indigenous communities in Brazil. The resulting social and environmental upheaval has severe repercussions on mental health, exacerbated by factors such as social marginalization, disrupted lifestyles and livelihoods, and exposure to violence(31,32).

The report "Violence Against Indigenous Peoples in Brazil" reveals a concerning rise in documented violence and the highest number of Indigenous suicides in recent years. The loss of territory and agricultural land, racism, poverty, social vulnerability, and inadequate healthcare access have been identified as key contributing factors to this alarming increase in suicides(7). The proliferation of alcohol and other drugs within numerous Indigenous villages is a growing concern. While attributed to various factors, this issue is particularly linked to the limited opportunities and lack of prospects faced by Indigenous Peoples.

The Brazilian Ministry of Health recognizes the Indigenous population as vulnerable and experiencing a high incidence of psychosocial issues, including chemical dependency (alcohol and other drugs), misuse of psychotropic medications, suicide, and violence. This alarming situation is attributed to the disruption of traditional ways of life, challenges in securing economic subsistence, and exposure to conflicts. These factors contribute to significant suffering within Indigenous communities, often leading to self-destructive behaviors (7,32). The alarming deterioration of mental health among Indigenous Peoples in Brazil, tragically culminating in a disproportionately high suicide

rate, underscores the heightened vulnerability experienced by this marginalized population. This stark disparity reflects the systemic denial of fundamental rights and the inadequacy of existing public policies. The suicide mortality rate among Indigenous individuals in Brazil, at 15.2 per 100,000, is nearly three times that observed in the non-Indigenous population (5.7 per 100,000), highlighting the urgent need for targeted interventions and culturally sensitive mental health support(4).

Public health actions and policies for Indigenous Peoples

Promoting Indigenous health necessitates a multi-sectoral collaboration that prioritises Indigenous voices and perspectives. Such collaborative efforts enable the implementation of integrated actions across various levels of government and society, ultimately striving to improve the quality of life and promote health and well-being for Indigenous communities. This need for a comprehensive and interconnected approach was a recurring theme in participant discussions regarding public health policies, with many emphasising the fundamental importance of guaranteeing the right to Indigenous Lands as a non-negotiable prerequisite for their health and well-being. One of the most contentious issues in Brazil revolves around the demarcation of Indigenous Lands, defined as areas inhabited by Indigenous Peoples for their productive activities, cultural preservation, and the continuation of their traditions. Indigenous Land is not merely a physical space; it is a fundamental component of cultural and religious identity, ensuring the survival of Indigenous communities and serving as their ancestral territory(29,33). Indigenous Peoples maintain a harmonious relationship with their cultures and spirituality, actively engaging in the protection, preservation, and continued development of their traditions to ensure the transmission and flourishing of their collective identity for future generations(4).

Water scarcity has emerged as a pressing global concern. Indigenous communities, acutely aware of the consequences, actively seek to conserve uncontaminated springs and restore those that have been polluted or damaged. This proactive approach stems from the understanding that environmental degradation and water scarcity directly threaten their survival. Beyond land and water rights, participants highlighted the need for comprehensive public policies and government actions that improve the quality of life for Indigenous people across multiple domains, including access to healthcare, education, sports, leisure, culture, and infrastructure. They

emphasized the importance of stricter legislation to prevent mining and deforestation on Indigenous lands.

Strengths and limitations of the study

This study embraced a culturally sensitive and trust approach, Building trust and rapport with Indigenous participants. This grounding in the Brazilian context enhances the relevance and applicability of the findings.

Despite these strengths, the study has limitations. Expanding the sample size and diversity to include a broader range of ethnicities, indigenous policymakers, and young people from various villages would have enriched the study's interpretive value and ensured a wider representation of Indigenous perspectives.

Furthermore, acknowledging the diverse cultural practices and beliefs within different Indigenous communities is crucial. While the restoration of communal balance, harmony, and collective well-being is a shared concern, the specific challenges stemming from environmental degradation vary across ethnic groups due to distinct historical, geospatial, and cultural contexts.

