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Research article

"There is no hope; only strong wind": How climate change impacts adolescent mental health in southern Madagascar

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ABSTRACT

Introduction: Climate change threatens children's and adolescents' health worldwide, but there is limited evidence of its effects on mental health in the low- and middle-income countries which are most affected. We focus on southern Madagascar to elucidate pathways through which climate change impacts mental health.
Materials and Methods: In this preliminary study, we collected survey (n = 83; 49 female) and focus group (n = 48; 28 female) data from 10 to 24-year-olds (M = 15.3).
Results: Adolescents were extremely anxious and depressed, with high climate anxiety. Adolescents indicated that climate changes influenced mental health through loss of household resources, uncertainty about the future, and disruption of coping mechanisms.
Discussion: Climate changes exacerbated the existential threats faced by the adolescents. In Madagascar, our results tentatively suggest that interventions and policies should address food and water security, promote adaptive farming practices, and build resources for coping.
Conclusion: Climate changes are having a profound impact on adolescent mental health in southern Madagascar. The mechanistic links through which these impacts occur may be different than in other, more frequently studied contexts. Research examining these pathways in more depth in Madagascar is urgently needed.

1. Introduction

Climate change is a threat to the health and wellbeing of children and adolescents, affecting their fundamental rights to survive and thrive [1–3]. Climate change results in more frequent and severe extreme climatic events (e.g., floods, heat waves), as well as longer-lasting environmental changes (e.g., rising sea levels, changed growing seasons), damaging the natural and social systems on which physical and mental health depend [4]. Half of children worldwide are at 'extremely high risk' from impacts of climate change [5].

Both extreme climatic events and chronic climate changes can lead to or exacerbate anxiety, depression, post-traumatic stress, and other psychological distress in adolescents [1,6–8]. Adolescents are especially vulnerable to the negative effects of climate change given their rapid social and biological development, and these negative effects of climate changes on their health and development may persist across the lifespan [1]. While there are direct, indirect, and overarching impacts of climate change on child and adolescent mental health, this has historically been the subject of limited research or policy action [6]. This is even more so in the low- and middle-income countries which are most heavily affected by climate change [9] and may be less well equipped to deal with both the changes in climate and their effects on the local population [10,11], but are the subject of very little research [12,13]. Rother and colleagues' review, for instance, found only two papers examining how extreme climatic events impact child or adolescent mental health anywhere in sub-Saharan Africa (onh flooding, in Namibia [14] and in Nigeria [15]). Similarly, Cosh and colleagues' systematic review on climate change worry, distress, and major affective disorders among adolescents found no studies conducted anywhere in Africa [16].

Madagascar, an island nation in the Indian Ocean, is one of the least developed countries in the world, with a gross national income of $487 (USD) per capita with a population highly dependent on subsistence farming. Children in Madagascar are extremely vulnerable to climate stresses such as water scarcity, flooding, heatwaves, disease

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susceptibility, and pollution, as well as to more general child vulnerabilities (e.g., child and maternal health and nutrition, lack of access to education or sanitation, and poverty) [17]. Southern Madagascar (Grand Sud) is one of the most severely climate change-affected areas in the world, and the first climate change-induced famine occurred in this region in 2021 [18,19]. While ecologically diverse, broadly, southern Madagascar has experienced substantial changes in climate conditions characterised by increased cyclones, prolonged periods of drought, and extreme heat. The landscape has become increasingly arid, with fertile land turning into desert and water sources depleting [18–20]. This is troubling because of all sequelae of climate change, food insecurity and water insecurity have the most intense and widespread impact on health, including mental health [7]. Southern Madagascar has seen both recurrent food and water insecurity arising from climatic changes [21–23].

As unwilling pioneers of the impacts of climate change, adolescents in southern Madagascar can provide information on challenges they experience as well as key insights into the ways in which climate changes impact adolescent mental health. We focus on adolescents in Androy, Madagascar to examine the pathways through which chronic climate changes affect mental health as well as the rates of psychological distress and climate anxiety. In this preliminary study, we use mixed methods to gain a deep understanding of participants' experiences, examining the potential pathways through which climate change impacts adolescent mental health in this region of Madagascar from perspective of affected adolescents.

