

Solar ultraviolet light: summary of epidemiologic evidence

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1. Overall summary

This section summarizes epidemiologic evidence cited in the tables below. The summary is limited to epidemiologic studies of the role of childhood sun exposure in adult skin cancer. I would appreciate feedback on any errors or omissions. don.wigle@sympatico.ca

| Health effect | Level of evidence ^a | Comments |
|---------------------------------------|---|---|
| Malignant melanoma of skin (adults) | Childhood sun exposure Sufficient | This summary is based on recent reviews and meta-analyses and original publications since 2000. Case-control studies in Europe found associations between melanoma and sunburns and hours of beach vacation during childhood (Rosso et al 1998, Pfahlberg et al 2001, Kaskel et al 2001). In their review and meta-analysis, Armstrong and Kricger (2001) concluded that melanoma associated with intermittent (recreational) and total but not occupational sun exposure. Another review concluded that the 13 case-control studies that assessed melanoma and childhood sun exposure showed no consistent effect of age-specific sun exposure (Whiteman et al 2001). A meta-analysis of 57 epidemiologic studies showed a stronger association between melanoma and a history of sunburns during childhood compared to sunburns during adulthood; the difference, however, was not statistically significant (Gandini et al 2005b). A meta-analysis of 57 epidemiologic studies showed a stronger association between melanoma and a history of sunburns during childhood compared to sunburns during adulthood; the difference, however, was not statistically significant (Gandini et al 2005). Another meta-analysis of 46 epidemiologic studies by Gandini et al (2005a) found dose-response relationships between melanoma and the numbers of common or atypical nevi on the whole body. Given that common and atypical nevi are associated with childhood sun exposure (e.g., see (Dulon et al. 2002)), the two meta-analyses by Gandini et al both point to the importance of childhood sun exposure as a cause of adult melanoma. |
| | Protective effect of sunscreen use (Inadequate) | A meta-analysis of 18 case-control studies found no overall association between melanoma and ever-use of sunscreens; there was an inverse association (i.e., protective effect) in the subgroup of 5 studies that adjusted for sun sensitivity and sunburn history (Dennis et al 2003). |
| Basal cell carcinoma of skin (adults) | Childhood sun exposure (Limited) Lifetime sun exposure Sufficient | A European case-control study found an association between basal cell carcinoma of skin and hours of beach vacation but not sunburns during childhood (Rosso et al 1998). A hospital-based case-control study in Italy also found no association between basal cell carcinoma and history of sunburn before age 20 years (Corona et al 2001). Other European case-control studies found associations between basal cell carcinoma and childhood sunburns (Naldi et al 2000) and lifetime average frequency of beach vacations (Vlajinac et al 2000) and number of beach vacations before age 20 years (Corona et al 2001). A large US longitudinal cohort study found associations between basal cell carcinoma of skin and adolescent frequency of summertime outdoor activities in swimsuits and lifetime number of |

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| | | blistering sunburns (van Dam et al 1999). A literature review and meta-analysis concluded that basal cell carcinoma was associated with intermittent (recreational) and occupational but not total sun exposure (Armstrong and Kricger 2001). |
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^a Sufficient evidence = based on peer-reviewed reports of expert groups or authoritative reviews that concluded that a causal relationship existed; limited evidence = relationships for which several epidemiologic studies, including at least one case-control or cohort study, showed fairly consistent associations and evidence of exposure-risk relationships after control for potential confounders; inadequate evidence = relationships for which epidemiologic studies were limited in number and quality (e.g., small studies, ecologic studies, limited control of potential confounders), had inconsistent results, or showed little or no evidence of exposure-risk relationships. Levels in parentheses are the author's interpretation of available evidence; other levels are based on expert group reviews.

2. Malignant melanoma of skin (adults)

| Reference, location | Design | Exposure | Results | Association ¹ | Covariates |
|--|---|----------|---|--|---------------------------------------|
| (Rosso et al. 1998), Turin, Italy, Spain, France | Case-control studies: 260 cases melanoma and 416 population controls from Italy; 420 cases basal cell carcinoma and 419 controls from all 3 countries | | Melanoma associated with sunburns during childhood; odds ratio | 3.8 (2.2-6.4) | Age, sex |
| | | | Melanoma associated with hours of beach vacation during childhood; odds ratios, 1-1600 and >1600 vs 0 | 1.8 (1.2-2.7) 1.3 (0.8-2.0) p-trend=0.05 | As above |
| (Pfahlberg et al. 2001), 7 European countries | Case-control study, 603 cases, 627 controls, 1994-1997 | | Melanoma associated with number of sunburns during childhood, independent of sunburns during adulthood; odds ratios, 1-2, 3-5 and 6+ vs 0 sunburns during childhood | 1.1 (0.8-1.5) 1.3 (0.9-1.9) 1.6 (0.9-2.8) | |
| (Armstrong and Kricger 2001), Australia | Review and meta-analysis of epidemiologic studies of skin cancer and sun exposure | | Melanoma associated with intermittent (recreational) and total but not occupational sun exposure; pooled odds ratios | intermittent 1.7 (1.5-1.9) occupational 0.9 (0.8-1.0) | |
| | | | | total 1.2 (1.0-1.4) | |
| (Kaskel et al. 2001), Munich, Germany | Case-control study, 271 melanoma cases, 271 controls, 1996-97 | | Melanoma associated with history of sunburn during childhood; odds ratio, ever vs never | 1.9 (0.9-4.2) | Matched for residence, age and gender |
| (Whiteman et al. | Review of 20 epidemiologic studies of | Variable | 13 case-control studies assessed | | |

