Adolescent well-being and the climate crisis

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Abstract (481 words)

The devastating impacts of the climate crisis are threatening global health in ways that are far greater than once feared. Adolescents are particularly vulnerable to the effects of climate change, being at a critical point of their life-course in their own biological, emotional and social development, and due to the fact that they face the burden of worsening adverse impacts of climate change throughout their lifetime. The climate crisis negatively impacts all aspects of adolescent well-being, with the already marginalized and most vulnerable adolescents – such as Indigenous adolescents, refugees, adolescents with disabilities or chronic disease, and adolescents marginalized due to race, ethnicity, gender and socioeconomic status – at greatest risk. It affects their physical well-being through increased risk of injury, lung disease, infectious disease and poor nutrition. It can disrupt their connectedness to family, friends and community through its effect on forced migration. The climate crisis also disrupts adolescents' safe and supportive environments through its effects on interpersonal and collective conflict and further research is necessary on effective interventions to protect adolescent well-being in climate-related humanitarian settings. Education and employment opportunities for adolescents are also impacted by climate-related extreme weather events and the effect of climate change and its response on agriculture and forestry, tourism and other climate-vulnerable sectors. Furthermore, exposure to extreme and slow-onset events impact adolescents' psychological well-being and the overwhelming and existential threat of the climate crisis causes feelings of disempowerment, impacting adolescents' agency, purpose, and resilience.

Governments, organizations and all sectors of society must do all that is necessary to respond rapidly to the climate crisis and to limit temperature rise to less than 1.5°C. Targeted interventions to protect adolescent well-being are also necessary and adolescents have an active role to play in promoting their own well-being and the well-being of their communities. Measures to protect adolescent physical well-being include actively involving adolescents in disaster preparedness and response measures and integrated monitoring systems with targeted public health messaging, as well as continued efforts to improve adolescents' baseline physical well-being. Adaptation measures are necessary to minimize the risk of climate-induced migration and conflict and, when migration and conflict do occur, appropriate interventions and support must be provided to maintain adolescents' connectedness and sense of belonging and ensure a safe and supportive environment. Climate-proofing schools will be necessary to support adolescent education, and skills training should focus on employment opportunities in the green economy. Adolescents and young people have taken action on climate change on a range of local and global stages, through advocacy, creating adaptation and mitigation projects, holding governments to account and engaging in policymaking processes. Adolescents – particularly those from disadvantaged groups and with fewer opportunities – must be recognized as equal partners and be involved in all climate-related policymaking processes that have an impact on their well-being, to ensure present and future adolescents not only survive but thrive, as we collectively and effectively respond to the climate crisis.

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Introduction

Already, the climate crisis is disrupting the well-being of populations of every age, in every world region.(1) The distribution is not equal, with the most vulnerable in society – both within and between countries – facing the greatest burden. The climate crisis interacts with other damaging processes, including biodiversity loss, ocean acidification, and freshwater use.(2)

In 2015, 197 Member States adopted the Paris Agreement, which set the target of limiting global temperature rise this century to "well below 2°C" above pre-industrial levels and to pursue efforts to limit the temperature rise to 1.5°C.(3) In the lead up to the UN Framework Convention on Climate Change conference, COP26, in Glasgow, countries have reviewed and updated their Nationally Determined Contributions to this commitment, however it is likely that, unless these targets are increased threefold to limit global temperature rise to 2°C and more than fivefold to be in-line with a 1.5 °C limit, each year of inaction will push targets further out of reach.(4) Even with the realization of recent commitments for net zero emissions, temperatures would rise above 2.5°C by the end of this century.(4)

At present, there are 1.2 billion people adolescents aged 10-19 years, comprising 16% of the global population, and 23% of the population in sub-Saharan Africa.(5) Africa's adolescents are the world's fastest growing population, and while the global adolescent population is projected to rise just 8% to 1.3 billion in 2050, in sub-Saharan Africa the number of adolescents will rise by 69%, from 253 million to 429 million.(6) Furthermore, adolescents in sub-Saharan Africa, Central and Southern Asia, Oceania (excluding Australia and New Zealand), and Latin America and the Caribbean also face the highest risk of dying,(7) and populations within these regions are among the most vulnerable to the effects of climate change.(8)

