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Preparing children for climate-related disasters during a COVID-19 pandemic

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How to prepare children for climate-related disasters in time of COVID_19 pandemic

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Children, vulnerability and disasters

Anthropogenic climate change has led to more frequent natural disasters affecting more people^{1 2}. Climate-related disasters such as floods, storms, droughts, and heat waves accounted 91% of total disasters between 1998 and 2017. Disasters are classified into geophysical, hydrological, climatological, meteorological, biological, and technological based on their causes^{3,4}. According to the Centre for Research on the Epidemiology of Disasters⁵, a disaster is a “situation or event which overwhelms local capacity, necessitating a request at the national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering”. Climate-related disasters such as floods, storms, droughts, and heat waves accounted for 91% of total disasters between 1998 and 2017.

Children are one of the most vulnerable groups In situations of climate-related disasters and disasters have different impacts on children including fatalities, injuries, child trafficking, child labor, separation and child abuse in different forms^{6,7}. United Nations Convention on the rights of the children, defined child as anyone under the age of 18⁸. Disasters affect different dimensions of children’s health and wellbeing both directly and indirectly. Children's physical health is in danger as they may be injured or killed immediately during or after disasters due to trauma, malnourishment, diseases and inadequate access to medical care^{6,9}. Disasters also can lead to mental health problems in children⁶.

Reducing vulnerability is a way to protect children in disasters¹⁰. Susceptibility of children to injury and their dependency to others for lifesaving, livelihood, decision making, and emotional support results in their vulnerability¹⁰. Children are more likely to suffer from exposure to traumatic events because of their circumstances such as physical, physiological and mental development^{10 11}. They are more likely vulnerable to challenges like malnutrition, dehydration, and exhaustion compared to adult¹⁰. As such, they

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3 need more protection before, during and after disasters. Such protections may be even more crucial for
4 children who are more vulnerable by virtue of their age (i.e. infants), living conditions (e.g. bad
5 infrastructure or lack of family support), ethnicity, disabilities, chronic diseases or preconditions. Attention
6 to children before disasters should be an integral part of disaster's preparedness and will reduce their
7 vulnerability¹⁰.
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11 **Children's preparedness for disasters**

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14 Preparedness is "the knowledge and capacities developed by governments, response and recovery
15 organizations, communities and individuals to effectively anticipate, respond to and recover from the
16 impacts of likely, imminent or current disasters"¹². Behavioral changes which lead to a child's preparedness
17 for disasters depend more than anything upon two factors: increased knowledge and skills & risk
18 perception.
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23 The first factor in shaping children's behavior and response to disaster is knowledge and education¹³.
24 Disaster education plays a major role in enhancing the awareness of children about disasters¹³. With an
25 increase in children's awareness on disasters, they can share their knowledge with adults and it may result
26 in adults' preparedness as well¹⁴. Disaster education for children can be conducted in schools, kindergartens,
27 child welfare centers, or other child service centers. Schools play a critical role in disaster risk reduction
28 because they facilitate the process of education of children on disaster risk reduction¹⁵. By utilizing
29 appropriate policy framework, skilled teachers, textbook and curriculum for learning as well as peer
30 education, schools provide an ideal space for children disaster's preparedness¹⁵.
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36 The second factor related to children's preparedness is risk perceptions. Risk perceptions is defined as
37 "beliefs about potential harm or the possibility of a loss. It is a subjective judgment that people make about
38 the characteristics and severity of a risk"¹⁶. When a child perceived likelihood, susceptibility, and severity
39 of a disaster (such as earthquake), then s/he would be able and willing to learn how to prepare¹⁶. For
40 example, risk perception during COVID_19 pandemics in the world was higher than any other hazard. So
41 people actively explored and learned protective measures.
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46 Before COVID-19 pandemic, there were many programs conducted for preparing children in many
47 countries. For example, in Iran, children gained disasters' knowledge via their school textbooks. In addition,
48 humanitarian and emergency organizations (e.g. Red Cross and Red Crescent Societies) in cooperation with
49 Ministry of Education conducted various programs for children of different ages. For instance, children in
50 kindergartens learned how to evacuate and seek shelter during an earthquake. They also became informed
51 about emergency phone numbers they need to know in case of an emergency. They were provided with a
52 special phone number to dial and listen to stories about safety. The International Red Crescent Society
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(IRCS) held training programs in schools to acquaint children with first aid skills, emergency evacuation, emergency shelters, and emergency move. Every year, a week is specified for conducting earthquake drills in schools. Almost all emergency preparedness educational activities for children have been suspended due to COVID-19 in many countries including Iran since February 2020. But, an earthquake or any other disaster may happen every day at any spot on the earth. Below are some points proposed for preparing children during this time.