Table 1
Demographics of study sample.

	Survey	Focus group
n	83	48
Age range (in years)	10 – 24	12 – 24
Mean age (*SD*) (in years)	15.3 (3.8)	15.9 (3.7)
% female	59 %	58 %

2. Methods

2.1. Study design

This project has a mixed methods design, with the collection of quantitative survey day from 83 adolescents and qualitative focus group data from 48 of those same adolescents.

2.2. Participants

We sampled 83 participants for the survey study, of whom 48 took part in 11 focus groups (Table 1). All focus group participants were also survey participants. Participants were sampled from 6 rural villages outside of Ambovombe in Androy, Madagascar (Fig. 1).

All participants experienced multidimensional poverty. Very few lived in households with electricity (13·3 %); none lived in a household with a motorbike, car, truck, or computer (0·0 %); a third (34·9 %) lived

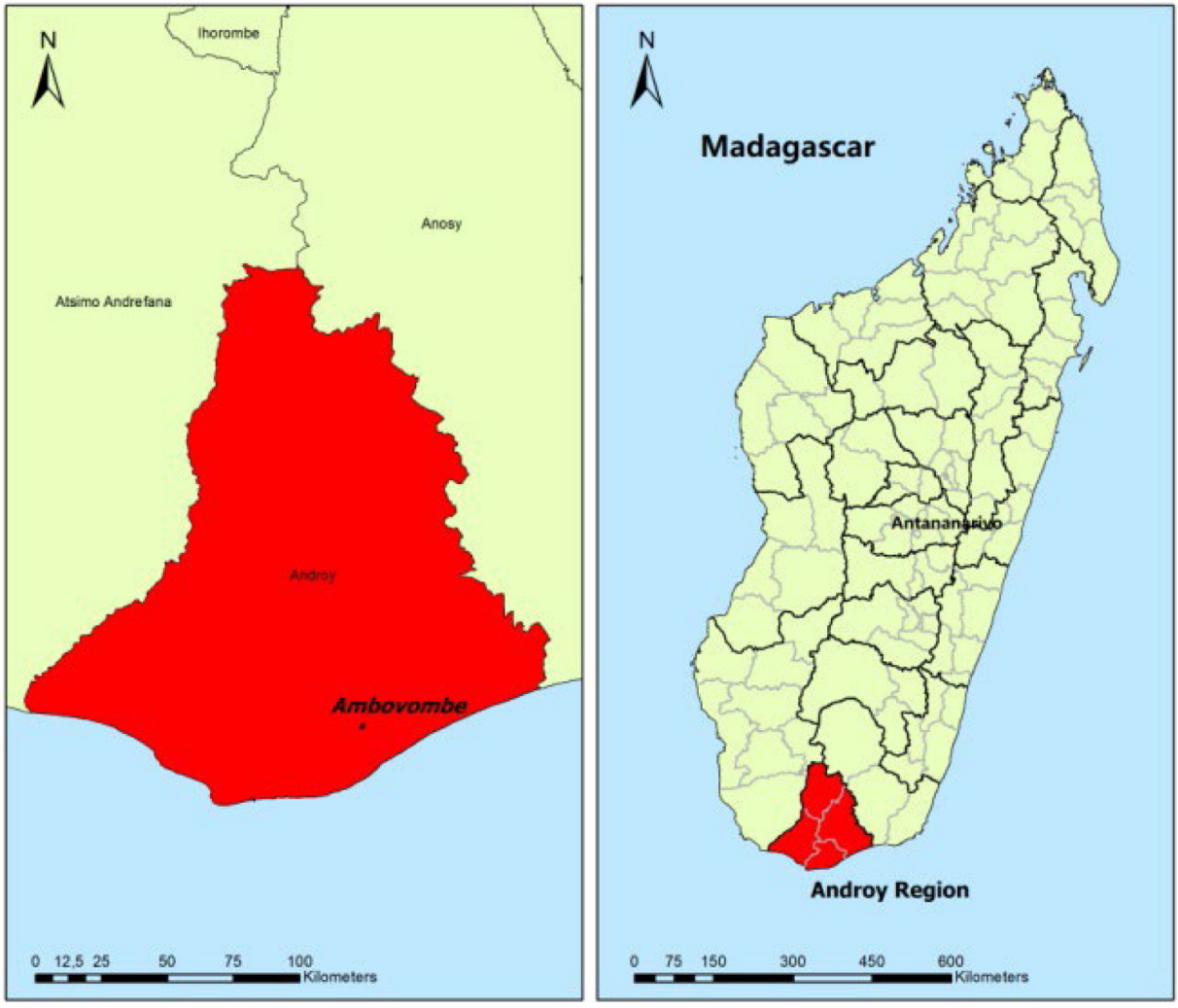

Fig. 1. Location of data collection (adapted from [24]).

in a household with a phone; and almost all either used a pit latrine (56·3 %) or had no toilet facilities, instead using the 'bush' (42·3 %).

2.3. Procedures

Communities chose which 10–24-year-olds would take part from their village. In March 2024, fieldworkers travelled in a group to the villages, conducting survey data collection and focus groups in quiet spots within the villages – typically on the ground under a tree or in the shade of a house. The fieldworkers were all Madagascan, residents of Ambovombe, with prior experience as data collectors. Participants received a bottle of water, soap, and a small snack as remuneration for participation.

To obviate issues of low literacy, survey data was collected out loud, with local fieldworkers asking survey questions aloud and inputting responses directly into the survey software KoboToolbox. KoboToolbox was developed for us in humanitarian contexts, and allows for data collection where internet access is not consistent. For the survey data, one fieldworker worked with one adolescent at a time. Fieldworkers (4 male, 2 female) had collected survey data before and were trained in our survey ahead of data collection. Alongside the survey, we conducted 11 gender-segregated focus groups (6 female groups, 5 male). We aimed to have the focus groups be segregated both by gender in line with cultural norms in the South as well as age (between older and younger adolescents), although in some