Adolescents are at a critical point in their biological, emotional and social development, where many factors will determine their lifelong well-being. Five domains for adolescent well-being described by Ross and colleagues (2020) are: good health and optimum nutrition; connectedness, positive values and contribution to society; safety and a positive environment; learning, competence, education, skills and employability; and agency and resilience.(9) The climate crisis poses risks to all five domains and indeed threatens the fundamental rights of children and adolescents.(10) The climate crisis also intersects with many existing vulnerabilities among adolescents, with differentiated risks due to geography, rurality, poverty, gender, ethnicity, disability, chronic disease, ethnicity, refugee status and among Indigenous populations.(11-13) The world will continue to warm this century, posing greater risks to the 1.3 billion adolescents that will be alive in 2050.(14)

This background paper explores the threats posed by the climate crisis on the five domains of adolescent well-being and the actions policymakers, intergovernmental and non-governmental organizations, and adolescents, their families and schools can take to protect adolescent well-being, in the face of a changing climate. In each instance, there are crucial measures to be taken to build adaptation and resilience in order to minimize the specific climate-related risks to adolescents' well-being, some of which are described below. Critically and concurrently, governments, businesses, and individuals must take urgent and far-reaching action to mitigate climate change, halving global annual emissions by 2030 and reaching global net zero emissions by the middle of this century. Thus, whilst

small and local examples of building adolescent adaptation and resilience are presented, these must be considered in the context of simultaneous rapid global decarbonization.

1. Achieving good health and optimum nutrition

The climate crisis affects the health and nutrition of adolescents through a wide range of mechanisms. Adolescents are vulnerable to the acute physical and psychological effects of climate-related disasters, but also to the indirect consequences of increased food insecurity, loss of land and forced migration, as well as concern around the future sustainability of our planet and their own future lives.(15) Food systems are simultaneously greatly impacted by climate change and major contributors to climate change, whilst achieving optimum nutrition at this point in the life course remains a global challenge.

Good health and optimum nutrition for adolescent well-being is described in detail in an associated background paper.(16) The climate crisis can increase the risk of mortality and disability due to unintentional injury, the leading cause of death and disability among adolescents, through its influence on the frequency and intensity of extreme weather events, particularly in low and middle income countries (LMICs). Girls, children and adolescents with disabilities and chronic diseases and of marginalized groups are at greater risk during extreme events.(13) Disaster management, preparedness and mitigation measures, with specific interventions for marginalized children and adolescents, are crucial for reduction of total population mortality related to extreme events.(13, 17) In Bangladesh improved cyclone preparedness, deployment of early warning systems, and construction of a network of cyclone shelters resulted in far fewer deaths (3,400) in a 2007 cyclone than a weaker cyclone in 1970 (at least 224,000 deaths).(18, 19)

Exposure to high temperatures and heatwaves can increase deaths in children aged up to 14.(20-22) Children and adolescents in slums are particularly vulnerable, as a result of the urban heat island effect, and limited access to water, artificial cooling and green space.(11) Deaths due to injuries, including both unintentional (i.e. drownings, transport, falls) and intentional (i.e. assault and suicide) also increase as a result of higher temperatures in every age group.(23) As children and adolescents spend more time outdoors, public spaces and parks with artificial shade and heavy tree canopies can be effective in reducing heat related symptoms.(24)

Asthma is the commonest chronic disease in adolescents worldwide and its severity is strongly associated with allergic sensitization.(25) Rising temperatures are leading to higher airborne pollen levels and longer pollen seasons, worsening air quality and causing asthma attacks, as well as other allergic symptoms.(21, 26-29) Additionally, thunderstorm asthma, which is the result of fracturing of pollen and spores into finer particles (making them more easily inhaled), is likely to become more frequent due to climate change.(30) One measure to reduce child and adolescent exposure to pollen is a traffic light warning system, advising the pollen level and whether it is safe to spend time outdoors.(31)

Air pollution is also associated with asthma in adolescents, even when the exposure happened early in life.(32) In addition, humidity and temperature, which are increasing due to climate change, play synergistic roles with air pollution in increasing childhood asthma hospitalizations.(33) Furthermore, long-term exposure to particulate matter reduces lung function in children and adolescents, which in turn affects respiratory health in later life.(34, 35)In a landmark ruling in the UK in 2020, air pollution was declared a contributing factor to the death of Ella Kissi-Debrah, who died from a severe asthma

attack in 2013.(36) Her case highlighted the inequities in the health impacts of air pollution and since her case there have been discussions in the effects of air pollution on people of color, living in the outskirts of big cities.(37)

Strategies in key sectors such as power generation, households and transport can reduce both greenhouse gas emissions and air pollutants.(38, 39) Measures to reduce air pollution exposure include, the shift from motorized to active transport wherever possible, the use of air quality indices, and the use of clean fuels and more efficient cookstoves.(40) School-based interventions could include siting schools away from major sources of air pollution, ventilation and air conditioning filters, and the use of data from low-cost sensors within school premises to help guide decisions regarding daily protective measures.(41)

