

REVIEW ARTICLE

Who uses sunbeds? A systematic literature review of risk groups in developed countries

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Abstract

Skin cancer is caused by ultraviolet radiation (UVR). Indoor tanning is a totally avoidable risk behaviour. This review addresses the specific characteristics of sunbed users and the differences in motivation and risk perception compared with non-users. This review is based solely on empirical original articles. Based on literature searches with widely used reference databases ('PubMed', 'OVID', 'Social Citation Index', 'ERIC – Educational Resources Information Center', 'Web of Science' and the 'International Bibliography of the Social Sciences'), we included studies from developed nations with a publication date between 1 January 2000 and 12 August 2008. All studies were selected, classified and coded simultaneously by both authors on a blinded basis. All searches were performed on 13 and 14 August 2008. In accordance with the QUOROM and the MOOSE Statements, we identified 16 original studies. The typical sunbed user is female, between 17 and 30 years old, and tends to live a comparatively unhealthy lifestyle: Users smoke cigarettes and drink alcohol more frequently and eat less healthy food than non-users. Users are characterized by a lack of knowledge about health risks of UVR, and prompted by the frequent use of sunbeds by friends or family members and the experience of positive emotions and relaxation by indoor tanning. This review is the first systematic review on risk groups among sunbed users that has been published in a scientific journal. There is still a lack of information among users, particularly among young people regarding the safety of solariums.

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Keywords

motivation, prevention, review, risk factors, sunbed, ultraviolet rays

Conflict of interest

The authors declare that there are no conflicts of interest.

Introduction

One in every three cancers diagnosed worldwide is a skin cancer.¹ Incidence rates of skin cancer are rising dramatically in developed countries.² Of all skin cancers, 80–90% are thought to be caused by ultraviolet radiation (UVR).^{3,4}

Apart from the sun, indoor tanning facilities (also called 'sunbeds', 'tanning booths', 'tanning salons', 'tanning parlours' and 'solariums') are the most important and increasingly frequent sources of UVR in developed countries.^{5,6} In the USA, for example, almost 30 million individuals tan indoors every year, including 2.3 million adolescents.⁷

Sources of support: None.

Because of this development, a legislation regulating artificial tanning is becoming a worldwide disputed question – in general as well as in the specific context of the overuse of artificial tanning facilities by adolescents.⁸ The following international and the national medical communities have advocated banning sunbed use for non-medical purposes: International Commission on Non-Ionizing Radiation Protection, the National Toxicology Program of the Department of Health and Human Services, the National Radiological Protection Board (United Kingdom), the National Health and Medical Research Council (Australia) and EUROSkin.^{1,5}

To date, none of these efforts was successful. In most developed countries, there is neither a legislation regulating sunbed use (for

example prohibition of sunbed use for minors or minimal qualification standards for solarium personnel) nor a complete ban.^{1,9,10} Parallel to this, the commercial indoor tanning business tries to thwart respective efforts and is soliciting sunbeds with extensive advertising campaigns. In the United States alone, artificial tanning is a \$1 billion-a-year industry.¹

Consequently, a considerable number of individuals are increasing their risk of skin cancer and skin ageing. The World Health Organization anticipates serious consequences of sunbed use including disfigurement, pain, suffering and early death, as well as substantial costs to national health systems for screening, treating and monitoring skin cancer patients.¹

For the planning and preparation of future potential public health interventions for skin cancer prevention, it is of primary interest to find out which biopsychosocial factors promote the use of sunbeds, and to identify typical risk groups.¹¹ This systematic review covers the current empirical research published between January 2000 and August 2008. It addresses the following questions:

What are the specific characteristics referring to biological, social and psychological factors of sunbed users in comparison to non-users? What are the significant differences in motivation and risk perception?

Methods

Literature search

The systematic procedure for this review follows the QUOROM statement, a document that was originally developed for the performance of meta-analyses of randomized controlled trials.¹² The QUOROM Group explicitly recommends the use of the QUOROM checklist and QUOROM flowcharts for systematic reviews such as the one conducted in this study. This article also conforms to the MOOSE Statement as far as possible. The MOOSE statement primarily not only refers to meta-analyses but also matches for systematic reviews to a large extent.¹³ The structured presentation of methods and results in this review is also in line with these statements.

