Skin cancer in outdoor workers exposed to solar radiation: a largely underreported occupational disease in Italy

F. Gobba,1 A. Modenese,1, * S.M. John2

1Department of Biomedical, Metabolic and Neural Sciences, Chair of Occupational Medicine, University of Modena & Reggio Emilia, Modena, Italy
2Department of Dermatology, Environmental Medicine, Health Theory, Institute for Interdisciplinary Dermatological Prevention and Rehabilitation (iDerm), Lower-Saxonian Institute of Occupational Dermatology (NIB), University of Osnabrueck, Osnabrueck, Germany

*Correspondence: A. Modenese. E-mails: alberto.modenese@unimore.it; albertomodenese1@gmail.com.

Abstract

Background Solar UV radiation (sUVR) is one of the main carcinogen exposures in occupational settings, and UV-induced skin cancers are the most frequent tumours in fair-skinned individuals worldwide.

Objectives According to this premise, we should expect a high number of occupational skin cancers reported to the national workers' compensation authorities each year, also considering that the incidence of skin cancers has been constantly increased in recent years

Methods We examined the data on reported non-melanoma skin cancers (NMSC) and actinic keratoses (AK) to the Italian National Workers Compensation Authority (INAIL) from 2012 to 2017, and we compared the number of reported skin cancers for outdoor workers with the expected numbers, obtained from currently available NMSC incidence rates for the Italian population applied to the occupational sUVR-exposed workers estimated with the CAREX methodology in Italy in 2005.

Results The cases of NMSC reported each year to INAIL in Italy are 34 per year on average, while for AK the mean number of reported cases is of only 15/year. We estimated a number of expected NMSC cases in Italy for solar UV-exposed workers ranging between 432 and 983, representing a proportion between reported vs. expected skin cancers of only 3.5–6.2%.

Conclusions Our study clearly shows that occupational skin cancers in Italy are largely underreported, and, accordingly, urgent initiatives should be taken to raise appropriate awareness to the problem of occupational sUVR-induced skin cancers, so that adequate preventive measures can be implemented rapidly.

Keywords: solar UV radiation, outdoor work, occupational skin cancer, occupational disease, non-melanoma skin cancer, keratinocytes carcinoma.

Received: 5 March 2019; Accepted: 13 June 2019

Conflict of interest

The authors declare no conflicts of interest

Funding

No research funds were received to carry out this research.

Introduction

Solar radiation exposure, mainly related to the ultraviolet (UV) component, is one of the most widespread occupational risks in Italy: according to the CAREX database, workers regularly exposed to solar UV radiation (sUVR) for more than the 75% of their working day are more than 700 000.1 Nevertheless, this evaluation possibly underestimates the real number of the sUVR-exposed workers, as various studies suggest that a large part of workers engaged, e.g. in agriculture and forestry, fishing, construction and mining (more than 2 500 000 in Italy) are exposed to sUVR levels largely exceeding the threshold limits2,3 valid for both natural and artificial UVR proposed by the American Conference of Governmental Industrial Hygienists (ACGIH),4 while the International Commission on Non-Ionizing Radiation Protection (ICNIRP)5 proposes the same limits only for artificial UVR exposure.

Solar UV can induce several adverse health effects in outdoor workers, mainly to the eye3,5,6 and the skin, including skin
cancers:7–9 solar radiation and UV are both classified among Group 1 carcinogens by the International Agency for Research on Cancer (IARC).7 In outdoor workers, the most relevant types of skin cancers related causally almost exclusively to sUVR exposure are basal cell carcinoma (BCC, [ICD11: 2C32]) and squamous cell carcinoma (SCC, [ICD11: 2C31]), including actinic keratoses as in situ SCC (Actinic intraepidermal squamous cell carcinoma; ICD11: 2E64.01)].10,11 These cancers are also the most frequent cancers in Caucasians in the general population;12 they are still most frequently referred to as melanoma skin cancers (NMSC), even though, more recently, the more exact term keratinocyte carcinoma was suggested.13 Cutaneous malignant melanoma (MM) is also believed to be correlated with UVR exposure, but in particular with intermittent UVR exposure, especially in early life, rather than with cumulative exposure, and the causal relation with occupational sUVR is considered less conclusive.14 Nevertheless, it has to be noted that recent studies suggest a possible association also for specific subtypes of MM, such as lentigo maligna melanoma (LMM), with chronic lifetime sun damage, while cumulative UVR exposure in some studies is claimed not to be a significant risk factor for superficial spreading melanoma (SSM) and nodular melanoma (NM).15

