BMJ Global Health

How climate change is shaping young people's health: a participatory, youth co-led study from Bangladesh, Guatemala and Nigeria

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To cite: Pinchoff J, Etetim E-O, Babatunde D, *et al*. How climate change is shaping young people's health: a participatory, youth co-led study from Bangladesh, Guatemala and Nigeria. *BMJ Glob Health* 2025;**10**:e016788. doi:10.1136/bmjgh-2024-016788

Handling editor Naomi Clare Lee

Received 10 July 2024
Accepted 6 January 2025

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ABSTRACT

Introduction Climate change is shaping adolescent and young people's (AYP) transitions to adulthood with significant and often compounding effects on their physical and mental health. The climate crisis is an intergenerational inequity, with the current generation of young people exposed to more climate events over their lifetime than any previous one. Despite this injustice, research and policy to date lacks AYP's perspectives and active engagement.

Methods Participatory, youth co-led qualitative focus group discussions were held in Bangladesh, Guatemala and Nigeria in mid-2023. A total of 196 AYP ages 12–25 years participated. Open-ended questions elicited responses regarding AYP knowledge, experiences and perceptions of climate change. Using NVivo software, translated transcripts were coded to explore and synthesise key thematic areas.

Results Respondents discussed varied climate exposures and associated health risks, for example, how flooding events were impeding access to sexual and reproductive health commodities. Acute climate events like flooding and cyclones increased perceived risk of early marriage and gender-based violence in Bangladesh and Guatemala. In Nigeria, respondents discussed health effects of extreme heat, and how droughts were shifting women into more traditionally male roles in agriculture and income-generating activities, increasing the perceived risk of household tensions and gender-based violence. Commonly reported themes included perceived climate impacts on sexual and reproductive health including early marriage or gender-based violence. Another common theme was anxiety about climate change, its effects on economic and food insecurity in communities and feeling hopeless, lacking agency and not feeling supported by local institutions, all linked with worse mental health.

Conclusion Our results summarise how AYP perceive climate change is affecting their physical and mental health, finding similarities and differences across these three settings. Our results can inform the development of policies and programmes that directly address AYP needs in a way that is inclusive and responsive.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The effects of climate change will unequally impact the lives of adolescents and young people living in low-income and middle-income countries that have contributed the least to global emissions yet face compounding harms over their lifetime. Emerging research highlights the myriad direct and indirect pathways through which climate change impacts the physical and mental health of youth with implications for their health, education and economic prosperity.

WHAT THIS STUDY ADDS

⇒ Incorporating youth perspectives and opportunities for participatory research elicits detailed perspectives on their context-specific experiences with the climate crisis, observed harms to their health and those in their communities. Young people feel hopeless and discuss the reinforcing cycle of generational poverty as climate harms their health and opportunities.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study can inform the development of research, policy and practice that aims to address adolescent health in the face of climate change, highlighting the health-related harms experienced across settings and the context-specific dynamics. Results highlight the need to recognise injustices faced by these communities, incorporating climate education so that young people understand more about causes and effects of climate change, and actively engaging young people in research and policy decision-making processes from which they are often excluded.

BACKGROUND

Climate change is increasing the frequency, duration and severity of extreme weather events, from heatwaves to more erratic rainfall and prolonged droughts.[1 2] Over

3 billion people live in contexts highly vulnerable to climate change, and within these geographies, the most vulnerable people and communities are those who have historically contributed the least to emissions and face compounding risks related to colonialism, poverty and marginalisation.[3] Under current climate policy pledges, the generation born in 2020 will experience a two-to-seven-fold increase in extreme events, particularly heat waves, compared with those born in 1960.[2] Despite the increased risks posed to this rising generation of 1.8 billion young people, they are not yet meaningfully engaged or included in climate research and policy decision-making. Effective climate justice will require the mobilisation and active engagement of adolescents and young people (AYP), an age group that will be concentrated in low-income and middle-income countries (LMICs).[4 5]

Climate change affects health both directly, through increased exposure to extreme temperatures or extreme weather events, and also indirectly by affecting inequalities and the social and economic determinants of health.[1 6 7] For example, there is a growing body of literature regarding climate-driven adverse health outcomes including nutritional status and food insecurity,[8 9] infectious disease risk,[10 11] respiratory disease,[12] and mental health and well-being.[13–17] Research tends to focus on the very youngest, children under 5 years, and the elderly, as they are considered the most vulnerable to climate change.[1 15 18] Fewer studies focus on AYP and how climate change is affecting their health and well-being during a critical juncture in the life course. Adolescence is a period of growth and change, and young people growing up today will experience many climate hazards with compounding and cascading effects on their physical and mental health. Experiences during these formative years, that coincide with a range of biological and social changes, can have a wide range of short-term and long-term impacts on health, with implications for a range of outcomes from schooling to economic prospects. It is crucial to focus on adolescent health because of how vulnerable they are to climate impacts during this formative age range, which can exacerbate existing health inequalities and harm their long-term potential with cascading impacts over their lifetime. Climate change threatens gains made to date to improve the health and well-being of communities around the world.

