



Ontario

Cancer Care Ontario

Action Cancer Ontario



# Cancer Risk Factors in Ontario

Ultraviolet Radiation



# ULTRAVIOLET RADIATION

Risk factor/exposure	Cancer	Direction of association	Magnitude of risk*			Strength of evidence <sup>a</sup>
			Total exposure	Intermittent exposure	Chronic exposure	
Solar ultraviolet (UV) radiation	Skin (melanoma)	↑	1.34 <sup>b</sup>	1.61 <sup>b</sup>	0.95 <sup>b</sup>	Sufficient
	Skin (BCC)	↑	0.98 <sup>c</sup>	1.38 <sup>c</sup>	1.19 <sup>c</sup>	
	Skin (SCC)	↑	1.53 <sup>c</sup>	0.91 <sup>c</sup>	1.64 <sup>c</sup>	
	Lip	↑	...	...	...	Limited
	Eye	↑	...	...	...	
UV-emitting indoor tanning devices	Skin (melanoma)	↑		1.15–1.22 <sup>d,e</sup>		Sufficient
	Eye	↑		1.30–3.40 <sup>a</sup>		Limited
	Skin (SCC)	↑		...		

Abbreviations: UV= ultraviolet; BCC= basal cell carcinoma; SCC=squamous cell carcinoma

Sources: <sup>a</sup>IARC, 2012; <sup>b</sup>Gandini S, 2005; <sup>c</sup>Armstrong, 2001; <sup>d</sup>International Agency for Research on Cancer Working Group on artificial ultraviolet (UV) light and skin cancer, 2006; <sup>e</sup>Hirst, 2009

\*Relative risk (RR) estimate for: highest exposure category to lowest for estimates of solar ultraviolet radiation; ever vs. never-use of UV-emitting tanning devices. ...Magnitude of risk not shown in table if strength of evidence is “probable” or “limited.”

## SOLAR ULTRAVIOLET RADIATION

### Background

- » Ultraviolet radiation (UVR) is a type of electromagnetic radiation that can be further subdivided into UVA, UVB and UVC.<sup>91</sup>
- » Sunlight is the major source of human exposure to UVR and is comprised largely of UVA, with a small component of UVB by the time it reaches the earth’s surface.<sup>91</sup>
- » UVR exposure can be classified into three types, based on the pattern of sun exposure: intermittent exposure (i.e., periodic bursts of exposure received, for example, during recreational outdoor activities), chronic exposure (i.e., more continuous exposure, often synonymous with exposures received in outdoor occupations) and total exposure (i.e., the combination of intermittent and chronic exposures).

- Solar and UV radiation have been classified as **carcinogenic** to humans (Group 1) by the International Agency for Research on Cancer (IARC).<sup>91</sup> According to IARC, there is sufficient evidence that solar UV radiation causes all major skin cancer types, including cutaneous melanoma, basal cell carcinoma (BCC) and squamous cell carcinoma (SCC). Limited evidence suggests that solar UV radiation also causes cancer of the lip and eye (conjunctival squamous cell carcinoma and ocular melanoma).<sup>91</sup>

- The relationship between solar UVR and skin cancer is complex:
  - Total cumulative lifetime exposure influences risk, but the pattern of sun exposure may be particularly important for different types of skin cancer. Cutaneous melanoma risk appears most strongly related to intermittent UV exposure,<sup>91-93</sup> while chronic exposure appears most important for SCC.<sup>91,94</sup> BCC generally shows an association with intermittent and chronic exposure (measured by objective indicators of skin damage) that is more modest in magnitude than the relationship of these exposures with melanoma and SCC.<sup>91,94</sup>
  - Cutaneous melanoma risk appears to depend on the body part exposed,<sup>91,95,96</sup> and dose and timing of exposure, with indications that childhood exposure may be particularly important.<sup>97,98</sup>
- Personal characteristics and exposures can modify the relationship between solar UVR exposure and cancer risk:
  - People with certain phenotypic characteristics—fair skin, light eyes, blond or red hair, and a tendency to burn rather than tan when exposed to sunlight—have higher susceptibility to UVR damage and subsequent risk of all types of skin cancer.<sup>91,94</sup>
  - People with certain rare genetic conditions (e.g., xeroderma pigmentosum, basal cell nevus syndrome)<sup>99</sup> and those sensitive to UVR due to immunosuppression (e.g., organ transplant recipients, patients with acquired immunodeficiency syndrome [AIDS] or human immunodeficiency virus [HIV]) and/or those who use certain photosensitizing agents (e.g., psoralens)<sup>91</sup> have high susceptibility to UVR damage.
- Individuals with outdoor occupations typically have chronic solar UVR exposure and are therefore at particularly high risk of developing squamous cell carcinoma. Outdoor workers typically demonstrate a lower risk of melanoma, but this observation may reflect self-selection of people at low risk of melanoma to outdoor work.<sup>91</sup>

## ULTRAVIOLET RADIATION EMITTING TANNING DEVICES

### Background

- » UV-emitting indoor tanning devices, including sunbeds and sunlamps, are the main source of deliberate exposure to artificial UVR and are primarily used for cosmetic purposes.<sup>91</sup>
- » Indoor tanning devices may have a UV intensity as much as 10–15 times stronger than the midday sun.<sup>91</sup>

- UV-emitting tanning devices are classified by IARC as **carcinogenic** to humans (Group 1). There is sufficient evidence that UV-emitting tanning devices cause cutaneous and ocular melanoma. There is limited evidence that UV-emitting indoor tanning devices cause squamous cell carcinoma.<sup>91</sup>
- Ever-use of indoor tanning devices increases the risk of cutaneous melanoma by 15%–22%,<sup>100,101</sup> with evidence that risk increases with greater frequency of use.<sup>102-104</sup> The few studies that have examined ocular melanoma risk have shown from 30% to as much as 3 times the risk compared with non-users for the highest exposure categories.<sup>91</sup> There is also some indication of a positive **dose-response** relationship.<sup>91</sup>
- The use of UV-emitting indoor tanning devices during adolescence and young adulthood may be associated with a particularly high risk of cutaneous and ocular melanoma.<sup>91,100,105,106</sup>

## OTHER ARTIFICIAL SOURCES OF ULTRAVIOLET RADIATION

- Other artificial sources of UV radiation include medical and dental applications, arc welding and industrial lamps.
- There is sufficient evidence in humans for the [carcinogenicity](#) of welding. Epidemiologic evidence supports a causal association between welding and ocular melanoma; whether this can be attributed to UV radiation is currently unknown.<sup>91</sup>

## BIOLOGIC MECHANISMS

- UV radiation exposure can induce [carcinogenesis](#) in several ways:<sup>64</sup>
  - UV radiation can damage DNA, either directly through the absorption of UVB or indirectly through the generation of reactive oxygen and/or nitrogen species in response to UVA.
  - UV radiation may introduce DNA mutations, including mutations to genes controlling cell proliferation ([oncogenes](#) and [tumour suppressor genes](#)) or cell signalling, and genes that code for enzymes that can detoxify by-products of [oxidative stress](#).
  - UV radiation can interact with the immune system to suppress local and systemic immune responses.