¹ Entries in this column include odds ratios, relative risks and certain other statistical measures of association as published in original epidemiologic studies; an entry of '+' means the measure of association was not an odds ratio or relative risk and was statistically significant at the 0.05 level; an entry of '(+)' means the association was almost statistically significant.

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| 2001), Australia | melanoma and childhood sun exposure published by 1999 | measurement of childhood sun precluded a meta-analysis | melanoma and childhood sun exposure but no consistent effect of age-specific sun exposure was observed | |
| (Dennis et al. 2003), USA | Meta-analysis, 18 case-control studies of melanoma and sunscreen use, published by April 2003 | | Melanoma not associated with ever-use of sunscreens (pooled odds ratio) | 1.0 (0.8-1.2) |
| | | | Inverse association between melanoma and ever-use of sunscreens among the 5 studies that adjusted for sun sensitivity and sunburns (pooled odds ratio) | 0.8 (0.7-0.9) |
| (Gandini et al. 2005b), European Institute of Oncology, Italy | Meta-analysis, 57 epidemiologic studies of melanoma and sun exposure published before September 2002 (5 cohort, 2 case-control nested within cohort and 50 case-control studies) | | Melanoma associated with intermittent sun exposure and sunburn history (pooled relative risk) | intermittent sun 1.6 (1.3-2.0) |
| | | | Association between melanoma and sunburn stronger for sunburn during childhood (pooled relative risks) | childhood sunburns 2.0 (1.5-2.7) |
| | | | | adulthood sunburns 1.5 (1.3-1.9) |
| (Gandini et al. 2005a), European Institute of Oncology, Italy | Meta-analysis, 46 epidemiologic studies of melanoma and nevi published before September 2002 (8 cohort, 2 case-control nested within cohort and 36 case-control studies) | | Dose-response relationship between melanoma and number of common nevi on whole body (pooled relative risks, 16-40, 41-60, 61-80, 81-100 and 101-120 vs 0-15) | 1.5 (1.4-1.6) 2.2 (1.9-2.6) 3.3 (2.6-4.2) 4.7 (3.4-6.5) 6.9 (4.6-10) |
| | | | Dose-response relationship between melanoma and number of atypical nevi on whole body (pooled relative risks, 1, 2, 3, 4 and 5 vs 0) | 1.6 (1.4-1.9) 2.6 (1.9-3.4) 4.1 (2.6-6.4) 6.6 (3.7-12) |

Malignant melanoma of skin (adults): summary

This summary is based on recent reviews and meta-analyses and original publications since 2000. Case-control studies in Europe found associations between melanoma and sunburns and hours of beach vacation during childhood (Rosso et al 1998, Pfahlberg et al 2001, Kaskel et al 2001). In their review and meta-analysis, Armstrong and Kricger (2001) concluded that melanoma associated with intermittent (recreational) and total but not occupational sun exposure. Another review concluded that the 13 case-control studies that assessed melanoma and childhood sun exposure showed no consistent effect of age-specific sun exposure (Whiteman et al 2001). A meta-analysis of 18 case-control studies found no overall association between melanoma and ever-use of sunscreens; there was an inverse association (i.e., protective effect) in the subgroup of 5 studies that adjusted for sun sensitivity and sunburn history (Dennis et al 2003). A meta-analysis of 57 epidemiologic studies showed a stronger association between melanoma and a history of sunburns during childhood compared to sunburns during adulthood; the difference, however, was not statistically significant (Gandini et al 2005b). A meta-analysis of 57 epidemiologic studies showed a stronger association between melanoma and a history of sunburns during childhood compared to sunburns during adulthood; the difference, however, was not statistically significant (Gandini et al 2005). Another meta-analysis of 46 epidemiologic studies by Gandini et al (2005a) found dose-response relationships between melanoma and the numbers of common or atypical nevi on the whole body. Given that common and atypical nevi are associated with childhood sun exposure (e.g., see (Dulon et al. 2002)), the two meta-analyses by Gandini et al both point to the importance of childhood sun exposure as a cause of adult melanoma.

