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Occupational Skin Diseases Caused by Solar Radiation

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A B S T R A C T

UV radiation is present in sunlight and can be emitted from numerous artificial sources. Outdoor workers are exposed to sunlight in a wide variety of occupations like sailors, fishers, construction workers, farmers, and other. Presented are the skin diseases caused by sunlight exposure. They may be of little medical importance such as stigmata or create problems like photoaging, skin carcinoma, melanoma, phototoxic and photoallergic reactions. Shown are briefly data on skin cancer in the Rijeka region in outdoor occupations, the legislation and necessity for prevention. Psoriatic patients need particular caution because they are exposed to UVR, tars, and immunosuppressive drugs during the treatment.

***Key words**: Outdoor work, photoaging, skin cancer, melanoma, psoriasis*

Introduction

Ultraviolet radiations (UVR) are non-ionizing rays and represent part of the electromagnetic radiation spectrum between visible light and X-rays. Like other optical radiations UVR can be reflected, scattered, transmitted or absorbed. According international convention UVR we can classify them on the basis of the wavelength into: long-wave UVA (320–400 nm), medium wave UVB (290–320 nm), and short wave UVC (200–290 nm)[1]. Each type of UVR has its characteristics: UVA rays is the most abundant component of solar UVR and it make up about 95% of UV rays that reach the earth's surface. Their energy is relatively small; however, they penetrate into the depth of the dermis, and pass the window glass and fabrics. In skin pathology they are of significance inducing a quick browning, causing aging of the skin and phototoxic and photoallergic reactions[2]. UVB rays make up 5% of solar photons reaching the earth's surface. They cause skin erythema, inflammation probably due to the releasing of mediators such as prostaglandins (E2, F2), histamine, and cytokines[3]. Acting directly on DNA they are mutagenic and can cause precancerous lesions and skin cancer and melanoma. UVC rays are the most energetic but solar UVC are absorbed by ozone in the stratosphere. They are germicidal[2].

In humans UVR effect, after absorption by chromophores like melanin, DNA, proteins, can be beneficial (photosynthesis of vitamin D, influence on mood) or cause numerous skin diseases, eyes diseases and local and systemic suppression of the cellular immune response. In some professions the acute or chronic exposure to UVR of solar origin (outdoor work) or from artificial sources (indoor work), in spite of the cutaneous defenses (melanin synthesized by melanocytes, stratum corneum, urocanic acid, DNA repair) can lead to occupational diseases[4,5]. The goal of this paper is to give a survey of the skin diseases caused by occupational exposure to solar UVR in outdoor workers, and briefly analyze their influence on skin cancer in Rijeka region.

Photodermatoses Caused by Outdoor Exposition to UVR

It is well known that prolonged sun exposure causes numerous skin diseases. The occupational exposure to solar UV radiation occurs in outdoor workers, and in indoor workers by artificial sources of UV. While some of these diseases are of little medical importance like in the

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case of pigmentations, telangiectasias or other stigmata, which don't impair the working capacity, some others cause serious concern[6]. The UVR can provoke skin alterations alone, or in combination with endogenous (porphyrins) or exogenous photosensitizing substances (furocumarins, cosmetics, dyes, tars oils)[6,7].

