

Climate Change and Childhood Communication Disorders:

A Literature and Policy Analysis

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Over the past few decades, scientists from a multitude of fields have been aggregating data to display the inevitability of climate change. Their data has empirically shown that as time progresses, people everywhere will have to deal with the various implications of a changing climate both directly and indirectly (ranging from anything like heat, to hydrologic stress, to weather hazards, etc). With the early and inchoate stages of these prospective implications already revealing themselves around the globe, the uncertainty of their existence is dwindling. In the scientific community, we have thus moved from asking *if* climate change will happen, to asking *how* and *when* climate change will happen.

With an undeniable consensus of scientists now supporting the inevitability of these climate changes, it grows necessary as members of the communication disorders field to start asking how climate change will affect our practices. It is becoming more and more apparent that, as professionals providing services to vulnerable populations, the many negative repercussions of climate change currently being discussed will most certainly affect our clients. Not only will they face increased risk to their health and rehabilitation via heat, drought, and other environmental stressors, but the way we approach therapy as professionals might also be unavoidably altered due to climate change.

With such inevitabilities in mind, this paper is meant to serve as an overview and scientific analysis of such impending questions, and is to serve as an attempt to forecast *how* and *who* climate change will affect in the field of speech pathology. After reviewing different populations within our field that will be affected, this paper will focus more specifically on children and how climate change will affect their psychological, educational, and developmental health more concerningly than other subset populations. With copious amounts of research

already studying how a changing climate will affect children and youth, this paper will further present how we can forecast increasing incidence of childhood communication and language problems, and what that means for our clinical practice and expertise.

With an overall issue of children's communication disorder in the face of a changing climate, this paper will follow a series of steps to elucidate its topic. To begin, it will display the causes and science behind climate change. This will serve as the foundation for explaining *what* is causing the paper's overall issue. Next, we will discuss the different manifestations of climate change, which will show the variability of ways problems shall arise. Leading from this, we will discuss the different ways health (and more specifically children's health) will be affected by such variabilities. Through direct causes like natural disasters, and more indirect causes like poverty, educational deficits, and enduring psychological distress, such health issues will be displayed. Lastly, with all of this information, the subsequent ramifications for communication disorders specifically will be conceptualized. With this we will be able to better exhibit the full extent to which climate change will affect children's communication disorders, and plan more preparedly for the future.

Introduction to Climate Change

To begin our assessment on how climate change will affect communication disorders , it is important to understand what climate change *is* and *means*.

Climate change is growing to be one of the defining dilemmas of the 21st Century. Science is increasingly showing us how the relatively stable climates humans have enjoyed for

past millennia are slowly deteriorating, causing concern about how we will live our lives under unprecedented climate conditions (McCarthy et al., 2001). With temperatures expected to increase, sea levels expected to rise, and food and water expected to grow more scarce, climate change is becoming a known existential threat that will affect populations everywhere. Consequently, as a profound antagonist to our historical understanding of human life, it becomes clear that climate change and its effects require more attention and more caution than ever before.

Defined as a “change of climate that is attributed directly or indirectly to human activity, altering the composition of the global atmosphere” (UNFCCC, 1992), climate change is becoming known as an incredible threat to our planet. Different from previous minor shifts to earth’s climate throughout its existence, climate change of the 20th and 21st Centuries is believed to be caused almost entirely by human activities, and not solely by a natural or benign progression of our atmosphere. Because of this, the climate change we are experiencing now is more rapid, more intense, and more severe than ever before, and is projected to cause serious harm in the years to come if proper steps are not taken in time.

According to the US Environmental Protection Agency, the current human led changes to our climate can be mostly attributed to a variety of unsustainable industry and cultural practices we are allowing to persist without regulation (Boden et al 2017, 1). However vast and diverse these industries and cultural tendencies are, four individual contributors can be held responsible for the current climate changes we are witnessing; Carbon Dioxide, Methane, Nitrous Oxide, and Fluorinated Gases (Simon-Lewis 2017, 1). Each of these four gases manifests in different ways

through industrial manufacturing, production, transportation, or profligate cultural habits, and, in its own way, is leading to the current climate instability happening all over the world.

<p>Carbon Dioxide: produced through fossil fuel pollution (oil, natural gas, and coal), solid waste and wood production, deforestation, and soil degradation. Some excess carbon dioxide in the air is reduced via natural processes, but some remains in the atmosphere for up to one thousands years. This is because of to the slow process by which carbon is absorbed by the ocean.</p>
<p>Methane: Produced through transport of oil, coal and natural gas. Methane emissions also result from livestock and agricultural practices and from the anaerobic decay of organic waste in municipal solid waste landfills. Methane lives in the atmosphere for up to 12.4 years</p>
<p>Nitrous Oxide: Produced via agricultural, combustion of solid waste and fossil fuels, and industrial activities. Lives in the atmosphere for up to 121 years</p>
<p>Fluorinated Gases: A group of gases containing fluorine that are produced from different industrial, commercial, and household activities that are not naturally occurring. Sometimes used as substitutes for ozone-depletion materials such as chlorofluorocarbons (CFCs).</p>

Figure 1.1: Greenhouse Gases. information sourced from Wired Magazine UK, Simon-Lewis, Alexandra, “What is climate change? Definitions, causes, and effects”. 2017

The production of these gases is believed to contribute directly to the global climate change scientists are currently documenting. With carbon dioxide as the primary contributor, comprising a total of 75% of all polluting global gas emissions (Boden et al 2017, 1), evidence in growing correlating increases in carbon outputs to increases in climate volatility:

