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Skin photoaging in farmers occupationally exposed to ultraviolet radiations

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Ultraviolet radiations; farmers; skin photoaging

Parole chiave
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Summary
Background: *Most personal exposures to UV radiations occur from outdoor activities and several studies detected a significant association between skin cancer and outdoor occupation.* **Objective:** *The aim of the study was to ascertain the prevalence of photoaging signs in a population of Italian farmers and in a population of indoor workers taking account of confounding factors.* **Methods:** *169 farmers and 198 indoor workers were classified for skin phototype and for skin photoaging, moreover 13 variables were taken into account. Marginal permutation tests were adopted for statistical analysis.* **Results:** *Farmers were significantly older than the indoor workers. In workers occupationally exposed to UV photoaging increased with increasing age and years of occupational exposure to sunlight. The distribution of skin phototype did not show significant differences in the two populations, while farmers showed a higher degree of photoaging than indoor workers.* **Conclusions:** *Even if farmers were older than the indoor workers it seems that outdoor work produces a higher degree of photoaging.*

Riassunto
«Fotoinvecchimento cutaneo in agricoltori professionalmente esposti a raggi ultravioletti». **Background:** *Numerosi studi mostrano una associazione significativa tra lavori che si svolgono all'aperto con esposizione personali a raggi ultravioletti (UV) e neoplasie cutanee.* **Oggetto:** *Scopo dello studio è quello di confrontare la prevalenza di fotoinvecchiamento cutaneo in una popolazione di lavoratori agricoli ed in una popolazione di lavoratori impiegati in lavorazioni indoor, tenendo in considerazione i fattori di confondimento.* **Metodi:** *169 agricoltori e 189 lavoratori indoor sono stati classificati per fototipo e per grado di fotoinvecchiamento; inoltre sono state considerate 13 variabili. Per l'analisi statistica sono stati utilizzati tests non paramentrici di permutazione.* **Risultati:** *I lavoratori agricoli erano significativamente più anziani dei lavoratori indoor. Nei lavoratori professionalmente esposti ai raggi UV il fotoinvecchiamento aumentava di grado con l'aumentare dell'età e degli anni di esposizione alle radiazioni solari. La distribuzione del fototipo tra le due popolazioni non mostrava differenze significative, ma negli agricoltori si osservava un maggior grado di fotoinvecchiamento rispetto ai lavoratori indoor.* **Conclusioni:** *Anche se l'età dei lavoratori agricoli era significativamente più alta di quella dei lavoratori indoor, il lavoro outdoor sembra comportare un maggior grado di fotoinvecchiamento cutaneo.*

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Introduction

Photoaging is a premature aging of the skin due to prolonged exposure to solar ultraviolet radiations (UV) as a result of cumulative DNA damage. Photoaging is superimposed on the changes due to genetic aging, and other forms of extrinsic aging (5). This process is characterized by clinical, histological and biochemical changes that differ from alterations in chronologically aged but sun-protected skin (2). It is characterized clinically by yellowish discoloration and thickening of the skin and histologically by deposit of elastotic material in the dermal connective tissue of the superficial to mid-dermis (solar elastosis). The degree of histopathological solar elastosis has been shown to correlate with the amount of UV radiation to which the skin has been exposed (1).

Sun-damaged skin may develop actinic keratosis and non-melanoma skin cancers (NMSC), mainly squamous cell carcinoma and basal cell carcinoma, located in the body regions exposed to sun (hands, head and neck). NMSC represent the most common malignancy (13) making up about 90% of skin cancers. The incidence of NMSC is not only linked to solar UV, but also to the influence of many well known factors such as race, skin phototype, latitude of country of residence, hereditary diseases, sunburn in childhood and outdoor working (3, 9, 11, 12, 14, 16). Most personal exposures to UV occur from outdoor activities and several studies detected a significant association between skin cancer and outdoor occupation (8).

Baille et al. (1) reviewed the published literature on invasive and non-invasive methods used to quantify photoaging concluding that histopathological solar elastosis alone should not be viewed as a 'gold standard' diagnostic test. Moreover the requirement of a skin biopsy procedure for histopathological assessment precludes its direct measurement in large population-based studies. At the moment there is no single method available that will provide accurate quantification of the degenerative changes associated with photodamage. Clinical examination is easy and it is currently considered a reliable strategy for assessing photoaging even if can be a somewhat challenging method of determining the level of photodamage to skin and should therefore be performed by an expert dermatologist.