cases segregation by age was not possible. Focus groups ranged in size from 3 to 6 participants (M=4·4 per group, Appendix A) and lasted 25 minutes on average; they were recorded with consent for subsequent analysis. In focus groups, a trained facilitator used iterative questioning to ask adolescents about climate change, how it has affected them, what and who they turn to for help, and what they want to see done in their community to address climate change and its sequelae. Ethical approval was obtained in February 2024 from Queen Mary University of London QME24.0324.

2.4. Measures

There are no survey measures available that have been validated for use with adolescents in Malagasy, so we used measures widely used elsewhere. Researchers fluent in Malagasy and English conducted translation and back-translation for all measures, to convert to the dialect of Malagasy spoken around Ambovombe. We used the 5-item WHO-5 (α = 0.53, [25]) to assess depressive symptoms, the 7-item GAD-7 (α= 0.56, [26]) to assess anxiety symptoms, the 10-item Climate Change Worry Scale (α=0.81, [27]) to assess concern about climate change, and the 8-item Food Insecurity Experience Scale (FIES) to assess food insecurity [28]. Finally, household wealth was assessed with a checklist measure of locally relevant indicators of wealth. See study OSF for the full questionnaire (https://osf.io/85anh/, 2024).

2.5. Analysis

We analysed the survey data using simple inferential statistics and conducted Pearson correlations to understand the relationships between the scales. For the focus group data, we conducted a thematic analysis, following a six-phase analytic process [29,30]. Focus groups were transcribed in Malagasy, then translated to English, then independently reviewed, and then English language transcripts were coded line-by-line using open coding by author MS, with theme development conducted by authors MS and KH. To promote trustworthiness and credibility in our thematic analysis, we employed continual discussion between authors MS and author KH, thick description, and the focus group data and initial themes were peer reviewed by author IM [31]. Because data was collected through focus groups in challenging conditions, we are not able to provide information on which of the adolescents said which quote, but do – where relevant – provide information by gender, as focus groups were conducted in gender-segregated groups.