A problem of NMSC in epidemiology is that, for various reasons, cancer registries worldwide often do not include data on these cancers, or the quality of data is controversial and data are frequently incomplete and/or cancers are underreported, resulting in a vast underestimation of their real incidence.16 In order to deal with this issue, recently, in Europe it has been proposed that in Cancer Registries agendas a special focus on cancers caused by identifiable risk factors that are amenable to preventive actions, e.g. occupational exposures and ultraviolet-related skin cancers, should be considered.17

According to data provided by the Italian Association of Medical Oncology (Associazione Italiana di Medicina Medica – AIOM), the Italian Association of Cancer Registries (Associazione Italiana dei Registri Tumori – AIRTUM) and the Italian National Institute of Health (Istituto Superiore di Sanità – ISS), in 2018 the expected new cases of BCC and SCC in Italy were, respectively, 64 000 and 19 000.18 In another study, performed in Trentino region, Northern Italy, Boi et al. calculated a standardized annual incidence of 61.5 per 100 000 (CI 58.5–64.5) for BCC and of 16.3 per 100 000 (CI 14.9–17.7) for SCC,19 but it has also to be considered that, in Northern Italy, the prevalence of NMSC is lower than in the south, and that, according to some studies, the incidence of these cancers is constantly increasing.20,21

Epidemiologically, the causal relation between occupational sUVR exposure and NMCS is now firmly established;10,11,22–24 however, only a few European countries recognize these cancers as occupational diseases.13,22 In Italy, NMSC, and also actinic keratoses (AK), are included in the list of occupational diseases that can be compensated in workers exposed to UVR and to sUVR by the Italian Workers’ Compensation Authority (Istituto Nazionale per l’Assicurazione contro gli Infortuni sul Lavoro – INAIL), while MM is not included in that list.25 Furthermore, according to the Italian legislation, the reporting of NMSC, and AK, in exposed workers is legally required.26 Considering the above-mentioned high incidence of NMSC, and the large number of workers exposed to sUVR, we should expect that these cancers are among the most frequent occupational cancers reported to INAIL.

We decided to test this hypothesis. Accordingly, we estimated the number of occupational NMSC expected in Italian workers according to the prevalence in the general population and the number of outdoor workers provided with the CAREX data for Italy,1 and we compared these estimates with the number of cases of sUVR-induced occupational skin cancers reported to INAIL during the period 2012–2017.

Materials and methods
We accessed the statistical database (‘Banca Dati Statistica’) of the Italian Workers’ Compensation Authority (INAIL)27 in the period 2012–2017. In this INAIL database, data are coded according to two broad occupational sectors: ‘Agriculture’ and ‘Industry and Services’; we have considered both. Within the ‘Industry and Services’ sector, the ‘Diseases caused by UV including solar radiation’ (code: 84) were selected, while for the ‘Agriculture’ sector we selected the ‘Diseases caused by UV including solar radiation’ (code 19). For the two groups of diseases in both sectors, we extracted the number of ‘actinic keratosis’ (code L57.0) and of ‘Epiteliomi cutanei delle sedi esterne’ (Skin epitheliomas of the exposed areas) (code C44) reported to the INAIL during the considered period based on the Italian legislation.25,26 Unfortunately in the public area of the INAIL statistical database, the number of AK and skin epitheliomas (i.e. non-melanoma skin cancer, NMSC) is reported, but no other information on workers or on the diseases’ characteristics is available.

