

Direct and indirect impacts of global climate change on mental health, and the  
barriers these impose on mitigation policies

## I. Abstract

Global climate change has broad environmental, economic, physical and mental health impacts that are interconnected. A positive feedback loop occurs between human health and environmental health: degradation of human health (mental and physical) in turn accelerates human-induced climate change which then further degrades human health. Diminishing human and environmental health may also create barriers for mitigation policy formation and implementation, which further positively feeds the cycle. Placing the onus of mitigating climate change upon consumers by means of guilt and conscience has been found to be detrimental due to the ensuing climate change distress, free riders and criminalization of poverty. Therefore it is recommended that public institutions be responsible for the formation and implementation of a climate change response. There are co-benefits of these mitigation strategies for both environmental and human health, while will further accelerate this negative feedback cycle and improve the overall quality of life for the environment and humans.

## II. Introduction

Within the global scientific community, there remains minimal uncertainty that climate change is occurring and that the recent observed climate change is driven by anthropogenic factors. Despite the prevalence and severity of mental and physical impacts that are induced by global climate change, the primary concern of governments and non-governmental organizations are the economic and environmental consequences. This paper will examine two types of psychological impacts: direct (experience of climate change events) and indirect (awareness of climate change). The relationship between physical health, mental health and environmental health will be examined and the barriers towards mitigation policy that may arise from degradation of these.

## III. Evidence for and Environmental Impacts of Global Climate Change

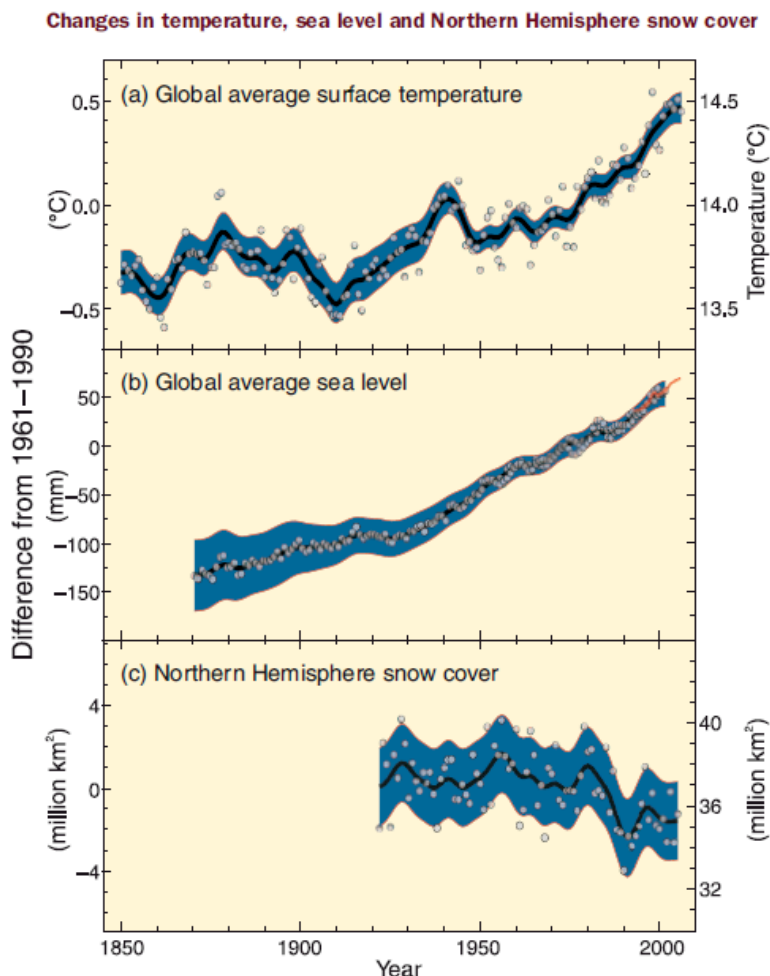
In the Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report (AR4), climate change is defined as

A change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2007).

The Global Mean Surface Temperature (GMST) has risen  $0.74^{\circ}\text{C} \pm 0.18^{\circ}\text{C}$  from 1906-2005 (Figure 1a). The majority of this warming has occurred in the last half century: the rate of warming over the last 50 years ( $0.13^{\circ}\text{C} \pm 0.03^{\circ}\text{C}$  per decade) is over double the rate over the last 100 years ( $0.07^{\circ}\text{C} \pm 0.02^{\circ}\text{C}$  per decade). As well, eleven of the last twelve years rank amongst the twelve warmest years since 1850 (IPCC, 2007).

Global average sea levels have risen (Figure 1b) at an average rate of  $1.8 \pm 0.5$  mm per year over 1961 to 2003 and at an average rate of about  $3.1 \pm 0.7$  mm per year from 1993 to 2000. The alterations to atmospheric circulation have led to a change in historical patterns and an

increased variability of precipitation, clouds, and storms. Increases in intensity and frequency of extreme weather events have been observed and are projected to increase in the future. In the AR4, the IPCC state that it is *likely* (probability of occurrence >66%) that heat waves have become more frequent over most land areas and *likely* that the frequency of heavy precipitation events or proportion of total rainfall from heavy falls has increased over most areas. The occurrence of extreme high sea level (the highest 1% of hourly values of observed sea level at a station for a given reference period; excludes tsunamis as these are not due to climate change) has *likely* increased at a broad range of sites worldwide since 1975 (IPCC, 2007).

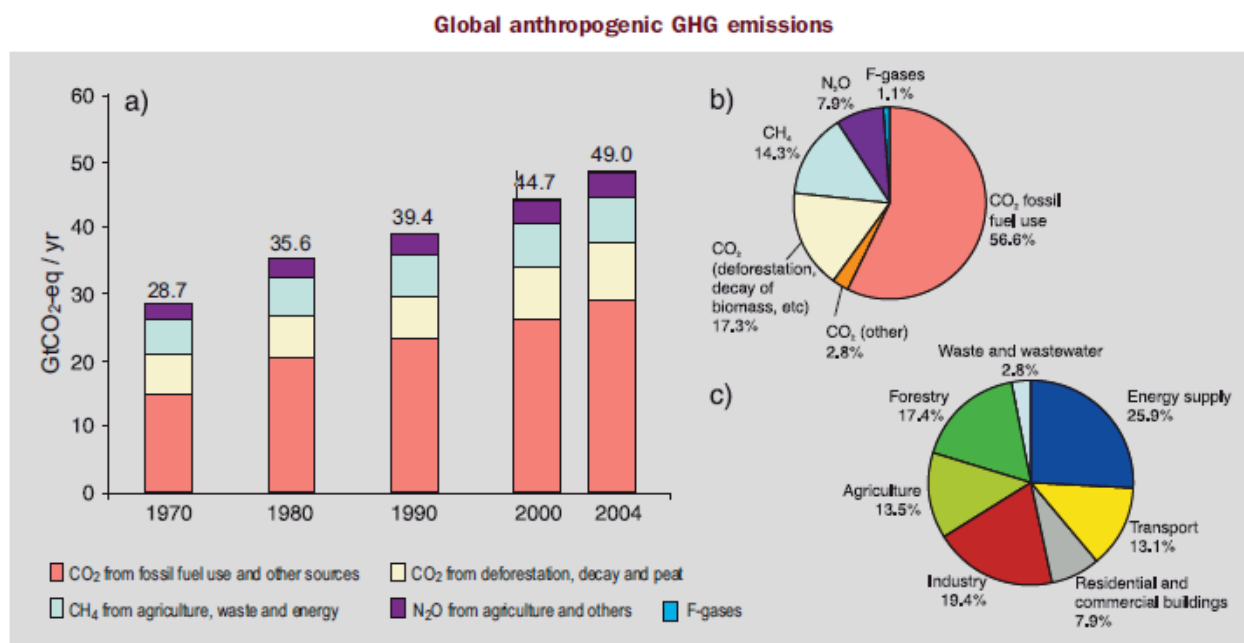


**Figure 1.** Observed changes in (a) global average surface temperature; (b) global average sea level from tide gauge (blue) and satellite (red) data; and (c) Northern Hemisphere snow cover for March-April. Observed changed relative to the period 1961-1990. Smoothed curves represent decadal averaged values and circles show yearly values (IPCC, 2007)

