33 Climate and Weather in the United States and Its Impact on People with Disabilities in Rural Communities

Noel A. Ysasi, Irmo Marini, and Debra A. Harley

Overview

Individuals living in rural areas are often vulnerable due to physical isolation, economic diversity, increased poverty rates, and minimal healthcare options, especially for those with disabilities and the elderly (Hales et al., 2014). However, when human health is drastically influenced by weather and climate in addition to the aforementioned rural characteristics, PWDs face greater vulnerability. Specifically, extreme heat, severe winter storms, drought, wildfires (which increase air pollutants), floods, hurricanes, and tornadoes all contribute to the development or exacerbation of medical and mental health conditions. How well a community responds and has the resources available to handle inclement weather determines how PWDs will be impacted. For example, individuals with limited mobility (i.e., wheelchair users) are highly vulnerable when public transportation is only an option if one travels great distances. Rural localities, however, may have poor evacuation and emergency response procedures, lack adequate sidewalk and curb cuts, have dirt roads nonnegotiable for wheelchairs, and lack social or family support to help during extreme weather conditions (Balbus et al., 2016).

Although Chap. 25 focuses on natural disasters commonly encountered in rural areas, the purpose of this chapter is to specifically address weather and climate conditions (e.g., extreme heat and drought conditions) and its impact on PWDs residing in rural communities. The reader is encouraged to read this chapter and Chap. 25 as companion chapters. In this chapter, we focus particularly on six regions: Northwest, Southwest, Great Plains, Midwest, Southeast, and Northeast, each with varying weather and climate conditions affecting individuals differently based on type of disability and/or health condition. In addition, we provide an overview of four categories of extreme events which include the following: (a) heat and droughts, (b) wildfires, (c) winter storms and severe thunderstorms, and (d) flooding related to hurricanes and coastal storms. Understanding the changes in weather and climate, and the underlying exposure and sensitivity to these environmental conditions based on disability and illness, can

N.A. Ysasi (✉)
College of Health and Human Services, Rehabilitation Services and Rehabilitation Counseling, Northern Illinois University, DeKalb, IL, USA
e-mail: nysasi@niu.edu

I. Marini
University of Texas-Rio Grande Valley, School of Rehabilitation Services & Counseling, Edinburg, TX, USA
e-mail: irmo.marini@utrgv.edu

D.A. Harley
Department of Early Childhood, Special Education, and Rehabilitation Counseling, University of Kentucky, Lexington, KY, USA
e-mail: dharl00@email.uky.edu

D.A. Harley et al. (eds.), *Disability and Vocational Rehabilitation in Rural Settings*,
DOI 10.1007/978-3-319-64786-9_33

improve the well-being outcomes when interventions and adaptation methods are provided in rural areas.

Learning Objectives
By the end of the chapter, the reader should be able to:

1. Identify common weather and climate conditions of each region within the United States.
2. Identify the weather and climate conditions and how they directly affect disability and health conditions.
3. Identify strategies for improving weather and climate health inequity in rural communities.

Introduction

Within the past 36 years, the United States has encountered precisely 196 weather and climate disaster events with losses exceeding 1 billion dollars for each (National Centers for Environmental Information [NCEI], 2016a, b). These events have consisted of 23 droughts, 24 floods, 7 freezes, 81 severe storms, 34 tropical hurricanes, 13 wildfires, and 14 winter storm events (NCEI, 2016a, b). In 2014, the Southwest experienced heat waves and droughts, the Northeast received over 20 inches of snow in certain parts of the region, the Southeast encountered severe weather outbreaks which brought tornadoes resulting in 5 fatalities and 50 injuries, and the Great Plains had one of the worst droughts in US history (NCEI, 2016a, b). For a person without a disability or health condition, finding shelter, lighting candles, gathering flashlights, or turning on a generator during a snowstorm may prove useful and be a practical solution. However, for those with disabilities who reside in rural communities, there may be the inability to gain access to a safe and secure location or higher ground (i.e., person uses a wheelchair). Power outages can affect health (i.e., bottles of insulin should not be kept in extreme heat or cold conditions, ventilators, power beds, etc.), and access to a quality healthcare provider after a storm has subsided may be unobtainable without available and accessible public transportation. These are just a few descriptors of the weather and climate conditions in the United States; however, when residing in rural communities in conjunction with having a disability, significant barriers and limitations are imposed upon this population. Before discussing disability and health in association with environmental conditions, we provide a brief overview of the six regions (aside from Alaska) along with population and disability rates for each. See Fig. 33.1 for the most common US climate trends.

Weather and Climate Conditions Along Six US Regions

Northeast

The Northeast region is home to more than 10 million rural residents with overall disability rates varying from 9.8% in Connecticut to 20.5% in West Virginia (as indicated in Table 33.1). Similar to other regions, the Northeast carries vast weather differences which range from extreme heat (which increases air pollutants), coastal flooding, river flooding, ice storms, droughts, and hurricanes. Climate change has also been a significant factor for increased heat conditions among states such as Maryland, Delaware, West Virginia, New York, and New Jersey, where projected temperatures above 90 °C are expected to increase (Melillo, Richmond, & Yohe, 2014). Within rural communities, there is a higher vulnerability to extreme heat as a result of housing construction, infrastructure, socioeconomic status (i.e., low-income families unable to afford air conditioning units), and type of disability (Melillo et al., 2014). For example, individuals with preexisting respiratory conditions are highly susceptible to infection and illnesses as a result of poor air quality related to extreme heat conditions and droughts (Melillo et al., 2014). The topography in this region varies significantly, where a vast number of rural areas have lower temperatures in the north and frequent

