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Istituto Europeo di Oncologia

# Reviews and Meta-analyses of Sun exposure and indoor tanning and skin cancer

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# Phenotypical factors and melanoma

Meta-analysis on 354 papers

Risk factors	Categories	Melanoma SRR 95%CI
Eye colour	Blue vs. Dark	1.47 (1.28, 1.69)
	Green vs. Dark	1.61 (1.06, 2.45)
	Hazel vs. Dark	1.52 (1.26, 1.83)
Hair colour	Red vs. Dark	3.64 (2.56, 5.37)
	Blond vs. Dark	1.96 (1.41, 2.74)
	Light brown vs. Dark	1.62 (1.11, 2.34)
Skin colour	Light vs. Dark	2.06 (1.68, 2.52)

# Other melanoma risk factors

Meta-analysis on 354 papers

Risk factors	Categories	SRR 95%CI
CMM Family history	Yes vs. No	1.74 (1.41, 2.14)
Actinic damage indicators	Pre-malignant and other skin-cancer lesions vs. No	4.28 (2.80, 6.55)
	Other indicators vs. No	2.02 (1.24, 3.29)
Density of freckles	High vs. Low	2.10 (1.80, 2.45)
Phototype	I vs. IV	2.09 (1.67, 2.58)
	II vs. IV	1.84 (1.43, 2.36)
	III vs. IV	1.77 (1.23, 2.56)

# Sun exposure and melanoma (CMM)

Meta-analysis on 354 papers

<b>RISK FACTORS</b>	<b>Summary RR high vs low exp.</b>
<b>Sunburns</b>	<b>2.03 (1.73; 2.37)</b>
<b>Total sun exposure</b>	<b>1.34 (1.02; 1.77)</b>
<b>Continuous pattern sun exp.</b>	<b>0.95 (0.87; 1.04)</b>
<b>Intermittent pattern sun exp.</b>	<b>1.61 (1.31; 1.99)</b>

# Meta-Analysis of risk factors by CMM body site and histological subtype rationale

Two phenotypic expressions at risk:

- Fair skin, red hair, prone to freckles with few naevi.
- Darker skin complexion and many naevi.

CMM may arise from at least two pathways and the initiating factors may differ:

- One related to **occupational sun exposure** for CMM of the exposed body site (head), at **older age: LMM**
- The other related to melanocyte instability (many **naevi**) and **sunburns** for CMM of the **trunk, younger age: SSM**

# Meta-analyses for melanoma by histological sub-types and body sites

24 studies (16,180 cases)

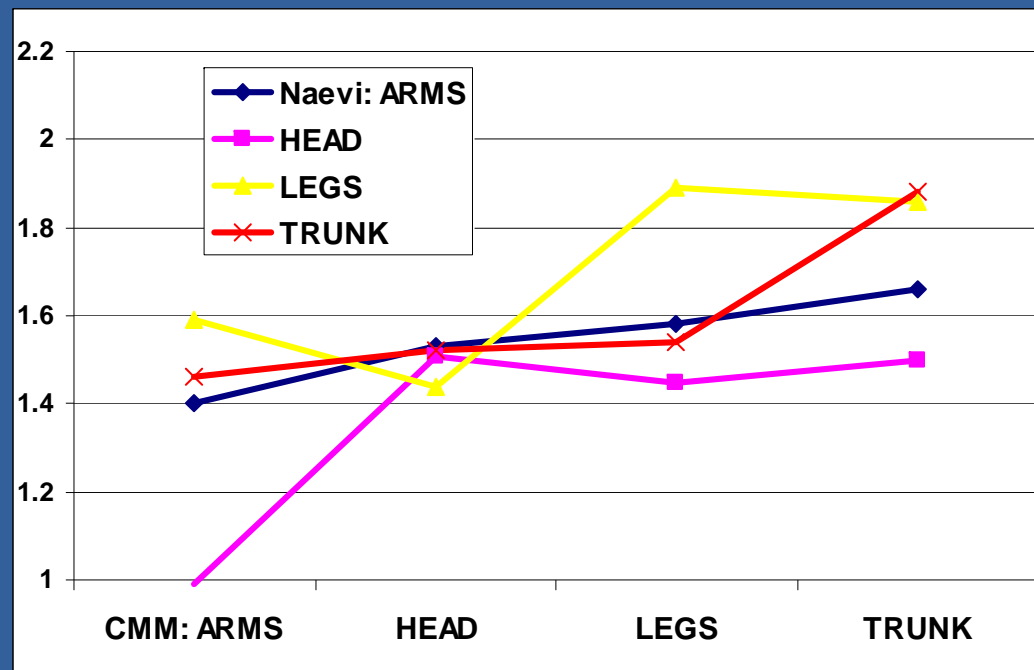
<b>Histological sub-types</b>	<b>Sunburn</b>	<b>Actinic damage</b>
<b>LMM</b>	<b>1.58 (0.79, 3.15)</b>	<b>2.36 (0.82, 6.82)</b>
<b>NM</b>	<b>0.91 (0.50, 1.65)</b>	<b>1.88 (0.63, 5.61)</b>
<b>SSM</b>	<b>1.56 (1.26, 1.93)</b>	<b>1.94 (1.13, 3.34)</b>