Global Carbon Emissions from Fossil Fuels, 1900-2014

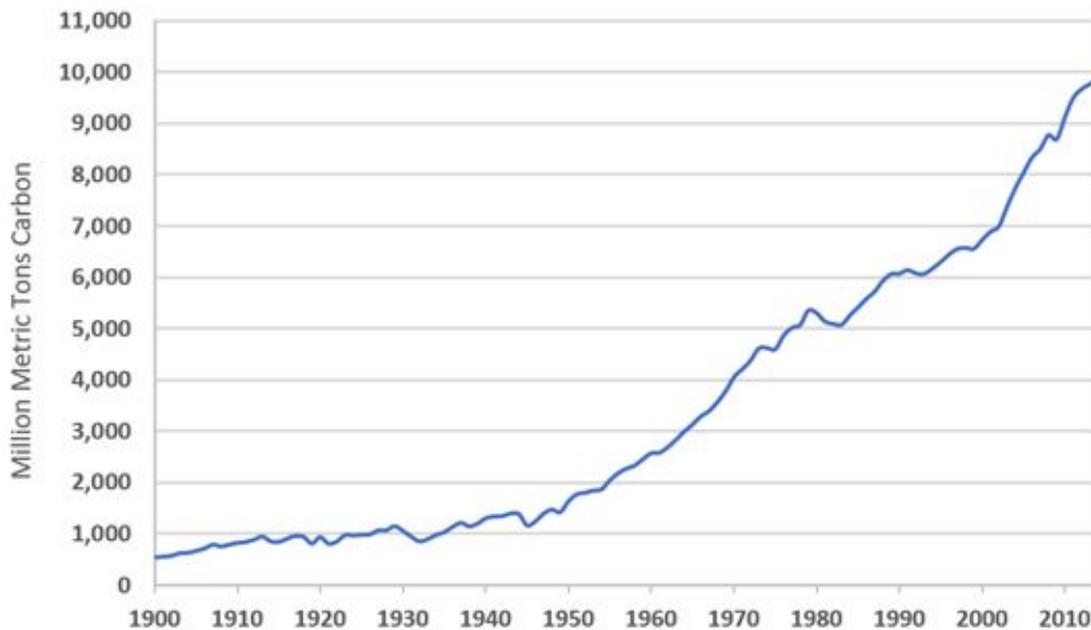


Figure 1.2: Sourced from the EPA. Boden et al “Global Greenhouse Gas Emissions Data”. 2017, pg 1

Shown in Figure 1.2 above, global carbon emissions can be seen increasing exponentially as the 20th century progresses. Paired with the other 3 pollutant gases, it is widely believed that the production of this gases is leading to many of the consequences of climate change already observed. Data points to phenomena like ocean acidification (Doney 2009, 1), increased global temperatures (Oppenheimer 2016, 11), and ecological degradation (McCarthy 2001, 75) as a result of these empirically documented carbon increases. The production of these gases should thus be considered extremely detrimental, and a leading cause of the climate change that will be discussed in this article.

If the pollution of these gases into our atmosphere wasn't bad enough, a physical phenomenon called the greenhouse effect is exacerbating things even more. Normally a positive phenomenon humans have historically relied on, the Greenhouse Gas Effect keeps the planet warm by trapping infrared radiation from the sun beneath the atmosphere. It is agreed by scientists that without the greenhouse effect, the Earth would be approximately 59 degrees F colder than it is today (Selin & Mann, 2017). However, even though the Greenhouse Effect is a positive thing in most cases, the current excess presence of the four aforementioned gases in our atmosphere is causing the planet to retain too much infrared radiation to function. Having the ability to absorb the spectrum of infrared light, the production of all of these gases at unbearable levels is subsequently causing the earth to warm far beyond its natural capacity, with molecules remaining trapped in the atmosphere for tens to hundreds of years.

The reality of unsustainable industrial gas production coupled with the greenhouse effect becomes an insidious pairing, responsible for many of the growing changes we are witnessing in our climate today. By trapping excess heat, pollutant gases are causing a series of microcosmic climate events witnessed in many parts of the world, with many past projections of these events already coming true. Some observable climate change effects already documented include shrinkage of glaciers, thawing of permafrost, later freezing and earlier breakup of ice on rivers and lakes, lengthening of mid to high-latitude growing seasons, poleward and altitudinal shifts of plant and animal ranges, declines of some plant and animal populations, and earlier flowering of trees (McCarthy 2001, 13). To the layman, these changes might not sound too noxious, but even the smallest shrinking of glaciers, or the slightest shift in animal populations, can cause serious implications for local sea levels, weather patterns, and ecologies. Thus, the observable changes

we are witnessing should be a serious cause for concern, as they have the potential to drastically shift the way we currently live our lives on Earth.

With the observable changes in our climate already showing, and with empirically documented increases in noxious gases in our atmosphere, many implications targeting human populations can be expected within the coming years. Even though climate change implications will be quite varied and diverse depending on local geographies and ecologies, populations everywhere can expect to experience both direct and indirect consequences of climate changes. Direct consequences can be viewed as weather events that can be physically seen or felt, like storms, sea level rises, wildfires, etc. These are the large scale, macroscopic, and obvious changes happening all around us. Indirect consequences on the other hand are a bit more insidious, as they arise in ways that cannot be directly seen or felt. They are the secondary consequences of the observable, large-scale climate change shifts, and include things like malnutrition, mental health issues, delayed literacy, increased diseases, and poverty. It is important to recognize this difference, as much of the more persistent impacts of climate change will be through indirect cause rather than direct causes, as they affect populations and societal structures more long-lastingly and more severely.