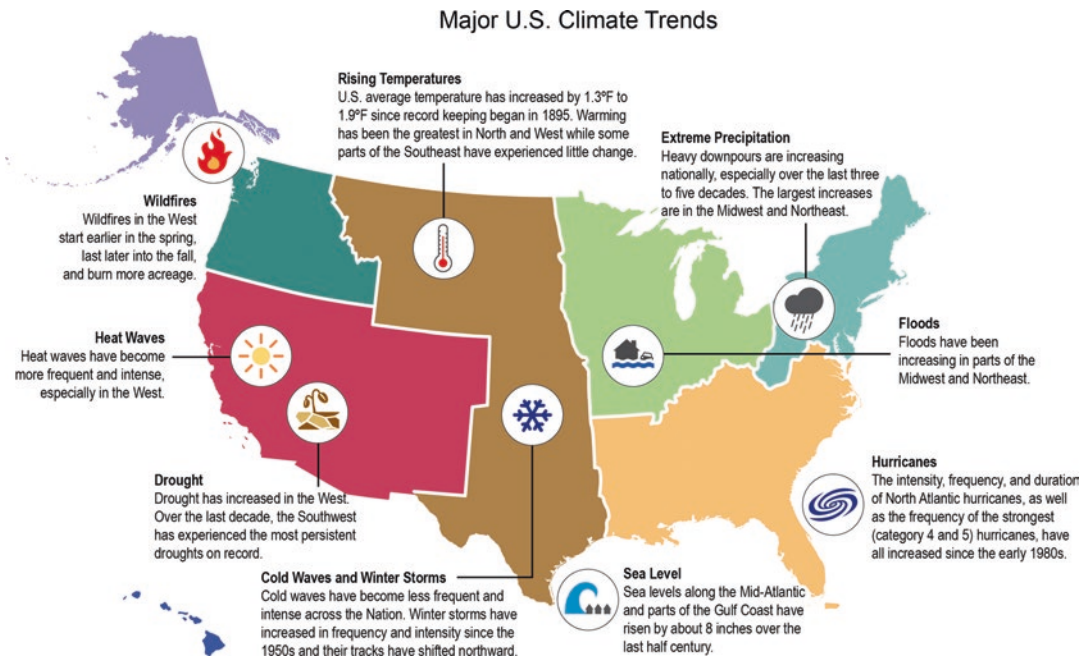

Fig. 33.1 Major US climate trends (*Note*: Adapted from "Climate change and human health," by Balbus et al. (2016))

Table 33.1 Northeast rural population and disability percentage

State	Total pop.	Urban/rural disabilities %	Rural pop.	% of rural pop.
Connecticut	3,574,097	11.2%/9.8%	429,155	12.01%
Delaware	897,934	11.8%/14.5%	149,985	16.7%
Maine	1,328,361	17.0%/15.9%	814,819	61.34%
Maryland	5,773,552	10.8%/11.4%	739,221	12.8%
Massachusetts	6,547,629	11.8%/10.2%	525,640	8.03%
New Hampshire	1,316,470	13.1%/12.7%	522,598	39.7%
New Jersey	8,791,894	10.4%/11.3%	467,768	5.32%
New York	19,378,102	11.0%/13.8%	2,349,997	12.13%
Pennsylvania	12,702,379	14.0%/13.5%	2,711,092	21.34%
Rhode Island	1,052,567	13.8%/10.1%	97,.524	9.27%
Vermont	625,741	16.1%/14.0%	382,356	61.1%
West Virginia	1,852,994	18.3%/20.5%	950,184	51.28%

Note: Adapted from: Stoddard (2014), U.S. Census Bureau (2010, 2015)

snowstorms in the winter. Yet summers in the south tend to be hot and humid with mild winter temperatures (Melillo et al., 2014). Nevertheless, the varying weather conditions (extreme heat waves, snowstorms, hurricanes, etc.) affect individuals with a wide range of disabilities (i.e., multiple sclerosis, spinal cord injury, rheumatoid arthritis, etc.).

Southeast

In 2010, the rural population within the Southeast region was nearly 17 million (US Census Bureau, 2010) with disability rates ranging from 11.2% in Georgia and 14.5% in Mississippi (Stoddard, 2014). Similar to the Northeast region, weather conditions differ as a result of geographic

distribution, with weather conditions varying from extreme heat, droughts, hurricanes, tornadoes, and winter storms (Carter et al., 2014). Additionally, many states within this region (i.e., Louisiana, Mississippi, Alabama, Georgia, Tennessee, North Carolina, and Kentucky) have encountered extreme weather and climate occurrences that have resulted in more than a billion dollar in damages for each event over the past 30 years (NCEI, 2016a, b). For example, on August 14, 2016, one storm accounted for 31.39 inches of rain in Louisiana and Mississippi, affecting a substantial number of PWDs from being able to evacuate or utilize medical equipment requiring a power source (Liberto, 2016). In 2015, 3 days accounted for 160 preliminary tornadoes with 83 confirmed across Mississippi, Alabama, Georgia, Tennessee, and North Carolina, resulting in 46 reported fatalities and damages exceeding 1 billion (NCEI, 2015). Hurricanes are also highly prevalent in this region as Hurricane Isaac in 2012 flooded Louisiana, Missouri, Alabama, and Florida, ultimately killing nine people with damages estimated at 2.8 billion dollars (NCEI, 2015). Although the Southeast experiences droughts which substantially affect rural populations, states along coastlines (i.e., Louisiana, Florida, and South Carolina) are more vulnerable to flooding as a result of the aforementioned severe storms, tornadoes, and hurricanes. In comparison to other regions, PWDs are highly vulnerable to the extreme weather conditions in the Southeast due to vast number of populated areas and high disability rates. Details of the Southeast rural population and disability percentage can be found in Table 33.2.

Midwest

Representing 20% of the national total (61 million) and 13 million (21%) residing in rural communities (Pryor, Barthelmie, & Schoof, 2013; Stoddard, 2014), the weather conditions in the Midwest pose significant threats to public health. Specifically, this region consists of extreme heat waves and freezing temperatures, tornadoes, droughts, and increased humidity, and as a result of human-induced carbon emissions, air and water quality is relatively poor which has profound effects among PWDs. The emissions of greenhouse gases, for instance, are 20% higher than the national average and have been a significant contributing factor for increased temperatures exceeding 100 °C and increased pollen seasons (Pryor & Barthelmie, 2013).

Apart from the extreme heat and degraded air quality, flooding, tornadoes (e.g., approximately 1035 between 1991 and 2010), and winter temperatures falling below zero are quite common in this region (NCEI, 2016a, b). In 2008, flooding alone caused 24 deaths in the Midwest and accounted for 15 billion dollars in lost revenues from agriculture yields, damaged levees, and closure of transportation routes which affected distribution of goods (Pryor & Barthelmie, 2013). Moreover, in 2013 and 2014 alone, Michigan, Missouri, Iowa, Indiana, and Illinois encountered severe flooding which damaged thousands of cars, businesses, and homes and affected rural communities which rely heavily on agriculture (NCEI, 2016a, b). For details outlining the Midwest population and disability rates, please refer to Table 33.3.

