Mini Review

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2019.20.003501

Outdoor Workers Exposed to Solar Radiation: A Spotlight on Immunomodulation

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ARTICLE INFO

Received: August 13, 2019

Published: August 21, 2019

Citation: Carlo Grandi, Maria Concetta D'Ovidio. Outdoor Workers Exposed to Solar Radiation: A Spotlight on Immunomodulation. Biomed J Sci & Tech Res 20(5)-2019. BJSTR. MS.ID.003501.

ABSTRACT

In outdoor occupational settings workers are exposed to several agents including solar radiation. The last one may induce short and long-term effects on both skin and eye and may exert a local (skin) as well as a systemic suppression of the immune response. A careful assessment of health risks due to exposure to solar radiation in outdoor workers is requested and an appropriate health surveillance has to be implemented, paying great attention to the study of the immune profile. Moreover, the implementation of preventive and protective measures, including education and training, is of paramount importance.

Keywords: Solar Radiation; Outdoor Workers; Immune System; Occupational Health

Introduction

Outdoor workers may be exposed to several physical, chemical and biological agents, which, by alone or in combination, may induce adverse health effects or exacerbate pre-existing clinical conditions. A lot of working activities are conducted outdoor, especially those related to agriculture/forestry, construction, fishing and maintenance of outdoor infrastructures [1]. Solar Radiation (SR) is a ubiquitous risk factor for outdoor workers. At ground level SR composition includes about 50% of infrared radiation, 45% of visible radiation and only 5% of Ultraviolet (UV) radiation.

The last component, although present in small amounts, is the most critical for human health, being associated with several acute and chronic effects [2,3]. In Europe, about 15 million workers are employed in outdoor activities and, although exposure to SR may cause serious adverse health effects on skin and eye [3-5], the risk is underestimated. The immunosuppressive effect of SR is due to the UV component and represents another critical feature in this regard. Local or systemic suppression of the immune system by UV radiation may, for instance, inhibit cell-mediated immune responses [6,7] and re-activate latent infections such as those due to herpes simplex and human papilloma viruses [8-10]. A key question is the vaccination's effectiveness, as a reduction of the immune response to vaccines following UV radiation exposure was shown in experimental animal models [7]. Local (skin) and systemic immunosuppressive effects of solar UV radiation may conversely result into beneficial effects, for instance inhibiting autoimmune reactions [11]. Vitamin D activation is one of the beneficial effects of exposure to solar UV radiation, but other beneficial health effects due to SR are recognized or speculated, including circadian rhythms regulation, promotion of general wellbeing, blood pressure lowering and reduction of the risk for some internal cancers [1,12].

Balancing potential detrimental and beneficial health effects of exposure to SR for outdoor workers at individual level is likely to go beyond the present scientific knowledge, but will be essential for an appropriate risk management, i.e. for a suitable implementation of both preventive and protective measures. Immune system modulation by SR plays a key role in this regard.

Discussion

On the basis of the experimental and epidemiological evidence concerning effects on skin and eye as well as immunomediated effects of SR [1,7-11,13], for an appropriate risk assessment and management in the outdoor activities it is crucial to determine the level of exposure to SR of the individual worker, types and levels of co-exposure to other physical, chemical and biological agents as well as phototype, health features and immunological status of the worker. Exposure to SR, specifically to the UV component, is largely dependent on time of day, season, latitude, altitude, atmospheric pollution, time spent in outdoor activities, environmental albedo and shieldings, use of individual protective

means [14,15]. Preventive and protective measures imply the assessment of individual exposure to solar UV radiation (it should also be important to assess long term cumulative exposure) and include compliance with exposure limits (when feasible), reduction of overall exposure duration, avoidance of sun in the central hours (if possible), use of sunscreens, sunglasses and appropriate clothing, health surveillance [16,17]. However, their combination may be different in different exposure situations and for different individual susceptibilities. Moreover, if personal protection is requested against multiple risk factors, the pertinent protective measures have to be harmonized.

