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Proportional melanoma incidence and occupation among White males in Los Angeles County (California, United States)

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A case-control analysis of cancer registry data was used to examine the hypothesis that occupational exposure to sunlight influences the risk of melanoma. Occupation at diagnosis was available for 3,527 cutaneous melanomas and 53,129 other cancers identified by the Los Angeles County (California, United States) Cancer Surveillance Program among non-Spanish-surnamed White males aged 20 to 65 years between 1972 and 1990. Occupational exposure to sunlight was assessed by blinded expert coding of job titles as indoor, outdoor, and mixed indoor/outdoor. Relative to indoor occupations, proportionate odds ratios (OR) adjusted for age, level of education, and birthplace were 1.16 (95 percent confidence interval [CI] = 1.07-1.27) for indoor/outdoor occupations and 1.15 (CI = 0.94-1.40) for outdoor occupations. However, increasing levels of the education or training required for the occupation was associated more strongly with increased melanoma occurrence (ORs adjusted for age, occupational sun exposure, and birthplace, were 1.0, 1.63, 2.09, 2.23, and 2.99 for low-skill occupation, high school, college, postgraduate, and doctoral levels, respectively). Analysis of melanoma occurrence by job titles confirmed a clear variation by the required education or training level but not by the category of occupational sunlight exposure. The findings suggest that lifestyle factors associated with higher levels of education may be more important determinants of melanoma risk than characteristics of the work environment. *Cancer Causes and Control* 1995, 6, 451-459

Key words: Education, males, melanoma, occupation, solar radiation, United States.

Introduction

Various lines of evidence implicate solar radiation as a cause of cutaneous malignant melanoma. Risk factors implicating solar radiation in the etiology of this cancer include low levels of melanin in the skin, the inability of the skin to tan in response to sun exposure, proximity to the equator in fair skinned populations, and increased recreational exposure to sunlight.[1,2] These findings have prompted investigators to consider occupational

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exposure to sunlight as a potential risk factor for melanoma. Studies comparing melanoma occurrence among occupations classified by relative amounts of exposure to sunlight report widely conflicting findings, however, with outdoor workers being at greater risk in some settings and indoor workers in others.[3]

The inconsistent findings may reflect a complex relationship between solar radiation and melanoma; some observations regarding this association remain unexplained. Intermittent sun exposure predicts melanoma risk more consistently than measures of cumulative sun exposure, raising the possibility that constant exposure to sunlight may be protective.[3] Some reports suggest that the link between solar radiation and melanoma may vary by both the histologic type and the affected part of the anatomy, distinguishing between normally covered and normally uncovered parts.[1] In addition, sun exposure during childhood and adolescence may be particularly important.[1,4] Thus, the effect of employment in indoor or outdoor occupations on the risk of melanoma among adult workers is difficult to predict.

An aspect of occupation that has been associated consistently with melanoma is socioeconomic status; melanoma risk increases with greater income levels, years of education, and professional status.[1,3,5,6] Since most higher-status occupations involve primarily indoor work, socioeconomic distinctions must be considered when evaluating the effect of occupational exposure to sources of light. We therefore examined the relationship between proportionate melanoma incidence and occupation, classified both by exposure to sunlight and the required education or training level, using data from a population-based cancer registry in Los Angeles County (California, United States). The sunny climate of southern California makes this a particularly appropriate population in which to observe distinctions between indoor and outdoor workers.

Materials and methods

The Los Angeles County Cancer Surveillance Program has operated as a population-based cancer registry within the University of Southern California School of Medicine since 1972.[7] The registry is charged with identifying and obtaining information on all histologically confirmed, incident cancer cases (excluding non-melanoma skin cancers) diagnosed within Los Angeles County. This task has been accomplished through active surveillance of pathology reports and death records (cancer has been a required reportable disease in Los Angeles County (LAC) since 1981; prior to that year medical facilities diagnosing cancer cooperated voluntarily). When each new case is registered, the patient's age, gender, race, religion, birthplace, occupation and industry, and tumor type and site are abstracted from the medical record. The occupational and industrial information has been coded according to the 1970 US Bureau of Census classification.[8]