Great Plains

The region is generally flatland; however, along the Continental Divide, elevation levels at the base of mountains generally go beyond 5000 feet above sea level (Shafer, et al., 2014). As a result of varying topography, the weather conditions can drastically differ. For instance, North Dakota, Kansas, and Texas can reach extreme heat conditions at 121 °F, while colder temperatures can be found in Montana hitting −70 °C (Shafer, et al., 2014). Aside from extreme heat and cold conditions, persons residing in this region are frequently challenged with winter storms, severe thunderstorms, drought, and rainfall which frequently result in floods (Shafer, et al., 2014). Disability rates also vary significantly in this region (i.e., 13.8–17.9%), with over 7.5 million people living in rural communities. The overall

Table 33.2 Southeast rural population and disability percentage

State	Total pop.	Urban/rural disability %	Rural pop.	% of Rural pop.
Alabama	4,779,736	15.5%/18.4%	1,957,932	40.96%
Arkansas	2,915,918	15.6%/19.2%	1,278,329	43.84%
Florida	18,801,310	13.1%/16.5%	1,661,466	8.84%
Georgia	9,687,653	11.0%/16.0%	2,415,502	24.93%
Kentucky	4,339,367	15.0%/19.9%	1,806,024	41.62%
Louisiana	4,533,372	14.5%/15.9%	1,215,567	26.81%
Mississippi	2,967,297	14.9%/17.5%	1,503,073	50.65%
North Carolina	9,535,483	12.5%/16.8%	3,233,727	33.91%
South Carolina	4,625,364	13.6%/17.5%	1,557,555	33.67%
Tennessee	6,346,105	14.1%/18.3%	2,132,860	33.61%
Virginia	8,001,024	10.4%/14.8%	1,963,930	24.55%

Note: Adapted from: Stoddard (2014), U.S. Census Bureau (2010, 2015)

Table 33.3 Midwest rural population and disability percentage

State	Total pop.	Urban/rural disability %	Rural pop.	% of rural pop.
Illinois	12,830,632	10.4%/12.8%	1,477,079	11.51
Indiana	6,483,802	13.8%/13.6%	1,786,702	27.56
Iowa	1,567,582	11.9%/12.0%	461,212	29.42
Michigan	9,883,640	14.4%/14.4%	2,513,683	25.43
Minnesota	5,303,925	10.8%/11.4%	1,417,614	26.73
Missouri	5,988,927	13.6%/16.8%	1,770,556	29.56
Ohio	11,536,504	13.9%/13.9%	2,546,810	22.08
Wisconsin	5,686,986	12.2%/11.4%	1,697,348	29.85

Note: Adapted from: Stoddard (2014), U.S. Census Bureau (2010, 2015)

impact such weather conditions have for PWDs can be life-threatening and will be discussed later in this chapter. For details outlining the demographic characteristics of each state, please refer to Table 33.4.

Southwest

Home to more than 7 million rural residents, the Southwest is considered the hottest and driest region in the United States and vulnerable to droughts, severe thunderstorms, flooding, and air pollution from wildfires (Garfin et al., 2014; U.S. Climate Data, 2016). Due to the extreme heat conditions, forest fires have increased by 650% in the Southwest and have contributed to health and safety concerns among residents (i.e., inhalation of smoke), loss of homes, and landslides as a result of erosion (Frisvold, Ma, & Ponnaluru, 2011; Morton, Roessing, Camp, & Tyrrell, 2003; Richardson, Champ, & Loomis, 2012; Western Forestry Leadership Coalition, 2010). Though the Southwest is generally known for their dry heat and droughts, some states such as Colorado are generally protected from these effects due to increased precipitation (Redmond, 2003). Other parts of the region, however, can encounter extreme flooding and erosion along the coast (i.e., California) as a result of rising sea levels and high tides (Garfin et al., 2014). With climate change in the hottest temperatures on record over the past decade, California is experiencing extreme drought, and what once was seasonal forest fire is now occurring almost all year round (Table 33.5).

Northwest

With rocky shorelines, volcanic mountains, and deserts, the topography in the Northwest varies substantially which contributes to the weather

Table 33.4 Great Plains rural population and disability percentage

State	Total pop.	Urban/rural disability %	Rural pop.	% of rural pop.
Kansas	2,853,118	12.5%/13.8%	736,157	25.8%
Montana	989,415	13.4%/14.2%	436,401	44.11%
Nebraska	1,826,341	10.7%/12.5%	490,655	26.87%
North Dakota	672,591	11.0%/10.2%	269,719	40.1%
Oklahoma	3,751,351	14.4%/17.9%	1,266,322	33.76%
South Dakota	814,180	11.9%/12.1%	352,933	43.35%
Texas	25,145,561	11.0%/14.8%	3,847,522	15.3%
Wyoming	563,626	12.2%/12.8%	198,633	35.24%

Note: Adapted from: Stoddard (2014), U.S. Census Bureau (2010, 2015)

Table 33.5 Southwest rural population and disability percentage

State	Total pop.	Urban/rural disability %	Rural pop.	% of rural pop.
Arizona	6,392,017	12.4%/16.7%	651,358	10.19%
California	37,253,956	10.4%/14.3%	1,880,350	5.05%
Colorado	5,029,196	10.1%/11.6%	696,435	13.85%
Nevada	2,700,551	13.3%/15.9%	156,754	5.8%
New Mexico	2,059,179	14.8%/15.4%	464,818	22.57%
Utah	2,763,885	9.7%/11.3%	260,290	9.42%

Note: Adapted from: Stoddard (2014), U.S. Census Bureau (2010, 2015)

conditions that can experience polar extremes from wildfires, snowstorms, and increased rainfall leading to flooding in lower valleys from the melting snow in the springtime (Mantua, Tohver, & Hamlet, 2010). Although this region can and generally does produce heavy rainfall (generally 12 inches more than most regions), it still does not compare to the yearly average of 47 inches in New York and 56 inches in Miami (Mass, 2008). The average temperatures and weather conditions differ based on geography (Kunkel et al., 2013; McGoldrick, 2011). For instance, winters in Oregon can reach an average high/low temperature of 49/37, while Idaho reaches 38/25 °C with average snow ranging from 5 to 10 inches per year in lower valley areas (U.S. Climate Data, 2016). Although seemingly quite mild, this region does bring about harsh winters accounting for severe ice storms in the Fraser River and Northwest Washington, freezing rain in the middle of the Columbia Basin, and large windstorms with winds ranging from 90 to 100 miles per hour (Kunkel et al., 2013) (Table 33.6).

