Frostbite has been described in military history for millennia. The Greeks encountered and discussed the problem of frostbite as early as 4000 BCE. Researchers have found evidence of frostbite in humans dating back 5,000 years, in an Andean mummy. Napoleon's Army was the first documented instance of mass cold injury in the early 1800s. According to Zafren, nearly 1 million combatants fell victim to frostbite in the First and Second World Wars, and the Korean War. Frostbite occurs when skin and underlying tissues freeze. The most common cause of frostbite is exposure to cold-weather conditions. But it can also be caused by direct contact with ice, frozen metal or very cold liquids. Specific conditions that lead to frostbite include:  

Medical conditions that affect your ability to feel or respond to cold, such as dehydration, excessive sweating, exhaustion, diabetes and poor blood flow in your limbs. Alcohol or drug abuse.  

Exercise can get the blood flowing and help you stay warm, but don't do it to the point of exhaustion. By Mayo Clinic Staff. Request an Appointment at Mayo Clinic.

Study of the risk of frostbite in humans with the help of a transient 3D finger model

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A new three dimensional transient human finger model was developed to predict the risk of frostbite in humans at different environmental conditions. The shape of the finger model was similar to that of a real human finger. Finite Element Techniques were used to build the finger model. Smith’s Model (1991) energy balance equations were used to calculate the temperatures in the current finger model. The current 3D finger model was validated against the experimental data of Wilson (1976) and Santee (1990). The model agreed well with the Wilson experiments and with the cold test in Santee experiments. The comparison indicates that the current finger model can be used to adequately predict the human finger responses in different environments. The current finger model was then tested in temperatures of 0, -10, -20, -25 and -30 oC and with different airspeeds 0, 3 and 6.8 m/s to assess the risk of frostbite in humans. Three resistances 0, 0.4 and 0.8 clo were used on the finger model to obtain responses in different environmental conditions. From the experimental results, an expression for safe glove resistance required to prevent frostbite in known temperatures was calculated. Also, the temperatures up to which a glove with known thermal resistance value can protect a human finger from frostbite was also computed.

Keywords: Frostbite; Human finger; Finite element

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