Table 1. Frequency of melanoma by histologic type and affected bodypart in 20-65 year old White males, Los Angeles County Cancer Surveillance Program, 1972-90

	Frequency
Total	78,041
Cancer site	
Melanoma	5,110
Other cancer	72,931
Histologic type	
Superficial spreading	1,701
Nodular	502
Hutchinson's freckle	161
Amelanotic	70
Spindle cell	58
Other types	134
Not specified	2,484
Bodypart	
Skin, face/scalp/neck	733
Skin, trunk	2,360
Skin, arm/hand	1,008
Skin, leg/foot	479
Skin, not specified	351
Eye	170
Other organs	35
Unknown	4

In this analysis, we compare cases of melanoma to cases of all other forms of registered cancer with respect to occupation as recorded by the Los Angeles County Cancer Surveillance Program among adult White males without Spanish surnames aged 20 to 65 years between 1972 and 1990. This group included 78,041 cases, of which 5,110 (6.5 percent) were histologically confirmed melanomas. Table 1 presents the distribution of melanoma cases by histologic type and affected bodypart. While all confirmed diagnoses have been reported, during the early years of the registry not all pathologists specified the histologic subtype, not all registrars abstracted it if specified, and subtype is not reflected on death certificates; thus, histologic details are unavailable for nearly half of the cases.

Females were not included due to elevated proportions of missing and misclassified occupation; non-White males were excluded due to their low risk of melanoma.[1] We restricted the analysis to melanoma cases of the skin, because noncutaneous melanomas (205 cases) are likely to be etiologically distinct. To avoid inclusion of misclassified non-White men, those

Table 2. Distribution of specific occupations by sun exposure levels,[a] Los Angeles County Cancer Surveillance program, 1972–90

Mainly indoor		Indoor/outdoor		Mainly outdoor	
Occupation	No.	Occupation	No.	Occupation	No.
Salesman	3,865	Truck driver	1,684	Construction worker	388
Machinist	1,415	Carpenter	903	Mail carrier	286
Accountant	1,079	Aerospace engineer	878	Gardener	283
Janitor	1,004	Teacher, precollege[b]	812	Delivery man	224
Lawyer	714	Real estate agent	714	Sailor	130
Physician	642	Painter	695	Road crew	125
Auto mechanic	601	Electrician	676	Crane operator	113
Electrical engineer	591	Guard/watchman	641	Roofer	107
Bartender	476	Plumber	516	Plasterer	105
Bank manager	476	Welder	406	Brickmason	72
Electrical technician	460	Police officer	396	Farmer	65
Restaurant/bar manager	359	Aircraft mechanic	351	Athlete	60
238 other occupations	24,189	80 other occupations	9,677	23 other occupations	478
Total	35,871		18,349		2,436

[a] Among those with reported occupations (total = 56,656).
[b] An additional 287 teachers represent specializations classifed as indoor.

reported to have been born in geographic regions with substantial non-White populations (Africa, Asia, or Latin America except Argentina, Chile, Costa Rica, and Uruguay) were eliminated (33 melanomas and 1,974 other cancers). We also excluded cases lacking specific data on occupation (193 melanomas and 5,726 other cancers classified as retired, and 1,152 melanomas and 12,102 other cancers with no occupation listed in medical records). The present analysis thus includes 3,527 cutaneous melanoma cases and 53,129 other cancer cases; melanomas comprise 6.2 percent of the cases included in this analysis.