Preparing children in the time of COVID-19 pandemic

In order to preparing children for climate-related disasters in the time of pandemics, we recommend that:

- 1- Disasters education for children has so far relied mostly on offline training with physical activities such as drills. During this pandemic, different innovative approaches have been applied to continue education in online formats. The same approaches could be applied for emergency preparedness. For example, virtual forums are appropriate alternatives to provide educations on different topics, e.g. first aid or preparedness for earthquakes, flood, and other disasters.
- 2- Creating required resources, especially interactive resources, for disaster preparedness is another way to prepare children in different languages. Countries according to their risk map (hazard-prone places) should produce relevant content and resources for children.
- 3- Increasing the children's risk perception with the help of media such as TV programs, video games, physical games, music, storytelling, and simulators.
- 4- Capacity building to train the people around the children including teachers, parents, the extended family members, nurses, school drivers, or care providers. Upon the shutdown of many centers, it is the best time to train people who work with children about disasters' preparedness. It can be very useful especially when COVID-19 threat has been removed.
- 5- Preparing marginalized children for disasters is vital. Intersection of childhood and racial and ethnic, social class, disability, gender, and residence inequalities increases vulnerability and therefore increases disasters' risk for children. One should note that entry points for intervention in such situation are social vulnerabilities.
- 6- An advocacy support by influential entities such as companies engaged in entertainment industry is required for raising the awareness of public and particularly the children about disasters' preparedness.

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Preparing children for climate-related disasters

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Children, vulnerability and disasters

Anthropogenic climate change has led to more frequent natural disasters affecting more people in the past few decades^{1,2}. Climate-related disasters such as floods, storms, droughts, and heat waves accounted for 91% of total disasters between 1998 and 2017. Climate-related disasters are strongly coupled and act as dominos. For example, drought and heat wave occur together. Drought leads to dry soils and as a result, solar energy evaporation will end to increase surface warming and consequent increased evaporation rate³. Drought and heatwave will increase the risk of wildfires. Furthermore, sandstorms, haze, and water conflicts are other consequences of drought. Disasters are classified into geophysical, hydrological, climatological, meteorological, biological, and technological based on their causes^{4,5}. According to the Centre for Research on the Epidemiology of Disaster⁶, a disaster is a “situation or event that overwhelms local capacity, necessitating a request at the national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering”.

Children are one of the most vulnerable groups in situations of climate-related disasters and disasters have different impacts on children including fatalities, injuries, child trafficking, child labor, separation, and child abuse in different forms⁷⁻⁹. Disasters affect different dimensions of children’s health and wellbeing both directly and indirectly. Children under five years experienced more diseases related to climate change than others¹⁰. Children's physical health is in danger as they may be injured or killed immediately during or after disasters due to trauma, malnourishment, diseases, and inadequate access to medical care^{7,11}. Disasters also can lead to mental health problems in children, including depression, sleep disorders, phobias, attachment disorders, and anxiety^{7,12}.

