

Skin Cancer Prevention

Behaviours Related to Sun Exposure and Early Detection

Richard Bränström



Stockholm 2003

FROM
THE DEPARTMENT OF ONCOLOGY AND PATHOLOGY
AT THE KAROLINSKA INSTITUTET,
STOCKHOLM, SWEDEN

Skin Cancer Prevention

Behaviours Related to Sun Exposure and Early Detection

Richard Bränström



Stockholm 2003

All previously published papers are reproduced with permission of the publisher.

Published and printed by Karolinska University Press

Box 200, SE-171 77 Stockholm, Sweden

© Richard Bränström, 2003

ISBN 91-7349-550-6

ABSTRACT

Skin cancer is an emerging public health problem in Sweden. Even though the most important risk factor for the development of skin cancer – sun exposure – is known, the incidence of skin cancer is still increasing. Every year approximately 30,000 people in Sweden are diagnosed with skin cancer and approximately 400 die of this condition. In addition to the deaths and suffering caused by skin cancer, its treatment incurs considerable health costs.

The aim of this thesis was to examine factors relevant to sun-related behaviours and early detection of malignant skin lesions. The preventive effects of two information strategies on sun-related behaviours and early detection of malignant melanoma were also studied.

Three samples were studied with questionnaires, these were: 52 female nurses attending a post-graduate course in research methodology at the Karolinska Institutet, 2,615 adolescents (13, 15 and 17 year of age) randomly selected from the population in Sweden, and 1,743 adults (18 – 37 year of age) randomly selected from the population in Stockholm County. The first sample completed the questionnaires in connection to lectures, whereas the other two responded to mailed questionnaires. Further, 90 patients recruited from the Karolinska hospital and 30 randomly selected persons from Stockholm County (18 to 79 year of age) participated in an interview study.

The results showed that the questionnaires commonly used to measure sun-related behaviours had sufficient reliability. The studies confirm previous findings that adolescents and adults in Sweden spend a lot of time in the sun, frequently with the intention of becoming tanned, and frequently become sunburnt. The studies also highlighted variables associated with sun-related behaviour. Knowledge about skin cancer was not associated with decreased sunbathing or increased sun protection behaviour among adolescents. In fact, high knowledge was positively related to frequent sunbathing. Positive attitudes towards sunbathing and having a tan were strongly related to exposure to solar radiation. Being around people who frequently sunbathe was related to intentional tanning and vacation to sunny resorts. To perceive sun exposure as risky increased the likelihood of intending to decrease sunbathing and undertake sun protection behaviour. Perceived control over the risks with sun exposure was associated with sun protection behaviour among women.

An individual ultraviolet (UV) radiation intensity indicator and information about the UV index (a measure of the intensity of solar radiation) did not affect sun-related behaviour more than general written information about sun protection. Health care providers seem to play an important role in early detection of malignant melanoma, as more than 1/3 of the melanoma patients interviewed said that their melanoma was detected at a visit to a physician for another reason. The ABCD criteria (a description of the characteristics of early melanoma) seem to increase laymen's ability to make adequate judgements of skin lesions and could be used in secondary preventive interventions.

The results of the present thesis contribute to the understanding of factors relevant to sun-related behaviours. Taking these factors into account when planning skin cancer prevention activities may improve the effectiveness of these efforts.

Keywords: skin cancer, malignant melanoma, sun exposure, sunburn, sun protection, prevention, early detection