Climate change is changing the geographical distribution, replication rates, survival and transmission of infectious disease pathogens, such as mosquito-borne, tick-borne and diarrheal diseases.(42-44) For instance, malaria is an under-diagnosed problem among adolescents and so prevention, diagnosis and treatment of malaria should have a high priority within adolescent health programs.(45, 46) Poor rural areas and growing urban slums often lack adequate water, sanitation, and hygiene, posing risk to adolescents' physical and mental well-being – a risk that will only be exacerbated by climate change. For many of the climate-sensitive diseases, clean water, sanitation and hygiene will help minimize the risk of infection.(47)

Adolescents experience significant increases in rates of post-traumatic stress disorder (PTSD), anxiety and depression following a climate-related disaster.(48-50) These outcomes are major risk factors for suicide, the third leading cause of death in older adolescents aged 15-19.(50-52) Extreme weather events can also evoke negative feelings of distress, helplessness and increased aggression and violence, as well as exacerbate psychotic illnesses, such as bipolar disorder and schizophrenia, illnesses which most commonly emerge in late adolescence.(51, 53) Furthermore, climate-induced forced migration can further amplify negative psychological impacts due to trauma and difficulties in adjustment.(54, 55)

The psychological well-being of adolescents living in LMICs is likely to be disproportionately affected, both as a result of a greater increase in frequency and severity of extreme events as well as a lower capacity to respond.(14) Large data gaps remain in assessing the psychological impact of climate change in adolescents, particularly the impact of indirect effects such as food insecurity and climate-related migration. We need more data on the scale of these risks, the size of at-risk adolescent populations, and evidence for the impact of targeted interventions.

Supporting the psychological well-being of adolescents before and after disasters is vital to reduce long-term effects. Increasing access to mental health support by strengthening climate-resilient health systems, training community members in mental health first-aid, and including adolescents in the design and evaluation of mental health support programs may contribute to reducing the burden on adolescent well-being.(56, 57)

Achieving optimal nutrition during adolescence, a period of rapid physical growth and cognitive development, is crucial. The triple burden of obesity, undernutrition, and climate change has been described as a global syndemic, due to the many interactions, their common underlying societal drivers and the fact that, between them, they are affecting most people in every country and region worldwide.(58) Higher average temperatures, extreme weather events, changing rainfall patterns and

the effect of high temperatures on labor capacity can all reduce crop yields and increase food insecurity, with women and girls in LMICs are often at greatest risk.(58, 59) Greenhouse gas emissions and climate change are also affecting marine food security, through ocean acidification and rising sea surface temperatures.(60) Adaptation measures are required to reduce the effect of climate change on food security and to support optimum nutrition in adolescents.(61)

Dietary change is also crucial for both climate change adaptation and mitigation, as well as addressing the three burdens of malnutrition.(58, 62) A reform of dietary guidelines – to align them with the evidence on achieving the zero hunger Sustainable Development Goal (SDG) and the commitments of the Paris Agreement – is recommended.(62, 63) Adolescents should have a strong role in the design and implementation of programs that promote health and nutrition for a sustainable future.(64, 65) Scaling Up Nutrition (SUN) Youth Leaders for Nutrition have created an adolescent nutrition advocacy guide.(66) We Eat Responsibly, an initiative in schools in eight Eastern European countries, taught students about the links between food, climate change, and water and land use.(67) The students were involved with surveys of thousands of households and helped identify actions for sustainable food consumption.

2. Fostering connectedness, positive values, and contribution to society

Through its effects on migration, climate change can impact on adolescents' connectedness to family, friends and community and all levels of society can be a risk or resource for a migrant adolescents' well-being. Adolescents are also engaged in many initiatives responding to climate change, which can help foster their connectedness, positive values, and contribution to society.

As described in the accompanying background paper, connectedness, positive values, and contribution to society are essential building blocks for adolescent well-being.(68) Connectedness relates to personal and social relationships with family, friends, and community. A key way climate change interferes with adolescents' connectedness is through its effects on migration. Attributing migration to climate change is difficult, however one recent study estimates that, by 2050, there could be up to 86 million internal climate migrants in sub-Saharan Africa, 40 million in South Asia, and 17 million in Latin America and in 2016 there were 24.2 million displacements in 118 countries due to natural disasters.(69, 70) Within and beyond these regions, certain communities and the adolescents within them, are particularly vulnerable, including Indigenous communities, small island and low-lying coastal communities, and rural communities.(71) Climate change can affect many patterns of migration – from rural to urban areas, seasonal and circular migration, planned relocation or forced displacement, and even immobility (i.e. due to physical, social and economic circumstances, people are unable to leave in the face of climate change threats).(71, 72)