We examined three aspects of occupation: exposure to sunlight during work; the level of education or training generally required for the position; and the specific job category itself. An occupational medicine physician (M.B.) blindly classified job titles into three categories of sun exposure during work: mainly indoor; indoor/outdoor; and mainly outdoor (Table 2). The largest group, indoor occupations, was designated as the reference category. We categorized the level of education or training generally required to undertake the occupation as an ordinal variable with eight levels: low-skill occupation; skilled occupation; artist/entertainer; high school diploma; technical/vocational training; college degree; predoctoral graduate degree; doctoral degree (a list of specific job titles by these levels is given in the Appendix). The artist/entertainer category was ordered following skilled occupations because academic degrees generally are not required for professional artists and entertainers although many of these individuals are likely to have extensive formal education. The group requiring the least training, low-skill occupations, was designated as the reference group. For the analysis of specific occupations, job titles representing subcategories of the same occupation (*e.g.*, English teacher and History teacher) were combined as long as they were believed homogeneous in terms of training and sunlight exposure during work.

We used proportionate odds ratios (OR), along with 95 percent confidence intervals (CI) from unconditional logistic regression models to estimate the effects of exposure to sunlight during work and the education/training level generally required for the occupation. The proportionate OR is preferable to the proportionate incidence ratio, frequently used in analyses of cancer registry data, because the OR better estimates the incidence rate ratio in a proportionate incidence study when the occurrence of the set of comparison diseases can be presumed unrelated to the exposure of interest.[9] We believe this assumption is valid for our choice of controls because solar radiation is not a suspected risk factor for cancers other than those of the skin. Further, to examine the association between education and the comparison cancers, we observed LAC site-specific cancer incidence rates by five education levels based on census tract data. Incidence rates for several major cancer sites increase with education while those for several others decrease with education; for all cancer sites combined, however, incidence rates across all five education levels were very similar.

As the best available substitute for information on

exposure to sunlight during childhood and adolescence, we examined place of birth as a potential confounder. Age was included in all models because proportionate melanoma incidence decreases with advancing age. Subgroup analyses by age group, year of diagnosis, affected body part, and histologic type of melanoma (those with sufficient numbers: superficial spreading melanoma, nodular melanoma, Hutchinson's melanotic freckle, nonspecific type) were conducted.

Occupation-specific age-adjusted ORs were estimated for the following: occupations with at least 20 observations in which the proportionate melanoma incidence was less than 4.5 percent or greater than 8.5 percent; each outdoor occupation with at least 50 observations; and occupations previously reported to be associated with an elevated occurrence of melanoma (chemist, airline pilot, finance broker, accountant, dentist, pharmacist, doctor, judge, university teacher, office clerk, worker exposed to radiation or photographic chemicals).[5,6] One job category with only 16 observations was included because four of these were melanoma cases. Except for the previously implicated occupations, others were eliminated from specific analysis if the estimated OR fell into the 0.50-2.0 range and the *P*-value was greater than 0.10.

We chose to use a defined occupational category as a reference group rather than compare each occupation to all others combined, in order to avoid a shifting referent. One large indoor occupational group falling in the education level of high school diploma, *i.e.*, salesmen (including clerks, representatives, agents except real estate, buyers, bill collectors, cashiers, and tellers), was chosen as a reference group for the purpose of estimating the proportionate OR for each of the specific occupations. This group includes the most numerous job title and those with similar activities and training, providing for a stable comparison. Additionally, it reflects a proportionate melanoma incidence comparable to that of all occupations combined. The

Table 3. Proportionate incidence odds ratios (OR) for occupational factors and cutaneous melanoma relative to other cancers in 20-65 year old White males, Los Angeles County Cancer Surveillance Program, 1972–90[a]