Weather and Climate Conditions and Their Impact Toward Disability and Health

As demonstrated, weather and climate conditions vary significantly among each region, though some overlap does exist. Depending on social, political, and economic factors, otherwise known as social determinants of health, people and communities can be more vulnerable to health risks (Braveman, Egerter, & Williams, 2011). Even more so, PWDs have extreme challenges during severe weather and climate events which directly cause and/or exacerbate medical and mental health conditions. Though a few examples of extreme event types and their impact toward disability have been provided, we will explore the significance of extreme heat, droughts and wildfires, flooding, and severe winter storms among PWDs in rural and small towns.

Prior to discussing these four natural disasters, however, the reader should be aware of how federal, and in all likelihood, local municipalities are prepared to deal with emergency response and

Table 33.6 Northwest rural population and disability percentage

State	Total pop.	Urban/rural disability %	Rural pop.	% of rural pop.
Idaho	1,567,582	13.1%/15.4%	461,212	29.42%
Oregon	3,831,074	14.5%/18.1%	726,692	18.97%
Washington	6,724,540	12.3%/15.6%	1,072,671	15.95%

Note: Adapted from: Stoddard (2014), U.S. Census Bureau (2010, 2015)

rescue in the United States. Specifically, the September 11, 2001, attack and its aftermath drew to the awareness of those with disabilities during emergency response and rescue (ERR) from upper floors in high-rise buildings necessitated improved evacuation procedures since elevators were powered off. Subsequent to that event was Hurricane Katrina, where federal and local emergency response for all New Orleans citizens and surrounding rural areas was slow and ill-prepared for flash floods, bacterial floodwaters, and power outages lasting weeks. Despite the abovementioned occurrences and the Emergency Management Reform Act of 2006 (designed to plan and implement emergency evacuation and shelters equipped for persons with disabilities), enactment continues to be stagnant.

Weibgen (2015) in the *Yale Law Review* cited the fallout after the 2011 and 2012 respective hurricanes Irene and Sandy in New York and New Jersey. Emergency response and rescue and emergency shelters were not set up for urban or rural residents with disabilities. In the *Brooklyn Center for Independent Living of the Disabled v. Bloomberg* class-action lawsuit that followed, the city of New York was cited for numerous violations. Mayor Bloomberg and the city of New York were found guilty of cutting all transportation, not having a coordinated plan to evacuate those with disabilities, waiting over 2 weeks to send first responders to high-rise buildings without power, and providing no education to 311 and 911 operators on how to evacuate persons in wheelchairs. In addition, the judge cited "benign neglect" of persons with disabilities where shelters and other evacuation centers were either inadequate or inaccessible (Weibgen). This is one of two such lawsuits in the United States, and it remains highly likely that ERR and education for first responders are still woefully inadequate. The implications for these inadequacies for rural persons with disabilities become even more troubling in the event of natural disasters. In rural areas with scarce services, persons with disabilities may have to rely upon the kindness of family and neighbors to evacuate them or keep them safe.

Extreme Heat

High ambient heat occurs among all six regions and affects a substantial range of illnesses and mental health. Persons with preexisting medical conditions such as cardiovascular disease, respiratory disease, diabetes, asthma, obesity, mobility impairments, and mental illnesses are at increased risk for exacerbating their health conditions when exposed to extreme heat (Gamble et al., 2016). Mental, behavioral, and cognitive disorders can also be triggered or exacerbated by heat waves, specifically, dementia, mood disorders, neurosis and stress, and substance abuse (Balbus & Melina, 2009; Hansen, Nitschke, Ryan, Pisaniello, & Tucker, 2008; Martin-Latry et al., 2007; Page, Hajat, Kovats, & Howard, 2012). While both medical and mental health can be directly affected by heat waves, side effects from prescription medication and heat exposure can occur. Research has identified the association between increased temperatures, respiratory and cardiovascular conditions requiring hospitalization, emergency room admittance, and death (Gamble et al., 2016). Medications used to treat mental health disorders (i.e., depression, anxiety, etc.) can also interfere with the body's ability to regulate temperature and increase susceptibility to the effect of heat, and dehydration from heat exposure can influence how

medications such as lithium (used for bipolar disorder) are absorbed by the body (Berko, Ingram, Saha, & Parker, 2014).

When we think of infrastructure damage, we rarely consider heat waves as the resulting cause; however, consider the 2003 Northeastern blackout indirectly caused by a heat wave, leaving many rural communities without power for weeks (Bell et al., 2016). For PWDs who require an uninterrupted source of electricity, this can pose a significant health concern and reduce quality of life, and for individuals with physical disabilities utilizing assistive technology, mobility can be impaired (i.e., motorized wheelchairs require recharging from an electrical power source). Such power outages and rotating blackouts can be life-threatening for those with respiratory diseases or paralysis requiring a ventilator. For many with these disabilities living in rural areas and low income, backup generator and charged backup batteries are critical necessities.

In addition, those with certain types of disabilities such as tetraplegia, cerebral palsy, and other medical conditions where body temperature regulation is impaired, heat exhaustion and heatstroke can quickly become life-threatening if the individual is not in an air-conditioned environment with temperature control. PWDs with these types of chronic illnesses and disabilities also have to consistently drink fluids to hydrate and flush their bladder and kidneys to avoid urinary infections since their condition (i.e., paralysis and neurogenic bladder) poses an inability for them to void on their own. As indicated within the overview of the six regions, overall disability rates tend to be proportionately higher than urban communities, and with high ambient heat, a significant portion of PWDs in rural communities are affected across the country.