Conclusion

Indigenous communities are disproportionately affected by environmental degradation and climate change, further compounded by challenges related to the demarcation of Indigenous lands, essential for their survival and cultural preservation. To address these pressing issues, they argue strongly that it is imperative to implement and strengthen intersectoral actions that prioritise environmental preservation, including water conservation, forest protection, and sustainable agricultural practices, thereby ensuring a brighter future for these communities. Traditional practices and knowledge foster a sense of belonging and cultural rootedness, but the lack of access to essential resources and the challenges of integration into mainstream society can create vulnerabilities. Furthermore, a complex interplay exists between the environment and Indigenous mental health, often associated with substance abuse and contributing to alarmingly high suicide rates. Public health policies need to be developed with Indigenous Peoples to address these multifaceted challenges. A holistic approach to health, coupled

with collaborative strategies that value the strengthening of connections with nature and community, are fundamental to promote the overall well-being of Indigenous peoples.

Data sharing statement

Data are available upon reasonable request

Ethics statements

Patient consent for publication

Not applicable.

Ethics approval

The research project was approved by the Research Ethics Committee of the University of Brasília (CEP/UNB) and by the National Research Ethics Commission (CONEP) under opinion no. 4,279,173, also respecting ethical standards established in Resolution CNS Resolution no. 510 of 2016 and Resolution CNS No. 466 of 2012 of CONEP (CAAE: 37321520.4.0000.5020).

Contributorship statement

AG serves as guarantor and accepts full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. SH, PJ, ID, and AM coordinated the study, edited, and revised the manuscript. JS, MR, and LC analyzed the quantitative data and wrote the first draft of the manuscript with additions from XZ and RS. All authors were involved in designing the study. All authors contributed to the article and approved the submitted version.

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Competing interests

No, there are no competing interests for any author.

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Conceptual representation about climate change and health in the Brazilian Indigenous context

304x187mm (96 x 96 DPI)

Interview Script

Vignette 1

An indigenous Brazilian activist took part in the official opening of the Climate Summit Conference (COP26) in Glasgow, Scotland in 2021. In her speech, the 24-year-old spoke about climate change and indigenous peoples. I'm going to show an excerpt from this speech:

Show video - Vignette 1 (https://bit.ly/3SwZsmq)

Questions

1 - What did you think of the video? Comment on the subject

2 - What caught your attention in the video? Why?

3 - In your opinion, could climate change affect the lives of indigenous people? How? In what way?

4- Could you comment further on public policies and climate change in Brazil? Can you name some actions that could help improve existing problems?

Vignette 2

Mental health problems are common among people all over the world, and among the indigenous population too. The following video illustrates some of this problem

Show video - Vignette 2 (https://bit.ly/3A6g6Tt)

1 - What did you think of the video?

2 - Which part caught your attention the most?

3 - Do you think climate change could affect the physical or mental health of indigenous people? Why? In what way? How?

4 - How could the indigenous person's death have been avoided?

5 - Would you like to comment further on public policies related to the mental health of indigenous people in Brazil? Can you name some actions that could help improve the existing problems?

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:
Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

YOU MUST PROVIDE A RESPONSE FOR ALL ITEMS. ENTER N/A IF NOT APPLICABLE

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Inter viewer/facilitator	Which author/s conducted the inter view or focus group?	10
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	5
3. Occupation	What was their occupation at the time of the study?	5
4. Gender	Was the researcher male or female?	N/A
5. Experience and training	What experience or training did the researcher have?	6
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	5
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	7
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	6
Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	5
Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	6
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	6
12. Sample size	How many participants were in the study?	5

13. Non-participation	How many people refused to participate or dropped out? Reasons?	6
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	5
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	6
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	6
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	7
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	N/A
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	7
20. Field notes	Were field notes made during and/or after the inter view or focus group?	8
21. Duration	What was the duration of the inter views or focus group?	8
22. Data saturation	Was data saturation discussed?	8
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	N/A
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	9
25. Description of the coding tree	Did authors provide a description of the coding tree?	N/A
26. Derivation of themes	Were themes identified in advance or derived from the data?	10
27. Software	What software, if applicable, was used to manage the data?	10
28. Participant checking	Did participants provide feedback on the findings?	14
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	10-14
30. Data and findings consistent	Was there consistency between the data presented and the findings?	15
31. Clarity of major themes	Were major themes clearly presented in the findings?	15
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	15

Once you have completed this checklist, please save a copy and upload it as part of your submission. When requested to do so as part of the upload process, please select the file type: *Checklist*. You will NOT be able to proceed with

submission unless the checklist has been uploaded. Please DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.