#### IV. Driving Factors of Global Climate Change

The observed changes in global climate are inconsistent with natural influences; humanity is the driving force behind the global climate change observed over the past 50 years (AGU, 2013). During the Cold War, there was a widely held belief that weapons of mass destruction would bring about the destruction of humanity and the planet. While this threat is still exacting

consequences today, a belief that weapons of mass environmental destruction—human population growth and total global pollution—are driving humanity and the planet to destruction has emerged (Trevors, 2010). Since the Industrial Revolution, there has been an observed increase in atmospheric concentrations of greenhouse gases (GHG), including carbon dioxide ( $\text{CO}_2$ ), methane ( $\text{CH}_4$ ), nitrous oxide ( $\text{N}_2\text{O}$ ), and halocarbons (Figure 2a), which have been linked to global anthropogenic greenhouse gases emissions (AGU, 2013). Water, soil and indoor and outdoor air pollution levels are rising and will continue to compound into the future if the business as usual model is continued (IPCC, 2007). Global overpopulation exacerbates the pollution and resource consumption problem. Due to unsustainable practices and population growth, there has been an increased usage of essential food, water, and energy resources and an increased production of waste. The removal of carbon sinks through deforestation, urbanization, and agriculture have contributed to natural processes being unable to move carbon to stores at the rate carbon is being taken out. Further stress is placed upon the biosphere in order to meet the demands of a polluting and exponentially growing human population; the result is a human-induced climate change.



**Figure 2.** (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004. (b) Contribution of anthropogenic GHGs to total emissions in 2004; measured in  $\text{CO}_2$  equivalents. (c) Contribution of different sectors to total anthropogenic GHG emissions in 2004; measured in  $\text{CO}_2$  equivalents (IPCC, 2007).

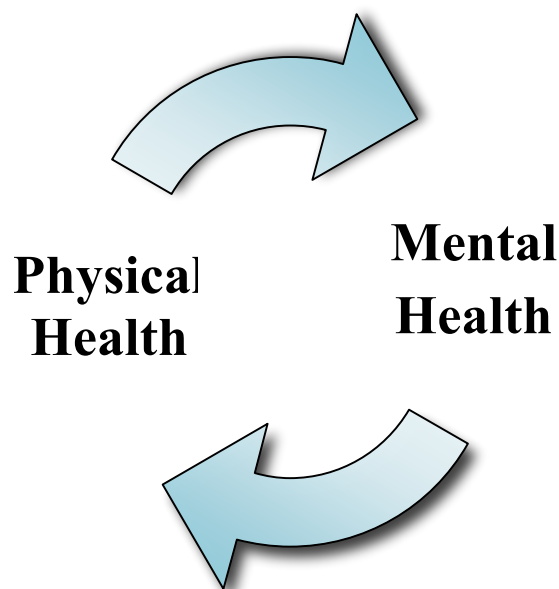
## V. Background on Mental Health

In the paper presented at the preamble to the constitution of the World Health Organization (WHO) in 1948, health was defined as “a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity” (WHO, 1948). Mental health includes a person’s ability to think, to learn, and to live with his or her own emotions and the reactions of others (Herrman, 2001). Not only must basic needs be met, but individuals must have a sense of purpose, they can accomplish personal goals, and contribute to society. These

are realised through supportive personal relationships, strong and inclusive communities, physical wellbeing, financial and personal security, rewarding employment, and a healthy and an attractive environment (Nurse, Basher, Bone, & Bird, 2010).

Mental illnesses are characterized by alterations in thinking, mood, and behaviour, and the associated distress and impaired functioning this places upon on a person's life (Berry, Bowen & Kjellstrom, 2010). The American Psychiatric Association's (APA) *Diagnostic and Statistical Manual of Mental Disorders* (DSM) is a handbook used globally for the diagnosis and classification of mental disorders. In the latest revision, the DSM-5, mental illnesses are categorized under several broad categories (see Appendix A). Each general category contains numerous more mental illnesses (APA, 2012), all unique with their differing set of causes, symptoms, effects and treatment (Berry, Bowen & Kjellstrom, 2010).

Poor mental health has been found to increase the risk of psychosocial factors and physical health (Nurse *et al.*, 2010). This creates a positive feedback loop between mental health and physical health (Figure 3): the degradation of mental health in turn accelerates the degradation of physical health, which then further degrades mental health.



**Figure 3.** Positive feedback loop between human's physical health and mental health.

## VI. Mental Health Impacts of Global Climate Change

Global climate change not only has widespread impacts on environmental health but it also has extensive effects on mental health. This paper divides these psychological impacts into two classes: direct (experience of climate change) and indirect (awareness of climate change).

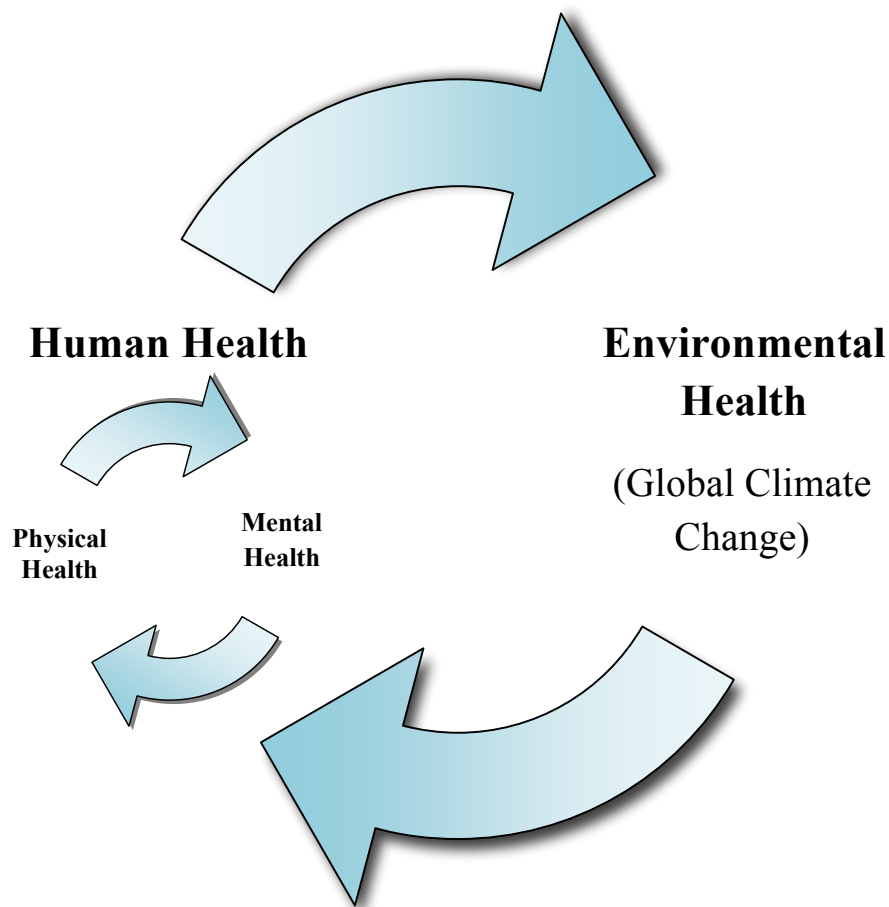
## Direct Effect

### *Presence of Nature in Living Environment*

Living in a natural environment—viewing nature and recreational activities in nature—has shown psychological benefits when compared to living in an environment with less green spaces (Nurse *et al.*, 2010). Simply observing the natural environment has restorative and rehabilitative effects. In a study of post-surgery patients in a suburban Pennsylvania hospital, patients were either placed in a room with a tree view or a brick wall view. Patients who had a window view of a natural setting were found to have shorter post-surgery hospital stays, fewer and weaker doses of pain relief medication, less postsurgical complications, and fewer negative evaluations of nurses (Ulrich, 1984). Children diagnosed with Attention Deficit Disorder (ADD) were found to have reduced symptoms upon exposure to nature in leisure activities. Activities that aggravated symptoms tended to disproportionately take place in non-green outdoor settings. Although this study was conducted in children, it was also found that these findings could be extended to adult's attention functioning (Taylor, Kuo, & Sullivan, 2001). In neighbourhoods with architecturally identical structures, areas with nearby nature had lower levels of aggression, anger, and violence compared to areas without nearby nature (Kuo & Sullivan, 2008).