Today, there is a concern regard the increase of UV radiation from solar origin resulting from depletion of the atmosphere ozone[8]. The exposition to UV typically causes skin lesions in photoexposed areas: face, neck, décolleté, forearms, and the back of the hands. Prolonged exposure to UV rays cause photoaging, actinic keratoses, cheilitis actinica and more important malignant tumors such as basal cell carcinoma, keratoacanthoma, squamous cell carcinoma, and melanoma[9]. About 5–10% of the adult population is working outdoor in Europe[9]. In these workers, especially with phototype I and II after Fitzpatrick, the exposure to UV rays can cause solar dermatitis, actinic cheilitis, and with time also cutaneous photoaging and skin tumors. Photoaging or extrinsic aging is characterized by the development of wrinkling, deep furrows, yellow discoloration, coarness, irregular pigmentation (lentigo actinica, guttate hypomelanosis), telangiectasias in the sun exposed areas[9]. Sometimes, translucent, dome shaped papule develop on the face (psudomilium colloidale), or one can see brown-black non-inflammatory papule and comedones periorbitaly (s. Favre-Racouchot). Some studies found that 2.5% of agricultural workers presented these lesions, whilst they were not present in a control group[10]. Most of these alterations are caused by UVA that generate reactive oxygen species (ROS) and penetrate deeper in the skin causing change not only in the epidermis (pigmentation) but even in the dermis (degeneration of collagen and elastic fibers)[11]. Studies in vivo in animal and humans have demonstrated that exposure of the skin to UVR provoke a decrease in pro colllagen-1 production and activation of transcription factors (AP-1, NFkB) leading to an increase of matrix metalloproteinases (MMPs), produced by keratinocytes and fibroblasts, like collagenase (MMP-1), gelatinase (MMP-3) and stromelysin (MMP-9), which results in collagen degradation[11]. New studies by Berenburg and al. demonstrate that in the photoaging after UVR exposure a role have also the damage of the mitochondrial DNA induced by ROS, because it have a little repair capacity[12]. In outdoor work frequently cause cancer in sailors, fishermen, watermen, farmers, asphalters, building workers, and others[6,9] (Table 1).

In some workers contact with plants or dyes can cause phototoxic and photoallergic reactions. Phototoxic dermatitis (photophytodermatitis) is a non immunologic reaction which can develop in anybody given sufficient phototoxic substance and sun exposure. They are common, characterized with erythema, blistering, pain, and then long lasting pigmentation. Phototoxic dermatitis is mostly caused by contact with plants that contain photosensitisers such as furocumarins. Furocumarins can be linear i.e. psoralens (5-MOP, 8-MOP), or angular like angelicin and pimpinellin. They bind to the nuclear DNA and cause cellular damage[13]. This can happen in florists, horticulturists, gardeners, farmers, loggers, food handlers and others. The plants causing phototoxic reaction are of the family apiaceae (formerly umbelliferae): celery (*Apium graveolens*), false Bishop's weed (Ammi majus), parsnip (*Pastinaca sativa*), parsley (*Petroselinum crispum*) cow parsnip (*Heracleum sphondylium*) that cause trimmer dermatitis, angelica. Members of other families of plants also can cause phototoxic reactions, so in the family rutaceae – rue (*Ruta graveolens*) and citrus species, and among the leguminosae Myroxylon balsamum and Psoralea corylifolia. Furthermore phototoxic reactions can induce figs (*Ficus carica*)[14–17].

TABLE 1
OUTDOOR WORKERS POTENTIALLY EXPOSED TO UV RADIATION

Fishermen	Farmers
Sailors	Gardeners
Watermen	Horticultural workers
Construction workers	Oilfield workers
Road workers	Pipeline workers
Brick masons	Military personnel
Postal carriers	Ski instructors
Policemen	Surfers

Interestingly celery infected with the fungus Sclerotina sclerotium contain more furocumarins and is more harmful than the uninfected plant. Sometimes the use of some drugs (diuretics, non-steroid anti inflammatory drugs, phenotiazines) oils, tars can also induce sensitization to solar UVZ[6,18].

Occupational Cancer in Outdoor Workers

The most serious long-term effect of exposure to natural or artificial UV light, particularly in light skinned, poorly pigmented people, is the induction of precancerous lesions and malignant skin tumors. At the end of the XIX century Unna associated the degenerative changes in epidermis and dermis, found in the sun exposed area of the skin, in sailors with the development of cancer[19]. In the same time Enziere observed that cancer of the lower lip was more common in peasants working outdoor than in people of the town, and shortly thereafter Dubreilh stated precancerous keratoses and skin cancer occurred more commonly in outdoor workers[20,21]. Later it was found that UVR induce mutation in the DNA of cells, particularly on pyrimidine bases (thymine and cytosine) forming a four-membered cyclobutane ring or 6,4 photoproducts. There are C-T or CC-TT transitions. Most of these DNA damage are quickly enzymatically corrected (nucleotide excision repair)[22,23]. These mutations are present in suppressor genes such p53 or PTCH, and if are not corrected, their product can't control the cell cycle and favor the cells' growth, proliferation and survival. Before 30 years Kripke and al. demonstrated in

irradiated mice the importance of the immune response in the carcinogenesis. So the clinical epidemiological data of skin cancer were confirmed and the cellular and molecular mechanism of UVR carcinogenesis better understand[24].