Reducing vulnerability is a way to protect children in disasters¹³. Susceptibility of children to injury and their dependency to others for lifesaving, livelihood, decision making, and emotional support results in their vulnerability¹³. Children are more likely to suffer from exposure to traumatic events because of their physical, physiological, and mental characteristics and development^{13 14}. They are more likely vulnerable to challenges like malnutrition, dehydration, and exhaustion compared to adult¹³. As such, they need more protection before, during, and after disasters. Such protection are even more crucial for children who are more vulnerable by virtue of their age (i.e. infants), living conditions (e.g., bad infrastructure or lack of family support),

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3 ethnicity, disabilities, chronic diseases or preconditions. Attention to children before disasters
4 should be an integrated with disaster's preparedness programs¹³.
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7 The distribution of climate-related disaster's risks is not similar for all children¹⁵. Intersecting
8 social characteristics (e.g., gender, ethnicity, or social class), climate change vulnerabilities (e.g.),
9 and health vulnerabilities (e.g., disability or chronic diseases such as diabetes) will influence the
10 risk and intensity of disasters among children. Climate change including frequent heatwaves,
11 extreme weather conditions and poor crop yields, exacerbates risk factors for child health due to
12 influencing disease transmission rate, affordability of food, and more conflict on food resources¹⁶.
13 The mentioned risk factor also exacerbate with social inequalities such as income, social status,
14 gender, residence, location, housing, disability, and access to health care^{16,17}. As a result, climate-
15 related disasters could increase inequalities and as such health outcomes among children¹⁶.
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23 **Climate-related disasters' mitigation and adaptation**

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26 Efforts to reduce or prevent climate-related hazards such as reducing or preventing greenhouse gas
27 emissions are defined as mitigation¹². It is necessary for mitigation to use renewable energy,
28 increasing efficiency of energy in older equipment, and changing consumer behavior¹².
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31 Children can be agents of behavioral change for climate change mitigation. As the future leaders
32 at local, national, and international level, they can help to reduce vulnerabilities in families and
33 communities and transfer knowledge to their community¹⁸. It was shown that children's
34 capabilities as agents are determined by their available resources and their environment
35 capabilities (caregivers, parents, friend, peers, teachers, and community)^{19,20}. Parents have a key
36 role in changing children 'behavior with activities such as: training children on environmental
37 ethics and mitigation strategies, buying green or environmentally friendly products for children,
38 and modeling of pro-environmental behavior¹⁸. Laswon et al. (2019) showed that children can
39 inspire adults especially their parents toward higher levels of climate concerns²¹.
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48 Moreover, children can advocate for climate change mitigation. There are several examples of
49 advocacy action of children and youth around the world, including seven young Portuguese appeal
50 to the European Court of Human Rights to force 47 European countries to stop further extraction
51 of fossil fuels following fires in Portugal in 2017²², fifteen years old Greta Thunberg in August
52 2018, asked the Swedish government for more activities on climate change, and more. Following
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3 Greta Thunberg's move, millions of children in cities around the world demonstrated climate
4 change²³. In the long term, participating children in climate change mitigation's programs leading
5 to fewer disasters and, consequently, less risk to children's health. In other words, children can
6 contribute to the health of children of different generations and be safe from the disasters caused
7 by climate change.
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10 11 12 **Children's preparedness for climate-related disasters** 13

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15 As long as government policies fail to fully address the drivers of climate-related disasters,
16 disaster's preparedness and education for children should be considered for protection of children
17 from disaster's risks. Preparedness is "the knowledge and capacity developed by governments,
18 response and recovery organizations, communities, and individuals to effectively anticipate,
19 respond to, and recover from the impacts of likely, imminent, or current disasters"²⁴. The
20 behavioral changes that lead to a child's preparedness for disasters depend more than anything
21 upon two factors: increased knowledge and skills & risk perception.
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28 The first factor in shaping children's behavior and response to disaster is knowledge and
29 education²⁵. Disaster education plays a major role in enhancing the awareness of children about
30 disasters²⁵. With an increase in children's awareness on disasters, they can share their knowledge
31 with adults and it may result in adults' preparedness as well²⁶. Disaster education for children can
32 be conducted in schools, kindergartens, child welfare centers, or other child service centers.
33 Schools play a critical role in disaster risk reduction because they facilitate the process of education
34 of children on disaster risk reduction²⁷. By utilizing appropriate policy framework, skilled teachers,
35 textbook and curriculum for learning as well as peer education, schools provide an ideal space for
36 children disaster's preparedness²⁷.
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44 The second factor related to children's preparedness is risk perception. Risk perceptions are
45 defined as "beliefs about potential harm or the possibility of loss. It is a subjective judgment that
46 people make about the characteristics and severity of a risk"²⁸. When a child perceived likelihood,
47 susceptibility, and severity of a disaster (such as earthquake), then s/he would be able and willing
48 to learn how to prepare²⁸. For example, risk perception during COVID_19 pandemic in the world
49 was higher than any other hazard. Therefore, people actively explored and learned protective
50 measures.
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Before COVID-19 pandemic, there were many programs conducted for preparing children in many countries. It is shown some examples in the Table 1. Most of the examples in various countries were conducted in schools.

