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Excessive Exposure to UV radiation and its Impact for Construction Workers: Article

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A B S T R A C T

Skin cancer is the most common type of cancer with approximately 1 million people being diagnosed with a form of skin cancer each year. Basal Cell Carcinoma, Squamous Cell Carcinoma, and Melanoma, are primarily caused by Solar Ultraviolet Radiation (SUVR) from exposure to the sun. UVA and UVB are two different types of UV rays penetrate the earth's surface. The labors and workers of the construction industries are constantly exposed to both types of SUVR. The continuous exposure to SUVR leads to various adverse health effects to the labors and workers of the construction industries. There are cancer cells in the top layer of the skin of human being called 'Epidermis', also referred to be 'Stage 0 melanoma'. This kind of In- situ melanomas has a prospect to develop even one millimeter deep into the skin, and thus it can show the way to more involved treatment and greater danger. The main aim of this review is to endow with a comprehensive overview of SUVR exposure risk of outdoor workers, including the UV exposure levels and eventually, to outline the preventive interventions to reduce occupational risk.

Keywords: Epidermis, In- situ melanomas; Outdoor work; Solar radiation; Squamous Cell Carcinoma; Ultraviolet radiation

1. Introduction

The concentration of harmful ultraviolet radiation becomes increasing on the earth due to the depletion of Ozone layer [5], [6], [7]. Ultraviolet (UV) radiation or ultraviolet light is a form of electromagnetic radiation, like radio waves, x-rays and light. On the electromagnetic spectrum, UV radiation comes between visible light and x-rays. That is, its wavelengths are shorter than the wavelengths of light and longer than those of x-rays. It is divided according to its effects on living tissue into three wavelength bands: UV-A, UV-B and UV-C

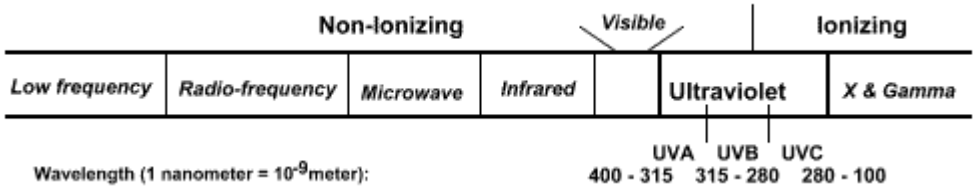

Fig.1 The Electromagnetic Spectrum

Operations that use artificial UV sources may expose workers to excessive UV radiation. These include: welding; processes involved in printing; curing of inks, paints, etc.; non-destructive testing (NTD) and material inspection; and UV disinfection in hospitals and laboratories. Outdoor workers may

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easily be overexposed to UV radiation from the sun during spring and summer. They include workers in construction, open-pit mining, logging, landscaping, road building and maintenance, agriculture and other sectors.

Ultraviolet (UV) radiation is a known cause of skin cancer, skin ageing, eye damage, and may affect the immune system [5], [6], [7]. People who work outdoors are the most likely of all workers to suffer health damage from exposure to UV radiation. Other people may be exposed to UV radiation at work from non-solar sources such as arc welding, the curing of paints, inks etc and the disinfection of equipment in hospitals and laboratories amongst others. In relation to non-solar sources of UV radiation, well designed engineering and administrative controls and in the case of arc welders, personal protective equipment can keep the risks to a minimum. However with outdoor workers who are regularly exposed to the sun for long periods of time, a more comprehensive strategy is required to minimize risks. This is because the sun (exposure source) cannot be controlled like other workplace exposure hazards [1].

2. Study Area

The town 'Ambo' is famed as a spa town located in the West Shewa Zone of the Oromia Region, west of Addis Ababa, this town has a latitude and longitude of 8°59′N 37°51′E8.983°N 37.850°E and an elevation of 2076 meters.

Fig.2 Location Map of the study area

3. Methodology

According to Subash Thanappan (2021), the negative impacts of any projects in different stages must be examined by the internal auditing team of any construction company [4]. As a part of EIA study, the existing level of safety measures among the labors, and the other staffs were identified through the 'Visual survey' at Awaro Stadium Construction Site (Fig 3) at Ambo Town of Oromia region in Ethiopia.

Fig.3 Construction Site in the study area

Following are the main factors that affect UV radiation were kept under consideration for the current review [2].

▪ Sun elevation: The higher the sun in the sky, the more intense the UV radiation. Therefore the UV radiation levels are highest around solar noon and in summer.

▪ Latitude: The closer to equatorial regions, the higher the UV radiation levels.

▪ Cloud cover: Solar UVR can penetrate through light cloud cover, and on lightly overcast days the UV radiation intensity can be similar to that of a cloud-free day. Heavy cloud can reduce the intensity of UV radiation. Scattered cloud has a variable effect on UV radiation levels, which rise and fall as clouds pass in front of the sun.

▪ Altitude: At higher altitudes, the atmosphere is thinner and absorbs less UV radiation.