The number of new NMSC cases, and also separately of BCC and SCC, expected in the Italian general population in 2018 was obtained from the Italian cancer registries data,18 while the Italian inhabitants in the same year from the Italian National Institute of Statistic (ISTAT),28 then, the crude annual incidence rate was calculated accordingly:

\[
\text{Crude incidence of NMSC/BCC/SCC} = \frac{\text{Expected new cases/Italian general population}}{\text{All NMSC: 83 000/ 60 483 973 = 1.4 cases/1000 inhabitants}}
\]

\[
\text{BCC: 64 000/ 60 483 973 = 1.1 cases/1000 inhabitants}}
\]

\[
\text{SCC: 19 000/ 60 483 973 = 0.3 cases/1000 inhabitants}}
\]

Another estimate of the incidence of BCC and SCC in Italy was also available from the study of Boi et al. performed in 19 in the Northern part of the country: the standardized incidence rates reported in this study (61.5/100 000 and 16.3/100 000 per year for BCC and SCC respectively) were additionally considered.

To estimate the number of the occupational skin cancers expected yearly in Italy, we postulated an incidence in workers...
similar to that of the general population; accordingly, the above-mentioned year/incidence rates were applied to the number of workers exposed to sUVR reported by the Italian CAREX (CARcinogen EXposure) study database.1

As INAIL data on the reported occupational skin cancers are coded according to ‘Agriculture’ and ‘Industry and Services’ sectors, we have also separately calculated the number of expected cases in these sectors; according to CAREX, the number of workers engaged is 390 000 in agriculture and 312 100 in the other sUVR-exposed activities (other outdoor workers), respectively.

Data used in this study are from published reports, all of which had been approved by the competent ethics committees; accordingly, approval from an ethics committee for this study was not needed, nor sought.

**Results**

The cases of NMSC and of AK reported each year to INAIL during the period 2012–2017 are presented in Figure 1: the total number of NMSC is 205, and the range of the number of cases reported per year is 25–47, with an almost twofold increase during the whole period; for AK, the total number of reported diseases in the period is 89, and the range of the number of cases reported per year is 14–24, but without any clearly increasing trend (Fig. 1).

Considering data separately from ‘Agriculture’ vs. ‘Industry and Service’ sectors (Fig. 2), the number of reported NMSC during the whole period (2012–17) is higher in agriculture, almost double compared with the other sectors: 139 cases vs. 66, respectively. Similar considerations are also valid for AK.

Regarding the expected cases calculated according to the Italian cancer registries’ data, the resulting number of annually expected NMSC in Italy for sUVR-exposed workers is 772 cases of BCC and 211 cases of SCC (Table 1). If we compare the mean number of occupational NMSC related to solar UV reported per year to INAIL in the period 2012–2017 and the expected cases, the ratio is 3.5% in the whole group of workers; considering the subgroups separately, the proportion is slightly higher for the agricultural workers compared with the other group: 4.2 vs. 2.5 (Table 1).

The number of expected cases of BCC and SCC is lower using the northern Italian data of Boi et al.19 but even in this case there is more than one order of magnitude of difference between reported and expected cases (Table 1).

For AK, the number is expectedly higher than SCC, but no prevalence data were available from Italian cancer registries.

**Discussion**

The mean number of occupational NMSC reported to Italian workers’ compensation authority (INAIL) in the period 2012–2017 is quite small, 34 cases/year, of which 23 in the agricultural sector and 11 in the other work sectors, while the cases expected, estimated by applying the crude incidence of NMSC in the Italian general population to the number of sUVR-exposed workers indicated by CAREX are 983 (Table 1): the ratio reported/expected is in the order of 3%.