# Summary RRs for +5 naevi

	CMM: ARMS	HEAD	LEGS	TRUNK
Naevi: ARMS	1.40 (1.20,1.62)	1.53 (1.27,1.84)	1.58 (1.36,1.82)	1.66 (1.44,1.92)
HEAD	<b>0.99</b> <b>(0.81,1.20)</b>	1.51 (1.25,1.83)	1.45 (1.22,1.71)	1.50 (1.26,1.78)
LEGS	1.59 (1.35,1.87)	1.44 (1.20,1.71)	1.89 (1.63,2.18)	1.86 (1.59,2.16)
TRUNK	1.46 (1.22,1.73)	1.52 (1.26,1.83)	1.54 (1.31,1.80)	<b>1.88</b> <b>(1.62,2.18)</b>

**P=0.005**

Melanocyte proliferation is an important requirement for unexposed body sites



# **MA on Artificial UV and skin cancer**

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## **IARC Conclusions**

There is evidence of an increase risk in the general population for ever exposure to sunbed/sunlamp and a clear increase in CMM risk in teens and twenties.

IARC moved UV to the first of five risk categories: sufficient evidence to define UV as carcinogenic to humans.

However there was no enough data to evaluate a dose-response effect with artificial light.



# Artificial UV and melanoma update

27 Included studies (n= 9512 cases)

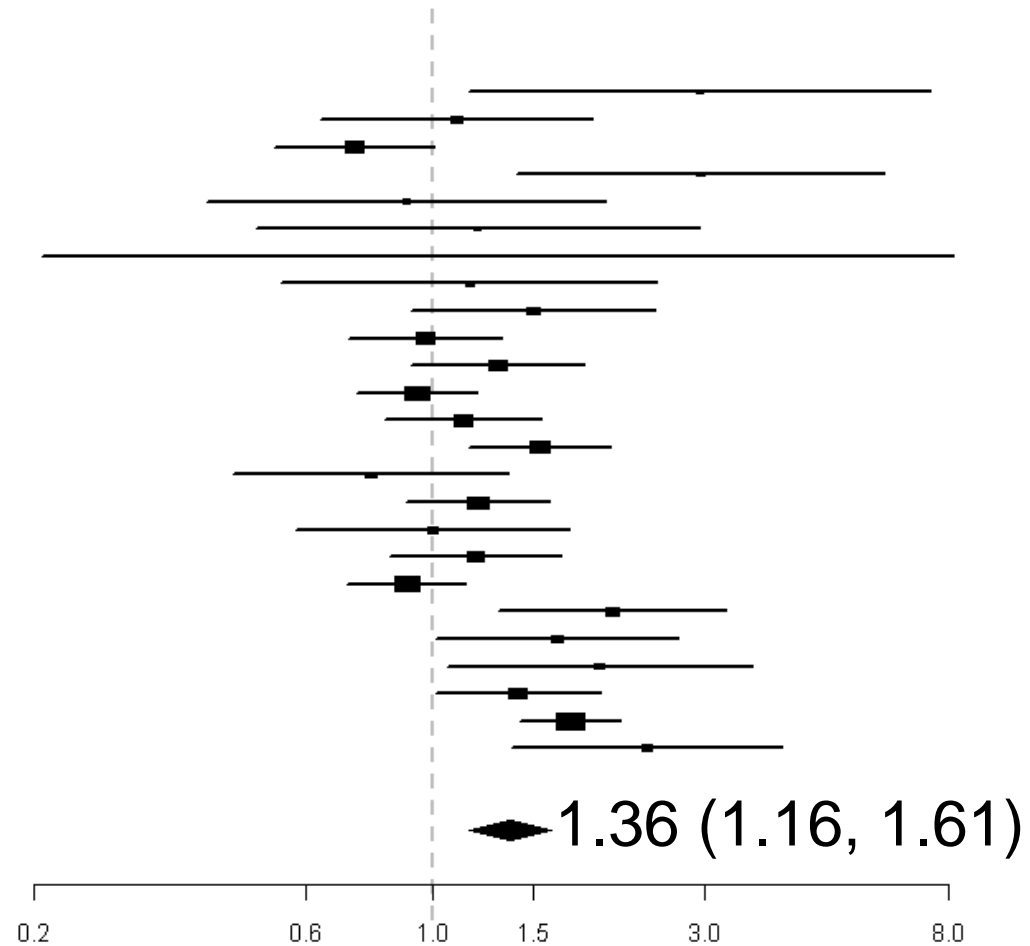
Study	Country	n. Cases	n. Controls
<b><i>Cohort or Population-based case-control studies</i></b>			
Veierød 2010	Norway, Sweden	412	10366*
Adam 1981	UK	169	207
Holman 1986	Australia	511	511
Osterlind 1988	Denmark	474	926
Zanetti 1988	Italy	208	416
Westerdahl 1994	Sweden	400	640
Holly 1995	USA	452	930
Chen 1998	USA	624	512
Walter 1999	Canada	583	608
Westerdahl 2000	Sweden	571	913
Han 2006	USA	200	804
Clough-Gorr 2008	USA	423	678
Cust 2010	Australia	604	479
Lazovich 2010	USA	1167	1101
<b><i>Other case-control studies</i></b>			
Klepp 1979	Norway	78	131
Holly 1987	USA	121	139
Swerdlow 1988	UK	180	120
MacKie 1989	UK	280	180
Dunn-Lane 1993	UK	100	100
Garbe 1993	Germany	280	280
Autier 1994	Multic.	420	447
Naldi 2000	Italy	542	538
Kaskel 2001	Germany	271	271
Bataille 2004	UK	413	416
Ting, 2007	USA	29	307