Types of Climate Change

Now that a general synopsis of climate change has been established, it is important to recognize some of the different types of climate change expected within the coming years. This chapter

will outline various types of climate change that are most relevant to this paper's overall topic of children's health; which includes things like heat, hydrologic stress, and weather hazards.

Heat

Increasing temperatures are one of the most publicized aspects of climate change, and are said to be contributing to many of the wide scale symptoms the planet is currently experiencing. Planet Earth has already experienced an average temperature increase of around 0.85 degrees C (Currie and Deschenes 2016, 17), leading to much cause for concern. To put that in context, one more degree Celsius above today's average (which scientists already say is very probable), would put the earth above the range of global temperature experienced in the last 10,000 years (Currie and Deschenes 2016, 17). However seemingly small, this gradual increase in temperature is expected to cause a variety of harmful consequences, ranging from higher mortality rates in pediatric and geriatric populations, increased damage to crops, reduced energy supply, increased violent conflict and increased preterm births (Blencowe et al 2013, 1). With increasing temperatures, the average American family is expected to experience 4 to 8 times as many hot days per year, which will cause increased heat stroke, heat exhaustion, and heat related mortality across the entire population (Oppenheimer 2016, 11).

These findings should be a cause for concern for everyone, as they delineate examples of ramifications climate change is expected to produce, simply from a small increase in temperature. Every American, if not every person on the planet, will experience these small changes. Whether directly or indirectly, small increases in temperature averages will change the way life exists on earth, and the way humans function biologically and sociologically.

Hydrologic Stress

Another expected consequence of climate change that scientists are expecting comes in the form of hydrologic stress, otherwise known as changes and shortages of water resources on Earth. As the primary essence of life, water has always been a necessity for established and stable societies. That is why the looming prospect of water depletion at the hands of climate change should be a cause for concern for everyone. According to Oppenheimer and Anttila-Hughes(2016), there are three major ways hydrologic stress will occur with climate change. The first is in the geographic shifting of precipitation patterns, drying out certain regions and making others wetter. Next is increased variability in precipitation, which will cause long dry periods in some places, and long wet periods in others. Lastly, hydrologic stress will reduce the mass of mountain glaciers in ranges such as the Himalayas and Rockies, significantly reducing storage of winter snows and thus springtime runoff, which is integral for agriculture and reservoir deposits.

With these prospects expected, many areas of the world will see their demand for water outstrip supply, as water scarcity and drought become more common. In other areas, a bombardment of precipitation will lead to flooding and sea-level rises, displacing populations at an unprecedented. Additionally, municipal water systems will be stressed, the cost of water will increase, agriculture will be threatened, and sanitation issues will grow common, all due to this prospect of hydrological volatility (McCarthy 2001, 191). All of these issues should therefore be kept in mind, as they are all relevant to the general topic at hand. With hydrologic stress thus becoming more common, a cause for concern is obvious.

Weather Hazards

Finally, a third type of climate change worth mentioning concerns weather hazards, which includes many different kinds of weather extremes like hurricanes, tornadoes, monsoons, earthquakes, wildfires, etc. Climate change is expected to alter the behavior of such climatological disasters, mostly due to increased temperature and precipitation (Oppenheimer 2016, 26). It is subsequently expected that such weather disasters will inadvertently cause increases in infrastructural and economic distress in many areas. Such distress is expected to cause consequential ripple effects; affecting the economy, education, government, and healthcare.

Examples of such unprecedented weather events are already happening on a seemingly frequent basis, with Hurricane Maria and Northern Californian wildfires most recently observed. 2017's Hurricane Maria caused unprecedented devastation to Puerto Rico and the Caribbean, leaving countries without power and debilitating its infrastructure. People in Puerto Rico specifically are still recovering from the devastation, with 50% of residents without power and a mortality rate surpassing 500 just a few months past the hurricane's landfall (Robles 2017, 1). An additional number of similarly devastating hurricanes occurred in the 2017 season, with Hurricane Harvey and Hurricane Irma causing equally unprecedented damage to areas around the Gulf of Mexico.

Northern California also fell victim to a similarly devastating weather event, this time manifesting as catastrophic wildfires. Due to dry conditions, much of Northern California was consumed in overwhelming conflagrations and was consequently evacuated. Many people lost their homes and livelihoods, with damages estimated at about three billion dollars (Winton and

Grad 2017, 1). Mortality rates were also very high, with numbers estimated at around 40 deaths for the single event (Nelson et al 2017, 1). The historic fires lasted for weeks, and left large swaths of California completely derelict and destroyed.

With such catastrophes happening on a much more frequent basis, historically significant weather hazards are unfortunately becoming a new norm. With many parts of the world susceptible to these weather hazards, and as they increasingly grow in power and devastation, pervasive damage to livelihoods and infrastructure is almost certain. As fires burn down countless homes, and as hurricanes rip up roads, bridges, schools, and businesses (which we are already witnessing), the mounting losses can be seen and felt. Also if material damage wasn't bad enough, mortality rates will also naturally rise as weather hazards tear towns and cities apart. Thus, with climate change underway, hazardous weather episodes like Puerto Rico's Maria and California's wildfires should be expected to occur more often, affecting populations in many areas across the globe.