▪ Ground reflection: Grass, soil and water reflect less than 10% of UV radiation; fresh snow reflects as much as 80%; dry beach sand about 15% and sea foam about 25%.

Risks associated with Ultraviolet Radiation in the Workplace

Upon the Direct Visual Survey, some of the risks associated with Ultraviolet radiation were identified. It includes:

1. As the study area is located at the higher altitude (2076 m above mean sea level), the negative impacts of UV radiation is "very high" for the site workers and staffs those who directly exposed to the sun during their work.

Fig. 4 Direct exposure to 'Sun light' in the study area

2. As the study area is close to equatorial regions, the UV radiation level is 'Very high' to cause adverse health effects that can manifest over both the short and long term. UV radiation is absorbed in the skin and the adverse health effects are mostly confined to the skin and eyes. In most cases it is considered that shorter wavelengths (UVB) are more harmful than longer wavelengths (UVA). Although exposure to small amounts of UV radiation can have beneficial effects, such as vitamin D synthesis in the skin, overexposure can cause serious acute (short-term) and chronic (long-term) health effects. The major risks associated with UV radiation for the workers include: Acute effects and chronic effects.

Acute Effects

Sunburn (*Erythema):* This is a reddening of the skin, with blistering and peeling in severe cases. Prolonged exposure to UV radiation causes a thickening of the skin's outer layer. Since people with lighter skin, hair and eyes have less pigment, they are more sensitive to UV exposure.

Welders' flash, also known as arc-eye and snow-blindness (P*hotokeratoconjunctivitis*): This is a painful irritation of the cornea and the conjunctiva (the membrane connecting the eyeball with the inner eyelid). There is a feeling of "sand in the eye" and sensitivity to light. UV-B is most effective in causing this "sunburn of the eye". The eye is more sensitive than the skin to UV radiation because it lacks the skin's horny outer layer and protective pigment. Symptoms appear from six to 24 hours after exposure and usually disappear within the following 48 hours. No permanent damage to the eye results unless a severe exposure has occurred [3].

Retinal injury, possibly resulting in loss of sight, may be caused by UV radiation in people who have had the lens of an eye (the crystalline) removed, for example due to cataracts. This can be prevented with UV-absorbing lens implants or eyeglasses. In the normal eye, the retina is protected from UV injury because the crystalline filters out UV.

Chronic Effects

Skin Cancer: Excessive exposure to UV radiation over many years has been shown to increase a person's risk of developing skin cancer. The most common types of skin cancer, basal cell carcinoma and Squamous cell carcinoma, are not usually life-threatening if treated early. Malignant melanoma is

a rarer but much more dangerous form of skin cancer. A person's chance of getting skin cancer increases with the lifetime UV dose, that is, the total UV radiation he or she has received. The risk of getting malignant melanoma also increases with the number of blistering sunburns experienced during childhood. An alarming increase in skin cancer rates in Canada over the last few years has been attributed to the excessive sun-tanning habits that became popular in the 1950s. Lighter-complexioned people are more likely to develop UV-related skin cancers than darker-complexioned people, so they should be particularly careful to minimize their UV exposure.

Photo aging: This is the premature aging of the skin caused by chronic exposure to UV radiation. The resulting changes in the skin include excessive wrinkling, dark spots, loss of elasticity and a leathery appearance.

Senile Cataracts: A senile cataract is a clouding of the lens of the eye in older people, often impairing vision and eventually requiring surgery. Long-term UV exposure has been shown to be an important factor in the development of this disease.

Effects of UV radiation on the skin:

Short-term exposure to UV radiation causes reddening of the skin, sunburn and swelling, which may be very severe. In some people this sunburn is followed by increased production of melanin, and is recognized as a suntan. Tanning is a sign that damaged skin is attempting to protect itself from further harm. A suntan is not an indication of good health and offers only minimal protection against further exposure. The most serious long-term effect of UV radiation particularly for white skinned populations is the induction of skin cancer. The non-melanoma skin cancers (NMSCs) are basal cell carcinomas and Squamous cell carcinomas. They are relatively common in white people, although they are rarely fatal. They occur most frequently on sun-exposed areas of the body such as the face and hands and show an increasing incidence with increasing age. The findings from epidemiological studies indicate that the risk of both of these skin cancers can be related to cumulative UV radiation exposure, although the evidence is stronger for Squamous cell carcinomas. Malignant melanoma is the main cause of skin cancer death, although its incidence is less than NMSC. A higher incidence is found in people with large numbers of naevi (moles), those with a fair skin, red or blond hair and those with a tendency to freckle, to sunburn and not to tan on sun exposure. Both acute burning episodes of sun exposure and chronic occupational and recreational exposure may contribute to the risk of malignant melanoma. Chronic exposure to solar radiation also causes photo ageing of the skin and actinic keratoses. Photo ageing is characterized by a leathery, wrinkled appearance and loss of skin elasticity while actinic keratoses are a known precursor to Squamous cell carcinomas.