Around 40% of the 79.5 million forcibly displaced people in 2019 were under the age of 18.(73) Climate-related factors can result in the separation of adolescents from their families, for example, in drought-affected northern Ethiopia, where adolescents were separated for reasons such as work, death of parents and lack of food.(74) Immigrant-origin children and adolescents may experience bullying, discrimination and social exclusion.(75) Factors such legal status, gender, socio-economic status, race, ethnicity and religion also interplay with how adolescents are treated and how they adapt.(76) In addition to its impacts on adolescents' connectedness, migration can also have negative effects on adolescents' safety, rights, physical and mental well-being. Unaccompanied children and

adolescents are the most vulnerable in migration and humanitarian settings facing increased risk of food insecurity, violence, sexual violence, trafficking and exploitation.(74, 77, 78) Mental health effects, such as PTSD, depression and anxiety are also very prevalent, with unaccompanied minors aged 17-18 at greatest risk.(79, 80) Migration also disrupts formal education and, in 2019, only 31% of refugee adolescents of secondary school age were enrolled in secondary school, while 77% children were enrolled in primary school.(81)

Promoting adolescent well-being in humanitarian and fragile settings is discussed in further detail in another background paper in this series.(82) With regard to assessing successful adaptation for immigrant-origin children and youth, three key elements have been described: developmental tasks, psychological adjustment, and acculturation.(76, 83) Global forces, the political and social contexts of reception, the microsystem of neighborhoods, schools, and families, and individual-level factors can all be risks or resources for an immigrant origin adolescent's adaptation.(76) For example, immigrant origin adolescents often attend under resourced and segregated schools, but well-integrated schools with adequate training of teachers and administrative staff of the needs of immigrant origin children and culturally relevant pedagogy, as well increased diversity among teachers, can promote their feelings of belongingness and improve adolescents' academic performance.(75, 76)

Turning to contribution to society, adolescents are involved in a wide range of climate change-related community initiatives, which can have substantial positive impact personal and collective well-being. Community initiatives, involving children and adolescents and tackling the climate crisis and the SDGs, have been captured in numerous reports.(10, 67, 84, 85) Such initiatives range from 50,000 young people from school environmental clubs planting trees around the region of Addis Ababa, to a youth-led initiative known as ChepeCletas that promotes walking, cycling and the use of public transport in San José, to Sandwatch, a global program of children and youth monitoring and acting to protect their coastal areas.(85)

Boarding school students aged 11-13 in west Uganda helped build water saving tanks and a vegetable garden, improving access to water and sanitation and food for the students, as well as saving and making money for the school.(67) In Barbados, students from a secondary school collected used vegetable oil from their homes and communities to produce biodiesel. The income generated from the sale of biodiesel and glycerine was shared with students and their school to fund other environmental and community activities.(86) More recently, during the pandemic, the "Global Youth Mobilization for Generation Disrupted" has been established, with over 250 million active young people, provides sustainable solutions to address the impact of and recovery from COVID-19.(87) Further adolescent-led and engaged community initiatives that help protect and promote adolescent well-being are also identified in the other sections of this paper.

3. Securing a safe and supportive environment

Through pathways such as its effects on conflict and migration, the climate crisis threatens the safe and supportive environment necessary for adolescents to thrive.

Adolescent well-being requires a safe and supportive environment, with equitable access to services, freedom from discrimination, and protection from violence and exploitation.(9) Through its effects on violent conflict, the climate crisis threatens this safe and supportive environment and also impacts on adolescents' connectedness with their families, peers, and communities. For example, through creating economic shocks and natural resource scarcity, climate change and climate variability has

already had an influence on organized armed conflict.(88) Many studies, particularly of Sub-Saharan Africa, have reported on relationship between low rainfall and increased risk of civil conflict in the recent past decades.(89) Future risks of conflict will only amplify as temperatures continue to rise.(88) Climate change also increases the risk of intimate partner violence, through both slow-moving stress as well as extreme events, and flow on impacts on livelihoods and poverty. Adolescent girls are at highest risk.(90-92)

Conflict, in all its forms, causes a range of impacts on adolescent well-being and development, which can have lifelong and second-generation effects. Conflict may lead to intentional and unintentional injuries, torture, sexual violence, neglect, malnutrition and stunting, infectious diseases, PTSD and trauma-related disorders, anxiety and depression.(93-95) Conflict also disrupts education and future employment prospects.(93) Evidence is lacking on specific interventions to protect adolescent well-being in climate-related conflict settings and it remains unclear whether such interventions should differ, based on their climate trigger.(93) However, efforts could be focused on climate change adaptation and conflict risk reduction as well as targeted interventions for adolescents in conflict settings.