This difference is dramatic, and we are confident that it is not related to an overestimation of the expected cases, also because the vast majority of the farmers and construction workers in Italy are usually males, and in male subjects, NMSC incidence is higher compared with females. On the contrary, the estimated number of expected occupational NMSC possibly will be lower than the real number. In fact, occupational sUVR is the main risk factor for NMSC in workers, and according to recent studies

---

**Figure 1** Number of non-melanoma skin cancers and actinic keratoses induced by occupational exposure to UV radiation, mainly comprising solar UV*, reported to INAIL in Italy in the period 2012–2017 (all working sectors considered) [*= for further details see Materials and methods section]
of Schmitt et al.23,24 the risk in exposed workers is probably between 1.5 and 2.5 compared with the non-exposed; as we have applied to the outdoor workers the incidence rates of the general population, an overestimation of the incidence is unlikely.

Furthermore, the number of exposed workers was derived from the CAREX database, but recent studies on sUVR occupational exposure suggest a high exposure in the large majority of the outdoor workers3 that exceeds the numbers proposed by CAREX; accordingly, again an overestimation of the number of exposed workers seems highly unlikely.

For comparison, in a recent study in Canada, Mofidi et al.29 estimated that 5.3% of all BCC and 9.3% of SCC are attributable to occupational sUVR exposure; using these estimations, the expected number of occupational BCC and SCC in Italy rises to 3392 and 1748 cases per year, respectively, compared with 711 and 211 (Table 1).

Using the data from Boi et al.19 the number of expected skin cancer is somewhat lower compared with the numbers estimated applying the Italian cancer registry 2018 incidence rates18 (Table 1), but this difference is coherent with the known north–south gradient of NMSC in Italy, likely related to UVR exposure: the study of Boi et al. was performed in the northern part of Italy, and differences in incidence in the order of more than 30% compared with the south have been reported.18 Furthermore, the study was performed more than 15 years ago, and the incidence of NMSC in Italy, as well as in most other countries, has significantly increased.20,21 Furthermore, in Trentino region a part of the population may spend a significant amount of time in altitudes, and as reported by Lichte et al. in the adjacent region of Austria, an increased prevalence of precancerous skin lesions and skin cancers should be expected in a part of the population working in the mountains.30

To date, few studies approach the problem of the (under) reporting of occupational NMSC to the national compensation authorities; this is not really surprising, especially considering that, currently, very few European countries recognize occupational sUVR-related skin cancer as an occupational disease.12 The significant underreporting observed in this study is coherent with recent data from Denmark31,32 and other countries,12 as previously highlighted.22 In order to reduce current overall negligence, with the ICD 11, released on 18 June 2018, WHO offers for the first time a post-coordination mechanism for occupational skin cancers. Additionally, in an unprecedented effort, WHO is currently conducting together with the International Labour Organisation (ILO) a global disease burden assessment of occupational sUVR-inflicted skin cancers.9 Many of the reasons for the gross underreporting of occupational skin cancers may be the same as extensively discussed recently in a large survey regarding the lack of notifications of work-related contact dermatitis in various south and east European countries, including bureaucratic hurdles, time-consuming forms, high workloads and no availability of financial incentives for doctors and patients.33 Furthermore, at least in Italy, as it happens for other occupational diseases, usually the majority of cases are reported by occupational physicians, but skin cancers often appear when persons are in their retirement age, so that they have no access to the workers’ health surveillance performed by these doctors.12

Other possible explanations of this large underreporting may be related to the roles and relations of the employers and employees in the companies, and are a common problem for all the occupational diseases. Among the suggested reasons of the underreporting, there are the possible legal and economic consequences for the companies when an occupational disease is recognized; also the increased job insecurity perceived in the workforce plays a relevant role, as it has been shown that precarious workers are less likely to report