TABLE OF CONTENTS

TABLE OF CONTENTS	4
LIST OF PUBLICATIONS	6
ABSTRACT IN SWEDISH – SAMMANFATTNING PÅ SVENSKA	7
ABBREVIATIONS	8
1 INTRODUCTION	9
1.1 SKIN CANCER.....	9
1.1.1 Malignant melanoma	9
1.1.2 Basal cell carcinoma	10
1.1.3 Squamous cell carcinoma.....	10
1.2 RISK FACTORS FOR SKIN CANCER	11
1.2.1 Ultraviolet (UV) radiation.....	11
1.2.2 Colour of unexposed skin	12
1.2.3 Propensity to sunburn and ability to tan.....	12
1.2.4 Constitutional factors and benign sun-related conditions	12
1.2.5 Hereditary risk of skin cancers	12
1.2.6 Other risk factors	13
1.3 THE ECONOMIC BURDEN OF SKIN CANCER	13
1.4 SKIN CANCER PREVENTION	13
1.5 THEORIES OF BEHAVIOUR AND BEHAVIOUR CHANGE	13
1.5.1 Behaviours involved in skin cancer prevention.....	13
1.5.2 Theories of health behaviour	14
1.5.3 Theory of planned behaviour	14
1.6 BEHAVIOURS RELATED TO UV EXPOSURE	15
1.6.1 Studies on UV-related behaviour and predictors.....	15
1.6.2 Outdoor sunbathing	15
1.6.2.1 Prevalence.....	15
1.6.2.2 Variables associated with outdoor sunbathing	16
1.6.2.3 Theoretical models applied to sunbathing	19
1.6.2.4 A comprehensive model of sunbathing.....	20
1.6.2.5 Implications for interventions	22
1.6.3 Outdoor activities involving sun exposure	22
1.6.3.1 Variables associated with outdoor activities involving sun exposure	22
1.6.3.2 Implications for interventions	23
1.6.4 Occupational and medical UV exposure	23
1.6.4.1 Variables associated with occupational sun exposure.....	23
1.6.4.2 Implications for interventions	24
1.6.5 Vacations at sunny resorts	24
1.6.5.1 Variables associated with vacations at sunny resorts.....	24
1.6.5.2 Implications for interventions	25
1.6.6 UV exposure in artificial tanning devices.....	25
1.6.6.1 Prevalence.....	25
1.6.6.2 Variables associated with sunbed use	26
1.6.6.3 Theoretical models applied to sunbed use	28
1.6.6.4 Implications for interventions	28
1.7 SUNBURN.....	29
1.7.1 Prevalence	29
1.7.2 Variables associated with sunburn.....	30
1.7.3 Implications for interventions	32
1.8 SUN PROTECTION	33
1.8.1 Variables associated with sun protective behaviour and sunscreen use	35
1.8.2 Theoretical models applied to use of sunscreen	36
1.8.3 Implications for interventions	36

1.9 SCREENING ATTENDANCE, SKIN SELF-EXAMINATIONS AND EARLY DETECTION OF CUTANEOUS MALIGNANT MELANOMA	37
1.9.1 Screening attendance.....	38
1.9.1.1 Variables associated with screening attendance	38
1.9.2 Skin self-examination and early detection.....	39
1.9.2.1 Variables associated with skin self-examinations and early detection.....	39
1.9.2.2 Theoretical models applied to skin self-examination and early detection.....	40
1.9.2.3 Implications for interventions	40
1.10 MEASUREMENT OF SUN-RELATED VARIABLES.....	41
1.10.1 Questionnaires	41
1.10.2 Diaries.....	42
1.10.3 Recall period.....	42
1.10.4 Non-response bias	42
1.11 SKIN CANCER PREVENTIVE INTERVENTIONS	43
1.11.1 Educational programs	43
1.11.2 Interventions using media communication.....	43
1.11.3 Brochures and pamphlets.....	43
1.11.4 The UV index.....	44
1.11.5 Interventions to promote early detection.....	44
2 AIMS	46
3 METHODS	47
3.1 PAPER I	47
3.2 PAPER II	47
3.3 PAPER III	47
3.4 PAPER IV.....	47
3.5 PAPER V.....	47
3.6 PAPER VI.....	48
3.7 INSTRUMENTS	48
3.7.1 Questionnaire items	48
3.7.2 Interview questions.....	51
3.7.3 Pictorial examples of skin lesions.....	51
3.8 STATISTICAL METHODS	51
4 RESULTS	53
4.1 PAPER I	53
4.2 PAPER II	53
4.3 PAPER III	53
4.4 PAPER IV.....	53
4.5 PAPER V.....	53
4.6 PAPER VI.....	54
5 GENERAL DISCUSSION	55
5.1 SURVEYS OF SUN-RELATED BEHAVIOURS	55
5.2 PREDICTORS OF SUN-RELATED BEHAVIOURS	55
5.3 THE UV INDEX	56
5.4 SECONDARY PREVENTION	56
5.5 METHODOLOGICAL CONSIDERATIONS.....	56
5.5.1 Samples	56
5.5.2 Use of questionnaires in data collection	57
5.5.3 Face-to-face interviews	57
5.5.4 Statistical considerations	57
6 CONCLUSIONS	59
6.1 RECOMMENDATIONS.....	59
6.2 FUTURE RESEARCH.....	59
ACKNOWLEDGEMENTS	60
REFERENCES	61

LIST OF PUBLICATIONS

This thesis is based on the following papers:

- Paper I Bränström R, Kristjansson S, Ullén H & Brandberg, Y. Stability of questionnaire items measuring behaviours, attitudes and stage of change related to sun exposure. *Melanoma Research* 2002; 12(5)513-519.
- Paper II Bränström R, Brandberg Y, Holm L-E, Sjöberg L & Ullén H. Beliefs, knowledge and attitudes as predictors of sunbathing habits and use of sun protection among Swedish adolescents. *European Journal of Cancer Prevention* 2001; 10(4)337-345.
- Paper III Bränström R, Ullén H & Brandberg, Y. Attitudes, subjective norms and perception of behavioural control as predictors of sun related behaviour in Swedish adults. Submitted to *Preventive Medicine*.
- Paper IV Bränström R, Ullén H & Brandberg, Y. A randomized population-based intervention to examine the effects of the ultraviolet index on tanning behaviour. *European Journal of Cancer* 2003; 39(7)968-974.
- Paper V Bränström R, Hedblad MA, Krakau I, Ullén H. Reasons to seek medical attention for a skin check-up: the layman's perspective. *European Journal of Public Health*, in press.
- Paper VI Bränström R, Hedblad MA, Krakau I, Ullén H. Laypersons' perceptual discrimination of pigmented skin lesions. *Journal of the American Academy of Dermatology* 2002; 46(5 Pt 1):667-73.