Droughts and Wildfires The Southwest, Southeast, Great Plains, and Midwest all experience droughts, while western regions have higher proportions of wildfires from extreme heat. Both contribute to reduced water quality, degraded air quality, reduced water quantity (only from droughts), and decreased life satisfaction, and, to a lesser extent, impact mental health (Bell et al., 2016). Of primary concern is the degraded air quality associated with wildfire smoke and air particles linked to droughts, affecting individuals differently based on age, illness, and type of disability. There is an increase in hospital admissions and deaths associated with cardiovascular and respiratory illnesses (e.g., asthma and chronic obstructive pulmonary disease) that involve decreased lung function (e.g., spinal cord injury at the cervical and thoracic level; Baja et al., 2010). While wildfires and droughts can worsen preexisting health conditions, they also account for premature deaths and increased risk for cardiovascular disease (Garcia, Yap, Park, & Weller, 2016; Gold et al., 2000; Pope et al., 2004, 2015). To improve health conditions from these effects, persons with the aforementioned health conditions should limit outdoor activities and decrease home ventilation to lower the inhalation of outdoor smoke (Laumbach, Meng, & Kipen, 2015; Weinhold, 2011). As noted earlier however, decreased life satisfaction is commonly associated with droughts and wildfires, particularly from the limitations imposed (i.e., reduced outdoor activity). Furthermore, research has indicated a strong association between these two event types and a negative impact toward mental health including grief/bereavement, increased substance use, and suicidal ideation (North, Ringwalt, Downs, Derzon, & Galvin, 2011).

In the case of wildfires in dry rural areas such as California often involving high winds, persons with mobility impairments are particularly vulnerable and must evacuate before the situation becomes dire. Rural disaster response and preparation for those with disabilities in most urban and rural areas across the United States are still inadequate despite Pres. George W. Bush's Executive Order in 2004 and enacted as the Emergency Management Reform Act of 2006 (Weibgen, 2015). Post Hurricane Katrina and the almost complete breakdown in federal and local emergency response preparedness for all Americans disabled and otherwise, the Emergency Management Reform Act was signed into law to better prepare these entities to evacuate and rescue individuals from such disasters as well as provide

accessible shelter. Unfortunately, enacting this law has been slow to occur concerning those with disabilities, and as such, persons with mobility disabilities in fast-moving wildfire situations need to be evacuated many hours or perhaps days in front of the wildfire's path.

Flooding The Midwest and Northeast have the largest increases in flooding, particularly over the past three to five decades as a result of coastal storms and hurricanes. With over 10 and 13.6 million rural residents with high disability rates in the Northeast and Midwest, respectively, PWDs are more vulnerable to life-threatening situations and greater health risks from flooding. Specifically, high disability rates in these regions along with damaging infrastructure as a result of flooding impact health in a variety of ways. Although not a comprehensive list, examples of associated health risks as a result of flooding include the following:

- Traumatic injury and death from drowning (associated with flash flooding)
- Mental health impact (longer term)
- Respiratory illnesses
- Preterm birth and low birth rate
- Carbon monoxide poisoning from related power outages
- Blunt trauma from falling debris or quick moving objects in floodwater
- Electrocution
- Puncture wounds
- Burns
- Sprains/strains
- Hypothermia
- Water contamination
- Post-event disease spread from infrastructure disruption (Bell et al., 2016)

The aforementioned injuries and infections have been observed more commonly in rural areas (Špitalar et al., 2014). Because rural areas are highly susceptible to flash flooding conditions developing rapidly, these communities have reduced time to notify residents to respond and prepare during emergency procedures such as warnings, road closures, and evacuations (Bell et al., 2016). Furthermore, approximately 40% of country roads are inadequate for travel, bridges longer than 20 feet structurally deficient, and transportation safety continuing to be a concern (U.S. Department of Transportation, 2012); many rural residents are unable to evacuate during extreme flood events. Moreover, the ability to respond to a flooding emergency poses challenges for the aging population living alone and PWDs with mobility impairments and disabilities which reduce reaction time and require assistance (i.e., dementia, traumatic brain injury, Down syndrome, etc.). Flooding and all the other inclement weather conditions again involve the potential for power outages, and the concerns for those with disabilities requiring power were noted earlier.

Winter Storms Despite global climate change, the severity and incidence rate of winter storms have increased since the 1950s with snowstorms generally produced in greater frequency in the Northeast and Midwest regions of the United States (Bell et al., 2016; Francis & Vavrus, 2012). From loss of power to inadequate driving conditions, winter storms present an array of challenges for all persons residing in a rural community throughout the United States but pose greater challenges for PWDs. If you have ever experienced living in a geographical region which produces heavy snowfall each year, then you understand the environmental conditions generally require suitable preparation. For instance, the Department of Homeland Security (2016) recommends placing fuel-burning equipment in a well-ventilated area and purchasing at least 2 weeks of nonperishable food items during the winter season.

Infrastructure and access can be one of the primary challenges posed on PWDs during extreme weather conditions. The following infrastructure conditions and access during freezing temperatures are common barriers many people encounter which ultimately increase vulnerability:

- Older buildings with steep ramps
- Freezing pipes (eliminating running water)
- Poor road conditions (i.e., unpaved roads)
- Blocked roads and/or road closure from heavy snowfall
- Power outages for several days (affecting food, medicine, and overall personal safety)

These are just a few examples of infrastructure barriers and how PWDs can be affected as a result. Specifically, restoring power in rural communities can take several days as demonstrated in 2011 when a pre-Halloween snowstorm left several thousand homes affected in the Northeast region for approximately 10 days (Horton et al., 2014). In an effort to keep warm, individuals can resort to extreme measures, particularly through the use of gasoline-powered generators, charcoal grills, and propane heaters. All of which contribute to carbon monoxide poisoning and frequently associated with illness and death during the winter season (Bell et al., 2016).

Addressing Climate-Related Health Inequities

Governments in rural areas are generally ill-prepared to respond swiftly and effectively to extreme weather and climate events, although individuals and voluntary associations often show significant resilience. Health risks increase and can be aggravated by an ill-funded and/or inadequately trained healthcare system generally characteristic of rural areas, including long traveling distances to healthcare providers and the reduced availability of medical specialists (Hales et al., 2014). There are a few recommendations, however, provided by Friel (2013) which emphasize the need for community health organizations to focus their attention toward improving weather and climate health inequity. These include the following:

Evidence-Informed Practice

This form of practice is implemented to design health-promoting programs by obtaining reliable data on the extent of the problem and up-to-date evidence on the cause of health inequities. For the rehabilitation counselor, it means identifying the potential benefits, harm, and cost of an intervention program. What works in an urban community may not be practical in rural areas. Furthermore, bringing together local experience (i.e., PWDs who have encountered barriers and healthcare inequality) in addition to experts in developing health-promoting programs is ideal for ensuring the success of this practice.