Overall, available literature on climate and adolescent health is focused on mental health, through 'eco-anxiety' and growing concerns about a future shaped by climate change.[19–23] While most research is from high-income countries, some studies are emerging from or include LMIC settings. A recent study found AYP 16–25 years of age across 10 countries reported a growing concern about climate change, or climate anxiety.[19] They found that girls were more concerned than boys, experiencing more negative emotions and overall 59% were very or extremely worried, and 84% at least moderately worried, with over half experiencing emotions including sadness, anxiety, anger, powerlessness, helplessness and guilt, and almost half said their feelings about climate change negatively affected their daily life.[20]

A recent report from Bangladesh, Jordan and Ethiopia shows that AYP living in poverty and with low access to formal health systems will be more affected, with fewer resources to prepare for, cope with and recover from various climate events.[24 25] Economic inequalities increase the risks of experiencing malnutrition and food insecurity, which are growing due to climate change.[24] Climate change will exacerbate the uneven distribution of social and environmental factors that create child health inequalities.[6] Due to limited institutional, social and economic resources, children and AYP in LMICs are more susceptible to the consequences of climate change, perpetuating a cycle of vulnerability and marginalisation.

In addition to poverty, gender plays an important role in climate risk and related harms, with women and girls disproportionately impacted by climate change. They face risks such as increased gender-based violence (GBV), difficulties accessing sexual and reproductive health (SRH) services, increased child marriage and increased likelihood of school dropout.[24 26 27] During extreme weather events, sexual and reproductive health and rights (SRHR) are negatively impacted with limited access to services and risks from being in shelters, where harassment and challenges with privacy and accessing clean water are widespread.[27 28] National Adaptation Plan (NAP) is a country-led process that helps countries identify their climate-related vulnerabilities and integrate climate change adaptation into policies, programmes and activities at all levels of planning, yet, as of 2021, only 10 of 19 reviewed NAPs refer to any component of SRHR in relation to climate.[29]

Of the research focused on the health and well-being of adolescents, the studies often do not directly include or engage them in the study design or data collection. Yet adolescent voices are critical in identifying key risks and experiences in relation to climate change, potentially able to identify challenges or provide solutions that adults may overlook.[24 30 31] Adolescents also have agency to contribute to climate adaptation and are part of intersectional communities, all of which must be considered when designing policies and programming if they are to be effective.[24] The climate change, global health and development sectors must consider how AYP can be engaged in meaningful capacities and supported as champions.[32] This may require new research methods, participatory approaches and the development of comprehensive youth consultation and engagement strategies.[32]

To address these gaps, we set out to engage with AYP to design, implement and synthesise results from participatory, qualitative focus group discussions (FGDs). The study was codesigned with recent participants of the Women Deliver Young Leaders programme, a mentorship programme for youth advocacy and engagement. The Young Leaders collaborated with qualitative research experts to design a content guide and questions to explore how young people are experiencing climate

change, including effects on their physical and mental health, education and futures. We conducted these youth co-led focus groups in climate-vulnerable regions of Bangladesh, Guatemala and Nigeria to understand how climate change is affecting AYP in different settings. Our results have various policy implications and can be used to inform future programmes and policies in each country, as well as to inform the global discourse on climate change.

METHODS

Study sites and participants

We conducted a multicountry qualitative study in regions of Bangladesh, Guatemala and Nigeria. The regions were selected based on their climate risks and links to local partners working with young people. The study centred on in-person FGDs, which all took place between April and July 2023. Each country varied slightly, but the FGDs included participants whose ages were between 12 and 25 years and included a combination of gender identity groups (male only, female only and mixed gender groups). In Bangladesh, a session for transgender AYP was also held. All respondents gave written informed consent before beginning the FGD, across all sites. Participants under the age of 18 also obtained parental consent to participate. The only inclusion criteria were the age category and residing in the region for at least 1 year. Participants were purposively sampled through existing networks with young people in each country and through support from the Women Deliver Young Leader based in each country. Each FGD was led by a trained facilitator with expertise in qualitative research methods and lasted 45–60 min. In Bangladesh, all 12 FGDs were held in an open space in the community and 2 were held in a room within a local college. In Guatemala, all six FGDs were held in a room at a small local hotel. In Nigeria, the 10 FGDs were conducted in open areas within the community or town halls. The facilitator was joined by a note-taker and the discussion was recorded after introductions, to maintain confidentiality. All notes were translated into English for analysis and coding. Table 1 highlights the key aspects of the FGDs in each country.