Table 1: some examples of Successful programs for children in climate-related disasters' preparedness countries

Country	Successful programs for climate-related disasters' preparedness
Cuba	National program for preparing children for hurricanes through early warning education, evacuation education, enhancing health literacy and awareness, national media active role in hurricane education and early warning, and teaching risk-prone area to people including children ²⁹
New Zealand	Shakeout drill (emergency evacuation) ³⁰ , The What's the Plan, Stan?, a voluntary, curriculum-based teaching resource for children disaster's preparedness ³¹ , museum-based hazard education program on students, teachers and parents ³² ;
USA	Shake out drill in schools and communities(drop, cover and hold on" drills for earthquakes and evacuation for tsunamis) ³²⁻³⁴
Turkey	National program that was titled 'Are We Prepared for a disaster?' for children ²⁵
Israel	Disaster education with lecture and drills for children ³⁵ , Light search and rescue training of high school students in Israel ^{36,37}
Portugal	Using the disaster awareness game for enhancing disaster's preparedness, curriculum-based teaching resource, interactive resources ^{38,39}
Indonesia	National school based disaster education (lecture, drill, curriculum) ⁴⁰
Chile	National disaster's education through drills for evacuation for major disasters, such as earthquakes and tsunamies ⁴¹
Iran	programs for children about first aid skills, evacuation drills, curriculum-based teaching resource for disasters education ⁴²
Japan	Tsunami preparedness via evacuation drills ⁴³ , disaster management drill, firefighting frill, acquiring skill of rescue and first aid, and curriculum-based teaching resource ⁴⁴

Innovative solutions for preparing children for climate-related disasters

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3 There are several ways to prepare children for climate-related disasters, besides traditional school-
4 based methods such as lecture, curriculum, and drills. There was shown that isolated school-based
5 programs increase disaster knowledge, but behavioral change is not forthcoming⁴⁵. Virtual reality
6 (VR) is a tool to facilitate disaster education and preparedness for children that its effectiveness
7 was proved in many studies⁴⁶⁻⁴⁸. This tool could be used for evacuation drills^{46,49}, firefighting
8 drills⁵⁰, first aid skills⁵¹, and other needed skills for disasters' preparedness. Moreover, children
9 with disabilities cannot participate in physical drills for climate- related disasters. The VR tools
10 eliminate this inequity and help children with disabilities such as children with hearing
11 impairment⁵², and children with autism spectrum⁵³ to prepare for disasters.

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Simulation games are another way to prepare children in different ages for disasters⁵⁴. These games
can be available via mobile devices and computers⁵⁵. The effectiveness of simulation games for
disasters' preparedness was proved in different studies and for different climate-related disasters
such as flood^{55,56}, hurricane⁵⁷, and earthquake⁵⁸. This way preparedness is affordable, accessible,
and available for many children around the world and will decrease inequity in health and disasters'
preparedness and social inclusion of groups at risk of social exclusion^{59,60}.

The Art such as storytelling are other effective ways to prepare children for climate-related
disasters⁶¹ and safety teaching⁶². This tool is effective especially for preschool children⁶³. It was
shown that climate-related disasters' education can improve the quality of preschools children
knowledge⁶⁴. Disasters' education with art can effectively help preschool children to participate in
disasters climate mitigation and disasters' preparedness activities⁶⁴. Researchers in a systematic
review found that programs designed for children 5-11 years old should have some characteristics
including the involvement of children's parents, using behavioral modalities (rather than
cognitive), and using interactive methods (play, art, stories, and games)⁶⁵. In addition, it was
recommended to prepared children with disabilities for disasters with art such as storytelling^{66,67}.