ABSTRACT IN SWEDISH – SAMMANFATTNING PÅ SVENSKA

Hudcancer är ett växande problem för folkhälsan i Sverige. Trots att den viktigaste riskfaktorn för att utveckla hudcancer - solexponering - är känd, fortsätter antalet hudcancerfall att öka. Årligen drabbas ca 30 000 personer i Sverige av någon form av hudcancer och ca 400 dör i hudcancer. Förutom de dödsfall och det lidande som hudcancer ger upphov till leder behandling av hudcancer till betydande sjukvårdskostnader.

Syftet med följande avhandling var att belysa faktorer kopplade till solrelaterat beteende och tidig upptäckt av malignt melanom. Vidare studerades vilka effekter två befintliga informationsstrategier har på solrelaterat beteende och tidig upptäckt av malignt melanom.

Tre grupper studerades med hjälp av frågeformulär. Dessa var: 52 sjuksköterskor som deltog i en vidareutbildning i forskningsmetodik vid Karolinska institutet, 2,615 slumpmässigt utvalda ungdomar (13, 15 och 17 år gamla) från hela Sverige, 1,743 slumpmässigt utvalda vuxna individer (18 – 37 år gamla) från Stockholms län. Den första gruppen besvarade frågeformulären i samband med föreläsningar och de två andra grupperna besvarade frågeformulären via brev. Förutom dessa grupper deltog 90 patienter från Karolinska sjukhuset och 30 slumpmässigt utvalda personer från Stockholms län i en intervjustudie.

Resultaten visade att de enkätfrågor som vanligen används för kartläggning av solrelaterat beteende har relativt god reliabilitet. Studierna bekräftar tidigare resultat som visat att både ungdomar och vuxna i Sverige spenderar mycket tid i solen, solar ofta för att bli bruna och bränner sig ofta efter att ha varit i solen. Studierna beskriver variabler av betydelse för solrelaterat beteende. Kunskap om hudcancer var inte kopplad till minskad solning och ökat skydds-beteende i solen. Tvärtom så var god kunskap kopplat till mer frekvent solning. Positiva attityder till solning och att vara solbränd var kopplat till exponering för ultraviolett strålning. Att ha många människor omkring sig som ofta solar var kopplat till medvetet solande och sol- och badresor. Att uppfatta solning som riskabelt ökade sannolikheten för att vilja minska sitt solande och att skydda sig i solen. Att uppleva kontroll över riskerna med solning var kopplat till solskydds-beteende bland kvinnor.

En individuell mätare av ultraviolett (UV) strålning och information om UV-index (ett mått på solstrålarnas styrka) tycks inte ha en stor betydelse när det gäller att förändra solrelaterat beteende. Sjukvårdspersonal föreföll ha en betydelsefull roll när det gäller tidig upptäckt av malignt melanom, då mer än 1/3 av de intervjuade melanompatienterna rapporterade att deras melanom upptäckts i samband med läkarbesök av annan orsak. ABCD-kriterierna, som beskriver hur tidiga melanom kan identifieras, tycks öka lekmäns förmåga att bedöma hudförändringar och skulle kunna användas i sekundärpreventiva interventioner.

Anhandlingens resultat bidrar till kunskapen om vilka faktorer som påverkar solrelaterat beteende. Genom att ta hänsyn till dessa faktorer kan mer effektiva hudcancerpreventiva interventioner utformas.

ABBREVIATIONS

ABCD	A – asymmetry, B – border irregularity, C – colour variegation, D – diameter > 5 mm
ANOVA	Analysis of variance
BCC	Basal cell carcinoma
CMM	Cutaneous malignant melanoma
DNS	Dysplastic nevus syndrome
NM	Nodular melanoma
PAPM	Precaution Adoption Process Model
SCC	Squamous cell carcinoma
SPF	Sun protective factor
SSM	Superficial spreading melanoma
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TTM	Transtheoretical Model
UV	Ultraviolet
UVA	Ultraviolet A radiation
UVB	Ultraviolet B radiation
UVC	Ultraviolet C radiation

1 INTRODUCTION

1.1 SKIN CANCER

Cutaneous malignant melanoma (CMM), basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) are three different types of cancers appearing on the skin (Ringborg & Lagerlöf, 1998). All three cancer forms are related to exposure to UV radiation (Armstrong & Kricker, 2001).