3. Results

3.1. Quantitative

Rates of mental health issues were extremely high, with mean scores of 31·85 (*SD*=15·98) on the WHO-5 and 12·78 (*SD*=3·50) on the GAD-7. The WHO-5 is often used as a screener for depression, with scores < 50 indicating probable depression; 82·1 % of our sample scored as having probable depression (Fig. 2). Scores of 8 or 9 are

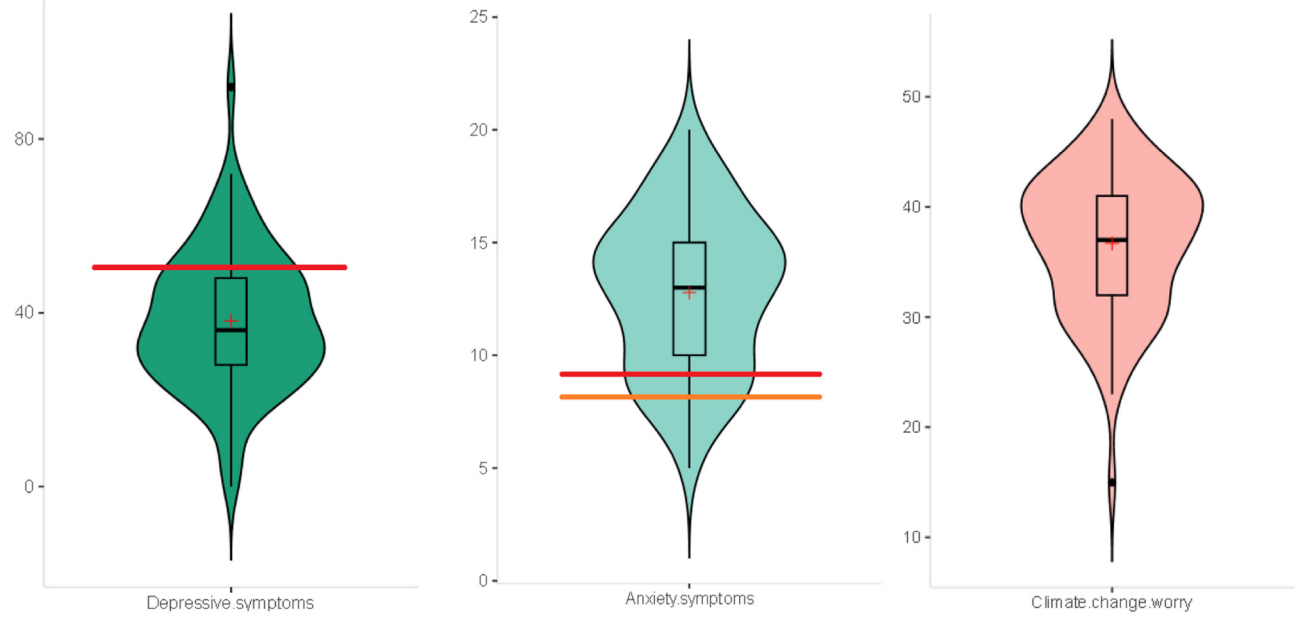

Fig. 2. Violin plots of participant depressive symptoms, anxiety symptoms, and climate change worry

Note: Scores below 50 (red line) on the WHO-5 indicate scores in line with depression and scores above 8 (orange line) or 9 (red line) on the GAD-7 indicate scores in line with generalised anxiety disorder. Possible scores on the WHO-5 range from 0 (lowest wellbeing) to 100 (highest wellbeing), on the GAD-7 from 0 (lowest anxiety) to 21 (highest anxiety), and on the Climate Change Worry Scale from 10 (lowest climate change worry) to 50 (highest climate change worry).

