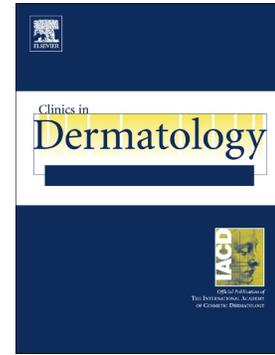


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Reflections on Dermatology: Past Present and Future

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Celestial Effects on the Skin

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Abstract

Many factors impact on the health and physiology of human skin, with some of them arising from outer space. This contribution explores four celestial influences on the skin:

- 1) the sun's ultraviolet light, which has both beneficial and deleterious dermatologic effects,
- 2) meteorite injuries,
- 3) possible lunar effects on the body's health,
- 4) cosmic radiation as a risk factor for skin cancer and pregnancy related complications.

Some of these extraterrestrial influences on skin health have taken on added significance as human beings increasingly spend more time at higher altitudes in aircraft, space ships and space stations.

Key Words: Meteorite injuries, cosmic radiation, solar effects on the skin, lunar effects on health

Running Title: Celestial Effects on the Skin

Introduction

From time immemorial, people have gazed at the sky and marveled at the beauty of the universe. It is now known that the cosmos can have important health effects on the human body and skin. The most obvious example is the sun, upon which all life on earth depends. Just over 100 years ago, the German Jewish pediatrician Kurt Huldshinsky (1883-1940) used ultraviolet radiation to cure rickets, a skeletal disorder of children that results from Vitamin D deficiency. It was subsequently shown that the sun's ultraviolet rays could have deleterious effects on the skin, causing skin cancer and photoaging. These are just some of the solar effects on the human body that this contribution highlights.

Besides the sun, there are other potential celestial effects on the skin and this contribution explores three of them: meteorites, lunar influences and cosmic radiation. Meteorite injuries are rare but nonetheless warrant consideration. There has been much speculation about whether the moon influences the human body, although definitive evidence of a direct lunar effect on human physiology and health is so far lacking. Cosmic radiation is a concern for persons spending time at higher altitudes or in space, such as aircrew and astronauts. There is still much we need to learn about the astronomic influences upon our health even as we continue to behold the majesty of the heavens above us.

The Sun and Ultraviolet Radiation

Beneficial Effects

Most ultraviolet (UV) radiation is absorbed by the ozone layer. The UVA and UVB radiation that does reach the earth's surface is important for many biologic processes. Plants use

UV radiation for photosynthesis by synthesizing carbohydrates as food sources. In humans, UVA and UVB promote the synthesis of melanin;¹ additionally, UVB stimulates the synthesis of vitamin D, prompting the conversion of 7-dehydrocholesterol to previtamin D₃, which isomerizes to vitamin D₃. This molecule is further converted in the liver to 25-hydroxyvitamin D₃. Subsequent processing in the kidney completes the conversion to 1,25-dihydroxyvitamin D, which is a critical factor for many important biologic processes and bone health. It may even be important in reducing the risks of high blood pressure, type 1 diabetes, and multiple sclerosis.¹

Deleterious Effects

UVA can produce free radicals and cause oxidative damage. UVB can cause DNA damage by creating pyrimidine dimers, leading to aberrant DNA replication and expression of genes.¹ The p53 gene along with the Fas/Fas-ligand pathway may particularly be involved in causing the dysregulation in the cell cycle. Applying proper SPF-15 sunscreen may reduce the risk of skin cancer by preventing p53 mutations.² In addition to affecting the cell cycle factors, UV can also impair immune reactivity against tumors, enhancing its carcinogenic potential.² In regards to particular groups being at more risk, pigmented skin is generally more protective, while skin that sun burns easily without tanning is at a higher risk for acquiring skin cancer. Specific diseases such as Xeroderma pigmentosum, in which individuals lack nucleotide excision repair proteins, can be exacerbated by exposure to sunlight. Even with respect to photosynthesis, excessive UVB can disrupt this biologic process by degrading reaction center D1-polypeptide.³

Meteorites

Injuries and Contact Dermatitis from Meteorites

Meteorites are varying sized rocks that orbit in space and that have a very small chance of actually landing on earth. In fact, it was calculated that there is only a 99 to 1 chance that in at least one of the centuries between 1700 to 2000 CE, a meteorite will hit a human targeted area. A notable case of a meteorite strike occurred in 1927, in which a 5 year old girl in Aba, Japan apparently was struck on the head by a small celestial rock. Although the meteorite was recovered, there were no eyewitnesses to the injury.⁴

Meteorites can cause dermatitis as in the case of a 31-year-old physicist who developed itchy plaques around his wedding ring finger. Testing revealed that the ring was made from a meteorite that was composed of a nickel-iron alloy. The patient's contact dermatitis, caused by the nickel component of the meteorite, resolved when he removed his ring thus avoiding further contact with nickel.⁵ This case highlights the effect that the composition of meteorites can have on human skin.