To address both medical and social science aspects involved, we used the following databases: PubMed, OVID, Social Citation Index, ERIC – Educational Resources Information Center, Web of Science and the International Bibliography of the Social Sciences. All searches were performed on 13 and 14 August 2008.

The literature searches have the following three limits ‘publication date from 1 January 2000 to 12 August 2008’, ‘English and German language’ and ‘human subjects’. Moreover, combinations of the medical subject headings (MeSH) ‘Risk’, ‘Ultraviolet Rays’ or ‘Solar Activity’, ‘Health Education’ or ‘*Health Knowledge, Attitudes, Practice’ and ‘Melanoma/aetiology/*prevention and control’ were applied. Furthermore, there were other keywords used such as ‘Sunbed’ or ‘Indoor Tanning’ or ‘Tanning Booth’ or ‘Solarium’ or ‘Sunlamp’ or ‘Artificial UVR’.

Study selection and study characteristics

A further inclusion criterion was the region covered by the study (inclusion criterion: developed country). Qualitative reports and qualitative reviews were excluded from this review because in such studies, no correlation between a variable of interest and indoor tanning is measurable. Also excluded were comments, studies with only descriptive analyses, studies testing the test–retest reliability of surveys and cluster analyses on behalf of describing the clustering of the parameters among the participants only. Among the results of our first search were six reviews. They did not deal with the questions we addressed but with other issues such as the contribution of tanning devices to the incidence of skin cancers or the evaluation of potential risks associated with tanning lamp exposure and the appropriate public health response. Others concentrate on the danger of indoor tanning and the current regulation of the tanning industry in the US or Australia. Another review summarized the available psychological studies on tanning behaviour to explore the reasoning, which underpins sunbed use. The selection steps for this review and the inclusion and exclusion criteria are presented in a flowchart (Fig. 1).

All studies were selected, classified and coded simultaneously by both authors between October and December 2008. The MOOSE statement asks in the methods section for information about the searchers’ qualifications: The first author is a medical sociologist (Dr. phil., MSc) and habilitated at the Medical Faculty of Heidelberg in ‘social epidemiology’. His research focus is on cancer prevention. The second author has a diploma in health economics (Dipl. Gesoek.) and is a scientist at the German Cancer Research Center. Her research focus is on clinical epidemiology. Both authors are endowed with the additional skill of organizing systematic reviews.

The selection steps presented in the figure were conducted in parallel by the two authors on a blinded basis. Working independently of each other, the two authors excerpted the study characteristics and the data in the tables. After selection steps 1 and 2, respectively, these duplicate tables were de-blinded and any deviations were discussed. The few differences in evaluation were addressed, producing the consensus displayed in Tables 1–3.

The total number of 47 hits was reduced to $n = 23$ on the basis of the abstracts and whittled down to $n = 16$ after reading all remaining articles (Fig. 1). We looked through the reference lists of the articles we had identified, chose further articles from these lists and again browsed their reference lists. We also did further research in the databanks of the EUROSkin institute, ADP institute and the MIPH. As a result, we found three more studies meeting inclusion criteria. These were added to our list (Fig. 1). The study characteristics and their results are excerpted in the tables.

Results

The key characteristics of all identified studies are summarized in Table 1. All included studies are cross-sectional surveys but differ with regard to sample size and sample source.