1.1.1 Malignant melanoma

Cutaneous malignant melanoma is the most lethal form of skin cancer. Approximately, 1,600 people are diagnosed with malignant melanoma annually in Sweden and about 360 die from it (The National Board of Health and Welfare, 2002b, 2003). Malignant melanoma has been registered in the Swedish Cancer Registry since 1958 and has had one of the highest increases in incidence among cancer diagnoses, see Figure 1 (The National Board of Health and Welfare, 2003). A similar development has been observed in many countries with a white population (Armstrong & Kricker, 2001). The incidence is highest in Australia, e.g. the incidence in Queensland (in northern Australia, latitudes 12-28S) is 53.5 per 100,000 and in Victoria (in southern Australia, latitudes 36-38S) 30.3 per 100,000 (Burton, 2000). The increase is assumed to be a consequence of altered sun habits and a subsequent increase of ultraviolet (UV) exposure (The National Board of Health and Welfare, 2001). A small decrease in the mortality rates has been observed during the past years in countries, including the Nordic countries, that have worked with skin cancer preventive interventions over a longer time period (Mansson Brahme, 2002; Severi, Giles, Robertson, Boyle, & Autier, 2000).

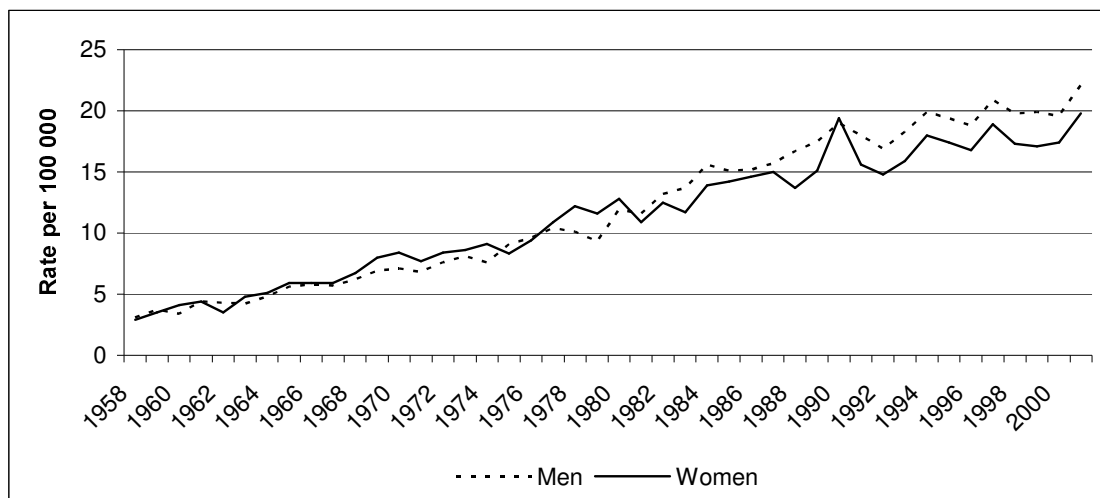


Figure 1. Age standardised incidence of malignant melanoma in Sweden from 1958 to 2001 (using the population in Sweden year 2000)(The National Board of Health and Welfare, 2003).

CMM results from malignant transformation of the pigment producing cell of the skin, the melanocyte (Koh & Lew, 1995). There are three major histogenetic types of CMM: superficial spreading melanoma (SSM), nodular melanoma (NM), and lentigo maligna melanoma (LMM). SSM is the most common histogenetic type of malignant melanoma of the skin and it also accounts for the largest increase (The National Board of Health and Welfare, 2001). LMM is the rarest of the three types. SSM and LMM initially grow mostly horizontally on the surface of the skin, and might proceed into vertical growth eventually. NM lacks the horizontal growth

phase and only grows vertically. The horizontal growth phase of SSM and LMM makes them potentially easier to discover by visual inspection of the skin than NM. The major characteristics of early SSM are irregular borders, uneven pigmentation, asymmetry, and diameter larger than 5 mm (R. J. Friedman, Rigel, & Kopf, 1985). Tumours that are restricted to the skin and have not spread to other sites can generally be cured. However, tumours that have spread to regional lymph nodes or other sites generally lead to death (Koh & Lew, 1995). The best predictor of outcome in tumours without metastases is vertical tumour thickness. Thin tumours are associated with a better prognosis (Sahin et al., 1997). This indicates a possibility to decrease mortality by early detection. Melanoma appearing on extremities and in younger people are also associated with a better prognosis (Sahin et al., 1997).