The aim of the study was to ascertain the prevalence of photoaging signs in a population of Italian farmers and in a population of indoor workers taking account of confounding factors.

Methods

Subjects

169 outdoor workers (133 males and 36 females) and 198 indoor workers (87 males and 111 females) were studied. The population of outdoor workers consisted of Caucasian farmers employed in wine growing and olive growing in 13 properties in a limited rural area of Tuscany. Indoor workers consisted of all Caucasian employees assigned to cellars on the same 13 farms and all Caucasian workers of a furniture factory located in the same rural area of Tuscany to avoid geographical differences.

All workers were classified for skin phototype using the Fitzpatrick classification (4) and for skin photoaging through Glogau classification (6) by a dermatologist. In tables 1 and 2 phototype and photoaging classifications respectively are reported. Skin diseases and symptoms were also assessed. Moreover confounding factors, summarized in the 13 variables reported in table 3, were taken into account. The use of protective clothing was also considered for farmers.

Statistical analysis

The dataset consisted of 367 sample units partitioned into two groups: the population of 169 agri-

Table 1 - Fitzpatrick sun-reactive skin types (4)

Skin type	Skin colour	Tanning response
Type I	White	Always burn, never tan
Type II	White	Usually burn, tan with difficulty
Type III	White	Sometimes mild burn, tan average
Type IV	Brown	Rarely burn, tan with ease
Type V	Dark brown	Very rarely burn, tan very easily
Type VI	Black	No burning, tan very easily

Table 2 - Glogau photoaging classification (6)

Type I	*no wrinkles* early photoaging mild pigmentary changes no keratoses
Type II	*wrinkles in motion* early to moderate photoaging early senile lentigines visible keratoses palpable but not visible
Type III	*wrinkles at rest* advanced photoaging obvious dyschromia, teleangectasia visible keratoses
Type IV	*only wrinkles* severe photoaging yellow-grey colour of skin prior skin maligancies

cultural workers and the group of 198 indoor workers. Thirteen variables were collected on each sample unit (table 3). In addition a further variable (i.e. the total outdoor working years obtained by anamnesis) was considered in the group of agricultural workers.

Table 3 - Variables measured in farmers and indoor workers living in rural areas.

Sex
Age
Phototype (Fitzpatrick classification)
Photoaging (Glogau classification)
Sunburn after exposure to solar UV radiation
Sunburn before 15 years of age (≤2 or >2)
Recreational exposure to solar UV radiation
Recreational exposure mode (intermittent or uninterrupted)
Recreational exposure, days per year
Hours of recreational exposure per day
Time of recreational exposure (10 am-6 pm or before 12 am and after 3.30 pm)
Outdoor hobbies
Exposure to UV tanning lamps

As regards statistical inference the main goal of the present study dealt with testing the homogeneity hypothesis in the two groups for each considered variable. To this aim, by assuming that the data are exchangeable between groups under the null hypothesis of global homogeneity, marginal permutation tests were adopted for assessing the homogeneity for each considered variable. The testing procedure was selected in order to avoid stringent model assumptions (such as Normal models) which are not likely to hold in the present setting. Actually, permutation-based techniques have been extensively considered for biomedical applications in recent years (10, 15).

In order to assess the homogeneity hypothesis with respect to the two groups the permutation Chi-squared and t-Student test-statistics were adopted for the qualitative-type or quantitative-type variables respectively. The p-values were computed on the basis of the permutation distributions of each appropriate test statistic (7). Data processing was carried out by means of the NPC Test 2.0 package (Methodologica Srl, Treviso, Italy).

Results

In tables 4 and 5 data on outdoor and indoor workers respectively are summarized.

Outdoor workers were predominantly males while indoors workers were mainly females. This difference was statistically significant ($p<0.001$). Farmers were significantly older than the indoor workers ($p<0.001$). This was mainly due to some outdoor subjects of advanced age who clearly influenced the mean.

The distribution of skin phototype did not show significant differences in the two populations, while farmers showed a higher degree of photoaging than indoor workers ($p<0.001$) (figure 1).