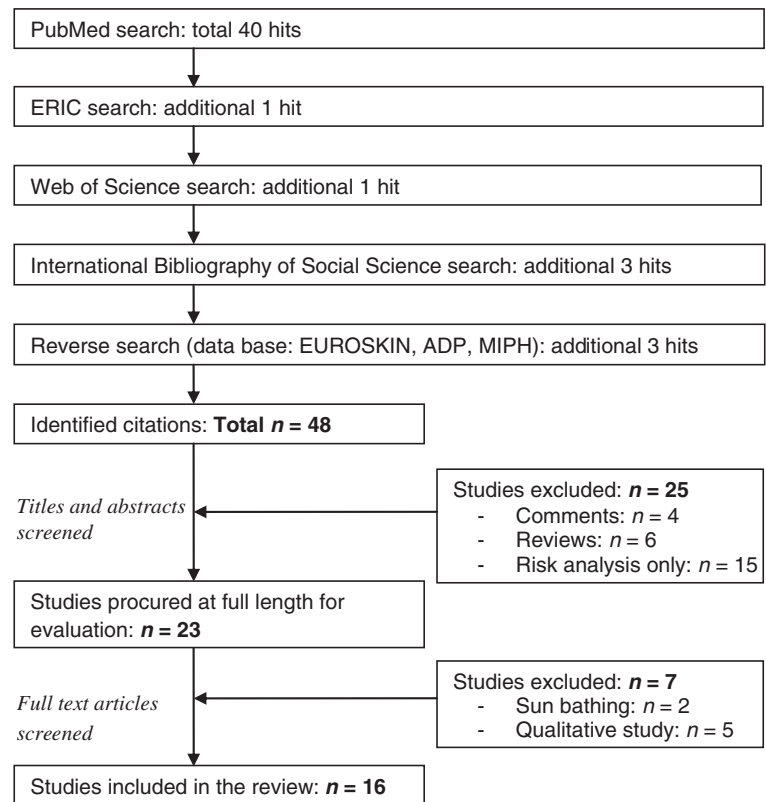


Figure 1 Selection process. EUROSkin, European Society of Skin Cancer Prevention; ADP, Association of Dermatological Prevention; MIPH, Mannheim Institute of Public Health.

They also vary in age limitations: five studies dealt exclusively with adolescents (≤ 18 years), and most studies included young adults (18–25 years: $n = 10$; Table 1). Most of the included studies are from the USA ($n = 9$), while the others were conducted in a European country ($n = 6$) or in Australia ($n = 1$). Moreover, 10 studies did a random selection (e.g. via telephone dialling or census data.) Because it is known that during spring, autumn and winter solariums are more often used than in summer, data generation periods should be reported. Details on data generation periods differ among the studies; some report on data generation per month, while others mention only the year of data generation. Furthermore, there was a peculiar difference between the definitions of ‘sunbed use’. Most studies asked for the lifetime prevalence of artificial tanning (‘have you ever tanned’) or for the 1-year prevalence, but some used more unspecific and less well-established indicators. It also seems noteworthy that about every one in 10 adolescents under 18 years is a sunbed user (Table 1).

With regard to sunbed use, factors such as biological, socio-structural, psychological, lifestyle and appearance-related factors play a role. All variables mentioned in the studies and correlating with solarium use are presented in Tables 2 and 3. Some factors like presence of freckles or moles, or nutritional habits were only investigated in one study. We only report results on factors that were investigated in several studies.

Concerning the biological factors age, sex and skin type typical sunbed users are young women aged 20–30 years with skin types III or IV

All studies demonstrate a gender effect, i.e. women regardless of their age are the main users of solariums. The rates of age-specific use show a typical bell curve. A positive correlation was found with age in studies questioning adolescents and young adults only, whereas a negative correlation was visible in studies concentrating on adults. In addition, individuals with skin types III and IV tend to use sunbeds more often than those with paler skin types. However, the synopsis in Table 2 shows that this does not imply that individuals with no or little suntan (skin types I or II) never use sunbeds. With regard to sociostructural factors, the level of education does not have a clear effect on sunbed use.

The most important psychological factors promoting sunbed use are socialization and emotional perception. Acceptance of indoor tanning by a user’s parents and the positive attitude of peers and friends towards indoor tanning as well as positive emotions and the perception of relaxation are psychological correlates that mainly occurred in studies from the US (Table 2).