Table 1 Description of key sample characteristics and demographics for each country

	Bangladesh	Guatemala	Nigeria
Region	South-western communities (Barishal, Satkhira, and Khulna), northern (Kurigram) and northeastern (Sunamganj) regions	Chisec, an indigenous community in Alta Verapaz department recruited via long-standing regional Abriendo Oportunidades project.	Gwagwalada Area Council, a suburb of Abuja, the capital of the Federal Capital Territory, and rural and suburban areas of Kano states
Climate risks	Southwestern low-lying coastal areas on the Bay of Bengal vulnerable to sea level rise, associated with salinity and river erosion, flooding and cyclone risks. Northern and northeastern districts are affected by riverine flooding and river erosion. Overall, cyclones, extreme heat, flooding and salinity are climate risks.	Rural highlands region home to indigenous communities and highly reliant on agriculture. Major flooding, drought and a shift to monocultures in the region causing environmental degradation.	Heat waves and drought are pervasive, with intense periods of rainfall and flooding.
Total FGDs/total participants	12 FGDs/97 participants, between 7 and 10 per group	6 FGDs/36 participants, between 5 and 7 per group	10 FGDs/80 participants, between 7 and 8 per group
Ages	12–25 years	15–22 years	18–25 years
Genders	Male only (32 participants), female only (32 participants), mixed gender groups (8 female and 9 male) and transgender AYP groups (16 total)	Male only (6 total in 1 group), female only (30 total over 5 groups)	Male only (7 participants), female only (40 total) and mixed gender groups (17 female and 15 male)
Study team	4 trained qualitative research assistants (2 male, 2 female) familiar with local and regional dialects in addition to Bengali. Women Deliver Young Leader participated.	2 trained field assistants able to collect information in Q'eqchi' and Spanish languages. Women Deliver Young Leader participated.	8 trained field assistants (4 per region, 2 males and 6 females total) who were local and able to collect information in English and Hausa. Women Deliver Young Leader participated remotely.

AYP, adolescent and young people; FGDs, focus group discussions.

Data collection, management and analysis

We created a content guide composed of open-ended questions regarding how climate change was observed in the community, how it was perceived to affect education and schooling, livelihood opportunities, health and mental health, and the role of young people in climate change. The questions were codesigned with the three recent participants from the Women Deliver Young Leader programme, from Bangladesh, Guatemala and Nigeria. The team also included qualitative research experts from each country.

All interviews were digitally recorded and stored on password-protected computers. Audio files were transcribed using a transcription protocol developed by the study team. Interviews conducted in languages other than English were translated. All transcripts were reviewed by two members of the study team and NVivo software (V.1.0; Lumivero, Denver CO) was used for data management and coding. The analytical strategy was a hybrid deductive-inductive thematic analysis approach, which involved data familiarisation, coding, generation of themes, reviewing themes and write-up of findings. For methodological rigour, a uniform codebook was systematically applied to data from all three countries, with necessary modifications made to accommodate country-specific nuances. Each study team individually coded the transcripts from their respective countries. This included a consensus-building process with different researchers reviewing transcripts, independently generating codes and using these to develop a final code book to ensure the codes were consistently applied. Subsequently, all coded files were merged into a single consolidated file, triangulated codes across sites and then synthesised. Any discrepancies encountered during the coding process were resolved through a consensus-building approach guided by the research objectives.

The authors used the Consolidated criteria for reporting qualitative research (COREQ) 32-item checklist in preparing this manuscript to ensure our approach is transparent and includes comprehensive reporting of qualitative findings.[33]

Patient and public involvement

We conducted a participatory qualitative study in collaboration with local entities in each country. All aspects of the study from the development of research questions to analysis and dissemination were codesigned through collaboration with a Women Deliver Young Leader in each country and additional local collaborations (eg, with the Abriendo Oportunidades programme in Guatemala). Findings will be disseminated in each study country by the local Population Council offices, in collaboration with the Young Leaders involved in the study, including at national and local events. Results will also be shared in non-technical language in briefs and social media messages. And lastly, findings will be presented at regional and global conferences including UNFCCC climate events.