In workers occupationally exposed to UV photoaging increased with increasing age and years of occupational exposure to sunlight ($p<0.001$ in both cases).

The relationship between phototype and photoaging in outdoor workers is summarized in figure 2. Again there was an association between photo-

Table 4 - Characteristics of study subjects and phototype-photoaging of outdoor workers occupationally exposed to UV

	Males	Females	Total
No.	133	36	169
Mean age (years)	46.1 ± 13.6	41.6 ± 11.3	45.1 ± 13.2
Years of occupational exposure to UV	19.4 ± 16.6	13.3 ± 12.5	18.1 ± 16.0
Phototype			
I	1 (0.7%)	2 (5.6%)	3 (1.8%)
II	44 (33.1%)	17 (47.2%)	61 (36.1%)
III	75 (56.4%)	14 (38.9%)	89 (52.6%)
IV	13 (9.8%)	3 (8.3%)	16 (9.5%)
Photoaging			
I	13 (9.8%)	6 (16.7%)	19 (11.2%)
II	38 (28.5%)	16 (44.5%)	54 (31.9%)
III	73 (54.9%)	13 (36.0%)	86 (51.0%)
IV	9 (6.8%)	1 (2.8%)	10 (5.9%)
Sunburn	69 (51.9%)	17 (47.2%)	86 (50.9%)
Sunburn in childhood			
No	78 (58.7%)	23 (63.9%)	101 (59.8%)
≤2	29 (21.8%)	6 (16.7%)	35 (20.7%)
>2	26 (19.5%)	7 (19.4%)	33 (19.5%)
Recreational exposure	62 (46.6%)	20 (55.5%)	82 (48.5%)
Outdoor hobbies	57 (42.9%)	10 (27.8%)	67 (39.6%)
Exposure to UV tanning lamps	2 (1.5%)	2 (5.5%)	4 (2.4%)

type classes and photoaging ($p<0.02$). In farmers there were no statistically significant differences between the sexes with regard to photoaging.

The studied populations were homogeneous with respect to the variable sunburn in general, while subjects not occupationally exposed to UV seemed to report more cases of sunburn during childhood ($p<0.03$). Indoor workers had a statistically significant higher recreational exposure than outdoor workers ($p<0.001$). When exposed to UV in leisure time indoor workers exposed themselves for more days ($p<0.001$) and more frequently for uninterrupted periods ($p<0.001$). During recreational exposure the two groups tended to be exposed at the same time of the day and for the same number of hours. The outdoor workers devoted more time to outdoor hobbies ($p<0.01$) but were more rarely exposed to UV lamps for tanning ($p<0.01$). Regarding the use of protective clothing in the outdoor population, 120 subjects (71.0%) wore a hat (78.4% baseball cap, 18.3% bandana, 3.3 % straw hat). In the summer farmers wore long trousers and T-shirts with short sleeves (67.2%), long trousers and long-sleeved T-shirts (14.1%), shorts and vest (10.7%) or short pants and bare chest (8.0%). Two basal cell carcinomas were identified in the agricultural population (both males, mean age 65.5 years) and 2 in indoor workers (1 male and 1 female, mean age 52.0 years).

Discussion

The studied populations differed with regards to sex and age. When sex did not seem to influence photoaging (in outdoor workers there was not a significant difference between males and females), there was a relationship between age and photoaging. However advanced age is typical of farmers and can be considered as a risk factor.

Table 5 - Descriptive and phototype-photoaging of indoor workers residing in a rural area

	Males	Females	Total
No.	87	111	198
Mean age (years)	38.1 ± 10.5	38.0 ± 10.3	38.0 ± 10.4
Phototype			
I	4 (4.6%)	3 (2.7%)	7 (3.5%)
II	21 (24.1%)	45 (40.6%)	66 (33.4%)
III	50 (57.5%)	53 (47.7%)	103 (52.0%)
IV	12 (13.8%)	10 (9.0%)	22 (11.15)
Photoaging			
I	55 (63.2%)	72 (64.9%)	127 (64.1%)
II	26 (29.9%)	35 (31.5%)	61 (30.8%)
III	6 (6.9%)	4 (3.6%)	10 (5.1%)
IV	0 (0%)	0 (0%)	0 (0%)
Sunburns	43 (49.4%)	65 (58.6%)	108 (54.5%)
Sunburns in the childwood			
No	45 (51.7%)	54 (48.7%)	99 (50.0%)
≤2	34 (39.1%)	29 (26.1%)	63 (31.8%)
>2	8 (9.2%)	28 (25.2%)	36 (18.2%)
Recreational exposure	61 (70.1%)	87 (78.4%)	148 (74.7%)
Outdoor hobbies	27 (31.1%)	20 (18.0%)	47 (23.7%)
Exposure to UV tanning lamps	4 (4.6%)	14 (12.6%)	18 (9.1%)