	Melanoma cases		Other cancers		Age-adjusted		Multivariate adjustment[b]	
	No.	%	No.	%	OR	(CI)[c]	OR	(CI)[c]
Sun exposure during work								
Mainly indoor	2,301	65.2	33,570	63.2	1.0	—	1.0	—
Indoor/outdoor	1,104	31.3	17,245	32.5	0.97	(0.90-1.04)	1.16	(1.07-1.27)
Mainly outdoor	122	3.5	2,314	4.4	0.78	(0.65-0.95)	1.15	(0.94-1.40)
Education/training required for occupation[d]								
Low-skill occupation	482	13.7	12,014	22.6	1.0	—	1.0	—
Skilled occupation	461	13.1	9,768	18.4	1.19	(1.05-1.36)	1.21	(1.06-1.38)
Artist/entertainer	122	3.5	1,617	3.0	1.52	(1.24-1.88)	1.59	(1.29-1.96)
High school diploma	609	17.3	9,370	17.6	1.54	(1.36-1.74)	1.63	(1.43-1.85)
Technical/vocational	196	5.6	2,155	4.1	1.93	(1.62-2.29)	1.86	(1.56-2.22)
College degree	744	21.1	9,313	17.5	1.95	(1.73-2.20)	2.09	(1.83-2.38)
Postgraduate degree	637	18.1	6,634	12.5	2.26	(2.00-2.56)	2.23	(1.96-2.52)
Doctoral degree	276	7.8	2,258	4.3	2.81	(2.40-3.29)	2.99	(2.53-3.53)
Place of birth								
Other[e]	1,413	40.1	31,688	59.6	1.0	—	1.0	—
California	785	22.3	6,717	12.6	1.82	(1.66-2.00)	1.80	(1.64-1.98)
Unknown	1,329	37.7	14,724	27.7	1.75	(1.61-1.89)	1.66	(1.54-1.80)
Age								
20-34	628	17.8	3,613	6.7	1.0	—	1.0	—
35-44	756	21.4	4,676	8.8	0.93	(0.83-1.04)	0.96	(0.86-1.08)
45-54	1,005	28.5	12,455	23.5	0.46	(0.42-0.52)	0.53	(0.48-0.59)
55-65	1,138	32.3	32,385	61.0	0.20	(0.18-0.22)	0.24	(0.22-0.27)

[a] For those with reported occupations (total = 56,656).

[b] Multivariate model includes age (in continuous form), birthplace, sun exposure, and education/training level; odds ratios for age categories (crude and adjusted by birthplace, sun exposure, and education/training level) were estimated separately.

[c] CI = 95% confidence interval.

[d] Training level generally required for reported occupation; see Appendix for detailed list.

[e] Includes all other US states, Canada, Europe, Australia, New Zealand, Chile, Costa Rica, Argentina, and Uruguay.

OR for the grouping of all occupations not included in the occupation-specific analysis (those not listed in Table 5) compared with the reference group was 1.03 (CI = 0.91-1.17).

Results

Table 3 presents ORs for the study factors of interest: occupational exposure to sunlight; education/training level; place of birth, and age. A modest decrease in the relative odds for outdoor work apparent in age-adjusted analysis is not borne out upon further adjustment for level of education or training. In fact, multivariate adjustment reveals a small increase in proportionate melanoma incidence associated with occupational exposure to the sun in southern California. In contrast, the striking increase in the relative odds of melanoma that accompanies increasing education or training level is only slightly altered by adjustment for occupational exposure to sunlight and place of birth.

Being born in California was associated with an approximate 80 percent elevation in melanoma odds (Table 3) compared with other temperate places of birth. No other birthplace region revealed a clear deviation from average melanoma occurrence. Only six percent of the men studied were born outside the US. Among men with birthplaces at similar latitudes to California, corresponding mainly to the more populated states of Texas and Florida, no elevation in melanoma occurrence was observed relative to men born farther from the equator (primarily the midwestern and northeastern US). For this reason, the only distinction retained in the analysis was between California and other places of birth. The OR for those with missing data on birthplace is similar to that for those born in California.

For subgroup analysis, the top four education/training levels were collapsed into two in order to enhance the precision of effect estimates. Observing the effect of exposure to sunlight during work by affected bodypart (Table 4), there was a slight, though statistically imprecise, contrast between melanomas of the leg, which occur somewhat less frequently in outdoor workers, and melanomas of the face, head, neck and trunk, which occur somewhat less frequently in indoor workers. The positive gradient of effect for the education/training level is most pronounced for melanomas of the leg, with the anomaly that the relative odds of melanoma of the leg is highest among artists and entertainers (OR = 3.40, CI = 1.97-5.87). Subgroup analysis by histologic type, age group, and time period showed little variation of the effects of occupational sun exposure or education level; consequently, these data are not presented.