RESULTS

Overall respondents discussed key perceived health effects categorised here into (1) communicable disease risks; (2) malnutrition and food insecurity; (3) SRH and gender-related health risks including access to health services and commodities and (4) mental health and eco anxiety. Illustrative quotes for each are included in table 2. Overall, the patterns were quite similar between the countries, though the climate exposures varied. A figure summarises some of the key patterns observed (figure 1).

Increased transmission of communicable diseases

Across all three countries, respondents discussed how they perceived climate change was linked to numerous communicable diseases such as cholera, malaria and respiratory infections. They discussed viral infections such as cough, influenza and acute respiratory infections that they perceived were more frequently occurring in relation to climate change, as well as the rise of vectorborne diseases (such as malaria). Some respondents reported that increased infectious disease transmission was perceived to be due to extreme weather events forcing them to be confined in crowded shelters.

In Guatemala and Bangladesh, young people mentioned a perceived rise in waterborne diseases due to flooding events. Floods and pollution of water sources meant that communities were left with no alternative than to use contaminated water for drinking and cooking that was perceived to increase rates of dysentery, cholera and other diarrheal diseases. In Nigeria, participants perceived that rising temperatures were increasing rates of varicella and meningitis in the community.

In addition to perceptions that climate change, particularly flooding and heat waves, were increasing the transmission of communicable diseases, participants also discussed the trickle-down effects of these illnesses. They discussed how being sick hinders their ability to engage productively, particularly at school. They perceived that increases in infectious diseases led to increased absenteeism across all three countries. They reported that children with certain conditions are advised by their parents to stay home to not exacerbate their poor health.

Increased malnutrition and food insecurity

Across all three countries, respondents discussed various intersecting ways that climate change was harming the availability and quality of food in their community, linking droughts and extreme heat to low productivity of agriculture. They discussed how low crop yields and infertile land were driving surges in food prices. Some mentioned how extreme flooding events not only killed growing crops but impeded the ability to cultivate new ones. Respondents reported that this lack of available and affordable food resulted in families being unable to maintain three meals per day. They are forced to skip meals and make tradeoffs in the types of food that they purchase, often selecting more affordable but less

Table 2 Illustrative quotes

Theme	Illustrative quotes
Theme 1: Increased transmission of communicable diseases	*When it floods, we are not sure if the water is clean or not. During floods, we have to search for clean water to wash, and if there's no clean water, we can't take a bath or clean ourselves*. – **Female FGD, Las Palmas, Guatemala** *Yes, then colds, coughs and asthma continue to persist. Due to the rate at which the climate is changing, various fungal diseases are increasing, itching, allergies, skin diseases. Children are developing various diseases, diarrhea is increasing, they don't want to eat, they are not getting proper nutrition*. – **Mixed FGD, Khulna, Bangladesh** *Overall, I will say there is more occurrence of illnesses during the hot season because… Whenever you sleep and wake up, you will experience a total body weakness and discomfort. You will experience a total weakness and shortening of breath…* – **Female FGD, Kano, Nigeria**
Theme 2: increased malnutrition and food insecurity	*We cannot eat essential vegetables due to climate change… we don't get vegetables as these all get submerged due to floods… our land is being submerged due to floods. After the flood goes away, we lack food, some people can only eat one of the three meals, some eat twice, because of this, people suffer a lot.* –**Male FGD, Sunamganj, Bangladesh** *In fact, we no longer have three square meals as we now eat twice a day and some people even eat less than that and people are not as healthy as they used to be… In the past there used to be varieties of different kinds of food such as spaghetti, rice… But now you will even see someone drinking garri (meal made purely from cassava) and continue their work…* – **Mixed FGD, Kano, Nigeria**
Theme 3: increase in gendered health risks and harms to sexual and reproductive health and rights Increased GBV Increased child marriage Challenges accessing commodities for family planning and menstrual hygiene	*Before, everyone in the family lived with the income that my father used to earn… When the disaster comes, after the disaster, the woman is working in a cigarette factory, doing work in five households, she did not work before. Now … her relationship with her husband has slowly deteriorated. Husband earns less money, now the woman earns more than him. Why would he stay with her? The family is broken and there are many available*. **- Transgender FGD, Barishal, Bangladesh** *A lot of women are fetching water in our own community even though it is a man that is expected to do those chores… But because he might be busy at work, and because his income is not much, and he cannot afford to buy water… The wife takes it upon herself to do these fetching of water… And it is as a result of climate change because all our wells and streams have all dried up therefore, we all depend on the community borehole as the only source of water…* – **Female FGD, Kano, Nigeria** *Some girls start relationships with boys from other communities during the summer. When there's flooding, they move to their boyfriends' communities. Girls do that to help their struggling families. Some mothers advise their daughters to do this because there's no more land or food in the community*. – **Female FGD, Seraxqen, Guatemala** *I have heard stories of the place being too hot; it's a bit closer to hell fire. So young girls get married early because some of them want to leave there, so climate affects them, so they marry early in that place. If you get married early you can leave the community*. – **Female FGD, Abuja, Nigeria** *However, due to climate change, that pharmacy is no longer open; instead, a pharmacy more distant is available. At this time, purchasing it is not a possibility. Because of this, I think the population of the whole country is rising rather than declining.* **– Transgender group, Barishal, Bangladesh** *The women who were using contraceptive methods couldn't do much [during the ETA and IOTA hurricanes], since the only health center was in another town. The road was flooded, so they couldn't pass through; some ended up getting pregnant. Those who had some money went to Chisec [municipal capital] to get [contraceptive] injections.* **– Female FGD, Seraxqen, Guatemala**
Theme 4: increased anxiety and depression, eco-anxiety and worry about the future (mental health harms)	*I think that people in the villages that have suffered from climate change do worry a lot. They aren't mentally or physically well, because they lost everything, they poured their hopes into their crops, their houses, and that all takes time to rebuild and recover, because people have to make the effort to get their things back. They worry about their families, too*. **– Female FGD, Chisec, Guatemala** *Sometimes I get frustrated, hopeless about the future of our community. I want to move from there*. – **Female FGD, Seraxqen, Guatemala** *Stress on the mind is a significant problem in addition to these physical issues*. – **Male FGD, Bakerganj Barishal, Bangladesh**