People-Centered Practice

This method involves both person-centered thinking and planning. Rehabilitation counselors and community leaders should focus on the individual, identifying strengths and abilities, aiding individuals in connecting with their community, while identifying and addressing what PWDs are communicating as current barriers frequently encountered. For instance, persons with respiratory complications in need of uninterrupted sources of electricity to rely on medical equipment (i.e., portable oxygen), and have discussed their concerns with community leaders, should feel confident a plan is in place for addressing power outages in a timely manner.

Prevention-focused practice To appropriately address climate and weather conditions and its impact toward health equity, public health practitioners should focus on removing barriers toward access and quality healthcare. Rather than solely focusing on behavioral change (i.e., expecting consumers to find and/or adapt to climate and weather conditions), one should center their approach by preventing or ameliorating the disadvantaged circumstances that come with living in rural communities. One example would be to incorporate or increase home healthcare services for PWDs who reside in rural areas.

Summary

The unique need of rural Americans who live with various disabilities is an area that has received limited research and attention by the

government regarding ERR planning and accessible safe haven shelters. Rural Americans with and without disabilities demographically often live in small towns with scarce social services including healthcare and funding for town infrastructure. Many rural residents deal with personal isolation and limited or no local healthcare clinics with highly trained staff and rely on volunteerism or the kindness of neighbors for assistance.

In dealing with natural disasters such as those described in this chapter, persons with certain disabilities become highly vulnerable in what may become a life-threatening situation or minimally to continue to be able to maintain their health. Persons with mobility impairments may experience little or no accessible travel options for expedient evacuation, and extended power outages may threaten the lives of those who rely on ventilators to breathe or whose temperature cannot be exposed to too hot or too cold weather conditions.

Town officials can better plan for inclement weather and emergency response by meeting with their residents with disabilities and plot a rescue response plan by including rural residents with disabilities in the process. Travel alternatives, backup generators, prescription medications, medical supplies, and making shelters accessible all must be included in such planning. Finally, planning for accessing trained medical providers in cases of emergency for residents with disabilities may literally become a matter of life and death.

Learning Exercises
Research Scenario

In a study conducted by Manangan et al. (2008), southern rural Georgia (Douglas, Vidalia, and Waycross communities) experienced more historic heat waves, had less access to hospital infrastructure (i.e., decreased adaptive capacity), and was reported to have an increased aging population living alone in comparison to other counties, thus increasing the vulnerability of southern Georgia's rural population (Manangan et al., 2008). However, the research failed to address the disability rates which account for 20.3% males and 23.9% females in Douglas, 23.5% males and 20% females in Vidalia, and 34% males and 28.6% females in Waycross (City Data, 2013), further increasing vulnerability among its rural residents in southern Georgia.

Research Scenario Question 1: Apart from identifying the demographic characteristics of an "aging population," and disability rates, what additional information would be beneficial to assess what factors increase vulnerability in a rural community? Hint: What specific issues exacerbate chronic health conditions and increase the probability of secondary complications occurring among people with disabilities? What specific chronic health conditions and illnesses are affected by extreme heat temperatures?

Experiential Activities

Below are two case scenarios. Read each one and respond to the questions.

Case Scenario I

John Cable is a 24-year-old rehabilitation client who has a C5 tetraplegia and ambulates by power wheelchair in a rural North Carolina town of 500 residents. You are seeing John today at his home where he resides with his elderly mother (his caregiver) as part of your monthly trip from Raleigh to visit your rural consumers who are receiving vocational rehabilitation services. Wilmington is the closest major urban area that is approximately 125 miles away. John is currently awaiting an accessible van that he can drive from his wheelchair but currently with no accessible travel options and no local public paratransit service. John is enrolled in an online education program and funded by vocational rehabilitation. On this day, a category three hurricane is 4 days away and has a 90% chance of hitting John's coastal town, and John is unaware because their television is broken.

1. Although not a part of your job duties, what steps can you take to make sure John and his mother will be okay?
2. How can you assist John and his mother in preparing for similar situations in the future?
3. What type of planning will you recommend? What strategies will you use?

Case Scenario II

Diagnosed at 6 months of age with cystic fibrosis, Colleen Silva is an 18-year-old high school graduate who is being visited by her transition counselor to determine her interests and goals to go to college. Currently, Colleen does regular home oxygen treatments and has a nebulizer and an inhaler. When the mucus becomes very thick, her lungs have to be suctioned with a suction machine. Colleen lives with her parents in a rural area about 85 miles away from the nearest urban center in Tulsa, Oklahoma. Her parents, who also have disabilities, had all the medical equipment funded from the Affordable Care Act; however, insurance rates are about to double and the family will no longer be able to remain insured. In assisting Colleen with her academic and vocational goals, your budget also allows for assisting your clients to maintain their health.

1. Knowing that Oklahoma is a highly volatile state concerning tornadoes and severe storms that often lead to power outages, how might you assist Colleen knowing that her rural town healthcare and social services are poorly funded and understaffed?
2. What are other resources you can identify for Colleen? Consider developing a resource manual.
3. What type of advocacy can you work with Colleen and her family in developing?

Key

Research Question 1 Answer Identifying the incidence rate of respiratory and cardiovascular illnesses and asthma, along with physical disabilities which directly impact respiratory health.

Options for Case Study I Answers (a) Contact the local authorities and emergency preparedness office in John's area and inform them of his current transportation situation and have him and his mother added to a list of residents that require "checking on" in the emergency and evacuation process. (b) Communicate with John's online instructor, inform him or her of the pending situation, and ask him or her to communicate with John as soon as possible. (c) If John has provided you with his emergency contact numbers, communicate with them as soon as possible. In each of these situations, it is not necessary to identify John as a VR client, only that you are aware of his situation.

Options for Case Study II Answer (a) Help to develop an emergency preparation and response plan, for example, having a backup power source such as a generator. It may be necessary to work with the consumer to identify funding sources to pay for it. (b) Recommend that she purchase her medication in a 3-month supply, rather than monthly. (c) Identify other funding sources to assist in paying for medical aids, and (d) work with community agencies and first responders to implement a registration system for people with disabilities, older persons, and those in need of assistance that would have a "check on" notification process in time of adverse weather or disaster.