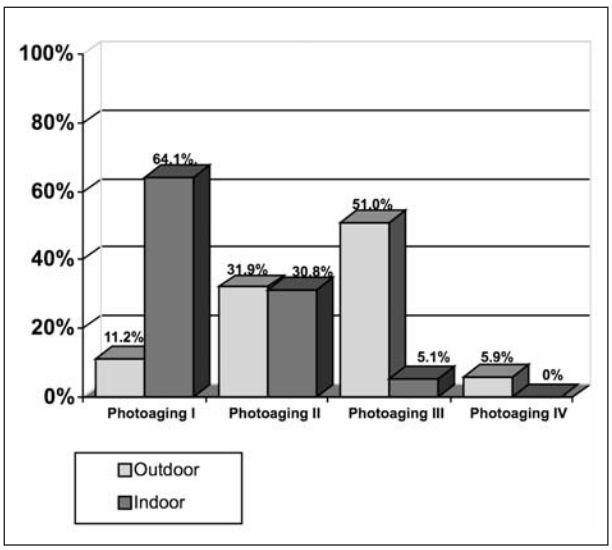

Figure 1 - Distribution of photoaging in the studied populations

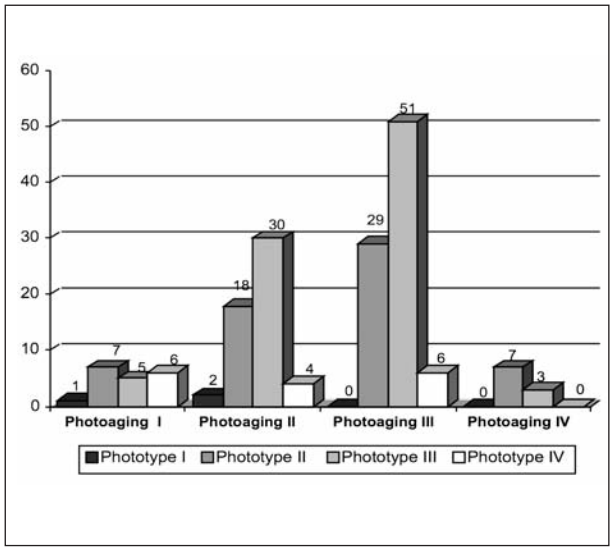

Figure 2 - Photoaging and phototype in outdoor workers

In the indoor population type I photoaging was predominant with a decreasing trend from II to III and type IV photoaging was not represented at all. Outdoor photoaging showed a reverse upward trend from I to III with type IV photoaging representing 6% of subjects.

Recreational exposure and the use of tanning lamps, which was much less common than in indoor workers, is not relevant in the pathogenesis of photoaging in agricultural workers.

Skin phototype did not affect the occurrence of a greater degree of photoaging in outdoor workers than in indoor workers, because the two groups were homogeneous for this variable. The role of skin phototype in the onset of photoaging was confirmed by the data on outdoor workers. This finding is particularly important in prevention because several studies reported that the vast majority of outdoor workers do not practice adequate sun protection, but intervention programmes were able to improve acceptance to follow the recommended prevention strategy (8).

Only 1.2 % of the agricultural population examined had a NMSC. This prevalence is close to that observed in indoor workers. This was most likely due to the mean age of the studied populations which was lower than the age when NMSC usually appear.

Conclusions

Even if farmers were older than the indoor workers it seems that outdoor work leads to a higher degree of photoaging. The relationship between phototype and photoaging was confirmed. The results of this study are of particular importance for prevention efforts.

No potential conflict of interest relevant to this article was reported

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