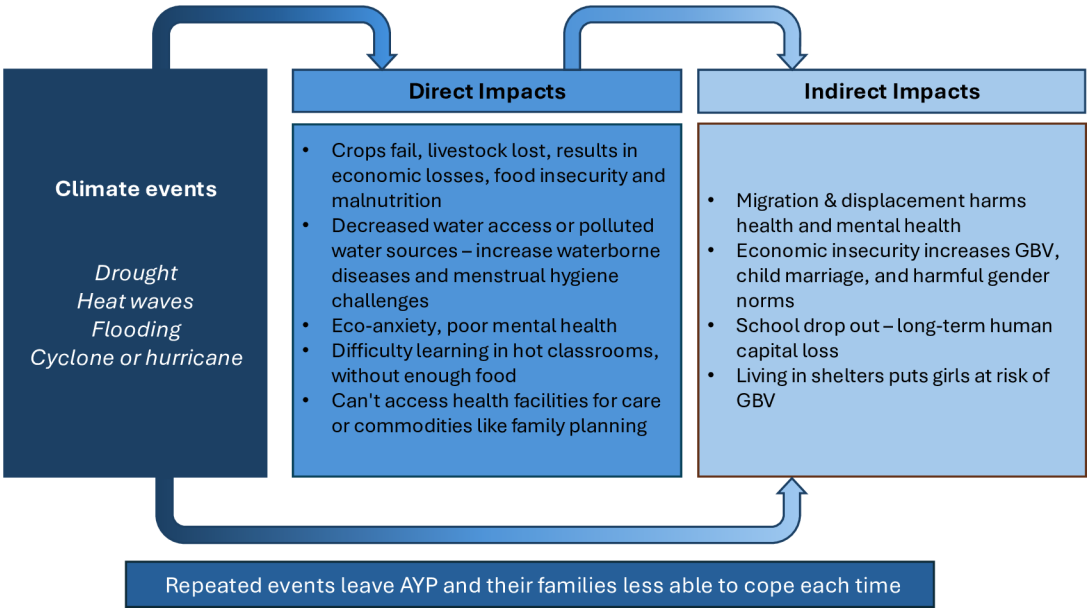

Figure 1 How climate events directly and indirectly impact AYP health. AYP, adolescent and young people; GBV, gender-based violence.

nutrient-rich options. The overall consequence was perceived as a compromised ability to secure a diverse and nutritious diet, leading to malnutrition. Poor nutrition was linked with difficulty learning, delayed cognitive development, and difficulty maintaining physical growth needs in this young age group.

In Bangladesh, participants discussed flooding and how this was affecting food availability. In Guatemala, participants reported that when people could not find clean drinking water because of climate events, they chose soda, which they perceived could increase rates of diabetes in the community. In Nigeria, participants noted the reduced variation in their diets due to climate change, relying on things like garri (a meal made only from cassava) to continue working.