We suggest more attention to the study of the immune profile of the individual worker during health surveillance, given the multifunctional role of the immune system and the immunomodulatory properties of several physical, chemical and biological agents (including SR) present in outdoor settings. We also remark the importance of information and training not only as a part of preventive measures against occupational hazards in a strict sense, but as an essential step to promote healthy lifestyles. A summary view of the key points discussed in this paper and some additional indications are given in Figure 1.

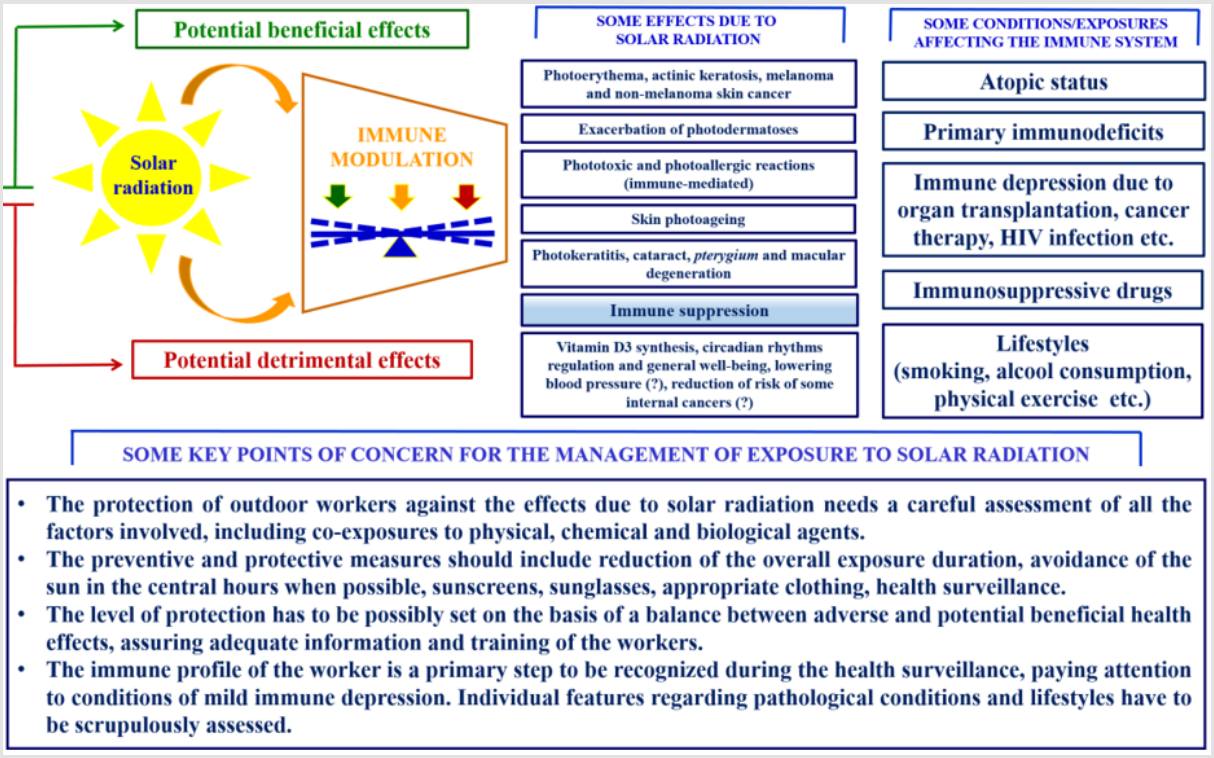

Figure 1: Features related to solar radiation exposure in outdoor workers (partially inspired by: Grandi C, D'Ovidio MC (2018) The interplay between solar radiation, climate change and immunotoxicants in relation to immune response modulation: A concern for outdoor workers' health. Am J Health Res 6:138-149).

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ISSN: 2574-1241

DOI: 10.26717/BJSTR.2019.20.003501

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