---

**Table 1** Occupational NMSC related to solar UV exposure (CAREX Italian exposure data) expected in Italy per year according to two different incidence estimates and comparison with the mean annual number of NMSC cases reported to INAIL in the period 2012–17

|                                | Number of expected occupational solar UV-induced skin cancers/per year in Italy estimated according to the incidence rates of the Italian cancer registries 2018 and of Boi et al., respectively, in: | 
|--------------------------------|-------------------------------------------------------------------------------------------------| 
|                                | All workers with occupational sUVR exposure (n = 702 100) vs. Agricultural workers (n = 390 000) | 
|                                | Cancer registries 2018 vs. Boi et al.19 Cancer registries 2018 vs. Boi et al.19 Cancer registries 2018 vs. Boi et al.19 | 
| Basal cell carcinoma           | 772 vs. 432 vs. 429 vs. 240 vs. 343 vs. 192                                                   | 
| Squamous cell carcinoma        | 211 vs. 114 vs. 117 vs. 64 vs. 94 vs. 51                                                     | 
| Non-melanoma skin cancer (total)| 983 vs. 546 vs. 546 vs. 304 vs. 437 vs. 243                                                  | 
| Percentage ratio between reported vs. expected UV-induced occupational NMSC | 3.5 vs. 6.2 vs. 4.2 vs. 7.6 vs. 2.5 vs. 4.5 | 

†Data estimated BCC:SCC.
‡Reported = mean number of occupational NMSC related to solar UV reported per year to INAIL in the period 2012-2017 according to Figures 1 and 2.
the occurrence of a suspected occupational disease to physicians, for fear of job loss.34

Accordingly, it can be said that the underreporting of occupational cancers is a well-known problem in occupational medicine, and not limited to skin cancers,35–37 but a reporting in the order of 3% of expected cases, as we estimated in our study, is entirely unacceptable. The current official German figures can give an estimate of the prevalence of occupational skin cancer in a similar-sized population like Italy. Even though in Germany, so far, only multiple AK (>5/year) and invasive SCC are recognized as occupational disease since 2015, this cancer entity is already the third most frequently reported occupational disease with 8358 cases in 2017 and figures are further rising.38

Unlike in Germany, in Italy and many other countries, a significant problem in studies on occupational skin cancer notifications is the inadequacy of available official data. In the public area of the INAIL statistical database, the number of NMSC, including AK, is accessible, but other relevant information on workers (as age) or on the diseases (as location) is not currently available. Regarding the coding of exposure, in Agriculture sUVR only (code 19) is considered; while, in Industry, artificial UV exposures are also included in a single subgroup (code 84); nevertheless, specifically considering the skin, the large majority of occupational cancers are presumably related to solar radiation, while a small (or most likely negligible) number is expected related to artificial UV radiation, e.g. in welding.6,9,39 Accordingly, we decided to merge data from Agriculture and Industry & Services sectors, and to create a summarizing variable of the total number of skin cancers reported to INAIL for workers occupationally exposed to sUVR radiation and to other UVR sources. This seems legitimate, as there are no epidemiological data consistently showing an increasing in skin cancer risk for welders, which may be related to other skin cancer risk for welders, e.g. clothing and total face masks to avoid painful skin burns and other occupational eye injuries40 and diseases, including UV-induced photokeratoconjunctivitis and photochemical cataract.9,41

Another possible limit of studying the expected number of occupational skin cancers in sUVR-exposed workers is related to cancer registries: while data on malignant melanoma are largely available since several years, in Italy, as in other countries, data for NMSC vary significantly in quality and coverage of the territory, due to insufficient data harmonization and heterogeneity of methods. The availability of validated questionnaires for the health surveillance of people with suspected occupational dermatoses could be a helpful tool to improve the registration of these diseases.42

This study has some limitations. One is that we applied the crude incidence of NMSC derived from the Italian cancer registries to the workers population. Another limitation is that we used the 2018 incidence data available for the Italian cancer registries, while data on the occupational cancers reported to INAIL are from the period 2012–17.