Given these three separate examples of expected climate changes now outlined, it is clear that many severe issues will arise affecting human populations on Earth. With prospects like heat increases, hydrologic stress, and weather hazards (among many others), the negative consequences we will all experience at the hands of climate change start to build up. Thus, a mounting concern is warranted by all citizens, as these issues will most likely affect everyone.

Not all populations will experience these negative consequences equally however. Depending on one's geographic location, nationality, socioeconomic status, or age, the effects of climate change might be different. Of all populations on Earth, children are believed to be the most vulnerable to all of the various aforementioned climate change scenarios. Consequently,

with their well-being at greatest risk, we must analyse how all of the climate change examples we just discussed will affect children specifically, and how their health might be impacted as climate volatility continues to increase.

Climate Change Implications for Children's Health

Oftentimes left out of scientific discussions, children are expected to be the population most severely affected by climate change, as they are physically and psychologically more susceptible to negative impacts of all expected climate change scenarios (Kousky 2016, 73). Statistically speaking, the World Health Organization estimates that children suffer more than 80 percent of the illness and mortality attributed to climate change, and is why specific focus is needed surrounding their vulnerabilities (Currie and Deschenes 2016, 4). Thus, with things like heat, hydrologic stress, and weather hazards already outlined, we will review the multitude of ways children's vulnerabilities have the potential to be affected by climate change; making them susceptible to a variety of health problems we are only beginning to understand.

Children and Heat

As a major factor expected from climate change, heat will be a large contributor to negative consequences experienced by children in the future. Essentially affecting the entire span of childhood, heat is expected to cause severe implications starting from fetal development in the womb all the way through adolescence, issues spanning all intermediary developmental stages. Public health studies shows us that children younger than 15 have a higher risk of dying from heat than adults do, with infants and children under 5 at particularly increased risk (Zivin and

Shrader 2016, 34). Additionally, for every degree celsius increase experienced around the world, even in developed countries, children will experience a mortality rate 50 to 100 times higher than adults (Zivin and Shrader 2016, 34).

These figures are made possible because with temperature increases, children are expected to face higher rates of heat stroke, higher rates of cardiovascular failure, proliferation of diseases, increased malnutrition, and even death (Zivin and Shrader 2016, 34). With heat related pollution of the ozone, children are also faced with increased rates of respiratory illness as well (Larr and Neidell 2016, 93). All of these health implications are expected because children have underdeveloped physiological systems and communication abilities, which prevent them from adapting to heat in ways adults are better able to.

Physiologically, due to their excess fatty tissue (an adaptive feature typically used by children to keep warm in cold weather), children retain more heat and sweat less than their adult counterparts. This makes excess heat very hard to manage. Also, communicatively, children are less likely than adults to manage their own heat risks. This is because they lack the general knowledge and communication skills to mitigate exposure to heat when they are outdoors. Unlike adults, they might be unaware that they are dehydrated, causing them to accidentally stay in the sun for too long, or they might lack vocabulary to describe heat ailments or dehydration (Zivin and Shrader 2016, 34). These several reasons make heat harder for children to bear, exposing them to greater health risks as temperatures increase.

Even more considerable are risks posed to fetuses, as premature births are expected to rise as a result of increased temperatures. In the article “High Ambient Temperature and the Risk of Preterm Delivery” from the American Journal of Epidemiology, higher temperatures are

directly tied to children being born too early. Not only is this a concern for expecting mothers, but also for the health of the babies being born as their risks for an array of disorders and disabilities exponentially increases. (Rupa et al 2010, 1109)

If all of those examples weren't bad enough, Zivin and Shrader additionally discuss how heat will pose long-term secondary effects to children's education and their ability to learn. In their article "Temperature Extremes, Health and Human Capital", the authors delineate how heat will cause supplementary impaired cognitive functioning, impaired fetal brain development, and impaired working memory skills (Zivin and Shrader 2016, 39). Children in future decades thus might have a more difficult time than their counterparts from past years in areas like learning, retaining information, developing literacy skills, and developing social skills.

All this evidence shows just some ways babies and children will be affected to the heat caused by climate change. These examples all raise concerns for many potential health issues at risk for being developed, posing many negative implications for the developing child.

Children and Hydrologic Stress

Serving as the second example of climate change discussed previously, hydrologic stress is also expected to be a major contributor to negative consequences experienced by children in the coming decades. As a resource integral for survival, stable access to water is necessary for children to thrive, and without water, many negative implications can be expected. As water thus grows more scarce over large parts of the planet due to climate changes, and as drought and agricultural shocks grow quite common, children's health is consequently at greater risk (McCarthy 2001, 215).

As hydrological stress begins to grow more common, water will become harder and harder to access, posing various climate issues to children. Most importantly, drought and its consequential effects on agricultural yields will be of significant importance, largely because agriculture is essential for children's food access and nutrition. Without proper and stable access to food, children may experience things like malnutrition, stunted growth, and even death. Shockingly, according to UNICEF, inaccessibility to food and consequential malnutrition is responsible for around half of all deaths of children under 5 years old around the world (Hayashi 2017, 5). Evidence also confirms that for every degree celsius our global temperature rises via climate change, agricultural yields will be additionally reduced by 10 to 30 percent (Akresh 2016, 54); making consequences of hydrological stress even more daunting. These current statistics are already quite staggering, and with continued climate change and subsequent drought, the looming prospect of increased childhood malnutrition, delayed development, and even death becomes a very real possibility.