# Artificial light and melanoma

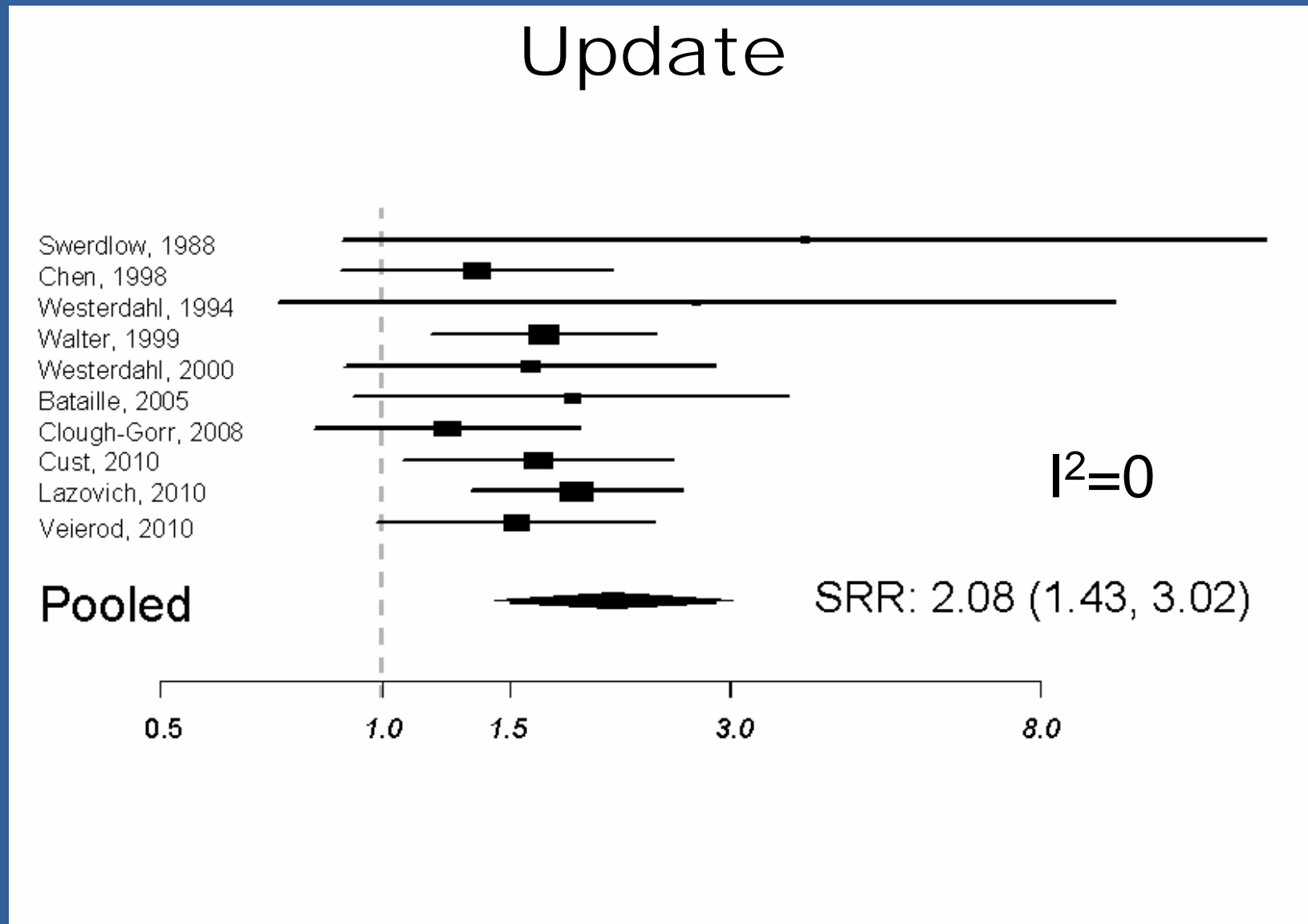
## Ever exposed: Update

Adam, 1981  
Holman, 1986  
Osterlind, 1988  
Swerdlow, 1988  
Zanetti, 1988  
Mackie et al, 1989 (Women)  
Mackie, 1989 (Men)  
Dunn-Lane, 1993  
Garbe, 1993  
Autier, 1994  
Westerdahl, 1994  
Holly, 1995  
Chen, 1998  
Walter, 1999  
Naldi, 2000  
Westerdahl, 2000  
Kaskel, 2001  
Bataille, 2004  
Bataille, 2005  
Han, 2006  
Tin, 2007  
Clough-Gorr, 2008  
Cust, 2010  
Lazovich, 2010  
Veierod, 2010