Other limitations are the impossibility to access to detailed information regarding the workers, e.g. age, specific occupational tasks, use of personal protective equipment (PPE) and photo-type, as well as information on the diseases, as location, staging and grading, and multiple lesions. This information is pivotal when studying the causal relation between outdoor work and skin cancers in more detail.3,48

However, in spite of these limitations, there are few doubts that the vast underreporting of work-related NMSC in Italy is real: the proportion of effectively reported diseases is less than the 5% of the cases expected; this difference is so large that it is almost impossible that other estimates calculated with different methods could significantly modify the result. This underestimation indicates that adequate professional skills and competences of the occupational physicians, within a collaborative multidisciplinary framework with dermatologists, are needed for a more effective health surveillance of solar UV-exposed workers, to reduce underreporting and underestimation of occupational skin cancers and improve prevention.

In conclusion, our study clearly shows that in Italy, as likely in other parts of Europe, the problem of occupational skin cancer in workers exposed to sUVR is grossly neglected, and many cases go unnoticed, largely un(der)reported and uncompensated. Considering solar UV risk, workplace preventive interventions are usually missing, and the same holds true to the regular health screening of outdoor workers – as high a risk population – for solar UV induced effects. This problem is not new, and it does not involve only Italy or Europe. Furthermore, it is not limited to skin cancers, but for skin cancers it is particularly relevant, and the proportion of reported vs. expected cases is dramatically low, also raising important ethical issues. In fact, many workers cannot receive adequate medical care and compensation for severe and highly chronic occupational actinic damage acquired during their working life. Moreover, because of the vast underreporting, respective authorities and governments lack adequate presentation of the true magnitude of the phenomenon, and consequently, the preventive measures needed are insufficiently implemented.

**Acknowledgments**

No research funds were received to carry out this research. Authors would like to thank Italian institutions and associations AIOM, AIRTUM, INAIL, ISS and ISTAT as they publicly provide relevant data that made our study possible.

**References**

1. Mirabelli D, Kauppinen T. Occupational exposures to carcinogens in Italy: an update of CAREX database. *Int J Occup Environ Health* 2005; 11: 53–63.
Occupational skin cancers underreported

2 Modenese A, Bisegna F, Borra M et al. Outdoor work and solar radiation exposure: Evaluation method for epidemiological studies. Med Pr 2016; 67: 577–587.

3 Modenese A, Korpinnen L,戈fba F. Solar radiation exposure and outdoor work: an underestimated occupational risk. Int J Environ Res Public Health 2018; 15: E2063.

4 American Conference of Governmental Industrial Hygienists (ACGIH). 2014 TLVs and BEIs. ACGIH, Cincinnati, OH, 2014. ISBN: 978-1-607260-72-1.

5 International Commission on Non-Ionizing Radiation Protection. ICNIRP statement – Protection of workers against ultraviolet radiation. Health Phys 2010; 99: 66–87.

6 Tenkate T, Adam B, Al-Rifai RH et al. WHO/ILO work-related burden of disease and injury: Protocol for systematic reviews of occupational exposure to solar ultraviolet radiation and of the effect of occupational exposure to solar ultraviolet radiation on cataract. Environ Int 2019; 125: 542–553.

7 International Agency for Research on Cancer (IARC). Radiation Volume 100 D. A Review of Human Carcinogens. WHO Press, Lyon, 2012. URL https://monographs.iarc.fr/wp-content/uploads/2018/06/mono100D.pdf (last accessed: 5 March 2019).

8 Modenese A, Farnetani F, Andreoli A, Pellacani G, Goebb F. Questionnaire-based evaluation of occupational and non-occupational solar radiation exposure in a sample of Italian patients treated for actinic keratosis and other non-melanoma skin cancers. J Eur Acad Dermatol Venereol 2016; 30(Suppl 3): 21–26.