Some examples of childhood diseases due to failed agriculture can already be seen in Sub-Saharan Africa. The region has been dealing with increased issues of drought and consequential malnutrition for some time, and closer examination of this region helps us gain insight into just how severe drought can be to the health of a child. Reviewed in the article "Year-to-Year and Seasonal Variations in Stunting among Preschool Children in Ethiopia" by Lindtjorn and Alemu (2002), the rates of stunted growth due to drought and malnutrition were studied in Ethiopian farming communities. This work shows that, in years of greater water abundance, and thus greater agricultural yields, children were less susceptible to stunted growth. On the other hand, in years when drought was in fact an issue, yields were meager and stunted

growth was more widely observed (Lindtjorn and Alemu 2002, 326). These data exemplifies how, as hydrologic stress and drought increase, childhood health problems exponentially increase too. Thus, with climate change looming, this study shows why we should be especially concerned for children's health with drought on the rise.

Drought is also expected to cause harm to children in another, more indirect way. With drought, instances of regional violence are also expected to increase. This trend should be seen as just as much of an issue to children's health as malnutrition. For example, according to Richard Akresh in his article "Climate Change, Conflict, and Children", a growing number of researchers have been studying the relationship between how drought and its consequential conflict will affect children (Akresh 2016, 51). Akresh shows that with reduced rainfall, especially in economies based on rain-fed agriculture, instances of civil wars and murder have increased (Akresh 2016, 54). Using data gathered after Burundi's civil war in October 1994, Akresh additionally shows that children who were most exposed to regional conflicts were more poorly nourished, performed more poorly in school, and had greater instances of stunted growth (Akresh 2016, 58).

Unfortunately, Burundi's violence is not an isolated incident. Akresh continues by citing another study from Eritrea with similar findings on children's health and conflict. By analyzing civil violence from May 1998, scientists sought to study whether or not an Eritrean village's proximity to conflict had any effect on its children's health. Similar to findings from Burundi, it was discovered that the closer a village was to conflict hotspots, the shorter and more malnourished children from that village were. This study along with the previous one regarding Burundi thus substantiate some of the negative health effects associated with exposure to

conflict. They further delineate why future conflicts due to water scarcity might pose various health risks to children, and should thus draw concern for prospects of climate change.

In summary, it is important to consider how hydrologic stress due to climate change poses a variety of issues to children. Primarily, general increases in drought are expected to cause direct health concerns as malnutrition increases. Additionally, as drought is believed to increase violence and conflict, it is important to consider how this might also affect children's health; with developmental implications like stunted growth of particular epidemiological concern. Thus, hydrologic stress should be noted as a major climate change ramification for children, and should be expected to cause many increased health issues as time progresses.

Children and Weather Hazards

Finally, weather hazards are also expected to pose health risks to children. These hazards can manifest in the form of a variety of natural disasters; ranging from hurricanes, to tornadoes, to earthquakes, to monsoons, etc. With increasing strength and ubiquity, these disasters are expected to become more and more of an issue for children as years progress; as their psychology and physiology are at increased risk. It is thus important to analyze how these weather hazards will cause increased harm, in order to deepen our understanding of children's expected climate change risks.

In the article "Impacts of Natural Disasters on Children" by Carolyn Kousky (2016), we are able to see how these weather hazards will directly affect young people. From the article, Kousky outlines three significant implications worth noting, which include damage to physical health, damage to mental health, and interruption in education. Within each of these effects,

Kousky addresses their individual ramifications; showing how many weather-related health risks of will grow common for children.

Firstly, in terms of damages to physical health, children are expected to suffer corporal harm at the hands of weather hazards. Generally manifesting as direct bodily injury, children are naturally subjected to cuts, broken bones, and even death in the event of extreme weather. Additionally, even more physical harm can be expected indirectly through things like malnutrition (caused by disruptions in food supply), diarrheal illness (caused by water pollution), and infection (caused by poor access to proper medical supplies and healthcare infrastructure); all at the hands of weather hazards. Furthermore, Kousky mentions that delayed-motor development, stunted growth, high cholesterol, and high blood pressure (Kousky 2016, 81) were also all observable in hazard exposed populations,; posing additional long-term health consequences to children. Damages to physical health therefore are varied, and exist both directly, as bodily harm, and more indirectly as malnutrition and infection.

Next, in terms of damages to mental health, weather hazards are posed to cause extreme psychological distress to children. In the event of a natural disaster, mental health issues children might face can stem from material damage to their homes and possessions, distress from long-term migration, grief from losing loved ones, neglect, abuse, economic loss, and social unrest (Kousky 2016, 82-84). However severe these issues are to everyone, they are of particular concern to children because unlike adults, children's brains are still developing, leaving them unable to manage such profound issues properly. Such extreme psychological distress thus has the potential to cause long-term trauma, leading to developmental issues and post-traumatic stress disorders (Kousky 2016, 82). Worst of all, such mental health consequences might not

manifest until long after the natural disaster subsides, sometimes affecting children well into their adolescent and adult lives undetected.

Kousky also mentions disruptions in education as a cause for concern. In the event of a natural disaster, children might have to flee their homes, infrastructure will be destroyed, and consequently education will take a backseat to many of the more life-threatening things going on in the child's life. These disruptions in education subject an otherwise smart and able child to reduced economic activity in the future, lower IQ, and the obvious fewer overall years of school; leaving them years behind others their age who are not subjected to disasters (Kousky 2016, 81). Subsequently, entire generations across large geographical regions will be left behind in their education, a cause for concern for governments preoccupied with state stability and state economies. Without an educated population, nations will not have the proper work force to maintain stability, develop, and compete on the international scale. Today's children affected by weather volatility and their progeny will thus be more subjected to more extreme poverty and cyclical economic instability, all at the hands of weather hazards.