Working to secure a safe and supportive environment, the Mercy Corps co-design adolescent programs in societies affected by displacement and conflict. They work with adolescents to help them reconnect with peers, their families and communities, regain a sense of personal safety, develop critical thinking skills, engage in employment and entrepreneurship, and in civic action projects that promote social cohesion and non-violence.(96) Their work with young Syrian refugees and their Jordanian host community improved self-reported insecurity and stress and reduced the stress biomarker, cortisol.(97)

Considering another aspect of safety, well-planned efforts to mitigate climate change can also help build a safer environment for adolescents and reduce road traffic injuries – the leading cause of death in 15-19-year-olds and the second leading cause of death in 10-14-year-olds globally.(98) While active transport has to be encouraged for the physical well-being of adolescents, as well as for mitigating climate change, lack of safe active transport spaces like footpaths and cycling lanes have been major barriers for adoption of cycling or walking as modes of regular transport by adolescents.(99) Protected footpaths and cycling lanes in urban areas can reduce road traffic injuries and make active transport safe and accessible to adolescents.

4. Ensuring good education and employment

Climate change affects adolescents' access to good education and employment opportunities. Large proportions of adolescents, mostly in developing countries, are already out of school and the impacts of climate change will make it more difficult for adolescents to have access to quality education.

Prior to the COVID-19 pandemic, one sixth of the global population of children, adolescents and youth were out of school, with secondary school age adolescents four times as likely to be out of school as children of primary school age.(100) Nearly nine out of ten of these out-of-school adolescents lived in sub-Saharan Africa, Southern Asia and Eastern and South-Eastern Asia, also regions most vulnerable to climate change.(101) As girls have been more deprived of educational opportunities compared to

boys, the impacts of climate change on education are also more likely to put girls at a disadvantage and girls are also more likely to be removed from school during climate-related events.(102, 103)

In the USA, extreme weather events are the commonest cause of unplanned school closures.(104) More frequent and intense extreme weather events negatively impact the academic performance of adolescents and children, especially during the latter part of an academic year.(105) Often, schools are turned into shelters during extreme weather events and the rehabilitation costs may drain the national budget at the expense of the education sector.(106, 107) Even one year after Cyclone Aila in Bangladesh, schools were still inaccessible due to water logging and damage to infrastructure. Girls were particularly affected due to inadequate sanitation facilities.(108) Furthermore, extreme air pollution events are also a cause of unplanned school closures in cities such as Delhi, Beijing and Bangkok.(109-111) The COVID-19 pandemic has also caused long-lasting disruption to primary, secondary and tertiary education across the world (112-114) and the OECD framework to guide the education response to the pandemic could be used to guide future emergency disruptions to education.(115)

Schools are critical to the protection of children and adolescents and the broader community during disasters through the provision of safe learning facilities, the development of safe operating procedures for disasters and emergencies, and through education in risk reduction and resilience.(116, 117) Children and adolescents have a unique ability to conceptualize and analyze risk and can take on the role as active responders – something that is recognized in the Disaster Risk Reduction and Recovery in the School Sector Development Plan of Nepal.(118, 119)

Irregular rainfall or drought can lead to degradation of livelihoods, forcing adolescents to sacrifice their education in order to supplement family incomes.(120) As secondary education is often not free or compulsory, adolescents are more likely to leave schools during times of financial hardship.(121) Increasing water stress and drought can also increase the time spent by adolescents (mostly girls) water hauling, leading to less time for school and education.(122) Aid and insurance for affected households as well as the development of water supply infrastructure leads to increased school enrolment for both boys and girls.(123, 124)

As hotter days increase, adolescents can often feel tired, get dehydrated and have poor concentration in class.(125) Heat exposed teachers are also less likely to provide quality education.(126) During hot weather, proper ventilation and air conditioning can improve test performance and learning outcomes.(127, 128) Schools can adapt by adjusting study hours to avoid the hottest part of the day, substituting closed shoes with sandals, using light clothing and provision of cold water.