9 Silva PM, Adam B, Alagawu C et al. WHO/ILO work-related burden of disease and injury: Protocol for systematic reviews of occupational exposure to solar ultraviolet radiation and of the effect of occupational exposure to solar ultraviolet radiation on melanoma and non-melanoma skin cancer. Environ Int 2019; 126: 804–815.

10 Schmitt J, Seidler A, Diepen TL, Bauer A. Occupational ultraviolet light exposure increases the risk for the development of cutaneous squamous cell carcinoma: A systematic review and meta-analysis. Br J Dermatol 2011; 164: 291–307.

11 Bauer A, Diepen TL, Schmitt J. Is occupational solar ultraviolet irradiation a relevant risk factor for basal cell carcinoma? A systematic review and meta-analysis of the epidemiological literature. Br J Dermatol 2011; 165: 612–625.

12 Ulrich C, Salavasta C, Agner T et al. The European Status Quo in legal recognition and patient-care services of occupational skin cancer. J Eur Acad Dermatol Venereol 2016; 30(Suppl 3): 46–51.

13 Karimkhan C, Boyers LN, DellaValle RP, Weinstock MA. It’s time for “keratinocyte carcinoma” to replace the term “nonmelanoma skin cancer”. J Am Acad Dermatol 2015; 72: 186–187.

14 Armstrong BK, Cust AE. Sun exposure and skin cancer, and the puzzle of cutaneous melanoma: A perspective on Fears et al. Mathematical models of age and ultraviolet effects on the incidence of skin cancer among whites in the United States. American Journal of Epidemiology 1977; 105: 420–427. Cancer Epidemiol 2017; 48: 147–156.

15 Arisi M, Zane C, Caravello S et al. Sun exposure and melanoma, certainties and weaknesses of the present knowledge. Front Med (Lausanne) 2018; 5: 235.

16 Anselmo Lima C, Sampaio Lima M, Maria Da Silva A et al. Do cancer registries play a role in determining the incidence of non-melanoma skin cancer? Eur J Dermatol 2018; 28: 169–176.

17 Zanetti R, Cobergh JH, Roos B. To accelerate cancer prevention in Europe. Challenges for cancer registries. Eur J Cancer 2018; 104: 151–159.

18 Associazione Italiana di Oncologia Medica, Associazione Italiana dei Registri Tumori, Istituto Superiore di Sanità. I numeri del cancro in Italia 2018. URL https://www.aiom.it/wp-content/uploads/2018/10/2018_NumeriCancro-operatori.pdf (Last accessed: 5 March 2019).

19 Boi S, Cristofolini M, Miccillo R, Polla E, Dalla PP. Epidemiology of skin tumors: data from the cutaneous cancer registry in Trentino, Italy. J Cutan Med Surg 2003; 7: 300–305.

20 Leiter U, Keim U, Eigentler T et al. Incidence, mortality, and trends of nonmelanoma skin cancer in Germany. J Invest Dermatol 2017; 137: 1860–1867.

21 Perera E, Gnaneswaran N, Staines C, Win AK, Sinclair R. Incidence and prevalence of non-melanoma skin cancer in Australia: A systematic review. Australas J Dermatol 2015; 56: 258–267.

22 John SM, Trakatelli M, Ulrich C. Non-melanoma skin cancer by solar UV: the neglected occupational threat. J Eur Acad Dermatol Venereol 2016; 30(Suppl 3): 3–4.

23 Schmitt J, Haufe E, Trautmann F et al. Is ultraviolet exposure acquired at work the most important risk factor for cutaneous squamous cell carcinoma? Results of the population-based case-control study FB-181 Br J Dermatol 2018; 178: 462–472.

24 Schmitt J, Haufe E, Trautmann F et al. Occupational UV-exposure is a major risk factor for basal cell carcinoma: results of the population-based case-control study FB-181. J Occup Environ Med 2018; 60: 36–43.