We can thus see via numerous examples why children will be of large concern moving toward the future. Of particular concern is to children is how climate change will affect their health; with multiple threats to their physical and mental development laid out in this section. With children's health on our minds, it is important for professionals and academics in relevant medical fields to start considering how climate change will affect their pediatric practices.

How will so many of the negative implications of climate change we are expecting change the face of the work we do, and the children we treat? How can pediatric health

professionals begin to incorporate climate change mitigation strategies into their own designated specialty areas? These types of questions begin to arise as the general state of children's health is expected to take a negative turn as a result of climate change.

With issues of climate change now directly tied to children's health, it grows imperative to study how these issues will affect my own field of Communication Disorders. As a discipline that deals very closely with children's medical and developmental issues, it grows exigent for me to consider how climate change will impact the way my field runs and operates. By understanding this, we can move on to discuss how my field might be affected by such changes, and what policies we can look at to help mitigate many of the disorders we can expect to see increase in the near future.

Climate Change Implications and Communication Disorders

With different types of climate change laid out in the previous section, and the multitude of consequences they will pose to children, the prospect of long-term and severe pediatric health consequences grows evident. Ranging from fetal damage, to physical harm, to persistent mental health issues, among many others, the entire span of a child's development becomes extremely vulnerable due to looming climate change, and should thus be a focus of pediatric health academia moving forward.

With this in mind, we will now move to focus on how my personal field of Communication Disorders will be affected by many of the aforementioned issues of climate change. With a focus on our work with children, I will propose many ways in which we might

see increase in childhood disabilities with the populations we work with, and the routes we can then expect to pursue moving forward.

What is Communication Disorders and Why is it Relevant?

In order to better understand what communication disorders is and why it is relevant to climate change and children's health, it is important to outline some definitions. As a growing field, communication disorders is a broad and comprehensive discipline with foundations in rehabilitative medicine and linguistics. Professionals with degrees in our field work to study and treat any kind of communication impairment across many populations of people. Ranging from newborns to geriatrics, communication disorder professionals are responsible for ameliorating a variety of diseases and disabilities; all of which deal with parts of the body concerning speech, language, hearing, and swallowing.

Even though the diseases we work with are quite varied and diverse, there are specific terms we use as professionals to help define encompassing attributes of all "communication disorders". Defined by the American Speech and Hearing Association (ASHA 2017), a communication disorder is "an impairment in the ability to receive, send, process, and comprehend concepts or verbal, nonverbal and graphic symbol systems. A communication disorder may be evident in the processes of hearing, language, and/or speech. A communication disorder may range in severity from mild to profound. It may be developmental or acquired. Individuals may demonstrate one or any combination of communication disorders. A communication disorder may result in a primary disability or it may be secondary to other disabilities(Block et al 1982, 1).

These communication disorders are thus focal aspects of our field, as we work to rehabilitate and/or cure any such problem. Communication disorders professionals are responsible for treating patients with a diverse array of problems, all of which impair their speech, hearing or communication in any ways. Through diverse things like strokes, genetic predispositions, traumatic brain injuries, developmental delays, toxic exposure, birth defects, etc., any type of impairment that can cause hindrances of speech, hearing, and language is added to our scope of practice. With damage to the body's development, to the brain, to the anatomy/physiology of speech and hearing organs, etc, communication disturbances can arise. Professionals in the field are then called in to see such patients, either long-term or short-term, and work to rehabilitate their language and speech issues.

Knowing this, with many disorders manifesting due to genetic, birth, and developmental defects, children are naturally wide recipients of communication disorders services. As they face issues ranging from reading/learning disabilities, autism spectrum disorder, Down's syndrome and other genetic predispositions, fetal trauma, oromuscular delays, and respiratory issues, children are large recipients of our rehabilitative health services (Block et al 1982, 1). Children are therefore important to much of the work we do, and are a notable population we have historically worked with.

It thus becomes important to consider how previously outlined examples of climate change will affect Communication Disorders as a field. With various children's health implications expected, affecting development, physiology, and education, it can be said that increases in climate change will consequently lead to increases in communication disorders. Children will be subjected to greater chances of developing a communication disorder due to the

effects of heat, hydrologic stress, and/or weather hazards, and so it is important as a field to recognize how this all might manifest, and what this will mean for our practice.

Within worst case climate change scenarios, many types of communication disorders are likely to increase due to heat, hydrological stress, weather hazards. Heat will cause socialization issues, and cognitive development issues, communication disorders will rise as many aspects of a child's speech and language will be affected (Zivin and Shrader 2016, 34). Specific communication disorders like voice impairments, preschool language issues, and learning disabilities can all manifest as a result of heat-related health symptoms, and will all affect the way a larger portion of children develop communicatively.

With hydrologic stress, and its subsequent increases in conflict and agricultural volatility, children will be subjected to side effects of post-traumatic stress, malnutrition, stunted growth, and muscular issues. With these health problems, children suffering from hydrological stress might show increases in communication disorders like orofacial dystrophies, apraxias, and dysarthrias; all due to hydrologically-caused malnutrition and impaired muscular development (Norman et al 2005, 143). This impaired development can in turn cause increases in language learning disabilities, preschool language acquisition disorders, or any other cognitive-based language impairment discussed earlier. (Norman et al 2005, 143). Additionally children might have increases in stuttering disorders or selective mutism disorders. This can be attributed to expected increases in anxiety and PTSD due to climate-caused conflicts and violence, both of which are expected to rise as health and hydrological stress grow common (Kousky 2016, 82).