SRHR and gendered health risks

In all three countries, respondents discussed increased risks for GBV, early marriage and challenges accessing health services and commodities. In addition, in Bangladesh, the threat of drinking water salinity in coastal areas was raised, which has been linked to poor SRH outcomes, such as perceived increasing rates of uterine infections and cancers (research has shown drinking water salinity is linked with hypertension and hypertensive disorders in pregnancy).[34 35]

Gender-based violence

Across all three countries, many of the climate-related health risks discussed were specific to women and girls. Similarities included the discussion of how climate change was perceived to increase GBV. With women sometimes forced to earn income to supplement their spouses' declining income, participants discussed how shifting gender roles and the financial insecurity caused by climate change could result in GBV and violence. Tensions between spouses were reported, increasing perceived rates of divorce or violence when women earned more or were more economically empowered. In addition to domestic GBV, in all three countries, participants discussed how climate-related challenges increased sexual harassment and violence, as women had to travel farther to fetch water or spend time in cramped quarters in shelters.

In Guatemala, violence was tied with younger girls leaving home to live with boyfriends, often to reduce the financial burden on their families. However, this left them at higher risk of GBV and also dependent on their boyfriends' families. In Guatemala, harassment was also tied to the region's growing dependence on monocultures, with strangers from other communities moving in to work on farms, and often harassing local women. In Bangladesh, women reported harassment when they were forced to move into shelters following extreme events and cited a lack of privacy in these shelters.

Child marriage

Participants also discussed shifting ages in marriage and increased risks of child, early and forced marriage. Some families sought marriages for daughters to alleviate financial burdens on the parents, while others considered it as a way to secure a promising future for their daughters. In all three countries, participants discussed that early marriage was related to parents' inability to provide for their children as livelihood options were harmed by climate change. In addition to marriage, participants discussed climate change in relation to fertility preferences. Many reported considering having fewer children to align their family size with what they felt they could provide for.

In Nigeria, marriage was sometimes a way to facilitate migration to a new location and escape extreme weather events such as heat waves. Similarly, in Guatemala, young girls often ran away from home to live with boyfriends, as a way to migrate away from climate-affected areas and their families' economic insecurity. For boys and young men, respondents reported they were marrying later so that they could find work and increase their income before pursuing marriage. On the other hand, in Bangladesh, some young men married earlier to secure a dowry from the bride's family, though sometimes they would then not stay in the marriage.

SRHR services and commodities

Additional gendered challenges are related to the reported barriers to critical products and SRH needs during flooding or cyclone events. Extreme weather events make facilities inaccessible or unaffordable, particularly to those in rural areas. In addition to challenges accessing SRH and maternal health services, respondents discussed challenges for menstrual hygiene and related products.

In Bangladesh and Guatemala, participants discussed how during the flooding season there was no access to contraception as hospitals and pharmacies shut down. Available pharmacies were not easily accessible when roads washed out, so women who rely on modern contraceptives were forced to consider natural ones. In Guatemala, this extended to pregnancy and maternal healthcare, with women forced to give birth at home or in shelters. In Nigeria, some young people believed that extreme heat was reducing the effectiveness of condoms, causing them to break. Participants in Bangladesh reported that AYP were taking contraceptive pills to stop menstruation altogether and avoid having to manage it during flooding events. In Guatemala, during flooding, there was a perceived shift in a reliance on natural pregnancy prevention methods when facilities were inaccessible.

In Bangladesh and Guatemala, in particular, girls reported that when confined to shelters they had a lack of privacy and challenges maintaining proper menstrual hygiene. Girls were unable to access stores to purchase pads, forcing them to opt for cloth that could not be cleaned easily, often resulting in infections. In Nigeria, due to extreme heat, young girls reported bathing frequently but this required multiple packs of pads that were unaffordable and there were tendencies for infections.

Mental health

Many participants across all three countries discussed their mental health and how climate change is increasing stress and anxiety as well as a sense of hopelessness about the future. Many discussed being unable to afford school, which reduced their economic prospects, and discussed how migration is becoming a compelling alternative. They discussed intergenerational poverty, and how climate change was making it difficult for them to carve out their future and do better than their parents as opportunities were not available around them. Participants noted individual events can affect physical and mental health of communities.

Across the three countries, more and more such events are occurring, disrupting lives and leading to a feeling of helplessness, and AYP reporting feeling deeply concerned about how climate is affecting their community and their future prospects, as they reported increasing absenteeism and dropping out of school due to climate change. They also discussed perceptions of limited support from local government or other stakeholders. Participants reported frustration with the lack of climate action and the challenges they faced spearheading any type of local initiative. Many participants reported wanting to take action but found it difficult to do much more than some localised events like planting trees or community clean ups.

The conversations around mental health were similar across the three settings. In Guatemala, there was a somewhat unique tie with long-standing frustrations with the government, and sense that indigenous communities have a history of exclusion and climate change was only exacerbating this.