Environments with green spaces provide inclusive places to meet, with significantly more people observed outdoors in areas with trees versus areas without trees (Coley, Sullivan & Kuo, 1997). The people observed in these green areas include a diverse range of ages with groups of youth, adults and seniors and mixed groups of youth and adults. By facilitating recreational activities and social interactions between different members of the community, green spaces fortify the bonds within the community, increase sense of community pride, and strengthen urban neighbourhoods. Increased participation in physical and social outdoor activities has shown to improve life satisfaction, depression, dementia, and other measures of quality of life (Sugiyama, Thompson, & Alves, 2009).

Conversely, the degradation of and limited access to a natural environment may lead to poor mental and physical health (Doherty & Clayton, 2011). A disconnection from one's inner self, others and the environment may make people less likely to apply mitigation strategies to lessen humankind's ecological footprint (Nurse *et al.*, 2010). This extends the positive feedback loop between mental and physical human health to also include environmental health (Figure 4); the degradation of human health creates a barrier to mitigation strategies and accelerates the degradation of environmental health (through human-induced climate change) which then further degrades human health.



**Figure 4.** Positive feedback loop between human's health (mental, physical) and environmental health.

### ***Extreme Weather Events***

There is a projected increase in the frequency, intensity, and global spread in extreme weather events due to climate change. These include landslides, wildfires, heat waves, hurricanes, cyclones, El Niño Southern Oscillation, rising sea-levels, floods, and droughts (IRFC, 2009). Certain regions in the biosphere and groups of people will be more vulnerable to these changes (IPCC, 2007). In the aftermath of a natural disaster or extreme weather event, adverse psychological effects have been documented and may still be prevalent even years after (Kessler *et al.*, 2008). The intensity and severity of the extreme weather event will determine the severity of the mental health symptoms. Between twenty-five and fifty percent of all people whom experience a natural disaster will have damaging mental health consequences (Shukla, 2013). The extent of the harm depends on a number of variables, including the age of the person, gender, ability to cope, prior health, and the proximity of the person to the disaster (Weems *et al.*, 2007).

### **Thermal Stress**

A general trend of increasing GMST has been occurring since the late 19<sup>th</sup> century, and this is projected to continue into the future (IPCC, 2007). A growing body of evidence supporting a causal relationship between heat and violence is emerging. Annual increases in mean

temperature from 1950 to 1999 in the United States of America (USA) has also been correlated with an increase in crime rate for assault, homicide, rape, robbery, and property crimes (Rotton & Cohn, 2003). Two major theories explain this trend: one, more people are outside their homes as a result of higher temperatures; and two, the increased release of stress hormones in response to excessive heat, which in turn leads to aggression (Simister & Cooper, 2005). Increases in intensity and frequency of heat waves may also cause delirium and neuropsychiatric syndromes, with symptoms such as altered consciousness, agitation, restlessness, unconsciousness, and even death (Shukla, 2013). Groups especially affected by heat waves include the elderly, athletes, socially isolated, the poor and those with cardiovascular, cerebrovascular, and respiratory diseases (Frumkin, Hess, Lubet, Malilay, & McGeehin, 2008; Haines & Patz, 2004)

## Hurricanes

Hurricane Katrina is the deadliest hurricane to have struck the United States of America within the past seven decades. High psychiatric morbidity afflicted the survivors immediately following the disaster, with no significant changes in prevalence two years after (Table 1). In a survey of 1043 residents, occurrence of any anxiety-mood disorders was 30.7% for the baseline survey (5-7 months after hurricane) and 33.9% for the follow-up survey (1 year after baseline survey) (Kessler *et al.*, 2008). Although the period following a natural disaster is when medical and psychiatric care is needed most, it is also the time where it is least accessible. This is due to the overwhelming demand for these services and chronic mental illnesses being a secondary concern (Page & Howard, 2010). This disrupts the mental health services for people with mental disorders prior to the disaster and for the influx of new cases following the disaster (Shukla, 2013).

	New Orleans Metro				Remainder of the sample				Total sample			
	Baseline		Follow-up		Baseline		Follow-up		Baseline		Follow-up	
	%	(s.e.)	%	(s.e.)	%	(s.e.)	%	(s.e.)	%	(s.e.)	%	(s.e.)
<i>Anxiety-mood disorders (30-day)</i>												
Serious	16.5	(2.6)	16.9	(2.6)	9.4	(2.2)	13.2	(2.5)	10.9	(1.8)	14.0*	(2.0)
Mild-moderate	27.8	(3.1)	24.9	(3.0)	17.5	(2.7)	18.6	(2.9)	19.8	(2.3)	19.9	(2.4)
PTSD	25.9	(3.1)	24.1	(3.0)	11.8	(2.4)	20.0*	(3.0)	14.9	(2.0)	20.9*	(2.5)
Any	44.3	(3.3)	41.8	(3.3)	26.9	(3.3)	31.7	(3.4)	30.7	(2.7)	33.9	(2.8)
<i>Suicidality (12-month)</i>												
Ideation	3.1	(1.2)	7.9*	(2.0)	2.8	(1.2)	6.0*	(2.0)	2.8	(1.0)	6.4*	(1.6)
Plan	0.8	(0.7)	3.0*	(1.4)	1.0	(0.9)	2.4*	(1.3)	1.0	(0.7)	2.5*	(1.0)
Attempt	0.7	(0.7)	0.9	(0.8)	0.8	(0.8)	0.0	(0.0)	0.8	(0.7)	0.2	(0.2)
(n)	(472)				(343)				(815)			

Abbreviation: PTSD, post-traumatic stress disorder.

\*Significant difference between baseline and follow-up surveys based on two-tailed within-respondent paired *t*-tests evaluated at the 0.05 level of significance.

**Table 1.** Trends in the estimated prevalence of DSM-IV anxiety-mood disorders (in the 30 days before interview) and suicidality (in the 12 months before interview) in the baseline and follow-up surveys. (Kessler *et al.*, 2008)



## Floods

Floods can devastate entire communities through the loss of people's lives—both the literal and metaphorical sense—by destruction, displacement and disruption. Injuries, drowning, food- and waterborne diseases, and vector-borne diseases are common in the wake of a flooding event (Frumkin *et al.*, 2008). Residents living along the flood plain have their homes and possessions either destroyed or damaged by the initial flood or later by contamination and pollution. The loss of sentimental and personal items was reported to be the most devastating; the cumulating of these elements often resulted in the loss of people's identity and attachment. Residents without a liveable home are forced into a temporary state of homelessness or living with relatives and friends. Quite often there is a shortage of room in these facilities and tensions may arise. Deterioration and termination of social relationships between partners, relatives, and friends is also common. Those fortunate enough to have a habitable home still reportedly feel displaced within their own home. Living in the ruined remains of their home in substandard conditions is a constant reminder of everything that has been destroyed. Loss of privacy may also put further psychological stress on the victims. The constant presence of flood restoration employees within people's homes and the mistreatment of belongings turn private homes and personal possessions into public property. Entire lives are put on hold for months or years as people try to deal with the aftermath and begin to reconstruct their lives. Constant battles with insurance companies, loss adjusters, flood restoration employees, building contractors, and retail outlets consume survivor's lives and increase stress because of the time used, conflicts, and delays (Carroll *et al.*, 2009).