Furthermore, prospective large-scale damage to infrastructure caused by weather hazards is also a huge concern for increasing incidence of communication disorders. This is because

treatment for these disorders is typically long-term, and is thus largely contingent upon strong and durable infrastructure. Without solid hospitals, schools, and clinics, treatment centers will essentially not exist, and communication disorders will consequently go untreated (Paul and Norbury 2012, 100).

Weather hazards also pose threats to language acquisition and development in general, as many children might not have access to schools, and thus formal language instruction. With much of the formal language we learn taught to us in classrooms, children without proper educational access due to catastrophic weather will have delayed writing and literacy skills, which might in turn delay language acquisition and cause increased preschool language disorders. Therefore, it can be assumed that as climate change implications begin to reveal themselves more frequently, communication disorders in children will exponentially increase as conflicts and malnutrition rise.

Climate Policy and Communication Disorders

With higher incidences of communication disorders thus expected with climate change, it grows exigent for professionals, clinicians, and academics alike to consider what our next steps should be. Through analyzing current policies being codified in governmental and intergovernmental spheres, we can better understand what some of these steps might be, and how we can help children's health moving toward the future. With this in mind, to better understand the scope of recent climate change policy measures we can look toward the Intergovernmental Panel on Climate Change (IPCC) for the most comprehensive and credible look at issues on the current

state of the climate. Via their Fifth Assessment Report (AR5), specifically designed for policymakers, the IPCC has published a long-winded evaluation on the current scope of climate change research and science. They then assess mitigation prospects for governments to consider, and ways climate change scenarios can be best bailed. Through this policy assessment, professionals in the communication disorders field can better understand what effects of climate change they can expect, numbers and figures they should know, and ways they can best mitigate the health risks of children as negative climate implications persist.

Additionally, through the AR5, communication disorder professionals are also given glimpses into ways government and policy have the most powerful tools to help improve climate related health issues in our field. Because of this fact, government and policy should thus be noted as essential routes we should take to best protect our patients as climate change issues continue.

The IPCC Fifth Assessment Report

The AR5 begins by outlining definitions and introducing climate change science for policy makers to consider. With their ultimate goal defined as “the stabilization of greenhouse gas emissions in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” (IPCC 2014, 4), AR5 immediately delineates the fact that preventing any further carbon emissions past currently projected levels is the utmost priority for governments and policymakers. By hindering any further progression of emissions, governments can render extreme scenarios of climate change less likely, and thus make adaptation and mitigation more feasible for everyone. Through intervention efforts and policy measures, AR5

explains that governments can use their financial and administrative powers to reduce national CO2 emissions, provide better access to healthcare, help shift national consumption cultures to more sustainable levels, help shift attitudes toward greater acceptance meat-free diets, and designing energy efficient transportation systems; all of which will bask pollution, poor air quality, and other major public health threats. AR5 thus helps delineate that governmental interventions are the best and most feasible way for large-scale climate change mitigation to occur. Government and policy should subsequently be relied on as the best possible way extreme climate change ramifications can be mitigated; allowing communication disorders professionals to worry less about potential health problems that might have otherwise come about.

AR5 continues by stating that with governmental interventions, desired levels of CO2 should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure food production is not threatened, and to enable economic development to proceed in a sustainable manner (IPCC 2014, 4). This additionally emphasizes that if states all do their part, responsible policy can in fact prevent climate change from reaching completely catastrophic levels. Thus, AR5 again helps show why climate change considerations are so important for policymakers and governments to understand, and why focusing on these issues at the governmental level grows so valuable to consider.

The AR5 then continues by outlining several important points for policymakers to consider. Some of these points include:

- International cooperation is necessary as CO2 is a transnational burden (5)
- Countries with greater financial capacities should help more (5)

- Economic evaluations (cost-benefits) should not be seen as issues more important than issues of social welfare (5)
- Water and food availability are dependent on strong and enforceable policy measures (17)
- Not all regions of the world will experience climate change equally, and so mitigation should be a global effort (5)
- Early action is extremely important (18)
- Emissions can be substantially lowered through changes in consumption patterns and effective policies (20)
- Decarbonization and changes in our energy sources are integral in sustainability mitigating climate change (20)
- If all of these perceived risks are better and more widely understood, greater action will be taken to combat these risks, and is why considering AR5 is so important (5)

With all of these points noted, the AR5 is showing how climate change doesn't have to be catastrophic, and if proper and responsible intergovernmental steps are taken the whole world will be better off. It is thus important for governments and policymakers to start acting as soon as possible, to prevent any further harm from occurring; emphasizing their role in leading climate change mitigation efforts.

AR5 and Communication Disorders. What Can We Learn?

Although AR5 is developed primarily with policy makers in mind, there are many things the communication disorders field can take away from its writing. By looking at its mitigation science, international collaborative efforts, and emphasis on auspicious policies, AR5 can teach our field that our best bet at helping save children is through pressuring members of government to act. We should use AR5's writing to better acknowledge our duty and responsibility as health professionals to persuade our elected officials to take these issues seriously, and to enact policies to balk climate change. This pressure will help children facing communication disorders grow less likely to develop health problems, and can help our field attain better funding, better resources, and better infrastructure to treat the patients who might suffer under future climate conditions.