1.1.2 Basal cell carcinoma

BCC is the most common of the three forms of cancer described in this thesis. BCC has very low metastatic potential and is thus considered to be less harmful in terms of mortality (Ringborg & Lagerlöf, 1998). BCC was not registered in the Swedish Cancer Registry until 2002, but estimations indicate that the incidence is about 25,000 cases annually (personal communication, Centre for Epidemiology, The National Board of Health and Welfare). The morbidity caused by BCC is thus substantial. BCC is often characterised as a pearly, semi-transparent papule (Ringborg & Lagerlöf, 1998). Larger BCC often ulcerate. BCC is divided into three main clinical groups: nodular, superficial and morpheiform (Koh & Lew, 1995). Even though BCC seldom metastasise, recurrent disease is common.

1.1.3 Squamous cell carcinoma

The annual incidence of SCC in Sweden is about 2,800 cases (The National Board of Health and Welfare, 2003). The increase in incidence of SCC is illustrated in Figure 2. This type of skin cancer is less severe in terms of mortality than malignant melanoma. About 50 persons die of non-melanoma skin cancer annually in Sweden (The National Board of Health and Welfare, 2002b). SCC is often characterised by a reddening gritty change in the skin, sometimes with skin that peels (Ringborg & Lagerlöf, 1998). SCC seldom metastasises.

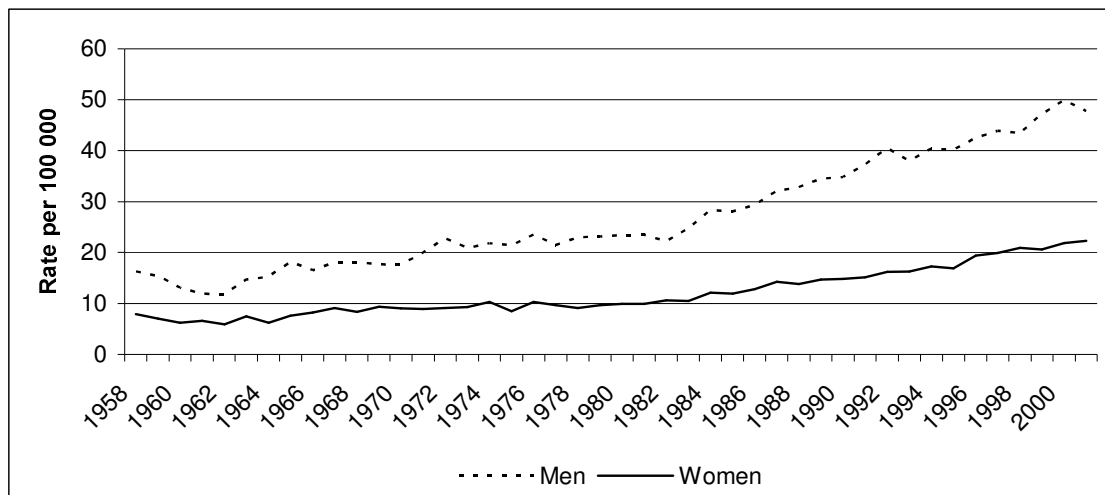


Figure 2. Age standardised incidence of non-melanoma skin cancer (mainly squamous cell carcinoma) in Sweden from 1958 to 2001 (using the population in year 2000)(The National Board of Health and Welfare, 2003).

1.2 RISK FACTORS FOR SKIN CANCER

1.2.1 Ultraviolet (UV) radiation

One potential explanation for the large increase in skin cancer is an increased exposure to UV radiation both from the sun and from artificial tanning devices such as sunbeds. Today it is widely recognised, and there is substantial scientific evidence to support the view, that UV radiation is an important aetiological factor in the induction of CMM, BCC and SCC (Armstrong & Kricker, 1996; Wang et al., 2001). However, there are some differences between the three main types of skin cancers. In studies of the aetiology of skin cancer, a distinction is often made between intermittent or recreational sun exposure and cumulative or total sun exposure. Intermittent solar exposure is hypothesised to be the major cause of CMM (Armstrong & Kricker, 2001). BCC is also perceived as being caused by sun exposure. The major hypothesis states that both total and intermittent sun exposure are important for the development of BCC (Armstrong & Kricker, 2001). SCC is the skin malignancy that has the strongest association with total lifetime amount of sun exposure (Armstrong & Kricker, 2001). As a result, SCC is common among outdoor workers (Koh & Lew, 1995). SCC has its highest density on the most sun-exposed parts of the body, e.g. neck, face and scalp. The hypothesis of cumulative and intermittent sun exposure in relation to skin cancer is illustrated in Figure 3.