DISCUSSION

Young people from communities in Bangladesh, Guatemala and Nigeria discussed a variety of health challenges created by climate change. Despite the different climate exposures, overall the effects were similar in the perceived effects on health overall. AYP make up 28% of Bangladesh's population, while over half of Guatemala's population and 70% of Nigeria's are under age 30—AYP today are the largest generation and they are facing a worsening climate crisis. AYP in our study discussed the direct links between climate hazards and various health outcomes, as well as how health was affected through more indirect pathways, mainly economic stress and infrastructure damage caused by extreme weather events. Participants across all three study countries reported similar perceptions of worsening climate conditions, and in all three settings discussed similar ways that climate was affecting health, and almost all reported feeling anxious and hopeless about their futures under climate change.

AYP perceptions that rainfall patterns are shifting, including more extreme rain events and flooding, are supported in the literature.[36] In many countries, extreme flooding events are tied to worse health outcomes, affecting food security, increasing the risk of waterborne diseases, increasing rates of infectious diseases such as malaria or dengue and driving displacement and migration.[15 37 38] The dynamics were slightly different in each country. In settings, such as Bangladesh, this includes an intensification in conditions that lead to cyclones and storm surges.[39] In Bangladesh, despite having a national Cyclone Preparedness Programme, challenges remain in transmitting warnings and information and opening

enough storm shelters to prevent overcrowded conditions.[40] Shelters may be schools, disrupting schooling and participants reported the shelters spread infectious diseases and created risk of harassment and GBV for girls. In Guatemala, the threat was described as more seasonal extreme flooding that cut-off indigenous communities from many critical services, making their towns isolated during the rainy season. This extreme flooding disrupted health services and commodities affecting a range of health outcomes for routine and emergency needs such as family planning, facility-based deliveries and access to menstrual products.[37]

Droughts and heat events are also increasing due to climate change, tied to growing food insecurity and malnutrition. Malnutrition can increase school absences, and impair cognitive development, physical growth and ability to learn and focus at school.[14 16] A study in the USA found that students' test performance was lower during high-heat days, and another linked hot school days to the racial achievement gap seen in the USA.[37] Drought is a driver of mass migration, conflict and famine, through water scarcity and food insecurity pathways, threatening health outcomes. Respondents in all three countries reported a perception that they and their communities are being forced to skip more meals, that food is more expensive and that they have less diverse diets due to droughts. In Guatemala, a unique factor was the expansion of monoculture, displacing local farmers, threatening local AYP's nutrition and causing the loss of indigenous livelihoods and farming methods.[41]

In all three countries, women and girls face many specifically gendered harms from climate change, as gender, health, especially SRHR, and climate change are closely linked.[27] For adolescent girls facing early marriage or increased care work and precarious education, climate impacts will have compounding health effects over time. Addressing shifting gender dynamics is also critical, as participants discussed how climate stress is forcing women and girls to take on more traditional male roles in agriculture, or work in other sectors, increasing tension in the household. Men may migrate for work, or as incomes fall due to reduced crop productivity, women are supplementing household incomes. The literature supports how this tension around climate, gender roles, earning and food security can increase GBV.[42 43] This gendered tension around income and climate was reported across the three countries.

More research is needed on marriage and relationships given the variation in behaviours reported and the potential of early marriage as a negative coping strategy for climate. Our participants discussed that child, early and forced marriages increased in some settings, especially for girls, while in others men married later, waiting until they could accumulate wealth and assets required for marriage. In Bangladesh and Nigeria, child marriage was through formal channels, while in Guatemala, informal relationships to escape being 'stuck' in isolated communities during flooding periods often increased their risk of GBV. In Bangladesh only, the threat of high drinking water salinity was reported as a cause of adverse health outcomes such as hypertension, as well as indirect patterns such as increasing child, early and forced marriage.[44]

Mental health is another major issue reported across all three countries as increasing due to climate change. Young people are increasingly reporting that they experience anxiety and depression, and feelings of hopelessness, due to climate change and the ways it is shrinking and constraining their opportunities. Little research is from LMICs, though the patterns are similar.[20] The cascading effects of climate (including multiple climate hazards, food and water insecurity, reduced economic prospects, increasing stress and violence) that exacerbate existing inequalities and vulnerabilities are well documented and were reported by some participants as drivers of poor mental health. The term eco-anxiety has been coined to highlight the major 'negative' emotions and hopelessness tied to climate change in young people particularly among indigenous communities or other vulnerable groups.[45] AYP today are exposed to more frequent and more harmful climate hazard events than any previous generation.[2] Respondents in our study reported these challenges. They discussed concerns that they would achieve less than their parents because of worsening agriculture conditions, and that they would challenges in diversifying their incomes as climate events harmed their educational attainment all were making them worried about their futures and more likely to experience worse mental health.