Sunbed users often show considerable lack of knowledge about risks of artificial UV radiation. They tend to be less well informed about the risks of sunbathing than non-users. They are also more convinced that tanning on sunbeds provides them with a

Table 1 Indoor tanning prevalences of the methodology of the reviewed studies on correlates of indoor tanning risk perception

Author	Study region	Age limitation (years)	Net-sample size	Sample source Population based: yes/no	Data generation period	Statistical method	Prevalence of sunbed use
Hamlet <i>et al.</i> 2004 ⁴⁰	UK, Scotland	8–11	1405	No, classroom survey in primary school	June 2003	Bivariate analysis	6.8% (5.5 month prevalence)
Cokkinies, <i>et al.</i> 2002 ¹¹	USA	11–18	1192	Yes	July–October 1998	Bivariate analysis and logistic regression analysis	10% (1-year prevalence)
Geller <i>et al.</i> 2002 ⁴¹	USA	12–18	10 079	Yes	1999	Logistic regression analysis	9.5% (1-year prevalence)
Demko <i>et al.</i> 2003 ¹⁴	USA	13–19	6903	Yes	April–August 1996	Bivariate analysis and logistic regression analysis	24.1% (lifetime prevalence); 17.6% (more than three times in life)
Hoerster <i>et al.</i> 2007 ¹⁶	USA (in the 100 largest US cities)	14–17	5274	Yes	January–December 2005	Hierarchical linear model	11.2% (1-year prevalence)
Lazovich <i>et al.</i> 2004 ¹⁹	USA, Minnesota and Massachusetts	14–17	1273	Yes	Fall 2000	Logistic regression analysis	12.0% male, 42.0% female (lifetime prevalence)†
Boldeman, <i>et al.</i> 2003 ⁴²	Sweden, Stockholm	15–19	4202	Yes	1993 + 1999	Bivariate analysis and logistic regression analysis	70% (female, 1993); 45% (female, 1999); 44% (male, 1993); 19% (male, 1999)†,‡
Monifrecola, <i>et al.</i> 2003 ⁹	Italia, Naples	16–21	756	No, random selection at 10 different high schools	November 1996–February 1997	Bivariate analysis	12.3%‡ 'users'
Knight <i>et al.</i> 2002 ²²	USA, Indiana	< 17–>27\$	489	No, selection among students from the Indiana University	September 1999	Bivariate analysis and logistic regression analysis	47% (1-year prevalence); 61% (lifetime prevalence)
Coups <i>et al.</i> 2008 ⁴³	USA	≥ 18	28 235	Yes	2005	Bivariate analysis	13.5% (1-year prevalence)
Danhoff-Burg 2006 ²¹	USA	18–23	164	No, selection among students from the University at Albany, New York, USA.	November–December 2003	Logistic regression analysis	35% (1-year prevalence)
Brånström <i>et al.</i> 2004 ¹⁵	Sweden, Stockholm	18–37	1752	Yes	May 2001	Logistic regression analysis	35% (current use of sunbeds)
Bagdasarov <i>et al.</i> 2008 ²⁰	USA	19–25	745	No, selection among indoor tanning students at a university	December 2005	Logistic regression analysis	100% (lifetime prevalence¶)

Table 1 (Continued)

Author	Study region	Age limitation (years)	Net-sample size	Sample Population based: yes/no	Data generation period	Statistical method	Prevalence of sunbed use
Lawler <i>et al.</i> 2006 ⁴⁴	Queensland, Australia	20–75	9298	Yes	February–November 2004	Logistic regression analysis	1.3% (1-year prevalence); 10.7% (lifetime prevalence)
Ezzedine <i>et al.</i> 2007 ⁴⁵	France	35–60	7303	Yes	2001	Logistic regression analysis	15% (lifetime prevalence)
Amir <i>et al.</i> 2000 ¹⁷	UK, Bradford	Not clearly defined (,employee)	470	No, selection among employees at the Bradford Hospitals NHS Trust	1996	Bivariate analysis and logistic regression analysis	46% (lifetime prevalence)

All studies are cross-sectional surveys. Sorting by age of the youngest participants.

†Mean not available because of the sampling procedure. ‡User: prevalence definition for user not specified. §Undergraduate and graduate students. ¶Sunbed use was inclusion criterion.

‘healthier’ type of tan and therefore on average underestimates the health risks of indoor tanning (Table 3).

Several lifestyle factors are correlated with sunbed use

In addition to their tanning habits, sunbed users also seem to live a generally less healthy lifestyle. They smoke or drink alcohol on a more regular basis, and eat less healthy and diet more frequently (Table 3). However, there is only one study investigating these aspects. Sunbed users’ personal perception of tanned skin as more attractive is an appearance-related factor of crucial importance.