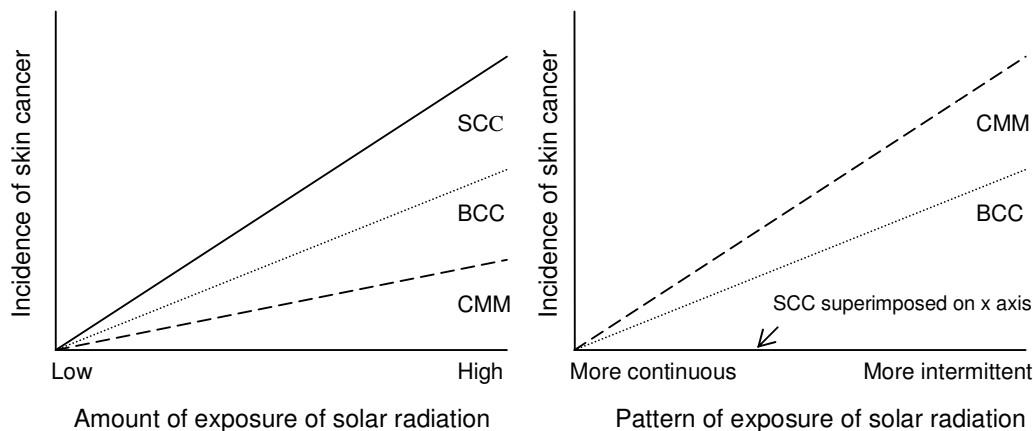


Figure 3. Illustration of the hypothesis regarding independence of amount and pattern of exposure to solar radiation as risk factors for BCC, SCC and CMM. On the left side, amount of exposure varies while the pattern is held constant. On the right side, the pattern varies while the amount is held constant (Adapted from Armstrong & Kricker, 2001).

UV radiation can be divided into three main groups according to wavelength, measured in nanometres (nm), i.e. UVA (320 – 400 nm), UVB (280 – 320 nm) and UVC (200 – 280). The ozone in the atmosphere absorbs much of the UVB radiation and all UVC radiation. The amount of UV radiation that reaches the surface of the earth varies according to the time of day, season, latitude, and altitude. In northern Europe, approximately half of all UV radiation reaches the earth during three peak hours in the middle of the day. Exposure of the skin to excessive UVB causes sunburn and can result in chromosomal damage (Wang et al., 2001). Therefore, UVB has been suggested to be the most important cause of skin cancer. However, there have been several studies concerning which type of radiation that contributes to the development of skin cancer and this issue has not yet been resolved. The radiation produced in

sunbeds is mainly UVA. There are studies showing an increased risk of both malignant melanoma and non-melanoma skin cancers among sunbed users (Karagas et al., 2002; Wang et al., 2001; Westerdahl, Ingvar, Masback, Jonsson, & Olsson, 2000).

1.2.2 Colour of unexposed skin

The risk of contracting skin cancer varies between people with highly pigmented skin and those with low skin pigmentation. The strongest evidence for an increased risk associated with light pigmentation is found for melanoma and the weakest for BCC (Armstrong & Kricger, 2001). Differences have also been found regarding the risk of developing skin cancer and ethnic origin. The most convincing evidence for a difference is found in studies comparing cancer risks in multi-ethnic populations living in the same environment (Armstrong & Kricger, 2001).

1.2.3 Propensity to sunburn and ability to tan

Skin sensitivity to sun exposure is often defined as the ability to tan and the risk of sunburn when exposed to the sun. Skin sensitivity has been found to be an independent risk factor for all types of skin cancer (Armstrong & Kricger, 2001). A frequently used way to classify people in terms of different degrees of sun sensitivity is Fitzpatrick's skin types. Respondents are classified according to self-assessed skin sensitivity in skin type from I to IV (Fitzpatrick, 1988; Rhodes, Weinstock, Fitzpatrick, Mihm, & Sober, 1987). Respondents can self-assess their skin sensitivity to the sun by identifying themselves as: skin type I ('Always burns, never tans'), skin type II ('Always burns, sometimes tans'), skin type III ('Sometimes burns, always tans'), and skin type IV ('Never burns, always tans').

1.2.4 Constitutional factors and benign sun-related conditions

Light hair colour, blue eye colour, and freckles have been associated with an elevated risk of developing skin cancer (Koh & Lew, 1995; Østerlind, 1992). The number of benign pigmented nevi is also related to increased risk of melanoma (Armstrong & Kricger, 2001; Augustsson, Stierner, Rosdahl, & Suurkula, 1990). Benign sun-related conditions such as solar keratoses have been linked to an increased risk of SCC in particular, but also melanoma and BCC (Armstrong & Kricger, 2001; Koh & Lew, 1995). Atypical or dysplastic nevi (DN) are precursors to melanoma and also indicators of increased risk (Augustsson et al., 1990).