Following the flood of 2000 in Lewes, Southern England, a study of 275 residents of 103 flooded households and 240 residents of 104 non-flooded households in the same postal district was conducted. Adults that had been flooded were found to have a four-times higher risk of psychological distress. Even after adjustments for physical illnesses were made, flooding remained highly significantly associated with psychological distress (Reacher *et al.*, 2004). Many flood victims experience Post-Traumatic Stress Disorder immediately following the natural disaster but also for a prolonged period after (Shukla, 2013). In the Carlisle flood in 2005, panic attacks, flashbacks, impaired sleep, and lack of motivation to start over was prevalent amongst the community (Carroll *et al.*, 2009). These high levels of psychological distress may also explain the excess amount of physical illnesses reported by flooded victims (Reacher *et al.*, 2004).

## Droughts

Regions experiencing drought face prolonged impacts on the community, including food and water shortages, malnutrition, familial strife, financial stress, and the decline in the overall health of the local environment and community (Frumkin *et al.*, 2008; Stain *et al.*, 2011). High levels of worry concerning droughts are significantly associated with higher levels of neuroticism, recent adverse life events, and employment status (Stain *et al.*, 2011).

## Environmental Refugees

Urban drift and mass migration due to droughts, floods, rising sea levels, and other human-induced extreme weather events are predicted to continue increasing into the near future (Page &

Howard, 2010). Environmental refugees are forced to abandon their homes, possessions, and their land, which may have been inhabited, used, and passed down for generations. Bonds between families, friends, significant others are jeopardized, and people may lose connection to themselves and their community (Shukla, 2013). Significant stress is also placed upon the community which may result in civil strife (Frumkin *et al.*, 2008). Migrating communities may be seen by receiving communities as a threat to their culture and competitors for their natural resources and jobs (Shukla, 2013). This may lead to an increased risk of discrimination and violence, and the resulting negative mental health impacts of this (Fritze *et al.*, 2008).

## **Vulnerable Groups**

Certain groups are more susceptible to the mental impacts of climate change events; these include the socioeconomically disadvantaged, individuals with pre-existing mental conditions, the elderly, racial and ethnic minorities, women, children (Doherty & Clayton, 2011; Frumkin *et al.*, 2008; Page & Howard, 2010; Shukla, 2013).

### ***Socioeconomically Disadvantaged***

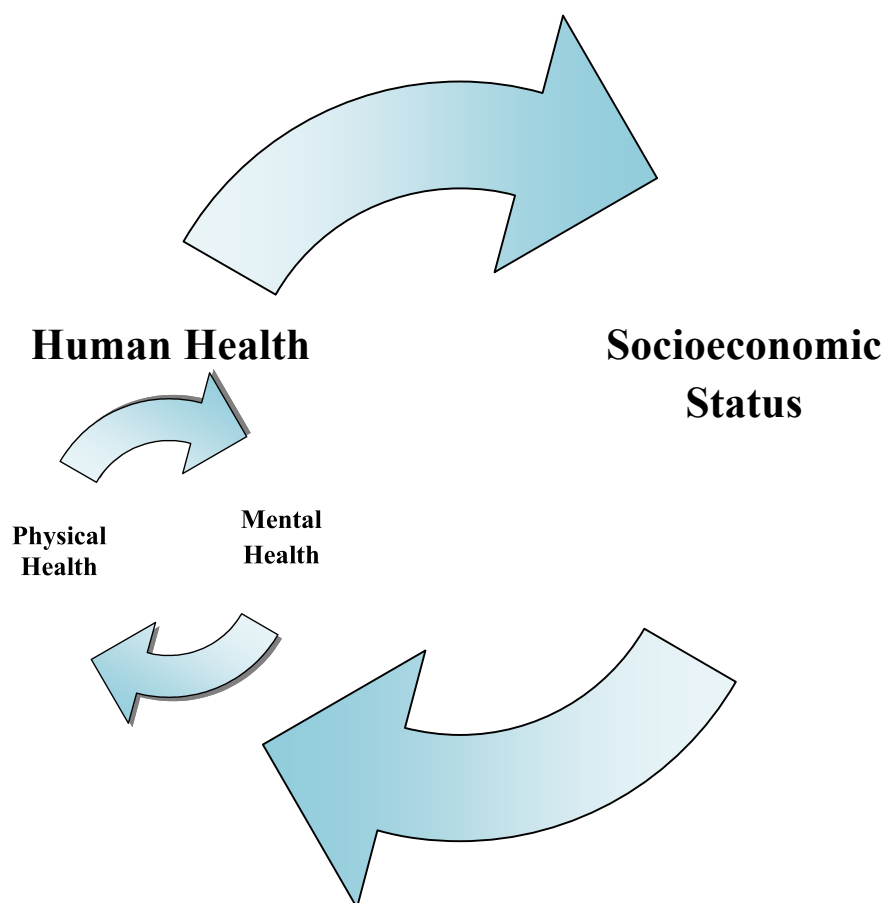
In the developed First World nations, a large disparity in wealth occurs leaving the homeless, unemployed, and those living below the poverty line at an increased risk of psychological risks. Within the last 5 years, approximately 5 million to 8 million Americans experienced homelessness (Shukla, 2013). With an increased frequency of heat waves, air pollution, severity of floods and storms, and changing distribution of West Nile due to climate change, the homeless are more vulnerable because of pre-existing illnesses (chronic disease, mental illness) and lack of shelter to the elements and mosquitoes (Ramin & Svoboda, 2009).

Regions of the world experience differing amounts of climate change (IPCC, 2007); these disproportionately take place in developing nations, which are especially vulnerable to psychological effects (Doherty & Clayton, 2011). Developing nations have poor adaptive abilities to a changing climate due to poverty, physical and service infrastructure, and economic reliance on climate vulnerable ecosystems. A decreased global food and water security will result in an increase in global food, water, and energy prices. Income security is then reduced, in the forms of financial stress and inability to afford essential goods, which will be felt most acutely by those in developing nations (Fritze *et al.*, 2008). Exponential population growth and prevailing economic, political, ethnic or religious tensions further aggravates the situation and may result in violent conflict within and between nations. In a recent study conducted in the Sub-Saharan Africa, long term trends in climate and short term extreme weather events had a significant impact on civil conflict. Climates more suitable for agriculture are associated with a decreased likelihood of conflict, positive changes in rainfall are associated with a decreased likelihood of conflict in the following year, and freshwater resources per capita are positively associated with the likelihood of conflict (Hendrix & Glaser, 2007).

### ***Pre-Existing Mental Conditions***

Those who have pre-existing mental conditions are also more susceptible to the mental impacts of climate change. In the event of natural disasters and extreme weather events, mentally ill people have more difficulty coping, lose access to ongoing mental health treatment and similar to those who are socioeconomically disadvantaged, may be living in substandard housing,

substance abuse and chronic diseases (Fritze *et al.*, 2008; Page & Howard, 2010; Shukla, 2013). A positive feedback loop also exists between mental health and socioeconomic status: poverty often leads to or worsens mental illness and mental illness often leads to or reinforces poverty (Anakwenze & Zuberi, 2013).



**Figure 5.** *Positive feedback loop between human's health (mental, physical) and environmental health*

### **Children**

Children are well aware that climate change is occurring and the impacts of climate change on self, family and community (Table 2); they also have higher levels of pre-disaster anxieties and more severe distress and post-trauma illnesses (Shukla, 2013). In a recent survey of Australian adolescents, it was found that significantly higher levels of distress and behavioural difficulties were observed in children living in areas of prolonged drought compared to the general population. There was also an increased reporting of emotional distress since the time the studied was conducted earlier in the same region (Dean & Stain, 2010). In another survey of Australian children, 25% reported that they feared that the world would end before they got older (Tucci, Mitchell & Goddard, 2011).