Pooled



# Artificial light in youth (<35) and melanoma



# Heterogeneity analyses

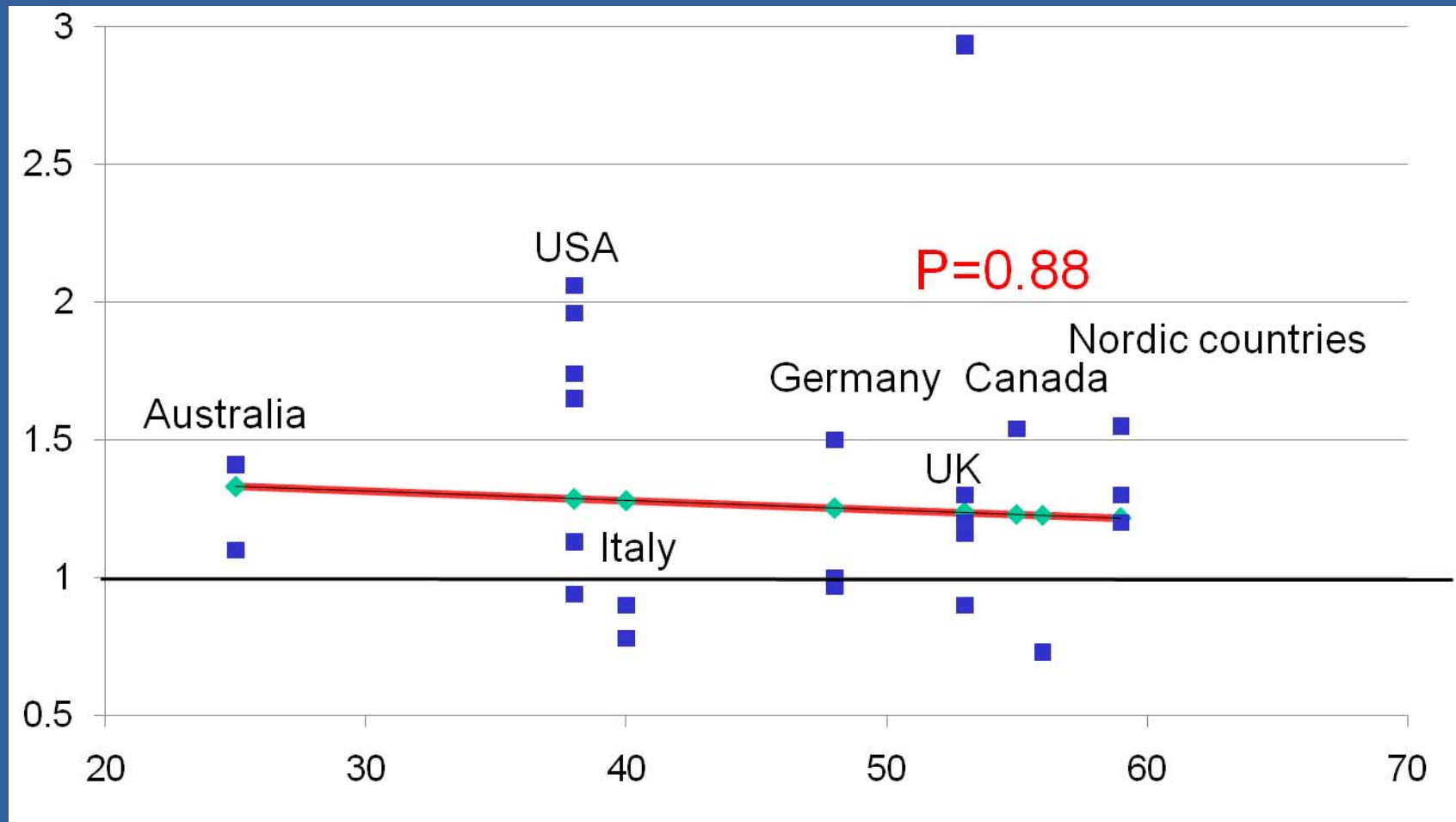
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Subgroup analyses, meta-regression, sensitivity analyses showed that none of the factors (adjustments, study designs, publication years, latitude...) influenced significantly between-study heterogeneity.

SRRs adjusted for sun-exposure/phenotypes and in population-based studies are very similar to main estimates, with wider CI.

No indication for publication bias  $P=0.99$ .

# SRR by latitude



Stratified and meta-regression analyses showed no change in risk in countries with different prevalent photo-types.

# Dose-response and time analysis

Type of exposure	SRR (95%CI)
Distant in time	1.49 (0.93-2.38)
Recent in time	1.10 (0.76-1.60)

Considering the risk by number of lifetime sessions,  
dose-response model:  $SRR=1.004$  (0.999–1.009)

we have a 4% increase in CMM with 10 sessions.

# Artificial light and Non-melanoma skin cancer

First Auth., PY	country	n. cases	n. controls	Skin cancers
Aubry, 1985	Canada	92	174	SCC
Badjdik, 1996	Canada	226	226	SCC+BCC
Corona, 2001	Italy	166	158	BCC
Karagas, 2002	USA	180	180	SCC+BCC
Walther, 2004	Germany	213	411	BCC
Han, 2006	USA	200	804	SCC+BCC

Type of NMSC	SRR (95%CI)
Squamous Cell Carcinoma	1.89 (1.10–3.24)
Basal Cell Carcinoma	1.16 (0.80-1.69)

# Indoor tanning by adolescents. I

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In a cross-sectional study, from 50 US states, of 10079 boys and girls:

- 7% at age 14
- 16% at age 15
- 35% age 17

*Geller et al. Pediatrics. 2002.*

Limiting tanning to help prevent melanoma:

- 77% in 1994
- 67% in 2007



Having a tan looks better:

- 69% in 1994
- 81% in 2007



*Robinsons et al. Arch. Derm. 2008*



# Indoor tanning by adolescents. II

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- 30% of Swedish and 24% of US adolescents were sunbed users. Frequent use (10 or more times) was reported by 8% and 12% in Sweden and US respectively. Girls more than boys.
- Majority of regulations in US and Europe do not address adolescent use. Where regulations exist compliance is low.
- With stricter regulations, in Australia between 18 and 31 melanomas, 200–251 squamous cell carcinomas and associated costs of \$AU 256,054 would be avoided per 100,000 persons.

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