Proportionate ORs for the occupations included in the job-specific analysis appear in Table 5, listed by

Table 4. Adjusted odds ratios (OR) for study factors by anatomical location of cutaneous melanoma versus other cancers in 20-65 year old White males, Los Angeles County Cancer Surveillance Program, 1972-90[a]

	Face/head/neck			Trunk			Arm/hand			Leg/foot		
	No.[b]	OR[c]	(CI)[c]	No.	OR	(CI)[c]	No.	OR	(CI)[c]	No.	OR	(CI)[c]
Sun exposure during work												
Indoor	327	1.0	—	1,075	1.0	—	480	1.0	—	242	1.0	—
Indoor/outdoor	131	0.93	(0.75-1.16)	563	1.21	(1.08-1.35)	214	1.05	(0.88-1.24)	98	0.91	(0.71-1.18)
Outdoor	19	1.26	(0.78-2.05)	66	1.28	(0.99-1.67)	21	1.00	(0.64-1.57)	8	0.75	(0.36-1.54)
Education/training required for occupation[d]												
Low-skill	61	1.0	—	245	1.0	—	91	1.0	—	36	1.0	—
Skilled	58	1.20	(0.84-1.73)	238	1.23	(1.03-1.48)	77	1.05	(0.78-1.43)	44	1.51	(0.97-2.35)
Artist/entertainer	14	1.48	(0.82-2.67)	59	1.50	(1.12-2.02)	18	1.23	(0.74-2.05)	21	3.40	(1.97-5.87)
High school	88	1.77	(1.26-2.49)	284	1.50	(1.25-1.80)	140	1.87	(1.42-2.46)	57	1.79	(1.17-1.76)
College/technical	134	2.15	(1.56-2.98)	456	1.97	(1.66-2.33)	185	1.98	(1.51-2.58)	90	2.26	(1.50-3.39)
Postgraduate	122	2.56	(2.87-3.52)	422	2.19	(1.85-2.58)	204	2.72	(2.11-3.51)	100	3.26	(2.21-4.82)
Place of birth												
Other[e]	186	1.0	—	662	1.0	—	337	1.0	—	139	1.0	—
California	134	2.53	(2.00-3.19)	360	1.69	(1.48-1.94)	170	1.63	(1.31-2.02)	76	1.74	(1.30-2.33)

[a] For those with reported occupations.
[b] Number of melanoma cases belonging to subtype; number of other cancers (control group) given in Table 3.
[c] CI = 95 percent confidence interval; estimates adjusted for age, birthplace, sun exposure, and education/training level.
[d] Training level generally required for reported occupation; see Appendix for detailed list.
[e] Includes all other US states, Canada, Europe, Australia, New Zealand, Chile, Costa Rica, Argentina, and Uruguay.

Table 5. Age-adjusted relative odds of cutaneous melanoma for specific occupations compared with salesmen and office clerks among 20-65 year old White males, Los Angeles County Cancer Surveillance Program, 1972-90