Theme	Quote
The environmental impacts of the drought	<p>'Our house tank is empty and we have to cart water all the time'</p> <p>'There is so much dirt'</p> <p>'It gets really windy – hot winds'</p> <p>'I would like to see something growing – we only see dead stuff'</p>
The impact of the drought on the local community	<p>'We are resilient people – we could leave, but we are determined – the community turns into a family'</p> <p>'Young people are moving out and not coming back – there is nothing to come back to'</p> <p>'The school is getting packages or deals because we are drought kids – we are underprivileged – we haven't got lots of stuff at school'</p>
The impact of the drought on family life	<p>'The drought can help you realise that a lot of money is not so important – there are other priorities'</p> <p>'The stress of the drought can pull families apart – divorce'</p>
The impact of the drought on country lifestyle	<p>'You can stick to your religion – you can go to church easily – it is nearby'</p> <p>'The schools are smaller and the classes are smaller and you get more help'</p> <p>'In the country you just feel safer – can walk about even at night'</p>
The impact of the drought on mental health	<p>'People need to think about the big plans ahead – it's scary – a lot of opportunities have gone – people are deciding to leave the farm or not'</p> <p>'It's mental – people might feel depressed because things might go – they might lose things because of the drought'</p>
Issues that might relate to climate change	<p>'Global warming could be having an effect'</p> <p>'People are wondering if it is climate change – starting to think it is – everybody talks about it'</p>

**Table 2.** Themes and relevant quotes from focus groups of Australian children living with prolonged drought

Upon examination of a variety of extreme weather events, it has been observed that victims's mental health is negatively impacted and a variety of mental disorders may also arise (Frumkin *et al.*, 2008). This raises questions as to how victims of extreme weather events can be able to mentally work towards mitigating climate change—a factor in the increased frequency and intensity of the very events that effects them—if they are not mentally, physically, and socially well.

## Indirect Effect

Although some people may not directly experience climate change, awareness that it is occurring has psychological implications. Climate change news and educational awareness programs worldwide have raised concerns within the public about climate change. This has resulted in climate change distress, which has symptoms characteristic of depression, anxiety, and stress (Searle & Gow, 2010). People may become overwhelmed by the magnitude of climate change because the information can be too unsettling and the solutions too difficult (Fritze *et al.*, 2008). Many may cope with this problem by minimising it, denying it, or avoiding it all together. Some may succumb to sadness, depression and numbness; others may become frustrated or angry. Others still may be overwhelmed with feelings of hopelessness and helplessness and fear for the inevitable future (Doherty & Clayton, 2011). Individuals face an increased vulnerability to climate change distress if they are female, less than 35 years of age, have a pro-environmental orientation, and possess high levels anxiety for the future (Searle & Gow, 2010).

Appeals to conscience to mitigate climate change may have a pathogenic affect on the long-term and short term mental health of a population. There are two subliminal messages underlying this: if you act, you are seen as a simpleton, who can be shamed into obeying while the rest of humanity free rides on your efforts; if you don't act, you are an irresponsible and immoral citizen. Guilt does not result in intelligence, change in behaviours or compassion. Rather, the guilty are consumed with their own anxieties; concerns for their own interests or the actual object often go unheeded (Hardin, 1968). As well, many of the lifestyle choices that are beneficial for human and environmental health are more costly in terms of money and time, in either the short or long term. By shifting the blame from producers to consumers, not implementing mitigation strategies due to the higher costs may be viewed as criminalizing poverty which may further contribute to climate change distress.

## VII. Mitigating Climate Change and Mental Illness

As seen in Figure 4, a positive feedback loop exists between human health (mental and physical) and environmental health. This poses the question of how the global community will develop a climate change response to break this cycle. Although the high monetary cost of mitigation and adaption policies may pose a barrier in itself, one must remember that the cost of climate change extends far beyond the gross domestic product (GDP), thus the necessity to form a global climate change response. Public health preparedness is based on three principles: primary prevention (the prevention of injury or illness); secondary prevention (early diagnosis of diseases to limit its advance and ensuing health burden); and tertiary prevention (reduction of morbidity, complications and restoration of functions). This public health response may be used as a framework for a climate change response (Frumkin *et al.*, 2008). Mitigation policies (primary prevention) will help to minimize, stabilize, or reverse global climate change through the reduction of anthropogenic greenhouse gas emissions. Adaption strategies and policies (secondary and tertiary prevention) will help to anticipate and respond for the inevitable effects of global climate change. These include both spontaneous responses to extreme weather events (early warning systems for heat waves, hurricanes, flooding) and long term impacts of continual climate change (universal access to adequate quantities of safe water) (Ebi & Menne, 2006).

Who will form and implement these mitigation and adaption strategies? Placing this upon the consumers by means of guilt and conscience does not work due to the ensuing climate change distress (Searle & Gow, 2010), anxieties and guilt, free riders (Harden, 1968), and criminalization of poverty. As well, decreases in quality of environmental health, human health and socioeconomic status—expedited through human-induced climate change—will make people less likely to form or implement these policies because of the disconnection from nature and the inability to take care of the biosphere health if an individual is not well within themselves (Nurse *et al.*, 2010). An external body from the general population is therefore needed to form a climate change response. Public institutions are defined as a set of humanly devised constraints that structure the political, economic and social interactions of a population through informal (sanctions, taboos, customs, traditions, and codes of conduct) and formal (constitutions, laws, property rights) constraints. The choice set of a population—whether or not to engage in a certain activity—is defined through institutions and the principles of economics (North, 1991). By having public institutions shaping mitigation policies, it will make acting in the social-interest also the self-interest, thereby driving the social change necessary to address climate change. Global citizens must also remember that the voice of a consumer extends beyond

that of his or her wallet. Sweeping social and constitutional changes arises when local citizens use their voice to advocate and push governments to change.