Effects of UVR on the eyes:

Responses of the human eye to acute overexposure of UV radiation include photokeratitis and photo conjunctivitis (inflammation of the cornea and the conjunctiva, respectively), more commonly known as snow blindness or welder's flash. Symptoms range from mild irritation to sever pain and possibly irreversible damage. There is evidence that chronic exposure to intense levels of solar radiation is a contributory factor in the development of age-related macular degeneration of the retina and cortical cataracts, both a cause of blindness.

4. Conclusions

There are a number of measures that can be put in place to control risks in the workplace. This would involve:

1. Engineering controls, for outdoor workers this would include the provision of shade cover or canopies. In the context of non-solar sources of UV radiation, suitable engineering controls measures would include opaque barriers, UV radiation blocking filters and door interlocking power supplies.
2. Administrative controls, for outdoor workers this would include rescheduling outdoor work programs where possible to be performed outside the peak UV radiation period (2 hours either side of solar noon), moving where possible the jobs indoors or to shady areas or rotating workers between indoor and outdoor tasks to lessen each employees total UV exposure. In the context of non-solar sources of UV radiation, administrative controls would include warning signs, keeping staff at a safe distance and limiting the time during which UV radiation sources are switched on. Training of supervisors and employees should be undertaken for workers exposed to solar and non-solar sources of radiation.
3. Personal protective equipment (PPE), if necessary, outdoor workers should be provided with protective clothing that is loose fitting, made of close weave fabric and provides protection to the neck and preferably to the lower arms and legs. Hats should shade the face, neck and ears and have a wide brim (8-10cm). If hard hats have to be worn, they should have attached neck flaps. Sunscreen should be a minimum SPF 15, and be broad-spectrum, that is block UVA and UVB, and be applied regularly and liberally to exposed skin. Sunglasses should be close fitting, of a wrap-round design and block at least 99% UV radiation. In the context of non-solar sources of UV radiation, arc welders in particular need to be provided with purpose-specific protective equipment.
4. Training should be offered to all employees exposed to medium to very high levels (see table 1) of UV radiation at work so that they understand the risks and what is expected of them while at the workplace.

5. Employers can also collaborate with occupational safety and health organizations to adapt or modify existing workplace wellness policies and training to include sun-safety information, such as employee programs focused on avoiding heat illness, because many sun-safety practices also help to prevent heat-related illnesses. Additionally, trainings can teach workers how to recognize the signs and symptoms of overexposure to UV radiation, and employers can encourage them to be role models for positive routine behavioral changes in their occupational, community, and family systems. One study found that Hispanic men aged 18 to 44 reported being more likely to talk to their family members and peers about skin cancer risk and prevention when they worked in outdoor jobs where employers encouraged use of sunscreen or protective clothing.

6. Long-sleeved shirts and pants made from closely-knit materials in darker colors offer the best UV protection.

7. Wearing sunscreen is an important part of protecting construction workers for UV rays. Sunscreen should be applied to all parts of exposed skin at least 20 minutes before going outdoors.

8. 85% of the daily UV exposure is usually from 11AM to 3PMs, it could be advised to the workers and labours not to spend lunch break outside in the hot sunny mainly to drastically reduce the UV exposure. While working in direct sunlight when UV levels are high, outdoor workers should:

- Limit the amount of time you work outdoors in the sun from 11 a.m. to 4 p.m.
- Seek shade as much as possible, especially during breaks
- Wear a wide brim hat (8 cm or more); attach a back flap and visor to a construction helmet
- Wear tightly woven clothing covering as much of the body as is practicable
- Apply broad spectrum sunscreen with a Sun Protection Factor (SPF) of 30 or higher on exposed skin. Reapply at noon and often if perspiring heavily
- Apply a broad spectrum lip balm with a SPF of 30 or higher

REFERENCES

[1] American National Standards Institute Z80.3–2001 “Nonprescription Sunglasses and Fashion Eyewear — Requirements” 1819 L Street, NW, 6th Floor Washington, DC, 20036.

[2] American National Standard Z136.1–2007 for Safe Use of Lasers. American National Standards Institute (ANSI). 11 West 42nd St., New York NY 10036.

[3] Ontario, Ministry of Labour Training and Skills Development, 1994.

[4] Subash Thanappan, Environmental Impact Assessment EIA – A Pivotal Tool for Sustainable Development, Lambert Academic Publishing, Germany, 2021.

[5] Blum HF. On the mechanism of cancer induction by ultraviolet radiation. IV. The size of the replicated unit. J Natl Cancer Inst. 1959;23:343–350.

[6] Bodiwala D, Luscombe CJ, Liu S, et al. Prostate cancer risk and exposure to ultraviolet radiation: further support for the protective effect of sunlight. Cancer Lett. 2003;192:145–149.

[7] Grady H, Blum HF, Kirby-Smith JS. Types of tumor induced by ultraviolet radiation and factors influencing their relative incidence. J Natl Cancer Inst. 1943;3:371–378.

[8] https://www.who.int/uv/publications/en/occupational_risk.pdf?ua=1