The Health Effects of Volcanoes

Introduction

Volcanoes are vents in the earth's crust where eruptions release lava, rock, steam, and gases, which can be hazardous to human health.[1] Volcanoes are one of the largest sources of non-anthropogenic air, soil, and water pollution.[2,3] There are around 1,500 potentially active volcanoes in the world, with the majority concentrated in the "Ring of Fire" around the Pacific Rim.[1,4] About 170 of these potentially active volcanoes are located in the United States.[4] Globally, close to 22 million people live within approximately three miles of an active volcano.[5] Those who live or work in close proximity to an active volcano are most at risk from the acute impacts of an eruption. Older adults, pregnant people, individuals with respiratory conditions, and children also may be more susceptible to the health impacts of volcanoes.[6,7] Additionally, many volcanic regions are popular tourist destinations. Although eruptions are rare, visitors, who may be less aware of the hazard than local residents, may be at risk if an eruption or degassing occurs.[8] While most impacts of an eruption are contained to the local area, volcanic ash can travel thousands of miles, affecting people far from the eruption site. Large eruptions can even impact the global climate, disrupting weather patterns, polluting water supplies, and reducing crop yields.[9,10] This factsheet provides an overview of health impacts related to volcanic eruptions, from the initial event into the recovery phase, as represented in the current literature.

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Acute Impacts

Volcanic eruptions can generally be classified into two main types: explosive eruptions, characterized by violent fragmentation of magma and ejection of pyroclastic material, and effusive eruptions, in which lava flows more steadily from the vent.[10] The health hazards presented by a volcano depend on the volcano's geology and the characteristics of the eruption that occurs.[3]

Volcanic Gases

Volcanoes can release harmful gases, including carbon dioxide, sulfur dioxide, hydrogen sulfide, hydrogen halides, and radon, as well as heavy metals such as lead and mercury.[7,11,12,13] These gases may be released during eruptions, but they can also be released during non-eruptive periods through a process called degassing.[14] Degassing can be harder to detect than an eruption because the gases that are released are not always visible.[7,14] For example, carbon dioxide is a colorless, odorless gas that volcanoes can release in fatal quantities.[7,14] Acute health impacts of exposure to carbon dioxide range from drowsiness, headache, fatigue, and concentration difficulties at low doses (1,000–10,000 PPM) to hallucinations, coma, and even death at high doses (>100,000PPM).[7,14] Sulfur dioxide can cause eye and respiratory tract irritation and, for people with asthma, airway constriction.[15] Other volcanic gases may cause similar symptoms, and radon exposure is linked to increased cancer risk.[12,16]

Pyroclastic flows

Explosive eruptions produce rock fragments called tephra.[17] Tephra mixed with volcanic gas can form fast moving pyroclastic flows with temperatures up to several hundreds of degrees celsius.[10] Pyroclastic flows can be deadly, causing traumatic injuries, severe burns, thermal lung injury, and asphyxia through inhaled ash.[1,10]

Volcanic Ash

Unlike large rock fragments that fall near the volcano's vent, volcanic ash, which is made up of small tephra less than 2mm in diameter, can be carried thousands of miles away by the wind.[17] Volcanic ash is the most wide-reaching volcanic hazard.[18] Even after the initial ashfall settles, volcanic ash that is later stirred up may be harmful if inhaled.[18] Acute health impacts of volcanic ash inhalation include eye and respiratory tract irritation.[6] Exposure to volcanic ash can worsen existing respiratory conditions, such as asthma and bronchitis.[19] Ash that contains silica may lead to silicosis.[6]

Lava Flows

During a volcanic eruption, lava generally moves slowly, giving individuals enough time to evacuate and avoid injury or death.[20] However, there is a risk to human health if a lava flow triggers another natural hazard. For example, lava can melt snow and ice to form a lahar, a debris flow that may reach speeds of up to 120 miles per hour, putting those in its path at risk of injury or death.[21] Lava flows and lahars may bury property, permanently displacing residents.[14,20]

Secondary Events

Volcanic eruptions can trigger floods, landslides, mudslides, and wildfires.[1] Additional information about these hazards is available through their respective factsheets. In addition, "laze" (lava + haze) can form when lava reaches ocean waters.[10]

Long-Term Health Impacts

There is evidence that living or working near a volcano can increase the risk of cancer,[22] including thyroid cancer,[2,22] hypothyroidism,[2] dental and skeletal fluorosis,[23] and respiratory illnesses.[24,25] Volcanic areas may be contaminated with heavy metals such as mercury and lead, which are harmful to health.[26] Further research is needed to better understand the long-term health impacts of exposure to volcanic ash, volcanic gases, and other volcanic hazards.

Mental Health Impacts

Research into the mental health impacts of volcanic eruptions is fairly limited. However, recent studies indicate that people who are exposed to volcanic eruptions may experience short and long-term mental health impacts, including psychological distress, PTSD, depression, and anxiety.[5] These effects may be more severe for individuals who lost family members, pets, and property, and for those who needed to evacuate.[5]

Infrastructure/Healthcare Impacts

Infrastructure, including healthcare infrastructure, may be damaged during a volcanic eruption.[17] Damage to roads and other infrastructure may make travel difficult or impossible, cutting people off from healthcare services. Lava flows and lahars can bury buildings and roads.[14,20] Because volcanic ash can travel high in the air, eruptions can impact aviation and flights may be delayed or canceled.[17,19] Ash can cause buildings to collapse, harm crops and livestock, and pollute the soil, air, and water.[1,10,27,17] Volcanic eruptions can also disrupt the power grid.[9]

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