With measures targeting things like clean water protection and sanitation, promotion of health care, vaccination services, increasing capacities for disaster preparedness and response, and poverty eradication, massive public health epidemics can be mitigated (IPCC 2014, 714) and communication disorders incidence will stop unnecessarily increasing. Policy measures like the AR5 thus delineate the importance for pressure on governments. AR5 shows how we can use policy to make the most pervasive impact in preventing further climate change, and how government will take the greatest leadership role in this fight only if we as professionals advocate for it.

What Should This Tell Us?

Communication disorders professionals are thus faced with an increasingly important task. With the AR5 in mind, we must ask ourselves what we can do to take greater political action, keep ourselves up to date, and participate more in policy formulations. From this, I have created what I call an “Action Model” for communication disorders professionals to use to make a difference for patients toward the future. Based off of the AR5’s outline for policymakers, my Action Model is designed for everyday health professionals to incorporate into their practices; in order to make a notable difference in their limited daily spheres, and to advocate for change democratically.

- **Learn:** Educate oneself more about climate change issues and how they will affect our specific patient populations. Use this information to inform therapy decisions. Consider how changes to therapy might benefit patients suffering from climate change related issues.
- **Connect:** Aim to build networks with fellow health professionals, NGOs, humanitarian organizations, and government. There is strength in numbers, spread the word and utilize resources.
- **Pressure:** Take action. Get in touch with government officials. Use your political agency to enact change and vote for people who support our causes. Make sure effective policies are at the forefront of our goals, as they are able to make the most widespread change as quickly as possible.

With the Action Model, we can strategize as a field to make a difference using our everyday powers as health professionals. In conjunction with effective policies, however bleak climate

change scenarios may seem, the greatest and most effective differences can be made for the health of our clients through professional-governmental partnerships. The AR5 should thus delineate steps that we should take as professionals. It should show that by supporting my Action Model, effective policy measures will be more widely supported and better implemented, and our field will benefit as a whole.

Future Outlooks for the Field

With the AR5 outlined, and with so many daunting climate change prospects presented, the future of our field comes into question. The need to consider how the climate might be affecting our patients will be increasingly integrated into assessment and screening protocol, and will require us as professionals to make clinical decisions based on climate-related diseases. Prospective changes to our standard set of therapy procedures should thus be analyzed, and considered moving forward as we take note of how climate change will affect speech pathology.

Some possible changes to our practice worth considering come most notably during the screening and assessment process. As climate change ramifications become more typical, it will be important for professionals to examine whether or not possible climate-related hazards are a cause or possible etiology of disorders children are presenting with. When a child comes into the clinic for a screening, we will need to ask ourselves if observable deficits might have roots in the heat, hydrological stress, or weather disasters mentioned earlier in this paper. Our standard set of questions asked during an intake session, including a background history, medical history, etc. will have to be expanded to include climate-related questioning. This will allow for more

accurate and more specific diagnostic prowess to determine possible etiologies of disorders.

Some of these questions might include:

- Does your child play outside for long periods of time during the day?
- If so, for how long?
- Do you have proper heating/cooling technology in your home?
- Do you and your child have stable access to drinking water and food?
- Have you or your child recently been exposed to a weather hazards (hurricane, droughts, etc.)?
- Have you recently been displaced from your home due to weather?
- If so, for how long?
- Does your child have stable access to education/educational facilities?
- Has your child's education ever been interrupted because of a weather disaster?

These and other questions will become routine aspects of the intake process as climate hazards grow more common. They will serve to identify etiologies that are possibly caused by climate changes, to make our diagnosis and subsequent prognosis more specified. Relating to heat, we will have to make sure the child has not been exposed for too long, or plays outside for too long as this can cause developmental issues. We will also have to make sure that the child and their family has proper access to heating/cooling technology in the home, in order to limit damage cause by intense heat for long durations. Relating to hydrological stress, we will have to make sure that the child has access to water and food as to not disrupt their developmental growth.

Additionally, we will also have to ask whether they have been displaced by weather hazards or rising sea-levels, as these can cause long-term trauma, disrupt education and literacy, and in turn cause possible communication disorders. It will be important therefore to incorporate climate-related questioning into our screening processes, to make more accurate diagnoses and to better accommodate and treat patients.

Final Summary

In conclusion, climate change and its threats are becoming and increasingly impending problem for everyone on earth. All professional disciplines will have to come to terms with such problems, as they will affect aspects of all fields in different and unprecedented ways. That being said, communication disorders will have its own unique issues it will have to deal with as climate change ramifications grow more common. Manifesting from problems associated with heat, hydrological stress, and weather hazards, all of our patients (most particularly children) will experience new threats to their speech and language production and development. This is why it is growing exigent for communication disorders professionals to consider how climate change ramifications will affect our practice, and what we can thus do as professionals to deal with said ramifications.

The approach outlined in this paper uses the “Action Model” to do just that. Once it is understood how climate change will affect us, the Action Model gives us the ability to use policy and government based approaches to solve our prospective issues. Using past policies as examples, such as the IPCC 5th Assessment Report, we can see policy and government as a route to best meet our clients’ needs. Taking the steps outlined in the “Action Model” can thus be seen

as one way communication disorders professionals can help adapt to prospective climate vacillations, and find ways to best help their patients moving toward the future.

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