Schools are also where adolescents learn about the impacts of, and solutions to, the climate crisis as well as active citizenship skills and global competencies. In order to help adolescents prepare to tackle the climate crisis, schools should incorporate climate change into their curriculum, and involve adolescents in living labs, where solutions can be suggested, tried and tested, and provide adolescents with the knowledge and skills to take action.(129) Furthermore, not only is education on climate change important for the support and motivation of adolescents, but it links directly with education standards and thus should be considered an essential component of school curricula.(130) Adolescents have also advocated for their right to education when faced with climate-related threats. For example, when it was identified that Santa Paz National High School in the Philippines was directly

in the path of a future landslide, school students led and won a campaign to have the school relocated.(131)

Education of adolescents also leads to intergenerational learning, as a result of adolescents educating their families and their communities, and can lead to broader societal action.(132, 133) In addition, informal education is instrumental to preparing adolescents to tackle the climate crisis, and is key component of many of the activities described throughout this paper.

By negatively affecting the health and education of adolescents, climate change also has a profound effect on their future employability. Adding to the problem, impacts of climate change on sensitive sectors, such as agriculture and tourism, as well as the cessation of greenhouse gas emitting industries, will alter future employment opportunities for adolescents.(134) Skills training in sustainable employment is a high priority.(135) A shift to a green economy is an opportunity to create millions of jobs, and tackle the climate crisis.(136) Resources, such as the "Youth Xchange: Green Skills and Lifestyles Guidebook", can impart green skills and climate change education to adolescents to prepare the future workforce for the green economy.(137)

6. Building agency and resilience and acting as agents for change

Despite being aware of the climate crisis for three decades, the world is still not on track to keeping global temperature rise within "safe" limits. Faced with the existential threat of climate change, adolescents have been acting as agents for change, often in the absence of support from older generations, including political leaders.

Box 1: Consultation with adolescents

To engage adolescents in the development of this background paper, nine young people from South Africa, Rwanda, India and the UK were consulted in a 90-minute online call. The call was arranged through Wowbagger Productions, who worked with young people aged 16-25 from the UK, India and South Africa and the UK Academy of Medical Sciences during the COVID-19 pandemic. Participants were asked to elaborate on their concerns on how climate change may affect their well-being, on how groups of adolescents may be differentially impacted, and what adults could do to support the well-being of adolescents whilst reducing the impacts of climate change. The transcript of the call was analyzed using thematic analysis, with three key themes identified:

"We lack support." Concerns were expressed about lacking adequate support in a wide range of areas, including mental health, chronic illnesses and disabilities, finances, education, and the transition towards greater independence when approaching adulthood. Some described how the climate crisis negatively impacted their mental well-being, particularly when feeling that they were lacking agency to influence climate policy-making.

"Our future is in danger." Concerns were raised that climate change adversely affects the future of adolescents, for example through missing school days due to heavy rainfall. Adolescents living in low-income countries, or belonging to otherwise disadvantaged socioeconomic groups, were considered disproportionately affected. They were frustrated that climate change was not a top policy priority in many places, and that competing economic and vested interests were jeopardizing meaningful action against the climate crisis.

"Communicate transparently." To hold governments accountable, the group demanded increased transparency in communication about climate policies and the inclusion of young people's voices in decision-making. As one young person summarized: "take us seriously, because climate change is huge, it's going to affect our lives in the long run."

During adolescence, individuals are engaged in a critical process of developing their identity, sense of purpose in life and their ability to make choices and influence their social and political environment. But, as adolescents begin to grasp the scale and severity of the climate crisis, many may feel overwhelmed when faced with this existential challenge, feel disempowered and pessimistic about the future, and feel frustration and anger towards older generations for not doing enough.(55, 56, 138) This sentiment was also captured in a small consultation with young people for this paper (Box 1).

Several new terms have emerged to describe emotional reactions to the global climate crisis, which can occur independently of experiencing an acute climate event and are linked to the threat of climate change to agency and resilience. Eco-anxiety and climate anxiety both refer to fears of future environmental disasters.(53) Ecological grief is the grief of experiencing or anticipating losses due to environmental change, and "Solastalgia" describes the distress of experiencing irreversible environmental changes to one's own home.(139, 140) These emotional reactions can compound other stressors in the life of adolescents and lead to negative impacts on mental well-being, but we have little data on the scale of these problems.(141) Validated methods of measurement and studies of preventive interventions are needed to fully support adolescents in developing constructive coping mechanisms. As Wu et al., 2020 demonstrate in China, including adolescents during the development phase ensured psychological research tools were more youth-friendly and appropriate to the issues adolescents face.(142)

Supportive and solution-oriented intergenerational dialogue on the emotional impact of climate change can help build a sense of collective engagement, community, and strengthen resilience.(138) Interventions that focus on strengthening climate change knowledge and hope, particularly in schools, can help ease climate anxiety among adolescents and motivate them to take action.(143-145) Furthermore, lessons can be learned from interventions that promote resilience and agency among adolescents experiencing other negative shocks to their well-being, such as the MPOWER program for people who have experienced domestic violence and abuse.(146)