25 Ministero del Lavoro e della Previdenza Sociale. Decreto 9 April 2008 - Nuove tabelle delle malattie professionali nell’industria e nell’agricoltura. GU n. 169 del 21-7-2008. URL http://www.salute.gov.it/imgs/C_17_normativa_1688_allegato.pdf (Last accessed: 17 April 2019)

26 Ministero del Lavoro e delle Politiche Sociali. Decreto 10 giugno 2014 - Approvazione dell’aggiornamento dell’elenco delle malattie per le quali è obbligatoria la denuncia, ai sensi e per gli effetti dell’articolo 139 del Testo Unico approvato con decreto del Presidente della Repubblica 30 giugno 1965, n. 1124 e successive modificazioni e integrazioni. GU n.212 del 12-9-2014. URL https://www.inail.it/cs/internet/docs/ucm_150161.pdf (Last accessed: 17 April 2019)

27 Istituto Nazionale per l’Assicurazione contro gli Infortuni sul Lavoro (INAIL). Banca dati statistica. URL https://www.inail.it/cs/internet/attivita/deti-esist-tut/2018-04/information/16083-informazioni.html (Last accessed: 5 March 2019)

28 Istituto Nazionale di Statistica (ISTAT). Bilancio demografico nazionale. URL https://www.istat.it/it/archivio/216999 (Last accessed: 5 March 2019).

29 Mofidi A, Tompa E, Spencer J et al. The economic burden of occupational non-melanoma skin cancer due to solar radiation. J Occup Environ Hyg 2018;15: 481–491.

30 Lichte V, Dennenmoser B, Dietz K. Professional risk for skin cancer development in male mountain guides - a cross-sectional study. J Eur Acad Dermatol Venereol 2010; 24: 797–804.

31 Caroe TK, Ebbehøj NE, Wulf HC, Agner T. Occupational skin cancer may be underreported. Dan Med J 2013; 60: A4624.

32 Caroe TK, Ebbehøj NE, Wulf HC, Agner T. Recognized occupational skin cancer in Denmark - data from the last ten years. Acta Derm Venereol 2013; 93: 369–371.

33 Moldovan HR, Voidaazan ST, John SM et al. The Eastern European experience on occupational skin diseases. Make underreporting an issue? J Eur Acad Dermatol Venereol 2017; 31(Suppl 4): 5–11.

34 Alaguney ME, Yildiz AN, Demir AU, Ergor OA. Physicians’ opinions about the causes of underreporting of occupational diseases. Arch Environ Occup Health 2019; 1–9.

35 Brugere J, Naud C. Recognition of occupational cancers in Europe. TUTB (Trade Union Technical Bureau) Newsletter 2003; 21: 38–39.

36 Galfuri E. Disparity between estimated numbers and reported cases of occupational cancer. Scand J Work Environ Health 1991; 17: 216–217.

37 Porru S, Carta A, Toninelli E, Bozzola G, Arioli C. Reducing the underreporting of lung cancer attributable to occupation: outcomes from a hospital-based systematic search in Northern Italy. Int Arch Occup Environ Health 2016; 89: 981–989.

38 Deutsche Gesetzliche Unfallversicherung (DGUV). URL https://www.dguv.de (Last accessed: 5 March 2019)
39 Falcone LM, Zeidler-Erdely PC. Skin cancer and welding. *Clin Exp Dermatol* 2019; 44: 130–134.

40 Gobba F, Dall’olio E, Modenese A, De MM, Campi L, Cavallini GM. Work-related eye injuries: A relevant health problem. Main epidemiological data from a highly-industrialized area of Northern Italy. *Int J Environ Res Public Health* 2017; 14: E604.

41 Modenese A, Gobba F. Cataract frequency and subtypes involved in workers assessed for their solar radiation exposure: A systematic review. *Acta Ophthalmol* 2018; 96: 779–788.

42 Chiesi A, Pellacani G, Di Rico R et al. Italian translation and validation of the Nordic Occupational Skin Questionnaire (NOSQ-2002). *Med Lav* 2016; 107: 205–212.