	Cases/total	OR[a]	(CI)[a]
Indoor occupations			
Salesman[b]	293/5,133	1.0	—
Funeral director/embalmer	6/27	5.3	(2.1-13.6)
Dentist	21/137	3.1	(1.9-5.1)
Flight attendant	4/16	2.6	(0.8-8.2)
Teacher (pre-college)[c]	35/287	2.4	(1.7-3.5)
Secretary	11/80	2.3	(1.2-4.4)
Lawyer/judge/law professor	99/754	2.1	(1.7-2.7)
Photographic engineer/lithographer	8/73	2.0	(0.9-4.2)
Scientist/college professor[d]	60/642	2.0	(1.4-2.7)
Bank manager/stock broker	73/649	1.9	(1.4-2.5)
Physician/pharmacist	71/739	1.8	(1.3-2.3)
Chemist	11/113	1.7	(0.9-3.2)
Airline pilot	9/94	1.6	(0.8-3.2)
Photographer	14/151	1.5	(0.9-2.7)
Computer programmer/analyst	41/342	1.5	(1.0-2.1)
Accountant	90/1,079	1.4	(1.1-1.8)
Engineer[e]	75/1,011	1.3	(1.0-1.7)
Office clerk[f]	23/363	0.8	(0.5-1.2)
Machinist	45/1,415	0.6	(0.4-0.8)
Radiology technician	2/38	0.6	(0.1-2.6)
Janitor	30/1,004	0.6	(0.4-0.9)
Cook	11/331	0.6	(0.3-1.0)
Assembler/bottler/checker/polisher	20/722	0.5	(0.3-0.8)
Operator: drill press/grinder/lathe/punch/stamp/riveter	5/223	0.4	(0.2-1.0)
Jeweler/watchmaker	2/88	0.4	(0.1-1.7)
Bookkeeper	3/129	0.4	(0.1-1.1)
Meat cutter	4/245	0.3	(0.1-0.9)
Bartender	7/476	0.3	(0.1-0.5)
Indoor/outdoor occupations			
Sign painter/letterer	5/29	4.0	(1.5-10.9)
Religious worker (nonclergy)	5/24	3.8	(1.4-10.6)
Chemical technician	6/36	3.0	(1.2-7.4)
Clergy	22/194	2.2	(1.4-3.5)
Teacher (pre-college)[g]	103/813	2.2	(1.7-2.8)
Fireman	27/233	2.1	(1.4-3.2)
Police/marshall/sheriff	66/494	2.1	(1.6-2.8)
Scientist/college professor[h]	12/106	2.0	(1.0-3.7)
Engineer[i]	187/2,575	1.4	(1.1-1.7)
Carpenter/cabinet maker	39/1,026	0.7	(0.5-0.9)
Truck driver	62/1,684	0.6	(0.5-0.8)
Guard/watchman	18/641	0.5	(0.3-0.9)
Freight/stock handler	9/285	0.5	(0.3-1.0)
Outdoor occupations			
Surveyor	7/54	2.4	(1.1-5.5)
Athlete	7/60	1.7	(0.8-3.9)
Delivery man	14/224	1.1	(0.6-1.9)
Gardener	18/283	1.1	(0.7-1.8)

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occupational sunlight exposure category. Among indoor workers, those with relatively high melanoma odds include funeral directors and embalmers, dentists, flight attendants, teachers with indoor specializations, secretaries, law professionals, photographic engineers and lithographers, scientists and professors with indoor specializations, bank managers and stock brokers, physicians and pharmacists, and to a lesser degree,

Table 5. Continued

	Cases total	OR[a]	(CI)[a]
Farmer	3/65	1.1	(0.3-3.4)
Mail carrier	14/286	1.0	(0.6-1.8)
Road crew	6/125	0.8	(0.4-1.8)
Sailor	5/130	0.8	(0.3-1.9)
Construction worker[j]	28/741	0.6	(0.4-0.9)

[a] OR = odds ratio; CI = 95% confidence interval.
[b] Salesman, counter/shipping/stock clerk, cashier, teller, buyer, bill collector, credit man.
[c] Indoor specializations: math, science, social science, fine arts, language, adult education.
[d] Indoor specializations: math, statistics, astronomy, physics, economics, political science, psychology, unspecified social science.
[e] Indoor specializations: electrical, industrial, mechanical, metal and material.
[f] File clerk, receptionist, telephone operator, office equipment operator, typist.
[g] Indoor/outdoor specializations: elementary, physical education, unspecified secondary.
[h] Indoor/outdoor specializations: agriculture, atmosphere/space, geology, biology, marine, unspecified physical/life, urban planning, sociology.
[i] Indoor/outdoor specializations: aerospace, chemical, petroleum, mining, civil, sales, unspecified.
[j] Construction/cement worker, crane/bulldozer operator, brickmason, roofer.

airline pilots, accountants, computer programmers, and engineers with indoor specializations. Among indoor/outdoor workers, those with relatively high melanoma odds include sign painters and letterers, lay religious workers, chemical technicians, clergy, teachers with indoor/outdoor specializations, firemen, police officers and sheriffs, scientists and college professors with indoor/outdoor specializations, and to a lesser extent engineers with indoor/outdoor specializations. Among outdoor workers, only surveyors display a clear increase in melanoma odds.