Young people who take part in climate action have increased feelings of agency and studies suggest this participation fosters critical skills that contribute to youth development.[46] Youth participation in climate advocacy can develop inclusive peer networks, foster intergenerational connections, and build solidarity and resilience.[46 47] Yet young people face challenges meaningfully engaging in policy action, and Indigenous youth and other marginalised groups face additional challenges and exclusions to participate in climate policy. To achieve transformative and inclusive climate and health action, young people need to be recognised as not just passive victims of the climate crisis but active agents, interested in pursuing action and leadership both individually and collectively.[46] However, it is crucial not to displace the burden of responsibility onto them, and instead to hold the governments and industries accountable that are creating the climate crisis.

This study has some limitations. First, we recruited participants through known networks with adolescents, so the results have limited generalisability and our participants may reflect more engaged youth. While we sought to include vulnerable groups such as transgender and indigenous youth, additional work to capture their perspectives is important. Second, there is a risk of social desirability bias or dominant voices, where participants may feel pressured to provide responses that conform to

group norms, or one voice may drive the conversation. Relatedly, FGD moderators may create some bias, but we tried to avoid this by working with trained qualitative researchers and including young people on the team and discussing the potential challenges in advance. We also held multiple FGDs in each country to try to avoid these challenges; however, the group dynamics in an FGD may still sway responses or the direction of the conversation.

CONCLUSIONS

Climate change is having a devastating impact on the health and well-being of AYP, particularly girls and youth from marginalised groups and climate vulnerable areas. The cascading effects of climate change are creating challenging situations that AYP perceive are affecting their life trajectories and long-term health. However, AYP are also demonstrating resilience and a desire to be agents of change. By investing in climate-resilient healthcare systems, increasing access to services and commodities during extreme weather including for mental health, understanding and prioritising the needs of women and girls, offering climate literacy and related curricula, and empowering youth participation in climate action, local communities, governments and young people themselves can develop a locally defined agenda and strategy, in which young people feel invested and supported.[46 48] Offering support and resources for mental health, including training for healthcare workers and fostering effective coping mechanisms, is also critical.[21 49] For researchers, using more participatory methods, such as working with young people to define research questions and interpret results, is critical to facilitate agency and action. For policy-makers, our results highlight the need to work across sectors and align policies on education, climate, health, gender and infrastructure. Investing financial resources in climate-resilient health systems, especially in climate-vulnerable areas, that address women and girls' specific needs and ensure access to services like SRH services (eg, menstrual hygiene products, contraception) and mental health services is critical.

Overall, strengthening the capacity of youth in local communities, equipping them with knowledge and resources to empower themselves, for example, through involvement in disaster risk reduction and preparedness plans or in practical hands-on work such as building storm shelters and improving sanitation facilities, can engage them in climate action. Creating platforms for AYP to participate in climate decision-making and actions, for example, through youth climate councils, climate advocacy training, mentoring youth climate leaders and funding youth-led projects, are ways to expand support from government and other adults. AYP are at the forefront of the climate crisis, bearing the brunt of current policy failures; therefore, their meaningful engagement is critical to achieve climate justice and effective resilience.

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Contributors JP conceptualised the study, drafted the study protocol and instrument, interpreted results and drafted and revised the article. She is the guarantor. E-OE informed the study protocol and instrument, supported data collection in Nigeria, led data analysis, interpretation and drafting and revision of the article. DB informed the concept of the study, interpretation of results and critical revision of the article. EB conceptualised the study, informed study protocol and instrument, interpreted results and provided critical revision of the article. SA led the qualitative study design and approach, instrument design, managed the project in Bangladesh, interpreted results and drafted and revised the article. TOA led the design and implementation of data collection in Nigeria, interpreted results and provided critical revision of the article. BMC led data collection and interpretation in Guatemala and provided critical revision of the article. ADV informed qualitative research design, oversaw the project in Guatemala and provided critical revision of the article. KA conceptualised the study, informed the protocol draft and instrument, managed the overall project, interpreted results and provided critical revision of the article.

Funding The study received funding from the Danish Ministry of Foreign Affairs.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and ethical approval was granted by the National Health Research Ethics Committee (NHREC/01/01/2007-11/04/2023), Kano State Ethical Board (Kano (SHREC/2023/3880) and the Population Council's Institutional Review Board in New York (protocol number 1020). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request.

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