References

Baja, E. S., Schwartz, J. D., Wellenius, G. A., Coull, B. A., Zanobetti, A., Vokonas, P. S. … Suh, H. H. (2010). Traffic-related air pollution and QT interval: modification by diabetes, obesity, and oxidative stress gene polymorphisms in the normative aging study. *Environmental Health Perspectives, 118*(6), 840.

Balbus, J. M., & Malina, C. (2009). Identifying vulnerable subpopulations for climate change health effects in the United States. *Journal of Occupational and Environmental Medicine, 51*, 33–37. https://doi.org/10.1097/JOM.0b013e318193e12e.

Balbus, J., Crimmins, A., Gamble, J. L., Easterling, D. R., Kunkel, K. E., Saha, S. … Sarofim, M. C. (2016). Introduction: Climate change and human health. In J. Melilo, C. Terese, & G. Yohe (Eds.), *The impacts of*

climate change on human health in the United States: A scientific assessment (pp. 1–841). Washington, DC: U.S. Global Change Research Program. doi:10.7930/J0VX0DFW

Bell, J. E., Herring, S. C., Jantarasami, L., Adrianopoli, C., Benedict, K., Conlon, K. … Escobar, V. (2016). Impacts of extreme events on human health. In A. Crimmins, J. Balbus, J. L. Gamble, C. B. Beard, J. E. Bell, D. Dodgen, … R.J. Eisen (Eds.), *The impacts of climate change on human health in the United States: A scientific assessment* (pp. 99–128). Washington, DC: U.S. Global Change Research Program. doi:10.7930/J0BZ63ZV

Berko, J., Ingram, D. D., Saha, S., & Parker, J. D. (2014). *Deaths attributed to heat, cold, and other weather events in the United States, 2006–2010 (Report No. 76)*. Hyattsville, MD: National Center for Health Statistics.

Braveman, P., Egerter, S., & Williams, D. R. (2011). The social determinants of health: Coming of age. *Annual Review of Public Health, 32*, 381–398.

Carter, L. M., Jones, J. W., Berry, L., Burkett, V., Murley, J. F., … Obeysekera, J. (2014). Southwest. In J. M. Melillo, T. C. Terese, & G. W. Yohe (Eds.), *Climate change impacts in the United States. The third national climate assessment* (pp. 396–417). Washington, DC: U.S. Global Change Research Program. doi:10.7930/J0N-P22CB

City Data. (2013). Waycross, Georgia. Retrieved from http://www.city-data.com/city/Georgia.html

Department of Homeland Security (2016). *Snowstorms and extreme cold*. Retrieved from https://www.ready.gov/winter-weather

Francis, J. A., & Vavrus, S. J. (2012). Evidence linking Arctic amplification to extreme weather in mid-latitudes. *Geophysical Research Letters, 39*(6), 1–6.

Friel, S. (2013).Improving equity. In C. Guest, W. Ricciardi, I. Kawachi, & I. Lang (Eds.), *Oxford handbook of public health practice* (3rd ed., pp. 406–416). doi:10.1093/med/9780199586301.001.0001

Frisvold, G., Ma, X., & Ponnaluru, S. (2011). Climate, water availability, energy costs, and national park visitation. In B. G. Colby & G. B. Frisvold (Eds.), *Adaptation and resilience: The economics of climate, water, and energy challenges in the American Southwest*. Washington, DC: Earthscan.

Gamble, J. L., Balbus, J., Berger, M., Bouye, K., Campbell, V., Chief, K., et al. (2016). Populations of concern. In *The impacts of climate change on human health in the United States: A scientific assessment* (pp. 247–286). https://doi.org/10.7930/J0Q81B0T.

Garcia, C. A., Yap, P. S., Park, H. Y., & Weller, B. L. (2016). Association of long-term PM2. 5 exposure with mortality using different air pollution exposure models: Impacts in rural and urban California. *International Journal of Environmental Health Research, 26*(2), 145–157.

Garfin, G., Franco, G., Blanco, H., Comrie, A., Gonzalez, P., Piechota, T., … Waskom, R. (2014). Southwest. In J. M. Melillo, T. C. Terese, & G. W. Yohe (Eds.), *Climate change impacts in the United States. The third national climate assessment* (pp. 462–486). Washington, DC: U.S. Global Change Research Program. doi:10.7930/J08G8HMN

Gold, D. R., Litonjua, A., Schwartz, J., Lovett, E., Larson, A., Nearing, B., … Verrier, R. (2000). Ambient pollution and heart rate variability. *Circulation, 101*(11), 1267–1273.

Hales, D., Hohenstein, W., Bidwell, M. D., Landry, C., McGranahan, D., Molnar, J., … Jadin, J. (2014). Rural communities. In J. M. Melillo, T. C. Terese, & G. W. Yohe (Eds.), *Climate change impacts in the United States. The third national climate assessment* (pp. 333–349). Washington, DC: U.S. Global Change Research Program. doi:10.7930/J01Z429C

Horton, R. S., Yohe, G., Easterling, W., Kates, R., Ruth, M., Sussman, E., … Wolfe, D. (2014). Chapter 16: Northeast. In J. M. Melillo, T. Richmond, & G. W. Yohe (Eds.), Climate change impacts in the United States. *Third national climate assessment*. Washington, DC: U.S. Global Change Research Program.

Kunkel, K. E., Stevens, L. E., Stevens, S. E., Sun, L., Janssen, E., Wuebbles, D., … Dobson, J. G. (2013). Regional climate trends and scenarios for the US national climate assessment: Part 9. Climate of the contiguous United States. *NOAA Technical Report NESDIS, 77*, 142–9.

Laumbach, R., Meng, Q., & Kipen, H. (2015). What can individuals do to reduce personal health risks from air pollution? *Journal of Thoracic Disease, 7*(1), 96–107.