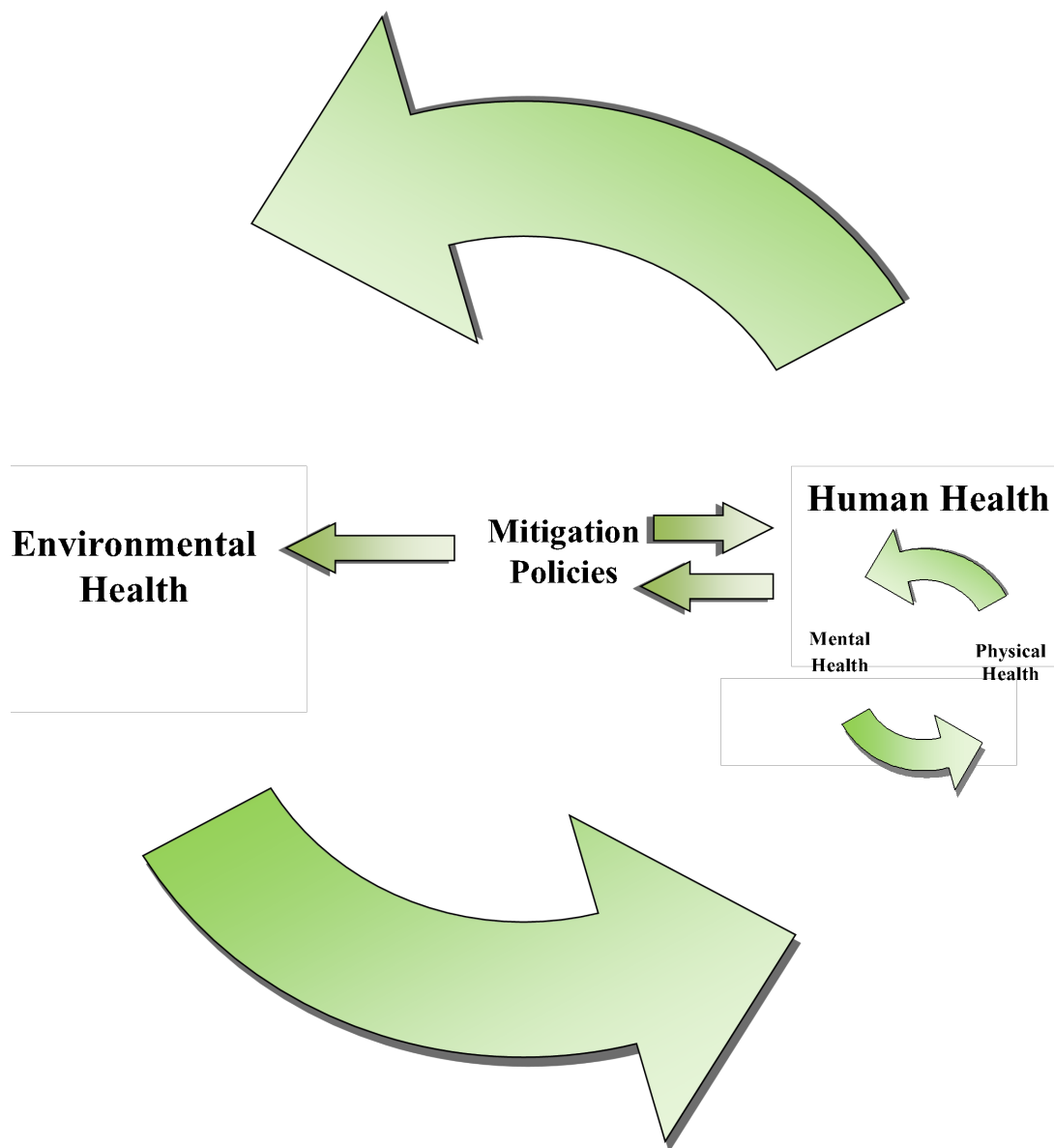
### Co-Benefits of Mitigation Policies

Climate change mitigation policies have been found to have co-benefits to environmental and human health (Frumkin *et al.*, 2008; Nurse *et al.*, 2010), examples of which are summarized in Table 3.

Mitigation Strategies	Environmental Health	Human Health
<b>Insulation of Homes</b>	Reduction in energy consumption, CO <sub>2</sub> emissions	Reduction in risk of cold and heat related illnesses, death
<b>Decreased Consumption of Meat</b>	Reduction in water usage, CO <sub>2</sub> emissions	Decreased meat intake correlated with decreased risk of certain cancers, cardiovascular mortality, lipid metabolism, blood pressure, diabetes, overweight and longer life expectancy)
<b>Active Transport (walk, cycle, transit)</b>	Reduction CO <sub>2</sub> emissions	Decreased risk of obesity and cardiovascular disease
<b>Presence of Nature in Living Environment</b>	Increase in carbon stores, quality and quantity of natural environment	Improvement in mental, physical, and societal health

**Table 3.** *Examples of mitigation strategies and their co-benefits to environmental and human health* (Gupta & Gregg, 2012; Hakim *et al.*, 1999; Sofi *et al.*, 2008)

Mitigation policies will not only reverse the positive feedback loop between environmental health and human health (mental and physical), but it will also enhance the rate at which it is restored back to its equilibrium state (Figure 6). Through the formation and implementation of mitigation policies by public institutions, improvements in human and environmental health will be made. This in turn makes individuals more likely to implement mitigation strategies because of his or her closer connection with nature and improved health, which in turn accelerates the improvements being made in human and environmental health.



**Figure 6.** *Negative feedback loop between human's health (mental, physical), environmental health and mitigation policies*

## Appendices

### Appendix A

Section II in DSM-5 Table of Contents (APA, 2013)

### **Section II: Diagnostic Criteria and Codes**

#### **Neurodevelopmental Disorder**

##### **Attention-Deficit/Hyperactivity Disorder**

Attention-Deficit/Hyperactivity Disorder

Other Specified Attention-Deficit/Hyperactivity Disorder

Unspecified Attention-Deficit/Hyperactivity Disorder

##### **Specific Learning Disorder**

Specific Learning Disorder

##### **Motor Disorders**

Developmental Coordination Disorder

Stereotypic Movement Disorder

##### *Tic Disorders*

Tourette's Disorder

Persistent (Chronic) Motor or Vocal Tic Disorder

Provisional Tic Disorder

Other Specified Tic Disorder

Unspecified Tic Disorder

##### **Other Neurodevelopmental Disorders**

Other Specified Neurodevelopmental Disorder

Unspecified Neurodevelopmental Disorder

#### **Schizophrenia Spectrum and Other Psychotic Disorders**

Schizotypal (Personality) Disorder

Delusional Disorder

Brief Psychotic Disorder

Schizophreniform Disorder

Schizophrenia

Schizoaffective Disorder

Substance/Medication-Induced Psychotic Disorder

Psychotic Disorder Due to Another Medical Condition

##### **Catatonia**

Catatonia Associated With Another Mental Disorder (Catatonia Specifier)

Catatonic Disorder Due to Another Medical Condition

Unspecified Catatonia

Other Specified Schizophrenia Spectrum and Other Psychotic Disorder

Unspecified Schizophrenia Spectrum and Other Psychotic Disorder

#### **Bipolar and Related Disorders**

Bipolar I Disorder

Bipolar II Disorder

Cyclothymic Disorder

Substance/Medication-Induced Bipolar and Related Disorder

Bipolar and Related Disorder Due to Another Medical Condition

Other Specified Bipolar and Related Disorder



Unspecified Bipolar and Related Disorder

**Depressive Disorders**

Disruptive Mood Dysregulation Disorder

Major Depressive Disorder, Single and Recurrent Episodes

Persistent Depressive Disorder (Dysthymia)

Premenstrual Dysphoric Disorder

Substance/Medication-Induced Depressive Disorder

Depressive Disorder Due to Another Medical Condition

Other Specified Depressive Disorder

Unspecified Depressive Disorder

**Anxiety Disorders**

Separation Anxiety Disorder

Selective Mutism

Specific Phobia

Social Anxiety Disorder (Social Phobia)

Panic Disorder

Panic Attack (Specifier)

Agoraphobia

Generalized Anxiety Disorder

Substance/Medication-Induced Anxiety Disorder

Anxiety Disorder Due to Another Medical Condition

Other Specified Anxiety Disorder

Unspecified Anxiety Disorder

**Obsessive-Compulsive and Related Disorders**

Obsessive-Compulsive Disorder

Body Dysmorphic Disorder

Hoarding Disorder

Trichotillomania (Hair-Pulling Disorder)

Excoriation (Skin-Picking) Disorder

Substance/Medication-Induced Obsessive-Compulsive and Related Disorder

Obsessive-Compulsive and Related Disorder Due to Another Medical Condition

Other Specified Obsessive-Compulsive and Related Disorder

Unspecified Obsessive-Compulsive and Related Disorder

**Trauma- and Stressor-Related Disorders**

Reactive Attachment Disorder

Disinhibited Social Engagement Disorder

Posttraumatic Stress Disorder

Acute Stress Disorder

Adjustment Disorders

Other Specified Trauma- and Stressor-Related Disorder

Unspecified Trauma- and Stressor-Related Disorder

**Dissociative Disorders**

Dissociative Identity Disorder

Dissociative Amnesia

Depersonalization/Derealization Disorder

Other Specified Dissociative Disorder

Unspecified Dissociative Disorder

**Somatic Symptom and Related Disorders**

Somatic Symptom Disorder

Illness Anxiety Disorder  
Conversion Disorder (Functional Neurological Symptom Disorder)  
Psychological Factors Affecting Other Medical Conditions  
Factitious Disorder  
Other Specified Somatic Symptom and Related Disorder  
Unspecified Somatic Symptom and Related Disorder

**Feeding and Eating Disorders**

Pica  
Rumination Disorder  
Avoidant/Restrictive Food Intake Disorder  
Anorexia Nervosa  
Bulimia Nervosa  
Binge-Eating Disorder  
Other Specified Feeding or Eating Disorder  
Unspecified Feeding or Eating Disorder