1.2.5 Hereditary risk of skin cancers

Approximately 5 to 10% of all melanoma patients report a family history of melanoma (Koh & Lew, 1995). However, self-reporting of cancer history is problematic since it includes difficulties in assessment due to recall bias. Nevertheless, a study using the Family Cancer Database in Sweden found an increased risk of skin cancers in skin cancer patients' offspring (Hemminki & Vaitinen, 1999). Individuals with several family members with melanoma and many DN, the so called dysplastic nevi syndrome (DNS) or atypical mole syndrome, run a high risk of developing melanoma (Platz, Ringborg, & Hansson, 2000). A rare genetic skin condition called xeroderma pigmentosum is a syndrome that leads to high sensitivity to sun exposure and impaired ability to repair DNA damage of UV radiation. This condition substantially increases the likelihood of developing melanoma and other skin cancers (Armstrong & Kricger, 1996). Studies of genetic alterations in melanoma patients have found some evidence for genetic familial predisposition for melanoma (Platz et al., 2000).

1.2.6 Other risk factors

An increased risk of developing skin cancer has also been found to be related to some occupations. SCC is more common among outdoor workers (Koh & Lew, 1995). An increased risk of contracting melanoma has been found among chemists, chemical workers, engineers, miners, pesticide workers, and telecommunication workers (Koh & Lew, 1995). An increased melanoma risk has also been found among pilots. It is, however, unclear if the risk is a result of exposure to cosmic radiation or life style factors associated with the occupation (Gundestrup & Storm, 1999). The associations between occupation and skin cancer are, however, ambiguous and should be interpreted cautiously.

Skin cancer, especially SCC, is a common cancer in patients after transplantation (Berg & Otley, 2002; Lindelof & Gabel, 2000). The risk of contracting cancer increases as a result of immunosuppressive medications taken after transplantation to prevent acute rejection of the transplanted organ.

1.3 THE ECONOMIC BURDEN OF SKIN CANCER

Cancer occupies second place in causes of death in Sweden (The National Board of Health and Welfare, 2002b). Twenty-five per cent of all deaths among men and 22% of all deaths among women are caused by cancer. Although the mortality rate due to skin cancer is relatively low, these cancer diagnoses contribute significantly to morbidity and subsequently to health care costs. A calculation was made of the costs for the treatment of skin cancers in Stockholm County (1.8 million inhabitants) (Carlsson, Eklund, Dal, & Ullén, 2001). The estimation showed that treatment of the three skin cancer diagnoses cost 60 million Swedish kronor in 1999. In addition to treatment costs, estimations were made of the costs for lost production because of sickness and death from skin cancer. This calculation showed a total cost of 178 million Swedish kronor. Further, the costs in terms of decreased quality of life for the patients and their families are substantial. Thus, there is reason to invest in skin cancer prevention work as there is a potential for considerable gains in quality of life and major reductions in health care expenditure.

1.4 SKIN CANCER PREVENTION

Primary prevention aims at reducing the incidence of a disease by removing its cause or risk factors. The prevention of malignant skin tumours has mainly been concerned with reducing UV exposure by altering sunbathing habits and use of artificial tanning devices such as sunbeds, and further, by increasing people's sun protective behaviour.

Secondary prevention of skin cancer has mainly involved regular follow-ups of high-risk individuals, occasional screening and health education about signs of malignancy with the aim of promoting early detection of malignant lesions.

1.5 THEORIES OF BEHAVIOUR AND BEHAVIOUR CHANGE

1.5.1 Behaviours involved in skin cancer prevention

The major target behaviours involved in skin cancer prevention are: outdoor sunbathing, outdoor activities involving sun exposure, vacations at sunny resorts, sunbed use, sun protection behaviour, skin self-examination, screening attendance, and early detection of malignant melanoma.

1.5.2 Theories of health behaviour

A number of social-psychological theories have been developed to describe and explain people's health behaviour. Some of the most widely applied theories relevant to individual health behaviour are the Health Belief Model, the Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB), the Transtheoretical Model (TTM), and the Precaution Adoption Process Model (PAPM) (Glanz, Lewis, & Rimer, 1997). Only the theory of Planned Behaviour will be more thoroughly explained here. Studies of skin cancer prevention, as well as studies in many other public health areas, have mainly focused on identifying attitudes, beliefs and personality characteristics of high-risk individuals compared with low-risk individuals (Bränström, Brandberg, Holm, Sjöberg, & Ullén, 2001; Mermelstein & Riesenber, 1992; Wichstrøm, 1994). These studies are important for finding groups that should be targeted with interventions. General attitudes and personality are, however, difficult to change with educational campaigns and thus there is a need for more applicable models for behaviour change. During recent years, several attempts have been made to produce comprehensive models of sun-related behaviours. These models have been based on one or several of the theories of individual health behaviour. Our understanding of the complex and continuous way in which behaviour and environment interact and influence each other offers an important insight into how health-related behaviour can be modified through health promotion interventions and highlights the obstacles in prevention (Bandura, 1977; Nutbeam & Harris, 1999). In one of the studies included in this thesis the Theory of Planned Behaviour is applied to sun-related behaviours.