To prepare children for climate-related disasters in the time of pandemics, we recommend that:

- 1- Disasters education for children has so far relied mostly on offline training with physical
activities such as drills. During this pandemic, different innovative approaches have been
applied to continuing education in online formats. The same approaches could be applied
for emergency preparedness. For example, virtual forums are appropriate alternatives to

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3 provide educations on different topics, e.g., first aid or preparedness for earthquakes,
4 floods, and other disasters.
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7 2- The family and the community play a key role in empowering the child to prepare for
8 climate-related disasters especially in the absence of schools, kindergartens, and other child
9 care facilities.
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11 3- Creating required resources, especially interactive resources, for disaster preparedness is
12 another way to prepare children in different languages especially children 5-11 years old.
13 Countries according to their risk map (hazard-prone places) should produce relevant
14 content and resources for children.
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16 4- Increasing the children's risk perception with the help of media such as TV programs, video
17 games, physical games, music, storytelling, and simulators.
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19 5- Capacity building to train the people around the children including teachers, parents,
20 extended family members, nurses, school drivers, or care providers. Upon the shutdown of
21 many centers, it is the best time to train people who work with children about disasters'
22 preparedness. It can be very useful especially when COVID-19 threat has been removed.
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24 6- Preparing marginalized children for disasters is vital. Intersection of childhood and racial
25 and ethnic social class, disability, gender, and residence inequalities increases vulnerability
26 and therefore increases disasters' risk for children. One should note that entry points for
27 intervention in such situations are social vulnerabilities.
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29 7- An advocacy support by influential entities such as companies engaged in entertainment
30 industry is required for raising the awareness of public and particularly the children about
31 disasters' preparedness.
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Preparing children for climate-related disasters

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Abstract

Climate-related disasters affect different dimensions of children's health and wellbeing both directly and indirectly. Reducing children's vulnerability and exposure to climate-related disasters is crucial to protect them against risks. Children as climate-change agents and future leaders at local, national, and international level can obviously contribute to reduce vulnerabilities in families and communities and transfer knowledge to them. Moreover, children can advocate for climate change mitigation. In the long term, participation of children in climate change mitigation programs may lead to fewer disasters and, consequently, less risk to their health.

As government policies have failed to fully address and respond to the drivers of climate-related disasters, disaster's preparedness and education for children should be considered an essential activity to protect children from disaster's risks.

Main factors in shaping children's behavior and response to disaster are increasing the risk perception and knowledge of the children. When a child perceived likelihood, susceptibility, and severity of a disaster (such as earthquake), then they would be able and willing to learn how to prepare for that.

So far, disaster education programs for children have mostly relied on offline school-based training. Different innovative approaches can be applied to continue education within online and digital formats including virtual reality, digital games, and online platforms. However, an advocacy support by influential entities such as companies engaged in entertainment industry is required to raise the awareness of public and particularly the children about disaster preparedness.

Key messages

1. With the rise of climate-related disasters, children's health is increasingly at risk.
2. Children should be involved in climate change mitigation programs.
3. Disaster preparedness programs should be developed to include all children with different conditions according to their social vulnerabilities and exposures and without discrimination.
4. It must be ensured that available disaster preparedness programs actually lead to disaster preparedness for children.
5. In addition to traditional disaster education programs for children, new and innovative methods should be widely used.
6. Involvement of various stakeholders such as family, community, government, civic institutions, and industries (including the entertainment industry) is essential in protecting children from disasters.

Children, vulnerability and disasters

Anthropogenic climate change has led to more frequent natural disasters affecting more people in the past few decades^{1,2}. Climate-related disasters such as floods, storms, droughts, and heat waves accounted for 91% of total disasters between 1998 and 2017. Climate-related disasters are strongly coupled and act as dominos. For example, drought and heat wave occur together. Drought leads to dry soils and as a result, solar energy evaporation will end to increase surface warming and consequent increased evaporation rate³. Drought and heatwave will increase the risk of wildfires. Furthermore, sandstorms, haze, and water conflicts are other consequences of drought. Disasters are classified into geophysical, hydrological, climatological, meteorological, biological, and technological based on their causes^{4,5}. According to the Centre for Research on the Epidemiology of Disaster⁶, a disaster is a “situation or event that overwhelms local capacity, necessitating a request at the national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering”.