often used as cut-offs for the GAD-7, with scores above this indicative of generalised anxiety disorder. 76.3–86.8 % of our sample scored as having probable generalised anxiety disorder, depending on if using the cutoff of 8 or 9 (Fig. 2). The adolescents had high levels of climate change concern (M=36.26, *SD*=7·48). Food insecurity was also severe, with an average FIES score of 7·03 (*SD*=1·21) out a maximum score of 8. Within the previous 12 months, 90 % had experienced their household running out of food, 95 % had been hungry but did not eat, and 69 % had gone without eating for an entire day; these are indicative of the very highest level of food insecurity. There were no differences by gender for any of the measures. Appendix B shows associations between study variables and Appendix C shows average participant endorsement for each item of the FIES.

3.2. Qualitative

Most people in the Androy region of Southern Madagascar are subsistence farmers or pastoralists, with lives which are closely connected to weather and to changes in the weather. Regardless of gender, adolescents in all focus groups identified similar climate changes in the region: increased heat, more frequent and severe droughts, stronger winds, and greater incidence of sandstorms. They were highly anxious and concerned about these climate changes. Through our thematic analysis, we identified three themes of the potential mechanisms through which climate change impacted their mental health: loss of household resources, a state of uncertainty, and a disruption of coping mechanisms.

3.2.1. Loss of physical resources

Climate changes led adolescents to have almost no or very limited food and water, which caused substantial fear and distress. When asked what the impacts of climate change were, adolescents in multiple focus groups immediately said "*kere*" which is the Malagasy word for famine (lit. 'starving to death'). Completely unprompted, multiple adolescents spontaneously mentioned seeing people starve to death, such as one girl who when describing her village said: "so many died . . . there were many elders, but they died because of the malnutrition."

Because climate change has caused these villages to become "very hot" with "no rain", this has led to "lack of food, malnutrition, water scarcity". The wind and lack of rain led crops to fail and water sources to dry up, with one participant indicating that now there is "no water and when sunlight is burning, we are suffering . . . There is no water to drink because the water in the borehole has been dried. There is no food . . . even cassava is missing." This type of sentiment was repeated over and over, in every focus group: "there is nothing to eat" and "there is no water to drink". Consequently, "life is a misery". For those adolescents that did have food and water, this tended to be poor quality and with limited variety; it was "cassava everyday: morning, noon, and evening." The cost of water was such that it was out of reach of most families, and many adolescents spontaneously brought up the exact price of a jerrycan of water, and how this had changed over the years.

In order to provide food and water, families were forced to sell what possessions they had. When asked what effect climate change had on their daily lives, one girl for instance said, "it has changed a lot because we are forced to sell our utensils like pots, everything we have left!" A boy in another village said: "We were forced to sell our assets to buy food. We did not get a fair price, because stuff we bought for 100,000 Ariary [∼20 Euro], we were forced to sell at 5000 Ariary [∼1 Euro] to prevent the children's death due to starvation".

The adolescents viewed this loss of physical resources and consequent health and mental health challenges to be a direct result of climate changes: "the climate was fine before but now we are suffering because of starvation." From the discourse, it is evident that the concern about starving to death, the direct experience of seeing others starve to death, and a constant state of malnourishment took their toll on the adolescents' mental health. They "are sad" about climate change "because we are afraid. Because we rely on rainfall."

3.2.2. State of uncertainty

The second theme encompasses the state of uncertainty that climate changes brought to adolescents' lives, and how this uncertainty causes them psychological distress. Adolescents indicated that climate changes had reduced their ability to farm, but they were not able to predict how their farming would be impacted in future: "There's nothing that we can predict." Weather is a changeable thing, and even though over time the weather has worsened, and their situation has been more and more tenuous, the adolescents were still hoping every day on the weather being better: wetter, calmer, and with less wind.