Liberto, T. D. (2016). *National Oceanic and Atmospheric Administration. August 2016 extreme rain and floods along the Gulf Coast*. Retrieved from https://www.climate.gov/news-features/event-tracker/august-2016-extreme-rain-and-floods-along-gulf-coast

Manangan, A. P., Uejio, C. K., Saha, S., Schramm, P. J., Marinucci, G. D., Brown, C. L., & Luber, G. (2008). Assessing health vulnerability to climate change: A guide for health departments. Retrieved from https://www.cdc.gov/climateandhealth/pubs/assessinghealth-vulnerabilitytoclimatechange.pdf

Mantua, N., Tohver, I., & Hamlet, A. (2010). Climate change impacts on streamflow extremes and summertime stream temperature and their possible consequences for freshwater salmon habitat in Washington State. *Climatic Change, 102*, 187–223. doi:10.1007/s10584-010-9845-2

Martin-Latry, K., Goumy, M. P., Latry, P., Gabinski, C., Bégaud, B., Faure, I., & Verdoux, H. (2007). Psychotropic drugs use and risk of heat-related hospitalization. *European Psychiatry, 22*, 335–338. https://doi.org/10.1016/j.eurp-sy.2007.03.007.

Mass, C. (2008). *The weather of the Pacific Northwest*. Seattle, WA: University of Washington Press.

McGoldrick, D. (2011). *Normal weather patterns of the Northwest*. Retrieved from http://www.brighthub.com/environment/science-environmental/articles/103855.aspx

Melillo, J. M., Richmond, T. T., & Yohe, G. W. (2014). Climate change impacts in the United States. In

J. M. Melillo, T. Richmond, & G. W. Yohe (Eds.), *Third national climate assessment*. Washington, DC: U.S. Global Change Research Program.

Morton, D. C., Roessing, M. E., Camp, A. E., & Tyrrell, M. L. (2003). *Assessing the environmental, social, and economic impacts of wildfire*. New Haven, CT: Yale University Global Institute of Sustainable Forestry.

National Centers for Environmental Information, National Oceanic and Atmospheric Administration. (2015). *State of the climate: Tornadoes for annual 2014*. Retrieved from https://www.ncdc.noaa.gov/sotc/tornadoes/201413

National Centers for Environmental Information, National Oceanic and Atmospheric Administration. (2016a). *U.S. Billion-dollar weather and climate disasters 1980–2016*. Retrieved from http://www.ncdc.noaa.gov/billions/events

National Centers for Environmental Information, National Oceanic and Atmospheric Administration. (2016b). *State of the climate: Tornadoes for August 2016*. Retrieved from http://www.ncdc.noaa.gov/sotc/tornadoes/201608

North, C. S., Ringwalt, C. L., Downs, D., Derzon, J., & Galvin, D. (2011). Postdisaster course of alcohol use disorders in systematically studied survivors of 10 disasters. *Archives of General Psychiatry, 68*(2), 173–180.

Page, L. A., Hajat, S., Kovats, R. S., & Howard, L. M. (2012). Temperature-related deaths in people with psycho sis, dementia and substance misuse. *The British Journal of Psychiatry, 200*, 485–490. https://doi.org/10.1192/bjp. bp.111.100404.

Pope, C. A., Burnett, R. T., Thurston, G. D., Thun, M. J., Calle, E. E., Krewski, D., & Godleski, J. J. (2004). Cardiovascular mortality and long-term exposure to particulate air pollution epidemiological evidence of general pathophysiological pathways of disease. *Circulation, 109*(1), 71–77.

Pope, C. A., Turner, M. C., Burnett, R. T., Jerrett, M., Gapstur, S. M., Diver, W. R., … Brook, R. D. (2015). Relationships between fine particulate air pollution, cardiometabolic disorders, and cardiovascular mortality. *Circulation Research, 116*(1), 108–115.

Pryor, S. C., & Barthelmie, R. J. (2013). The Midwestern United States: Socio-economic context and physical climate. In S. C. Pryor (Ed.), *Climate change in the Midwest: Impacts, risks, vulnerability and adaptation* (pp. 12–47). Bloomington: Indiana University Press.

Pryor, S. C., Barthelmie, R. J., & Schoof, J. T. (2013). High-resolution projections of climate impacts for the Midwestern USA. *Climate Research, 56*, 61–79. doi:10.3354/cr01143

Redmond, K. T. (2003). Climate variability in the intermontane West. Complex special structure associated with topography, and observational issues. In W. M. Lewis Jr. (Ed.), *Water and climate in the Western United States* (pp. 29–48). Boulder, CO: University Press of Colorado.

Richardson, L. A., Champ, P. A., & Loomis, J. B. 2012. The hidden cost of wildfires: Economic valuation of health effects of wildfire smoke exposure in Southern California. *Journal of Forest Economics, 18*, 14–35. doi: 10.1016/j.jfe.2011.05.002

Shafer, M., Ojima, D., Antle, J. M., Kluck, D., McPherson, R. A., Petersen, S., … Scanlon, B. (2014). Great plains. In J. M. Melillo, T. C. Terese, & G. W. Yohe (Eds.), *Climate change impacts in the United States. The third national climate assessment* (pp. 441–461). Washington, DC: U.S. Global Change Research Program. doi:10.7930/J0D798BC

Špitalar, M., Gourley, J. J., Lutoff, C., Kirstetter, P. E., Brilly, M., & Carr, N. (2014). Analysis of flash flood parameters and human impacts in the US from 2006 to 2012. *Journal of Hydrology, 519*, 863–870.

Stoddard, S. (2014). *Disability Statistics Annual Report*. Durham, NH: University of New Hampshire.

U.S. Census Bureau. (2010). *2010 Census urban and rural classification and urban area criteria*. Retrieved from https://www.census.gov/geo/reference/ua/urban-rural-2010.html

U.S. Census Bureau. (2015). *American fact finder. Percent of people with a disability*. Retrieved from http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

U.S. Climate Data. (2016). *Temperature, precipitation, sunshine, and snowfall*. Retrieved from http://www.usclimatedata.com/

U.S. Department of Transportation, Federal Highway Administration. (2012). *Planning for transportation in rural areas*. Retrieved from http://www.fhwa.dot.gov/planning/publications/rural_areas_planning/page03.cfm

Weibgen, A. A. (2015). The right to be rescued: Disability justice in an age of disaster. *Yale Law Review, 124*(7), 2406–2469.

Weinhold, B. (2011). Fields and forests in flames: Vegetation smoke and human health. *Environmental Health Perspectives, 119*, 386–393. doi: 10.1289/ehp.119-a386

Western Forestry Leadership Coalition. (2010). The true cost of wildfire in the western U.S. Retrieved from http://www.wflccenter.org/news_pdf/324_pdf.pdf