3. Basal cell carcinoma of skin (adults)

| Reference, location | Design | Exposure | Results | Association ² | Covariates |
|--|---|----------|--|--|---|
| (Rosso et al. 1998), Turin, Italy, Spain, France | Case-control studies: 260 cases melanoma and 416 population controls from Italy; 420 cases basal cell carcinoma and 419 controls from all 3 countries | | Basal cell carcinoma not associated with sunburns during childhood; odds ratio | 1.3 (0.7-2.3) | Age, sex |
| | | | Basal cell carcinoma associated with hours of beach vacation during childhood; odds ratios, 1-1600 and >1600 vs 0 | 1.9 (1.4-2.7) 3.0 (2.1-4.2) p-trend=0.02 | As above |
| (van Dam et al. 1999), USA | Cohort study, 3273 cases of basal cell carcinoma among 44,591 male health professionals, age 40-75 yr; self-reported basal cell carcinomas during follow-up 1986-1994 | | Basal cell carcinoma associated with frequency of summertime outdoor activities in swimsuit as teenagers; odds ratios, 1, 2 or several vs 0 times/wk | 1.4 (1.1-1.8) 1.2 (1.0-1.6) 1.3 (1.0-1.6) 1.4 (1.1-1.8) p-trend<0.05 | |
| | | | Basal cell carcinoma associated with lifetime number of blistering sunburns (p trend < 0.0001) | | |
| (Naldi et al. 2000), Italy | Multicentre case-control study, 528 cases basal cell carcinoma, 512 controls | | Basal cell carcinoma associated with number of sunburns before age 15 yr; odds ratios, 1 and 2+ vs 0 sunburns | 2.8 (1.9-4.1) 3.9 (1.6-9.2) | |
| (Vlajinac et al. 2000), Yugoslavia | Hospital-based case-control study, 200 cases basal cell carcinoma, 399 controls | | Basal cell carcinoma associated with freckling before age 15 yr; odds ratio | 2.7 (1.3-5.5) | Eye colour, susceptibility to sunburn, beach vacations, outdoor work in summer, occupational chemical |

² Entries in this column include odds ratios, relative risks and certain other statistical measures of association as published in original epidemiologic studies; an entry of '+' means the measure of association was not an odds ratio or relative risk and was statistically significant at the 0.05 level; an entry of '(+)' means the association was almost statistically significant.

| | | | | exposure, previous basal cell carcinoma, history of acne, cosmetic use of tar |
|---|--|--|--|---|
| | | Basal cell carcinoma associated with 7+ wk/yr of beach vacation (lifetime average); odds ratio | 1.8 (1.2-2.6) | As above minus beach vacations and plus childhood freckling |
| (Armstrong and Kricger 2001), Australia | Review and meta-analysis of epidemiologic studies of skin cancer and sun exposure | Basal cell carcinoma associated with intermittent (recreational) and occupational but not total sun exposure; pooled odds ratios | intermittent 1.4 (1.2-1.5) occupational 1.2 (1.1-1.3) total 1.0 (0.7-1.4) | |
| (Corona et al. 2001), Italy | Hospital-based case-control study, 166 cases basal cell carcinoma, 158 controls, 1995-1997 | Basal cell carcinoma associated with number of beach vacations before age 20 yr; odds ratios, 3-4, 5-8 and 9+ vs 0-2 | 1.8 (0.8-4.4) 3.7 (1.5-9.0) 4.5 (1.9-11) | Age, sex, pigmentation, family history skin cancer |
| | | Basal cell carcinoma not associated with history of sunburn before age 20 yr; odds ratio, yes vs no | 0.9 (0.4-1.6) | |

Basal cell carcinoma of skin (adults): summary

A European case-control study found an association between basal cell carcinoma of skin and hours of beach vacation but not sunburns during childhood (Rosso et al 1998). A hospital-based case-control study in Italy also found no association between basal cell carcinoma and history of sunburn before age 20 years (Corona et al 2001). Other European case-control studies found associations between basal cell carcinoma and childhood sunburns (Naldi et al 2000) and lifetime average frequency of beach vacations (Vlajinac et al 2000) and number of beach vacations before age 20 years (Corona et al 2001). A large US longitudinal cohort study found associations between basal cell carcinoma of skin and adolescent frequency of summertime outdoor activities in swimsuits and lifetime number of blistering sunburns (van Dam et al 1999). A literature review and meta-analysis concluded that basal cell carcinoma was associated with intermittent (recreational) and occupational but not total sun exposure (Armstrong and Kricger 2001).

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