Discussion

Statement of principle findings

The typical sunbed user is female, between 17 and 30 years old, and tends to lead a comparatively unhealthy lifestyle. He/she smokes or drinks alcohol more frequently and eats less healthy food than non-users. Having tanned skin is his/her ideal of beauty. This risk group is also characterized by a lack of knowledge about health risks of UV radiation, prompted by frequent use of sunbeds by friends or family members, and feeling good while tanning. Several studies show well-established tanning habits even for adolescents.

Study limitations and strength

Methodological limitations of the presented studies are different definitions of sunbed use, validity of self-reports, over-sampling of certain groups, restrictions for representativity and the cross-sectional design.

One problem for a systematic synopsis is that the included studies use different definitions of sunbed use. Some studies ask for lifetime prevalence, others define ‘use’ as ‘more than three times in life’¹⁴ or non-specified as ‘current use’.^{9,15} Some studies cover the 1-year prevalence.

Another limitation of nearly all studies is missing information about the validity of self-reports because the information on sunbed use was from the users themselves. Only some studies that concentrate on adolescents included questioning the parents additionally.^{11,16} However, self-reports may be a source of bias. On the one hand, those who use sunbeds are more likely to participate or complete the questionnaire.¹⁷ On the other hand, the respondents could answer in a socially desirable manner. (Even though sunbed use is not perceived as being as problematic as excessive consumption of alcohol or cigarettes, a bias is possible, especially when questioning adolescents via phone calls.^{11,16,18,19}) The first phenomenon would lead to over-reporting, and the latter to under-reporting. To what extent these two bias sources influence the results and possibly neutralize each other, cannot be quantified.

Although in almost all studies, an over-sampling either of women/girls relative to men/boys of 2:1 or even higher or of fair skin (cancer) type relative to darker skin type of 2:3 is evident, only a few studies adjusted for these variables.^{18,20}

Table 2 Results of literature review on biological, sociostructural and psychological factors of sunbed use

Correlates	Number of studies/ region	Empirical findings		No correlation††
		Positive correlation	Negative correlation	
Biological factors				
Gender: female	10/ USA:6 EUR:3 AUS:1	Amir <i>et al.</i> 2000; Bagdasarov <i>et al.</i> 2008; Bränström <i>et al.</i> 2004; Cokkinides <i>et al.</i> 2002; Ezzedine <i>et al.</i> 2007; Geller <i>et al.</i> 2002; Hoerster <i>et al.</i> 2007; Knight <i>et al.</i> 2002; Lazovich <i>et al.</i> 2004; Lawler <i>et al.</i> 2006		
Age	14/ USA:8 EUR:5 AUS:1	Boldeman <i>et al.</i> 2003; Cokkinides <i>et al.</i> 2002; Demko <i>et al.</i> 2003; Geller <i>et al.</i> 2002; Hoerster <i>et al.</i> 2007; Knight <i>et al.</i> 2002; Lazovich <i>et al.</i> 2004	Amir <i>et al.</i> 2000; Bränström <i>et al.</i> 2004; Coups <i>et al.</i> 2008; Ezzedine <i>et al.</i> 2007; Lawler <i>et al.</i> 2006	Bagdasarov <i>et al.</i> 2008; Hamlet <i>et al.</i> 2004†
Age of parents	1/USA	Hoerster <i>et al.</i> 2007		
Race	1/USA			Cokkinides <i>et al.</i> 2002
Non-hispanic white	1/USA	Hoerster <i>et al.</i> 2007		
Skin sensitivity: skin type I or II (no/mild tan)	9/ USA:6 EUR:3	Ezzedine <i>et al.</i> 2007	Boldeman <i>et al.</i> 2003‡; Bränström <i>et al.</i> 2004; Demko <i>et al.</i> 2003; Geller <i>et al.</i> 2002; Hoerster <i>et al.</i> 2007	Boldeman <i>et al.</i> 2003§; Cokkinides <i>et al.</i> 2002; Knight <i>et al.</i> 2002; Lazovich <i>et al.</i> 2004
Presence of freckles	1/EUR	Ezzedine <i>et al.</i> 2007		
Presence of moles	1/EUR		Amir <i>et al.</i> 2000	
Sociostructural factors				
Socioeconomic status	1/EUR			Ezzedine <i>et al.</i> 2007
Level of education: high	1/EUR		Bränström <i>et al.</i> 2004	
Level of education of parents: high	3/USA		Demko <i>et al.</i> 2003	Cokkinides <i>et al.</i> 2002; Hoerster <i>et al.</i> 2007
(Parental) income: high	3/ USA:2 AUS:1	Demko <i>et al.</i> 2003; Lawler <i>et al.</i> 2006		Cokkinides <i>et al.</i> 2002
Employment status: Employed	1/AUS	Lawler <i>et al.</i> 2006		
Place of residence: urban	3/ USA:2 AUS:1	Lawler <i>et al.</i> 2006	Cokkinides <i>et al.</i> 2002; Demko <i>et al.</i> 2003	
Climate	1/USA			Geller <i>et al.</i> 2002
Psychological factors				
All/most/some friends tan	5/ USA:4 EUR:1	Bagdasarov <i>et al.</i> 2008; Bränström <i>et al.</i> 2004; Geller <i>et al.</i> 2002; Hoerster <i>et al.</i> 2007; Lazovich <i>et al.</i> 2004		
Tanning salon visit for socializing	1/USA	Danhoff-Burg <i>et al.</i> 2006		
Parents' sunbed use	3/USA	Cokkinides <i>et al.</i> 2002; Hoerster <i>et al.</i> 2007; Lazovich <i>et al.</i> 2004		
Parents' allowance to tan indoors	2/USA	Hoerster <i>et al.</i> 2007; Lazovich <i>et al.</i> 2004		