Taking meaningful collective action against the climate crisis is often cited as one way of helping young people gain a greater sense of agency when faced with this existential threat.(147) Indeed, embracing their sense of agency and being driven by the inaction of older generations, the youth climate movement has become one of the most influential forces for global action on climate change.(148) Children and adolescents from high-income and low and middle income countries have been working together to call on big-polluting countries to stronger national and international action.(131) In August 2018, 15-year-old Greta Thunberg and other young activists sat in front of the Swedish Parliament, an action which has since mobilized over 14 million people in 7,500 cities across every continent.(149) During the COVID-19 pandemic, the youth climate movement did not stop, but adapted, with online protests and community organizing through Zoom.(150)

Adolescents have supported climate change litigation cases, using human rights and child rights arguments to require governments to take stronger mitigation measures. The prototype was the *Urgenda v. State of the Netherlands* case. In June 2015, the Dutch government was obliged to reduce greenhouse gas emissions in proportion to its share of the responsibility, a decision upheld over two appeals.(151) In April 2018, the Colombian Supreme Court ruled in favor of 25 youth plaintiffs arguing that deforestation in the Amazon threatened their rights to a healthy environment.(152) More recently, cases involving adolescents have been filed in Peru and South Korea, as well as a legal complaint filed by 16 young people before the UN Committee on the Rights of the Child against the states of Argentina, Brazil, France, Germany and Turkey.(151, 153, 154) In September 2020, supported by the Global Legal Action Network, six Portuguese young people, aged between 8 and 21, took the first case of its kind to the European Court of Human Rights, alleging that 33 European countries have failed to enact the emissions cuts needed to protect their futures.(155)

Adolescents and young people have also been working to engage in policymaking processes, as is recognised under the Rights of the Child.(10) However, there remains frustration among young people as their meaningful engagement is often neglected.(156, 157) According to YOUNGO (the Children and Youth constituency to the UNFCCC) representatives from a range of backgrounds, their involvement in these platforms has often been tokenistic and "youth washing", rather than as equal and serious political actors.(156)

Youth-led and youth-serving organizations have helped produce the Global Consensus Statement on Meaningful Adolescent and Youth Engagement, which could be endorsed by and used as a guide for governments, NGOs and schools (see Box 2).(158) Accordingly, policymakers must reach out to civil society organizations, school and university clubs, and other youth networks in order to achieve meaningful engagement.(159) UNESCO chair "Global Health and Education" is also running an initiative to promote effective and genuine youth participation.(160)

Box 2: Global Consensus Statement on Meaningful Adolescent and Youth Engagement

The Global Consensus Statement was developed in 2018, through consultations with around 30 youth-led and youth-serving organizations. Its definition and principles of meaningful adolescent and youth engagement are described below.(158)

Meaningful adolescent and youth engagement is an inclusive, intentional mutually-respectful partnership between adolescents, youth, and adults whereby power is shared, respected contributions are valued, and young people's ideas, perspectives, skills and strengths are integrated into the design and delivery of programs, strategies, policies, funding mechanisms, and organizations that affect their lives and their communities, countries, and world.

Meaningful adolescent and youth engagement recognizes and changes the power structures that prevent young people from being considered experts regarding their own needs and priorities, while also building their leadership capacities. Young people includes 'adolescents' ages 10-19 and 'youth' ages 15-24 regardless of socioeconomic status, ethnic identity, sexual orientation, gender identity and expression, sex characteristics, marital status, religion, disability, political affiliation, or physical location.

Since its launch, more than 200 organizations have endorsed this statement.

Conclusion and recommendations

Adolescents are at a critical point in their biological, emotional and social development. The climate crisis threatens this development and impacts all areas of adolescent well-being. It increases the risk of injury, allergies, asthma and infectious diseases in adolescents; targeted adaptation measures are necessary to protect their physical health. Climate-related disasters and the concern of current and future impacts of the climate crisis can affect adolescents' psychological well-being. We must support the psychological well-being of adolescents now so that they are well-equipped, resilient, and able to engage in collective action for a net-zero carbon future. Climate change and adolescent nutrition are interrelated challenges that must be tackled together and policies that support dietary change as well as food system adaptation and mitigation interventions are required.

Climate change, conflict, migration, and adolescent well-being are inter-linked and further research is required to identify effective interventions to support adolescents during climate change-related disruptions to their environment. Adolescents are today's students and emerging workforce. Whilst climate change puts their education and job prospects at risk, their knowledge and innovation are key to tackling the climate crisis. Faced with the overwhelming threat of climate change, adolescents have been acting in diverse and innovative ways to protect the well-being of current and future generations.