Children are one of the most vulnerable groups in situations of climate-related disasters and disasters have different impacts on children including fatalities, injuries, child trafficking, child labor, separation, and child abuse in different forms⁷⁻⁹. Disasters affect different dimensions of children’s health and wellbeing both directly and indirectly. Children under five years experienced more diseases related to climate change than others¹⁰. Children’s physical health is in danger as they may be injured or killed immediately during or after disasters due to trauma, malnourishment, diseases, and inadequate access to medical care^{7,11}. Disasters also can lead to mental health problems in children, including depression, sleep disorders, phobias, attachment disorders, and anxiety^{7,12}.

While parents, caregivers and the state have primary responsibility to protect children in the face of disasters, reducing children’s vulnerability is an important way to protect children in disasters¹³. Susceptibility of children to injury and their dependency to others for lifesaving, livelihood, decision making, and emotional support results in their vulnerability¹³. Children are more likely to suffer from exposure to traumatic events because of their physical, physiological, and mental characteristics and development^{13 14}. They are more likely vulnerable to challenges like malnutrition, dehydration, and exhaustion compared to adult¹³. As such, they need more protection before, during, and after disasters. Such protections are even more crucial for children

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3 who are more vulnerable by virtue of their age (i.e. infants), living conditions (e.g., bad
4 infrastructure or lack of family support), ethnicity, disabilities, chronic diseases or preconditions.
5 Attention to children before disasters should be an integrated with disaster's preparedness
6 programs¹³.
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10 The distribution of climate-related disaster's risks is not similar for all children¹⁵. Intersecting
11 social characteristics (e.g., gender, ethnicity, or social class), climate change vulnerabilities
12 (e.g.), and health vulnerabilities (e.g., disability or chronic diseases such as diabetes) will
13 influence the risk and intensity of disasters among children. Climate change including frequent
14 heatwaves, extreme weather conditions and poor crop yields, exacerbates risk factors for child
15 health due to influencing disease transmission rate, affordability of food, and more conflict on
16 food resources¹⁶. The mentioned risk factors also exacerbate with social inequalities such as
17 income, social status, gender, residence, location, housing, disability, and access to health
18 care^{16,17}. As a result, climate-related disasters could increase inequalities and as such health
19 outcomes among children¹⁶.
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28 **Climate-related disasters' mitigation and adaptation**

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31 Efforts to reduce or prevent climate-related hazards such as reducing or preventing greenhouse
32 gas emissions are defined as mitigation¹². It is necessary for mitigation to use renewable energy,
33 increasing efficiency of energy in older equipment, and changing consumer behavior¹².
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37 Depending on their age, and levels of development children can be agents of behavioral change
38 for climate change mitigation. As the future leaders at local, national, and international level,
39 they can help to reduce vulnerabilities in families and communities and transfer knowledge to
40 their community¹⁸. It was shown that children's capabilities as agents are determined by their
41 available resources and their environment (caregivers, parents, friend, peers, teachers, and
42 community)^{19,20}. Parents have a key role in changing children 'behavior with activities such as:
43 training children on environmental ethics and mitigation strategies, buying green or
44 environmentally friendly products for children, and modeling of pro-environmental behavior¹⁸.
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3 Children can advocate for climate change mitigation. There are several examples of advocacy
4 action of children and youth around the world, including seven young Portuguese appeal to the
5 European Court of Human Rights to force 47 European countries to stop further extraction of
6 fossil fuels following fires in Portugal in 2017²², fifteen years old Greta Thunberg in August
7 2018, asked the Swedish government for more activities on climate change, and more. Following
8 Greta Thunberg's move, millions of children in cities around the world demonstrated climate
9 change²³. In the long term, participating children in climate change mitigation's programs leading
10 to fewer disasters and, consequently, less risk to children's health. In other words, children can
11 contribute to the health of children of different generations and be safe from the disasters caused
12 by climate change.
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21 **Children's preparedness for climate-related disasters**