A lack of certainty about the future is very challenging to mental health, especially when the lack of certainty is about whether they or their family will have any food. The adolescents indicated that "when it is raining, we are happy because crops are growing well, so we can have daily food to eat" whereas when there was a strong wind or a drought, they were afraid, felt depressed, and slept a lot. When the weather was "changing good, we are happy, but if that is not the case, we are discouraged". Indeed, some of the participants seemed to have moved beyond uncertainty to a deep sense of powerlessness. They felt helpless, with one boy saying, "I have no idea what I can do to be happy. . . I can't find what to do [to be happy] for real." While farmers generally are used to good years and bad years even in absence of famine – and consequently live in some hope that better times will return in the future [32] – that hope seems to have been extinguished for many in southern Madagascar.

3.2.3. Disruption of coping mechanisms

Despite challenges of climate change to their mental health, the adolescents identified many resilience resources. These included close friends and family, religious faith, supportive communities, going to school, and opportunities for fun (games, music, reading). However, some of the coping mechanisms that they would use in order to mitigate the effects of climate changes on their lives were themselves disrupted because of climate change. Our final theme encompasses this disruption to their coping mechanisms, including their ability to go to school and opportunities to have fun.

Climate change both directly and indirectly impacted their ability to go to school. It did so directly, by making the school inaccessible during extreme climatic events: "We're not going to school because of the *tiomena* ['red wind', sandstorm], and when we are at school, the teacher sometimes cancels classes [because of the weather]." Some schools were not built to withstand the more extreme weather which has arisen from climate change, with participants indicating they need "a school resistant to the wind". Climate change also indirectly impacted their ability to pay their school fees: "due to lack of resources because of climate change, I stopped going to school."

Poverty associated with climate change also directly impacted their ability to have fun. Most (72·3 %) of the adolescents did not have a radio in their household, but those who did said that dancing and listening to the radio were ways to cope with climate change. In one focus group, when one of the boys said that listening to the radio was something which helped them, another countered that "we are not listening to radio because we don't have one. Most of us don't have a radio." Because many of the adolescents' families had sold their possessions or did not have sufficient resources to buy a radio in the first place, they did not have the ability to listen to the radio or dance to music to help them cope. One boy said "to be happy" he would want "hobbies every day", but instead indicated that there are "not many options but just staying around". While she still had "playing" as an option, one girl poignantly said: "We don't have a radio, but we play with other kids. . . we play, or we think about starvation."

4. Discussion

We conducted this preliminary mixed methods study to examine potential mechanisms through which climate change impacts adolescent mental health in an understudied but highly impacted population, and to build an evidence base for additional work on climate change and mental health in southern Madagascar. We also assessed levels of depression, anxiety, and climate change worry among adolescents in this area. As a result of climate changes, adolescents in southern Madagascar described experiencing a loss of physical resources, a state of uncertainty and helplessness, and a disruption to coping mechanisms. Losing resources and feeling uncertain about the future caused substantial fear and distress, but unfortunately activities and resources which may help them to cope were themselves impacted by climate change. This deterioration in their resilience resources made them less able to deal with additional climate shocks or ongoing fear and anxiety from climate change.

More than half of children in southern Madagascar are undernourished and with extremely high water insecurity [4,22]. This was clear in our project, with the spectre of climate change clearly being viewed through the prism of its impacts on local food and water security, in line with systems thinking understandings of how climate change impacts mental health [33]. While food insecurity on its own can lead to depression and anxiety [34], in our sample, the effects of this insecurity were exacerbated by climate changes and were made especially difficult by the perceived unstoppable downward trajectory of their farming output as a result of climate changes. This is consistent with other work in low- and middle-income countries which has found that both chronic climate changes and extreme climatic events negatively impact food insecurity, which has been associated with poorer mental health among adolescents [35,36]. However, the impacts of climate change on adolescent mental health in high-income countries appear to look different; adolescents in high-income countries similarly view climate change as a significant problem, but do not tend to identify immediate salient effects on their lives [36–38] and indeed may find opportunities for empowerment [39,40]. Adolescents in other countries have indicated feelings of betrayal and moral injury from insufficient government responses to climate changes [41], but adolescents in our sample did not raise this issue. These differences in the impacts of climate change by country impact level suggest that developing effective policies, practices, and interventions to preserve the mental health of children and adolescents affected by climate changes and extreme weather events requires an understanding of how it is impacting them locally.