Table 2 (Continued)

Correlates	Number of studies/ region	Empirical findings		No correlation††
		Positive correlation	Negative correlation	
Experience of positive emotions and relaxation by indoor tanning	3/ USA:2 EUR:1	Bränström <i>et al.</i> 2004; Cokkinides <i>et al.</i> 2002; Danhoff-Burg <i>et al.</i> 2006		
Experience of lifting up the spirits by indoor tanning/sensation seeking	2/USA	Cokkinides <i>et al.</i> 2002		Bagdasarov <i>et al.</i> 2008
Experience with adverse effects of indoor tanning, e.g. skin cancer and other health effects	4/ USA:1 EUR:3		Amir <i>et al.</i> 2000	Bränström <i>et al.</i> 2004; Ezzedine <i>et al.</i> 2007; Knight <i>et al.</i> 2002
Belief that in general very few people develop skin cancer	1/EUR	Amir <i>et al.</i> 2000		
Belief that tanning beds are safe	3/ USA:2 EUR:1	Hoerster <i>et al.</i> 2007¶; Knight <i>et al.</i> 2002		Monfrecola <i>et al.</i> 2000†
Belief that sunbeds are safe compared with natural sunlight	1/EUR	Amir <i>et al.</i> 2000		
Belief in premature skin ageing because of tanning	2/ USA:1 EUR:1		Amir <i>et al.</i> , 2000	Knight <i>et al.</i> 2002
Ever heard about melanoma risk because of sun exposure	2/ USA:1 EUR:1	Ezzedine <i>et al.</i> 2007		Knight <i>et al.</i> 2002
Knowing the definition of sunburn	1/EUR			Ezzedine <i>et al.</i> 2007
Knowing the definition of sun protection factor	1/EUR	Ezzedine <i>et al.</i> 2007‡		Ezzedine <i>et al.</i> 2007§
Aware of the consequences of sunburn and tanning	3/ USA:1 EUR:2		Ezzedine <i>et al.</i> 2007‡	Ezzedine <i>et al.</i> 2007§; Lazovich <i>et al.</i> 2004; Monfrecola <i>et al.</i> 2000†
Aware of the relationship between sunburn and skin cancer	1/EUR			Ezzedine <i>et al.</i> 2007
Personal or family skin cancer history	2/ USA:1 EUR:1		Amir <i>et al.</i> 2000	Knight <i>et al.</i> 2002
Cognitive ability	1/USA		Demko <i>et al.</i> 2003	
Thoughtful decision making	1/USA			Demko <i>et al.</i> 2003
Health provider counselling about protection from sun	1/USA			Cokkinides <i>et al.</i> 2002

†Authors do not report a *P*-value, therefore no significant correlation is assumed ‡for girls/women only §for boys/men only ¶parental opinion ††not significant for *P* ≤ 0.05.