1) Other Meteorite Injuries

Another widely known meteorite strike occurred in Chelyabinsk, Russia. This event happened on February 15, 2013, causing more than 1000 injuries.⁶ 3613 apartment buildings were shattered and out of the 452 body injuries, 5.3% of the people experienced sunburns. One resident of Korkino, which is 30 km away from the original site, experienced peeling of the skin.⁷ For this particular meteorite impact, the composition was characterized by shock melt veins, including both high pressure and high temperature elements. The jadeite in this meteorite had a needle-like characteristic, as it quickly underwent crystallization.⁶ Additionally, the skin

effects may also occur from meteorites of lesser impact. In 1954, a woman, Ann Hodges (1920-1972), was struck by a meteorite at her home in Oak Grove, Alabama near Sylacauga. The black chondrite rock bruised her left thigh and side, but she was still able to walk (**Figure 1**).

Unfortunately, the attention of being struck by a meteorite created frenzy and havoc in her life, contributing towards significant stress.⁸

Lunar Effects

Lunar Effects on Health

The lunar geophysical cycle is fundamental to much of earth's biology, affecting both the ecosystem and human biology. Although no clear documentation connects the moon with pathologies of the skin or body, there are several theories and explanations about their possible association. The increase in cardiovascular deaths, suicides, and accidents and hospitalizations during a full moon has increased public interest.⁹ An example of a possible connection between the lunar cycle and a skin condition might be the association of a flare of acne and a full moon. It has been observed that a significant portion of women tend to have their menstrual cycles synchronized around the full moon¹⁰, which may just be coincidental. At the same time, many of these women also experience premenstrual acne flares¹¹, inviting speculation about whether there might be an association between the lunar cycle, menstrual cycle and acne flares. Additionally, sleep duration and deep sleep are attenuated during a full moon which can weaken the immune system and collagen formation, and thus be evident cosmetically;^{12,13} however, claims of the lunar effects on skin more commonly delve into folklore.

1) Werewolves and Hypertrichosis

The lunar cycle is often associated with lunacy, or at least the notion that the moon influences aggressive human behavior. The superstition of werewolves transformation under a full moon is widely popular in folklore and English literature.¹⁴ Although the legend of the werewolf often arises in antiquity, congenital generalized hypertrichosis has several dermatologic consequences that can be linked to lunacy. Also referred to as “werewolf syndrome”, congenital hypertrichosis lanugo (CHL) appears as lanugo hair failing to disappear in early life and progressing into terminal hairs. Similarly, congenital hypertrichosis universalis patients show similar features, but with terminal hairs present at birth. Hypertrichosis may occur with other complex syndromes. Pigmentary retinopathy, a disorder involving damage to the receptors and areas of the retina, includes hypertrichosis with hyperpigmentation of the face and extremities. Patients with Cornelia de Lange Syndrome, a developmental disorder with multiple congenital defects, may exhibit premature aging of the skin (wrinkling and sagging), while Barber-Say Syndrome, a rare congenital disorder with ectodermal dysplasia, is characterized by atrophic lax skin.¹⁵ Although no clear documentation links these skin pathologies with the moon, the combination of the lunar emergence of the werewolf, lunacy, and hypertrichosis can form a basis for expanding knowledge on the lunar effects on the skin.

Cosmic Radiation Effects

Cosmic radiation involves space radiation originating from the sun within our solar system or from various other stars outside of our solar system.^{16,17} This consists of high-energy particles found in atoms, x-rays, and gamma rays and can prove to be harmful with prolonged exposure.¹⁶⁻

¹⁸ Fortunately, the earth's atmosphere serves as a protective barrier to shielding the body from the damaging effects of cosmic radiation.¹⁹ At higher altitudes the level of protection provided against this type of radiation from the atmosphere is significantly reduced.¹⁹ This may pose a potential risk to individuals who spend extensive amounts of time at these high altitudes, including astronauts and flight attendants.¹⁹

Prolonged exposure to various other types of space radiation has been shown to have detrimental effects to one's health, including malignancies²⁰ and reproductive problems.²¹ Cosmic radiation itself has been shown to negatively impact pregnancies leading to miscarriages and possibly birth defects.²² Such overexposure to cosmic radiation may cause an increased likelihood of skin cancers including melanoma skin cancer^{17,23} and non-melanoma skin cancers such as basal cell skin carcinoma.^{17,24}

Considering the detrimental effects of radiation, newer spacesuits and shuttle designs have incorporated protective measures; however, there are still limitations to their effectiveness.^{25,26} The Centers for Disease Control also added recommendations that pregnant crewmembers should reduce the amount of physically demanding tasks and lower their time on longer flights.²⁷ Further studies are needed to better define the potential risks of cosmic radiation on the health of the body and its skin.

Conclusions

The celestial effects on the skin are complex. Sunlight can impact on vitamin D synthesis and contribute to skin cancer. Meteorites, cosmic radiation and maybe even the moon, can also have significant effects on the skin. Our knowledge of the influence of the atmosphere on the body, in particular, is in its early stage.

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Legend for Figure 1 (Ann Hodges meteorite slice)

Sylacauga meteorite slice. (Smithsonian National Museum of Natural History, WashingtonDC. Creative Commons Attribute-Share Alike 2.0 Generic). The meteorite, from which this slice came, fell on November 30, 1954 near Sylacauga, Alabama with one fragment injuring Ann Hodges.

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Figure 1