TABLE 2
SKIN CANCER AND OCCUPATION IN RIJEKA REGION

	Mohar N. 1976 %	Stašić et al. 1998 %
Fishermen/Sailors	28.3	9.5
Other outdoor workers	18.7	11.8
Farmers	10.2	9.4
Housewives	35.4	11.8
Other	7.5	56.9

Epidemiologic studies assessed the relevance of UVR in the development of basal cell cancer is related to cumulative sun exposure and also to intermittent exposure (on the trunk), while squamous cell carcinoma is more related to lifelong cumulative exposure. In the case of melanoma it seems to be associated with intense intermittent UVR exposure, and is located often on the back in males and on the lower legs in females[25,9]. Studies from Australia and USA demonstrated the importance of outdoor work for the development of basalioma, squamous skin cancer and melanoma; whilst data from Europe are contrasting[4,25,26]. So in Finland and Sweden, there were no association of outdoor work in farmers, forestry workers and construction workers and skin cancer. An explanation could be that in these countries the cumulative exposure is relatively low[27,28]. Probably also the different health systems and legislation in the European countries makes it difficult to compare the data[26]. Recent studies in gardeners demonstrated the importance of sun exposure ours, the time of the day, natural shade in the work place, and indoor breaks during peak ambient UVR for the total UVR dose received[29]. In Croatia, studies by Jakac the pioneer in occupational dermatology, and by Mohar, demonstrated that skin cancers are frequent in the Rijeka region in fishers, sailors, but also in construction workers, ship workers and farmers[30,31]. It was also found that the cancer developed mostly in fair skinned worker. In more recent years the frequency of skin cancer in fishers and sailors is dropping (see Table 2)[32]. This can be explained with the lower number of workers in these professions, and they begin to work later. Fisher work today mostly by night, and don't use tars, and perhaps use sunscreens. The high number of cancer in housewives can be explained by the fact they frequently work outdoor in their vegetable gardens or truck farms. Some reports outline the importance of sun exposure as a health risk in professional cyclist, mountain guides, policemen[33]. So Moehrle et al. demonstrated in mountain guides carrying dosimeters the day dose of UV exceeded the limits 6 and more folds and this is suggestive for an increased risk of skin tumors[33]. It is not easy to obtain the verification that the cancer is occupational because there is a long period between the exposure and its development. Particular caution need psoriatic patients because they are exposed to phototherapy (UVB, PUVA, heliomarinetherapy) tars, and immunosuppressive drugs during the treatment, and so are at high risk for development of cancer. In conclusion there is a necessity to prevent the excessive exposure to sunlight in outdoor workers, because the exposure to solar UVR can lead to various skin diseases. For this reason it is to purpose legislation measure, educate the workers to undertake adequate protection measures like wearing appropriate clothing, hats, eye protectors, seek shade, and use sunscreens.

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PROFESIONALNE BOLESTI KOŽE PROUZROKOVANE SUNČEVIM ZRAKAMA

S A Ž E T A K

UV zrake nazočne su u sunčevom svjetlu što dopire do zemlje, ali nastati mogu i iz brojnih umjetnih izvora. Radnici različitih zanimanja kao što su pomorci, ribari, građevinari, poljodjelci i drugi koji rade na otvorenom izloženi su UV zrakama. Prikazane su bolesti i stanja koja mogu nastati uslijed djelovanja UV zraka na kožu pri radu na otvorenom. Ponekad to su neznačajne promjene kao stigmata, ali katkad mogu biti značajne kao što su fotostarenje, rak kože, melanom, fototoksične i fotoalergijske reakcije. Ukratko su iznijeti stariji i noviji podaci o raku kože po zanimanjima u Riječkoj regiji, problemi legislature i potrebe prevencije. Posebnu pažnju zaslužuju bolesnici s psorijazom koji su još više izloženi UV zrakama, katranima i imunosupresivima tijekom liječenja.