In the case of southern Madagascar, our preliminary findings point to some areas of potential intervention to reduce the effects of climate changes on adolescent mental health. The first would be improvements to food and water security – which, given their importance to all areas of children's development, would likely have substantial and cascading effects [9,12,13,17]. Second, given that many adolescents felt powerless as a result of climate changes, implementing farming interventions to teach how to adapt farming practices to climate changes, or providing information on national and international responses to climate change may be effective in empowering Malagasy adolescents. Third is improving safe and easy access to school. Finally, policies, practices, or interventions which increase coping resources such as music, dancing, and art may be beneficial. With extreme climatic events only becoming more frequent in Madagascar [7,42], there is an urgent need to intervene now to protect the health and mental health of these young people [43,44].

This is one of the first studies of adolescent mental health in Madagascar, and one of a tiny number of studies of climate impacts on child or adolescent mental health anywhere in Africa [10]. It does have some limitations. *First*, there are no validated measures of mental health, wellbeing, or climate anxiety in Malagasy, much less in the dialect around Ambovombe. We conducted translation and back translation for our survey measures, but the relatively low internal reliability for the WHO-5 and GAD-7 point to a need for locally relevant assessments of mental health. If we are to assess the effects of climate change on children and adolescents and determine whether interventions are effective, we need reliable and valid mental health measures in the contexts most affected by climate change. *Second*, this is a convenience sample and may not be representative of the population of adolescents in Androy as a whole. *Third*, while in as much as possible the adolescents completed the survey out loud away from others, the presence of non-residents to a village brought considerable attention and some adolescents completed the surveys within likely earshot of others in their community who had gathered. *Fourth*, we conducted focus groups with the adolescents but, given the sensitive nature of many responses, it may have been more suitable to conduct interviews. The fieldworkers were from the Ambovombe area, but were not previously known to the participants, which may have impacted participants' willingness to share in the focus groups. *Fifth*, the thematic analysis was conducted on the English translations of the transcripts, rather than the native Malagasy. *Finally,* this is a relatively small sample size, cross-sectional study and while it can point to potential pathways, more research with larger samples and locally developed or validated measures would be needed to determine causal mechanisms.

4.1. Conclusion

The findings of this study highlight the profound impact of climate change on adolescent mental health in southern Madagascar. While this is only a preliminary study, it fills an identified need by beginning to examine the causal pathways through which climate change impacts mental health [6] and to build the evidence base for this in low- and middle-income countries, which are currently very poorly represented in this literature [12,13,45,46]. The extremely high prevalence of anxiety, depression, and climate change worry, coupled with severe food insecurity and disruptions to coping mechanisms, underscores the urgent need for targeted interventions.

Data sharing

The quantitative data necessary to reproduce the analyses presented here are publicly accessible, at the study OSF (https://osf.io/85anh/). The anonymised focus group is available upon request. The analytic code necessary to reproduce the analyses presented in this paper is available at the study OSF. The materials necessary to attempt to replicate the findings presented here are publicly accessible at the study OSF. The analyses here were predominantly qualitative and so were not pre-registered.

Declaration of competing interest

None of the authors have anything declare. We have no competing interests.

CRediT authorship contribution statement

Kristin Hadfield: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Matylda Sulowska:** Writing – original draft, Investigation, Formal analysis. **Nambinina Rasolomalala:** Writing – review & editing, Methodology. **Samuel Solomon:** Writing – review & editing, Methodology, Investigation. **Satry Ramaroson:** Writing – review & editing, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Isabelle Mareschal:** Writing – review & editing,

Supervision, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.joclim.2025.100438.

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