USA, United States of America; EUR, Europe; AUS, Australia.

A further drawback is that the results in some studies are based on selected samples (e.g. students) and on a relatively small sample size, which affects the precision of the chosen estimates and the representativity.²¹ For some studies, the response rate is unknown because the authors do not mention this rate or the number of addressed individuals respectively.^{18,21,22}

All studies selected a cross-sectional study design, which limits conclusions regarding age differences (e.g. differences may represent cohort effects) as well as causal associations between perceived risk and risk behaviours. The systematic approach of our review is mostly in accordance with the guidelines for Cochrane Reviews²³ with one major exception; while Cochrane Reviews take into account all available reviews regardless of the language they are written in, we limited our study to publications in English or

German. Thus, we cannot exclude the possibility of a language bias. In addition, we described characteristics that are relevant for the quality of a study, e.g. sample size, sampling procedure and statistical methods. Despite the recommendations of the Cochrane Collaboration, we did not assess the quality of the methods used in the studies. Finally, the Cochrane editorial team is usually involved in the writing process of a Cochrane review. This was not the case in our study as it was written independently and then submitted to *J Eur Acad Dermatol*.

Relation to other studies

Even though the indoor tanning industry claims the opposite,²⁴ molecular and animal studies have shown the danger of tanning beds.^{7,25} Recent reviews convincingly prove the causal association

Table 3 Results of literature review on lifestyle factors and appearance-related factors of sunbed use

Correlates	Number of studies (region)	Empirical findings Positive correlation	Negative correlation	No correlation††
Lifestyle factors				
Smoking	5/ USA:2 EUR:3	Amir <i>et al.</i> 2000; Boldeman <i>et al.</i> 2003‡; Ezzedine <i>et al.</i> 2007; Lazovich <i>et al.</i> 2004		Bagdasarov <i>et al.</i> 2008; Boldeman <i>et al.</i> 2003§
Sun exposure in leisure time or during hobbies	5/ USA:2 EUR:3	Boldeman <i>et al.</i> , 2003; Ezzedine <i>et al.</i> 2007		Bagdasarov <i>et al.</i> 2008; Cokkinides <i>et al.</i> 2002; Monfrecola <i>et al.</i> 2000†
Outdoor occupation	1/EUR			Ezzedine <i>et al.</i> 2007
Nudism practice	1/EUR	Ezzedine <i>et al.</i> 2007		
Apply sunscreen or other sun protection	3/ USA:2 EUR:1	Ezzedine <i>et al.</i> 2007; Lazovich <i>et al.</i> 2004	Cokkinides <i>et al.</i> 2002	
Use of sunglasses	1/EUR	Ezzedine <i>et al.</i> 2007		
Substance use, e.g. alcohol	2/USA	Demko <i>et al.</i> 2003		Bagdasarov <i>et al.</i> 2008
Nutritional habits: healthy	1/USA		Demko <i>et al.</i> 2003‡	Demko <i>et al.</i> 2003§
Physical activity: high	1/USA		Demko <i>et al.</i> 2003‡	Demko <i>et al.</i> 2003§
Dieting	1/USA	Demko <i>et al.</i> 2003		
Behavioural control	1/EUR			Bränström <i>et al.</i> 2004
Appearance-related factors				
Belief in attractiveness gain by tan	8/ USA:7 EUR:1	Bagdasarov <i>et al.</i> , 2008; Bränström <i>et al.</i> 2004; Danhoff-Burg <i>et al.</i> 2006; Geller <i>et al.</i> 2002; Hoerster <i>et al.</i> 2007¶; Knight <i>et al.</i> 2002; Lazovich <i>et al.</i> 2004		Cokkinides <i>et al.</i> 2002
Belief that it is worth getting burnt or tanned	3/ USA:1 EUR:2	Amir <i>et al.</i> , 2000; Geller <i>et al.</i> 2002; Ezzedine <i>et al.</i> 2007		
Self-acceptance with the look/self-esteem	1/USA			Bagdasarov <i>et al.</i> 2008
Body piercing and tattoos	1/USA			Demko <i>et al.</i> 2003
Physical maturity: more mature	1/USA	Demko <i>et al.</i> 2003‡		Demko <i>et al.</i> 2003§
BMI: high	1/USA		Demko <i>et al.</i> 2003	

†Authors do not report a *P*-value, therefore no significant correlation is assumed ‡for girls/women only §for boys/men only ¶parental opinion ††not significant for $P \leq 0.05$.