**Elimination Disorders**

Enuresis  
Encopresis  
Other Specified Elimination Disorder  
Unspecified Elimination Disorder

**Sleep-Wake Disorders**

Insomnia Disorder  
Hypersomnolence Disorder  
Narcolepsy

**Breathing-Related Sleep Disorders**

Obstructive Sleep Apnea Hypopnea  
Central Sleep Apnea  
Sleep-Related Hypoventilation  
Circadian Rhythm Sleep-Wake Disorders

**Parasomnias**

Non-Rapid Eye Movement Sleep Arousal Disorders  
Sleepwalking  
Sleep Terrors  
Nightmare Disorder  
Rapid Eye Movement Sleep Behavior Disorder  
Restless Legs Syndrome  
Substance/Medication-Induced Sleep Disorder  
Other Specified Insomnia Disorder  
Unspecified Insomnia Disorder  
Other Specified Hypersomnolence Disorder  
Unspecified Hypersomnolence Disorder  
Other Specified Sleep-Wake Disorder  
Unspecified Sleep-Wake Disorder

**Sexual Dysfunctions**

Delayed Ejaculation  
Erectile Disorder  
Female Orgasmic Disorder  
Female Sexual Interest/Arousal Disorder  
Genito-Pelvic Pain/Penetration Disorder

Male Hypoactive Sexual Desire Disorder  
Premature (Early) Ejaculation  
Substance/Medication-Induced Sexual Dysfunction  
Other Specified Sexual Dysfunction  
Unspecified Sexual Dysfunction

**Gender Dysphoria**

Gender Dysphoria  
Other Specified Gender Dysphoria  
Unspecified Gender Dysphoria

**Disruptive, Impulse-Control, and Conduct Disorders**

Oppositional Defiant Disorder  
Intermittent Explosive Disorder  
Conduct Disorder  
Antisocial Personality Disorder  
Pyromania  
Kleptomania  
Other Specified Disruptive, Impulse-Control, and Conduct Disorder  
Unspecified Disruptive, Impulse-Control, and Conduct Disorder

**Substance-Related and Addictive Disorders**

**Substance-Related Disorders**

Substance Use Disorders  
Substance-Induced Disorders  
Substance Intoxication and Withdrawal  
Substance/Medication-Induced Mental Disorders

**Alcohol-Related Disorders**

Alcohol Use Disorder  
Alcohol Intoxication  
Alcohol Withdrawal  
Other Alcohol-Induced Disorders  
Unspecified Alcohol-Related Disorder

**Caffeine-Related Disorders**

Caffeine Intoxication  
Caffeine Withdrawal  
Other Caffeine-Induced Disorders  
Unspecified Caffeine-Related Disorder

**Cannabis-Related Disorders**

Cannabis Use Disorder  
Cannabis Intoxication  
Cannabis Withdrawal  
Other Cannabis-Induced Disorders  
Unspecified Cannabis-Related Disorder

**Hallucinogen-Related Disorders**

Phencyclidine Use Disorder  
Other Hallucinogen Use Disorder  
Phencyclidine Intoxication  
Other Hallucinogen Intoxication  
Hallucinogen Persisting Perception Disorder  
Other Phencyclidine-Induced Disorders  
Other Hallucinogen-Induced Disorders

Unspecified Phencyclidine-Related Disorder

Unspecified Hallucinogen-Related Disorder

**Inhalant-Related Disorders**

Inhalant Use Disorder

Inhalant Intoxication

Other Inhalant-Induced Disorders

Unspecified Inhalant-Related Disorder

**Opioid-Related Disorders**

Opioid Use Disorder

Opioid Intoxication

Opioid Withdrawal

Other Opioid-Induced Disorders

Unspecified Opioid-Related Disorder

**Sedative-, Hypnotic-, or Anxiolytic-Related Disorders**

Sedative, Hypnotic, or Anxiolytic Use Disorder

Sedative, Hypnotic, or Anxiolytic Intoxication

Sedative, Hypnotic, or Anxiolytic Withdrawal

Other Sedative-, Hypnotic-, or Anxiolytic-Induced Disorders

Unspecified Sedative-, Hypnotic-, or Anxiolytic-Related Disorder

**Stimulant-Related Disorders**

Stimulant Use Disorder

Stimulant Intoxication

Stimulant Withdrawal

Other Stimulant-Induced Disorders

Unspecified Stimulant-Related Disorder

**Tobacco-Related Disorders**

Tobacco Use Disorder

Tobacco Withdrawal

Other Tobacco-Induced Disorders

Unspecified Tobacco-Related Disorder

**Other (or Unknown) Substance-Related Disorders**

Other (or Unknown) Substance Use Disorder

Other (or Unknown) Substance Intoxication

Other (or Unknown) Substance Withdrawal

Other (or Unknown) Substance-Induced Disorders

Unspecified Other (or Unknown) Substance-Related Disorder

**Non-Substance-Related Disorders**

Gambling Disorder

**Neurocognitive Disorders**

Delirium

Other Specified Delirium

Unspecified Delirium

**Major and Mild Neurocognitive Disorders**

Major Neurocognitive Disorder

Mild Neurocognitive Disorder

Major or Mild Neurocognitive Disorder Due to Alzheimer's Disease

Major or Mild Frontotemporal Neurocognitive Disorder

Major or Mild Neurocognitive Disorder With Lewy Bodies

Major or Mild Vascular Neurocognitive Disorder

Major or Mild Neurocognitive Disorder Due to Traumatic Brain Injury  
 Substance/Medication-Induced Major or Mild Neurocognitive Disorder  
 Major or Mild Neurocognitive Disorder Due to HIV Infection  
 Major or Mild Neurocognitive Disorder Due to Prion Disease  
 Major or Mild Neurocognitive Disorder Due to Parkinson's Disease  
 Major or Mild Neurocognitive Disorder Due to Huntington's Disease  
 Major or Mild Neurocognitive Disorder Due to Another Medical Condition  
 Major or Mild Neurocognitive Disorder Due to Multiple Etiologies  
 Unspecified Neurocognitive Disorder

### **Personality Disorders**

General Personality Disorder

#### **Cluster A Personality Disorders**

Paranoid Personality Disorder

Schizoid Personality Disorder

Schizotypal Personality Disorder

#### **Cluster B Personality Disorders**

Antisocial Personality Disorder

Borderline Personality Disorder

Histrionic Personality Disorder

Narcissistic Personality Disorder

#### **Cluster C Personality Disorders**

Avoidant Personality Disorder

Dependent Personality Disorder

Obsessive-Compulsive Personality Disorder

#### **Other Personality Disorders**

Personality Change Due to Another Medical Condition

Other Specified Personality Disorder

Unspecified Personality Disorder

### **Paraphilic Disorders**

Voyeuristic Disorder

Exhibitionistic Disorder

Frotteuristic Disorder

Sexual Masochism Disorder

Sexual Sadism Disorder

Pedophilic Disorder

Fetishistic Disorder

Transvestic Disorder

Other Specified Paraphilic Disorder

Unspecified Paraphilic Disorder

### **Other Mental Disorders**

Other Specified Mental Disorder Due to Another Medical Condition

Unspecified Mental Disorder Due to Another Medical Condition

Other Specified Mental Disorder

Unspecified Mental Disorder

## Literature Cited

- Adger, W., Barnett, J., Brown, K., Marshall, N., & O'Brien, K. (2013). Cultural dimensions of climate change impacts and adaptation. *Nature Climate Change*, 3(2), 112-117.  
doi:10.1038/nclimate1666
- American Geophysical Union. (2013). Human-induced climate change requires urgent action.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.
- Anakwenze, U., & Zuberi, D. (2013). Mental health and poverty in the inner city. *Health & Social Work*, 38(3), 147.
- Berry, H., Bowen, K., & Kjellstrom, T. (2010). Climate change and mental health: a causal pathways framework. *International Journal Of Public Health*, 55(2), 123-132.  
doi:10.1007/s00038-009-0112-0
- Carroll, B., Morbey, H., Balogh, R., & Araoz, G. (2009). Flooded homes, broken bonds, the meaning of home, psychological processes and their impact on psychological health in a disaster. *Health & Place*, 15(2), 540-547. doi:10.1016/j.healthplace.2008.08.009
- Coley, R.L., Sullivan, W.C., & Kuo, F.E. (1997) Where does community grow?: The social context created by nature in urban public housing. *Environment and Behavior*, 29(4), 468-494. doi:10.1177/001391659702900402
- Dean, J. G., & Stain, H. J. (2010). Mental health impact for adolescents living with prolonged drought. *The Australian Journal of Rural Health*, 18(1), 32-32. doi:10.1111/j.1440-1584.2009.01107.x