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23 As long as government policies fail to fully address the drivers of climate-related disasters,
24 disaster's preparedness and education for children should be considered for protection of children
25 from disaster's risks. The preparedness interventions, need to be considered in relation to the
26 evolving capacities of the child. In other words, the age, levels of abilities as well as cognitive
27 and physical development of the child are crucial components in the discourse of disaster
28 preparedness for children and cannot be taken for granted. Preparedness is "the knowledge and
29 capacity developed by governments, response and recovery organizations, communities, and
30 individuals to effectively anticipate, respond to, and recover from the impacts of likely,
31 imminent, or current disasters"²⁴. The behavioral changes that lead to a child's preparedness for
32 disasters depend more than anything upon two factors: increased knowledge and skills & risk
33 perception.
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43 The first factor in shaping children's behavior and response to disaster is knowledge and
44 education²⁵. Disaster education plays a major role in enhancing the awareness of children about
45 disasters²⁵. With an increase in children's awareness on disasters, they can share their knowledge
46 with adults and it may result in adults' preparedness as well²⁶. Disaster education for children can
47 be conducted in schools, kindergartens, child welfare centers, or other child service centers.
48 Schools play a critical role in disaster risk reduction because they facilitate the process of
49 education of children on disaster risk reduction²⁷. By utilizing appropriate policy framework,
50 skilled teachers, textbook and curriculum for learning as well as peer education, schools provide
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an ideal space for children disaster's preparedness²⁷. Children's opportunities to access these sources of education are crucial factors. Their access could be simply by the lack of resources such as school, teacher, daycare or the financial means to access them. The access could also be constrained in the presence of resources. For example, child's gender, social class or ethnic background could be some of the hurdles to utilize the existing resources.

The second factor related to children's preparedness is risk perception. Risk perceptions are defined as "beliefs about potential harm or the possibility of loss. It is a subjective judgment that people make about the characteristics and severity of a risk"²⁸. When a child perceived likelihood, susceptibility, and severity of a disaster (such as earthquake), then they would be able and willing to learn how to prepare²⁸. For example, risk perception during COVID_19 pandemic in the world was higher than any other hazard. Therefore, people actively explored and learned protective measures.

Before COVID-19 pandemic, there were many programs conducted for preparing children in many countries. It is shown some examples in the Table 1. Most of the examples in various countries were conducted in schools.

Table 1: some examples of Successful programs for children in climate-related disasters' preparedness countries

Country	Successful programs for climate-related disasters' preparedness
Chile	National disaster's education through drills for evacuation for major disasters, such as earthquakes and tsunamies ²⁹ .
Cuba	National program for preparing children for hurricanes through early warning education, evacuation education, enhancing health literacy and awareness, national media active role in hurricane education and early warning, and teaching risk-prone area to people including children ³⁰ .
Indonesia	National school based disaster education (lecture, drill, curriculum) ³¹ .
Iran	Programs for children about first aid skills, evacuation drills, curriculum-based teaching resource for disasters education ³² .
Israel	Disaster education with lecture and drills for children ³³ , light search and rescue training of high school students in Israel ^{34,35} .

Japan	Tsunami preparedness via evacuation drills ³⁶ , disaster management drill, firefighting drill, acquiring skill of rescue and first aid, and curriculum-based teaching resource ³⁷ .
New Zealand	Shakeout drill (emergency evacuation) ³⁸ , The What's the Plan, Stan?, a voluntary, curriculum-based teaching resource for children disaster's preparedness ³⁹ , museum-based hazard education program on students, teachers and parents ⁴⁰ .
Portugal	Using the disaster awareness game for enhancing disaster's preparedness, curriculum-based teaching resource, interactive resources ^{41,42} .
Turkey	National program that was titled 'Are We Prepared for a disaster?' for children ²⁵
USA	Shake out drill in schools and communities (drop, cover and hold on" drills for earthquakes and evacuation for tsunamis) ^{40,43,44} .