USA, United States of America; EUR, Europe; AUS, Australia.

between the use of sunbeds, squamous cell carcinoma and cutaneous malignant melanoma, even after adjusting for sunburns, sunbathing and sun exposure.^{5,7} A causal effect on basal cell carcinoma is being discussed. The number of studies with their often small number of cases does not allow for a conclusive statement.^{5,26} Furthermore, exposure to UVR via sunbeds has other acute health consequences, including skin burns, eye burns and ocular disorders, and suppression of immune functioning. This demonstrates the health risks caused by sunbeds.

However, use of sunbeds is a risk factor that is modifiable, and even completely avoidable. Appearance-related motives (e.g. looking attractive, perceived attractiveness and self-presentation motives) have been identified as strong psychosocial indicators of

intentional sunbed use among adolescents.²⁷ It is particularly adolescents and young adults who regard the promised benefits of UVR exposure (e.g. tanned skin, opportunity for socialization, conforming to normative beliefs) as outweighing the hazards for skin cancer. Banks *et al.* presume that body image and self-esteem are stronger forces in the face of social pressure than the knowledge about long-term harmful effects of UVR.²⁸ This is apparent in both genders even though girls are generally more aware of exposure risks.²⁹

Recently published studies even discuss a tanning addiction as a cause of sunbed use, especially among young adults.³ In qualitative interviews for example, some users reported their tanning behaviour as addictive (so called 'tanorexia',^{30,31}).

Finally, the lowest frequency of solarium use is reported from Australia, the country with the highest skin cancer incidence rates worldwide and well-established elaborated skin cancer information campaigns – also against solarium use.^{32,33}

Conclusions

The study has shown that there is still a lack of information among the public and especially among adolescents regarding the safety of solariums. Furthermore, those individuals – mainly young women – who show a risky behaviour when smoking or drinking alcohol and who stress the importance of looking attractive are more susceptible to sunbed use. This is more evident if the individual surroundings approve of their behaviour.

On the background of the results of this study, it will therefore be a major challenge for preventive interventions by public health policy that commercial facilities will continue to promote indoor tanning as safe despite the evidence of risks for short-term (e.g. burning skin, allergies, skin abnormalities) as well as long-term adverse health effects.^{5,34}

In a first step, broadening the limited knowledge and understanding the adolescent's and adult's motives are important aspects to be able to reach the general public's attitudes and beliefs.^{35,36,37} But it has to be noted that an increase in knowledge alone, for example by information campaigns, 'is not always processed as to lead to more prudent behaviour'.³⁸ Two further strategies appear to be particularly promising: Regulations for sunbed use in accordance with WHO recommendations, and long-term influence of socially accepted concept of ideal beauty. The WHO has recommended that sunbeds should not be used by anybody worldwide, especially not by persons under 18 years of age.^{1,2} In addition, EUROSKIN has recently called for a utilization ban for minors in a general statement, and in agreement with the sunbed industry and the associations of tanning salon owners, claimed that this ban should be a common legal European one. (Apart from that, the EUROSKIN statement contained further recommendations; see^{1,39}). To achieve a long-term and above all sustainable decrease in the rate of artificial tanning, public opinion will have to change regarding what is aesthetically admirable. It will take a concentrated joint effort on behalf of scientists, public health officials, healthcare organizations, industry and politicians to bring about a change in the belief that natural or artificial tans are attractive and healthy.

This review is the first systematic review on this issue that has been published in a scientific journal. It summarizes the current state of research on correlates of a risk behaviour that in our opinion is not paid enough attention. Our results should contribute to identifying risk groups and developing prevention strategies for different target groups, particularly with regard to adolescents.

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