Indoor workers with relatively low melanoma odds include bartenders, meat cutters, factory workers, janitors, and machinists. Indoor/outdoor workers with reduced melanoma odds include guards and watchmen, truck drivers, and carpenters. Outdoor workers with clearly low melanoma odds are limited to construction and related workers. A few occupations with greater than 20 observations yielded no cases of melanoma (with 20 or more observations at least one case of melanoma would be expected); indoor workers: pattern/model makers ($n = 45$), shoe repairmen ($n = 41$), busboy/dishwasher ($n = 37$), nonprivate housekeepers ($n = 21$), outdoor workers: miners ($n = 62$), electrical power linemen ($n = 56$), farm workers ($n = 36$).

Discussion

The overall effects estimated for occupational sunlight exposure, weakly implicating outdoor work, do not provide solid evidence for an influence of sun exposure during work on melanoma occurrence. The occupation-specific estimates, which can be compared within categories of occupational sun exposure and education, do reveal a pattern of melanoma occurrence linked to education level and minimally influenced by occupational exposure to sunlight. Three professional groups spanned indoor and indoor/outdoor specializations: scientists and college professors, teachers, and engineers; within each of these occupations the effect estimates are very similar across categories of occupational exposure to sunlight.

Except for dentists, the occupations with estimated relative risks greater than 2.5—*i.e.*, funeral director/embalmer, sign painter/letterer, lay religious worker, and chemical technician—are based on five or six melanoma cases out of a total of 24 to 36 cases. These occupations have little in common and although they exclude the null value, the confidence intervals around these estimates are wide.

Melanoma has been reported to occur after immunosuppression, and several of the occupations linked to high melanoma occurrence in LAC males are among those likely to be held by men with AIDS. For these reasons, we examined proportional melanoma incidence relative to the distribution of Kaposi's sarcoma across occupations in the study population. Overall, melanoma was not more common among occupations with a high proportion of Kaposi's sarcoma cases.

The strong association with education level supports the notion of a critical exposure period during youth because the attained education level is determined strongly by socioeconomic status during early life. Further evidence of the importance of childhood exposure in determining melanoma risk is the OR of

1.80 associated with California birth, a proxy for youthful residence in a sunny climate. This OR is likely to underestimate the effect of growing up in California because data relevant to migration show that a considerable proportion of cases registered by the Los Angeles County Cancer Surveillance Program were born at more northerly latitudes and moved permanently to California at an early age; this number is much larger than the number who were born in California, spent their youth elsewhere and returned before diagnosis.[4]

Cancer registry records have characteristics that must be considered. The recorded occupation is based on information listed in the medical record at the time of diagnosis and does not reflect the entire occupational history; it is, however, likely to represent the individual's occupation prior to becoming ill. Although occupational stability varies by occupation, there is no reason to suppose that such stability is different for melanoma cases and other cancer cases within occupations. Misclassification on occupation is therefore likely to be nondifferential and probably would contribute to an underestimation of occupational effects; the same would be true for misclassification arising from the use of job titles to classify exposure to sunlight during work.

One identifiable group with inadequate information on occupation includes those older men classified as retired. These cases were excluded because their socioeconomic status and the nature of their daily activity is unknown. The proportion of melanoma cases classified as retired was 4.0 percent, whereas 8.1 percent of other cancer cases were classified as retired; the discrepancy is presumably due to the older age distribution of other cancers. In order to observe the extent to which retired cases deviate from average on melanoma occurrence independent of age, the retired category was compared to the reference group of salesmen to estimate the age-adjusted OR for melanoma; the resulting estimate, 0.94 (CI = 0.78-1.13), suggests that cases classified as retired comprise a group that is fairly representative of LAC cancer cases in general when age is taken into account.