Innovative solutions for preparing children for climate-related disasters

There are several ways to prepare children for climate-related disasters, besides traditional school-based methods such as lecture, curriculum, and drills. There was shown that isolated school-based programs increase disaster knowledge, but behavioral change is not forthcoming⁴⁵. Virtual reality (VR) is a tool to facilitate disaster education and preparedness for children that its effectiveness was proved in many studies⁴⁶⁻⁴⁸. This tool could be used for evacuation drills^{46,49}, firefighting drills⁵⁰, first aid skills⁵¹, and other needed skills for disasters' preparedness. Moreover, children with disabilities cannot participate in physical drills for climate-related disasters. The VR tools eliminate this inequity and help children with disabilities such as children with hearing impairment⁵², and children with autism spectrum⁵³ to prepare for disasters.

Simulation games are another way to prepare children in different ages for disasters⁵⁴. These games can be available via mobile devices and computers⁵⁵. The effectiveness of simulation games for disasters' preparedness was proved in different studies and for different climate-related disasters such as flood^{55,56}, hurricane⁵⁷, and earthquake⁵⁸. This way preparedness is affordable, accessible, and available for many children around the world and will decrease inequity in health and disasters' preparedness and social inclusion of groups at risk of social exclusion^{59,60}.

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3 The Art is another effective way to prepare children for climate-related disasters⁶¹ and safety
4 teaching⁶². This tool is effective especially for preschool children⁶³. It was shown that climate-
5 related disasters' education can improve the quality of preschools children knowledge⁶⁴.
6 Disasters' education with art can effectively help preschool children to participate in disasters
7 climate mitigation and disasters' preparedness activities⁶⁴. Researchers in a systematic review
8 found that programs designed for children 5-11 years old should have some characteristics
9 including the involvement of children's parents, using behavioral modalities (rather than
10 cognitive), and using interactive methods (play, art, stories, and games)⁶⁵. In addition, it was
11 recommended to prepared children with disabilities for disasters with art and storytelling^{66,67}.
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19 To prepare children for climate-related disasters in the time of pandemics, we recommend that:
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- 22 1- Disasters education for children has so far relied mostly on offline training with physical
23 activities such as drills. During this pandemic, different innovative approaches have been
24 applied to continuing education in online formats. The same approaches could be applied
25 for emergency preparedness. For example, virtual forums are appropriate alternatives to
26 provide educations on different topics, e.g., first aid or preparedness for earthquakes,
27 floods, and other disasters.
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- 29 2- Children should be involved in climate change mitigation programs. They can be agents
30 of climate change mitigation and advocate for that. Their participation will change the
31 behavior of families and communities and will also have intergenerational effects.
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- 33 3- The family and the community play a key role in empowering the child to prepare for
34 climate-related disasters especially in the absence of schools, kindergartens, and other
35 child care facilities.
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- 37 4- Creating required resources, especially interactive resources, for disaster preparedness
38 and removing the constraints to utilize those researches are other ways to prepare
39 children in different languages especially children 5-11 years old. Countries according to
40 their risk map (hazard-prone places) should produce relevant content and resources for
41 children.
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- 43 5- Children's risk perception should be increased with the help of media such as TV
44 programs, video games, physical games, music, storytelling, and simulators.
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- 6- Capacity building to train the people around the children including teachers, parents, extended family members, nurses, school drivers, or care providers. Upon the shutdown of many centers, it is the best time to train people who work with children about disasters' preparedness. It can be very useful especially when COVID-19 threat has been removed.
- 7- Preparing marginalized children for disasters is vital. Intersection of childhood and racial and ethnic social class, disability, gender, and residence inequalities increases vulnerability and therefore increases disasters' risk for children. One should note that entry points for intervention in such situations are social vulnerabilities.
- 8- An advocacy support by influential entities such as companies engaged in entertainment industry is required for raising the awareness of public and particularly the children about disasters' preparedness.
- 9- Local and community oriented policies should be crafted to reach out to parents of younger children, providing them with tools and resources, education and opportunities to prepare themselves and strengthen their capacities to protect their children during the disasters

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