Adolescents have the right to be heard in decisions made about their future.(161) Drawing from the five domains of adolescent well-being, Table 1 presents recommendations to ensure adolescent well-being. Critically, we all must take rapid action to reduce greenhouse gas emissions, halving global annual emissions by 2030 and reaching net zero as soon as possible. In many circumstances, adolescent involvement in tackling the climate crises is key to protecting the well-being of all generations, and to promoting their agency and resilience. Young people represent our future leaders and change-makers – those that will make decisions in face of increasingly harsh climatic conditions. As we continue through this critical decade, action on climate change, both targeted and widespread, is paramount to safeguard our current and future adolescents.

Table 1. Recommendations to ensure good adolescent well-being while responding to the climate crisis.

Across all domains	**Good health and optimum nutrition**	**Connectedness, positive values, and contribution to society**	**Safe and supportive environment**	**Learning, competence, education, skills, and employability**	**Agency and resilience**
Take the actions necessary to ensure temperature rise is limited to 1.5 °C. Integrate well-being outcomes for adolescents in all climate policies. Promote, respect and fulfil adolescent rights.	Develop Disaster Risk Reduction and Recovery measures that minimize the effect of climate-related extreme events on injury and illness in adolescents and disruption to education. Design indoor and outdoor environments, particularly schools and parks, to have passive and active cooling mechanisms to minimize adolescents' exposure to heat. Invest in real-time air quality monitoring to measure both allergens and air pollutants and deliver targeted public health messages to adolescents and their families. Introduce air quality guidelines for schools to protect the health of adolescents from air pollution, as well as the programs to ensure these guidelines are met. Increase funding to improve access to adolescent mental health care, and ensure climate change adaptation and resiliency planning in mental health systems. Increase funding to establish a robust evidence-base on psychosocial interventions and coping strategies for adolescents facing the climate crisis, particularly for those living in low- and middle-income countries. Adjust research tools to measure the psychological effects of climate change in order to inform interventions, catering these specifically to adolescents by involving them as active participants in the development process. Ensure adolescents are involved in the development and evaluation of local adolescent mental health and psychological support services. Support communities in creating climate change resilience plans that address psychological wellbeing. Introduce food based dietary guidelines that fulfil adolescent nutrition requirements as well environmental sustainability requirements, as well as the programs to see these guidelines are met.	Support the development and adaptation of immigrant-origin adolescents through measures including supportive resettlement programs, the promotion of cultural pluralism, and the training school staff about the needs of immigrant-origin adolescents and culturally relevant pedagogy. Develop programs and support for active engagement of adolescents in disaster risk reduction, adaptation and climate change mitigation, and building active citizenship skills. Foster sensitivities and values towards the environment through activities such as spending time in nature.	Fund and implement adaptation measures that reduce the risk of climate-related conflict, forced migration and trapped populations. Fund the implementation and assessment of targeted interventions for adolescents in climate-related humanitarian settings. Adopt policies that support adolescent well-being in humanitarian settings of any cause, including the abolishment of child and family detention and the implementation of family tracing and reunification or placing unaccompanied adolescents who cannot be reunited with their families in family-like settings, appropriate and inclusive education, access to healthcare, including sexual and reproductive health services and age-, culture- and context-appropriate mental health services. Promote active transport in adolescents, invest to make roads safer and develop infrastructure necessary for active transport such as footpath and cycling lanes.	Introduce disaster risk reduction and climate change education as part of the school curriculum. Invest in the weather proofing of school infrastructures and adopt strategies to counter heat-related adverse learning and performance outcomes. Implement programs that support the development of entrepreneurial skills and employment in the green economy. Prepare adolescents to adapt to massive changes in lifestyles, helping them cope effectively with fears for the future. Provide hopeful messaging when delivering climate change education, in order to ease climate anxiety and motivate action on climate change. Support the development of action competence to tackle the climate crisis by introducing programs such as living labs, where action solutions can be suggested, tried and tested. Teach adolescents skills and competencies in active and global citizenship, and environmental stewardship.	Implement interventions that focus on strengthening climate change knowledge and hope. Endorse the Global Consensus Statement on Meaningful Adolescent and Youth Engagement and redefine what meaningful youth engagement and participation looks like within policymaking processes, by considering them as important stakeholders to ensure their needs, vulnerabilities, rights and agency are reflected in the policymaking process as well as the resulting policies. Facilitate intergenerational dialogue by creating opportunities for adolescents to participate in meaningful collective engagement and decision-making on climate change.

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