- Doherty, T. J., & Clayton, S. (2011). The psychological impacts of global climate change. *The American Psychologist*, 66(4), 265-276. doi:10.1037/a0023141
- Ebi, K., Kovats, R., & Menne, B. (2006). An approach for assessing human health vulnerability and public health interventions to adapt to climate change. *Environmental Health Perspectives*, 114(12), 1930-1934. doi:10.1289/ehp.8430
- Fritze, J. G., Blashki, G. A., Burke, S., & Wiseman, J. (2008). Hope, despair and transformation: Climate change and the promotion of mental health and wellbeing. *International Journal of Mental Health Systems*, 2(1), 13-13. doi:10.1186/1752-4458-2-13
- Frumkin, H., Hess, J., Luber, G., Malilay, J., & McGeehin, M. (2008). Climate change: The public health response. *American Journal of Public Health*, 98(3), 435-445. doi:10.2105/AJPH.2007.119362
- Kessler, R., Galea, S., Gruber, M., Sampson, N., Ursano, R., & Wessely, S. (2008). Trends in mental illness and suicidality after hurricane katrina. *Molecular Psychiatry*, 13(4), 374-384. doi:10.1038/sj.mp.4002119
- Kuo, F.E., & Sullivan, W.C. (2001) Aggression and violence in the inner city: Effects of environment via mental fatigue. *Environment and Behavior*, 33(4), 543-571. doi:10.1177/00139160121973124
- Gupta, R., & Gregg, M. (2012). Using UK climate change projections to adapt existing english homes for a warming climate. *Building and Environment*, 55, 20-42. doi:10.1016/j.buildenv.2012.01.014

- Haines, A., & Patz, J. A. (2004). Health effects of climate change. *JAMA: The Journal of the American Medical Association*, 291(1), 99-103. doi:10.1001/jama.291.1.99
- Hakim, A. A., Curb, J. D., Petrovitch, H., Rodriguez, B. L., Yano, K., Ross, G. W., . . . Abbott, R. D. (1999). Effects of walking on coronary heart disease in elderly men: The Honolulu heart program. *Circulation*, 100(1), 9-13. doi:10.1161/01.CIR.100.1.9
- Hardin, G. (1968). The tragedy of the commons. *Science*, 162 (3859), 1243-1248. doi:10.1126/science.162.3859.1243]
- Hendrix, C. S., & Glaser, S. M. (2007). Trends and triggers: Climate, climate change and civil conflict in sub-saharan africa. *Political Geography*, 26(6), 695-715. doi:10.1016/j.polgeo.2007.06.006
- Intergovernmental Panel on Climate Change. (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK, 976pp.
- Jyotsana Shukla. (2013). Extreme weather events and mental health: Tackling the psychosocial challenge. *ISRN Public Health*, 2013 doi:10.1155/2013/127365
- Link, B. G., Susser, E., Stueve, A., Phelan, J., Moore, R. E., & Struening, E. (1994). Lifetime and five-year prevalence of homelessness in the united states. *American Journal of Public Health*, 84(12), 1907-1912. doi:10.2105/AJPH.84.12.1907
- North, D. C. (1991). Institutions. *The Journal of Economic Perspectives*, 5(1), 97-112.\



- Nurse, Jo., Basher, D., Bone, A., & Bird, W. (2010). An ecological approach to promoting population mental health and well-being — A response to the challenge of climate change. *Perspectives in Public Health*, 130(1), 27-33. doi:10.1177/1757913909355221
- Page, L. A., & Howard, L. M. (2010). The impact of climate change on mental health (but will mental health be discussed at copenhagen?). *Psychological Medicine*, 40(2), 177-180. doi:10.1017/S0033291709992169
- Ramin, B., & Svoboda, T. (2009). Health of the homeless and climate change. *Journal of Urban Health : Bulletin of the New York Academy of Medicine*, 86(4), 654-664. doi:10.1007/s11524-009-9354-7
- Reacher, M., McKenzie, K., Lane, C., Nichols, T., Kedge, I., Iversen, A., Hepple, P., Walter, T., Laxton, C., & J Simpson on behalf of the Lewes Flood Action Recovery Team. (2004). Health impacts of flooding in Lewes: A comparison of reported gastrointestinal and other illness and mental health in flooded and non-flooded households. *Communicable Disease and Public Health / PHLS*, 7(1), 39.
- Rotton, J. & Cohn, E.G. (2003) Global warming and U.S. crime rates: An application of routine activity theory. *Environment and Behavior*, 35(6), 802-825. doi:10.1177/0013916503255565
- Searle, K., & Gow, K. (2010). Do concerns about climate change lead to distress? *International Journal of Climate Change Strategies and Management*, 2(4), 362-379. doi:10.1108/17568691011089891
- Simister, J., & Cooper, C. (2005). Thermal stress in the USA: Effects on violence and on employee behaviour. *Stress and Health*, 21(1), 3-15. doi:10.1002/smi.1029

- Sofi, F., Cesari, F., Abbate, R., Gensini, G. F., & Casini, A. (2008). Adherence to mediterranean diet and health status: Meta-analysis. *BMJ: British Medical Journal*, 337(7671), 673-675. doi:10.1136/bmj.a1344
- Stain, H. J., Kelly, B., Carr, V. J., Lewin, T. J., Fitzgerald, M., & Fragar, L. (2011). The psychological impact of chronic environmental adversity: Responding to prolonged drought. *Social Science & Medicine* (1982), 73(11), 1593-1599. doi:10.1016/j.socscimed.2011.09.016
- Sugiyama, T., Thompson, C., & Alves, S. (2009). Associations between neighborhood open space attributes and quality of life for older people in Britain. *Environment and Behavior*, 41(1), 3-21. doi:10.1177/0013916507311688
- Taylor, A.F., Kuo, F.E., & Sullivan, W.C. (2001). Coping with add: The surprising connection to green play settings. *Environment and Behavior*, 33(1), 54-77. doi:10.1177/00139160121972864
- Trevors, J. T. (2010). Total abuse of the earth: Human overpopulation and climate change. *Water, Air, and Soil Pollution*, 205(1), 113-114. doi:10.1007/s11270-009-0232-4
- Tucci, J., Mitchell, J., Goddard, C. (2007). Children's fears, hopes and heroes: modern childhood in Australia. *Australian Childhood Foundation*
- Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 224(4647), 420-421. doi:10.1126/science.6143402
- Weems, C. F., Pina, A. A., Costa, N. M., Watts, S. E., Taylor, L. K., & Cannon, M. F. (2007). Predisaster trait anxiety and negative affect predict posttraumatic stress in youths after

hurricane Katrina. *Journal of Consulting and Clinical Psychology*, 75(1), 154-159.

doi:10.1037/0022-006X.75.1.154

WHO (1948), Paper presented at the preamble to the constitution of the World Health Organization as adopted by the International Health Conference, New York, NY.

Zhou, X., & Rana, M.P. (2012). Social benefits of urban green space. *Management of Environmental Quality: An International Journal*, 23(2), 173-189.

doi:10.1108/14777831211204921