The proportion of cases with unreported occupations differs between melanomas (24 percent) and other cancers (17 percent). We believe this is because melanoma diagnoses are more likely to occur in outpatient clinics where occupation is less likely to be recorded than it is in hospital admissions. The age-adjusted odds of melanoma are 1.37 (CI = 1.21-1.55) times greater among those with unreported occupations relative to the reference group of salesmen. If this excess is explained by a higher proportion of outpatient melanoma diagnoses, the excluded melanoma cases with unreported occupations may represent an excess of more affluent and highly educated individuals. Such a selection bias would result in an underestimate of the effect of education. The same selection mechanism may have preferentially excluded melanoma cases with indoor occupations; this might explain the slight elevation in relative risk observed among persons who spend part or all of their workday outdoors.

A comprehensive review of reported studies of melanoma occurrence by occupation shows overall consistency of the LAC occupation-specific results with those produced by various methodologic approaches.[1] One recent study[6] of all cutaneous melanomas occurring in Sweden during 1961-79 reported age-adjusted standardized registry ratios using population denominators for each occupation. The following occupations conveyed excess melanoma risk in Swedish men: airline pilot, judge, accountant, finance broker, secretary, chemist, teacher, dentist, pharmacist, and physician, as well as bank and office clerk, housekeeper, journalist, and military position. Low risk occupations were not listed. The same report presented proportionate registration (incidence) ratios by occupation for 3,991 cutaneous melanomas occurring in England and Wales during 1971-78, implicating a similar list of high status professions, additionally including cleric and surveyor. Some of the variation observed in diverse settings may result from differences in the socioeconomic characteristics of the reference group.

The overpowering effect of education relative to that of exposure to sunlight during work suggests that some lifestyle factor other than occupation strongly determines melanoma risk. The particularly pronounced association of education level with melanomas of the leg and the exceptional occurrence of melanomas of the leg in artists and entertainers constitute additional evidence of exposures unrelated to work that increase the risk of melanoma, given that men's legs are generally protected from sources of light during work. Other studies have shown that elevations in melanoma occurrence among indoor workers correspond to normally covered parts of the body,[10] while several reports have linked recreational outdoor activities to melanoma risk.[3] A logical conclusion is that the lifestyle common among well-educated persons, characterized by prolonged periods of minimal exposure to the sun interspersed with sporadic recreational sunlight exposure, increases the risk of melanoma.

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Appendix. Listing of occupations forming education/training levels

Low-skill (10 most frequent)

Truck driver, janitor, guard/watchman, bartender, welder, construction worker, cook, checker, assembler, stock handler

Skilled (10 most frequent)

Machinist, carpenter, painter, electrician, auto mechanic, plumber, aircraft mechanic, tool and die, sheetmetal worker, heavy equipment mechanic

Artist/entertainer

Actor, athlete, author, dancer, designer, decorator, entertainer, musician/composer, painter, photographer, sculptor

High school (10 most frequent)

Salesman, real estate agent, sales manager, office clerk, restaurant manager, buyer, expediter, mail carrier, shipping clerk, stock clerk

Technical/vocational

Technician, policeman, fireman, draftsman, bookkeeper, sheriff/bailiff, real estate appraiser, statistical clerk, practical nurse, surveyor

College

Airline pilot, air traffic controller, advertising agent, computer programmer, editor/reporter, flight attendant, forester, personnel/labor relations, office manager, public administration official, publicity writer, radio/t.v. announcer

Postgraduate

Accountant, architect, bank manager, computer specialist, engineer, librarian, archivist, actuary, chiropractor, podiatrist, dietician, registered nurse, therapist, clergy, social worker, non-university teacher/counselor, health administrator, school administrator

Doctorate

Lawyer, judge, dentist, optometrist, pharmacist, physician, veterinarian, scientist, college professor, college administrator