1.5.3 Theory of planned behaviour

According to the Theory of Reasoned Action (TRA), developed by Martin Fishbein and Icak Ajzen, human behaviour can be predicted by a person's beliefs about the likely outcomes of the behaviour, the evaluations of these outcomes (behavioural beliefs), beliefs of normative expectations of others, and motivation to comply with these expectations (normative beliefs) (Conner & Norman, 1995). The model is best at predicting reasoned action or behaviour under deliberate control, but less good at predicting behaviours that are habitual, require special knowledge or behaviour that is not under deliberate control (Conner & Norman, 1995). Sunbathing is probably somewhere in between, partly a habitual behaviour but also under deliberate control. For the sake of better explaining behaviours not under complete deliberate control, the TRA was expanded with a third component: perceived behavioural control. Perceived behavioural control accounts for an individual's experience of personal control over the behaviour in question. According to this theory, called the Theory of Planned Behaviour (TPB), our behaviour is determined by three different considerations: beliefs about a behaviour and thoughts about the consequences of that behaviour (behavioural beliefs), beliefs about the normative expectations of others and motivation to comply with these norms (normative beliefs), and perceptions about the presence of factors that may facilitate or impede performance of the behaviour and the perceived power of these factors (control beliefs) (Ajzen, 2002). Together, these three factors or behavioural beliefs' constructs, *attitudes towards the behaviour, subjective norms and perceived behavioural control*, lead to an intention to behave. If a sufficient degree of control exists, the intention is expected to lead to actual behaviour. The theory is supported in a newly conducted meta-analysis encompassing 185 studies (Armitage & Conner, 2001). In that analysis the theory seemed to explain between 27% and 39% of the variance in behaviour and behavioural intention. The theory has been applied to a wide variety of health-related behaviours. A few earlier studies have applied the theory to sunbathing habits

and sun-protective behaviour but these have used small and non-randomised groups (Ajzen, 2002; Hillhouse, Adler, Drinnon, & Turrisi, 1997; Hillhouse, Turrisi, & Kastner, 2000).

1.6 BEHAVIOURS RELATED TO UV EXPOSURE

1.6.1 Studies on UV-related behaviour and predictors

A majority of the studies on sun-related behaviours have been conducted in countries with high levels of ambient UV radiation, and among inhabitants with white and sensitive skin. The situation in Sweden and the other Scandinavian countries is different from other countries with respect to sun exposure. Long winters with few hours of sun and short mild summers with intermittent sunny days and moderate levels of ultraviolet radiation characterize the climate. The ambient solar radiation in Sweden is low with few sunny hours per year. As a result, many people in Sweden engage in intensive intentional tanning during the summer and travel regularly to warmer countries. This makes special demands on primary preventive efforts to reduce the exposure of UV radiation in the population. People do not want to protect themselves from the sun; they are actually seeking the sun. A study conducted by the European Commission measuring beliefs about the dangers with different sun-related behaviours found people in Sweden to be less concerned about 'having a tan' or 'sunbathing for three hours in the middle of the day' than people in other member states (INRA (EUROPE) European Coordination Office, 1997). According to the same study, people in Sweden are the most likely to sunbathe in the middle of the day and try to obtain a tan as quickly as possible at the beginning of the summer vacation. Despite primary preventive efforts in Sweden during the past decade, people are still exposing themselves to large amounts of UV radiation through sunbathing and recreational outdoor activities. In a survey of the sun habits of the population in Stockholm County during the summer of 1999 (n=6,800), 33% of the women and 17% of the men reported frequent sunbathing with the intention of obtaining a tan during the past year (Boldeman et al., 2001). Further, 45% reported having travelled abroad on a vacation to a sunny resort during the past year.

1.6.2 Outdoor sunbathing

Sunbathing often refers to 'an intentional stay in the sun with the purpose of obtaining a tan'. This type of behaviour has become more frequent in Western society since the shift in the meaning of tanned skin in the early 1900s. Before the Industrial Revolution, a pale complexion was prized as an indication of status, demonstrating that the individual was not a peasant who needed to work outside. With industrialisation, the working class left the fields for the factories. This included a change in life-style and a re-evaluation of the meaning of tanned skin. The year-round tan became associated with status and wealth as it indicated that the person could afford to spend time in the sun and travel to sunny resorts (Koblenzer, 1998). Since then, people have enjoyed sunbathing and tanning during leisure time, and studies of people's attitudes have indicated that, for many, a suntan means physical and emotional health and attractiveness (Borland, Marks, & Noy, 1992; Broadstock, Borland, & Gason, 1992; Koblenzer, 1998).

1.6.2.1 Prevalence

Surveys of Swedish sunbathing habits have been made at irregular intervals and among different groups in the population. Summaries of random population-based surveys conducted in Sweden, including information about author, year, sample, method, and frequency of

extensive sunbathing, are presented in Table 1. It is apparent from Table 1 that there are inconsistencies in the items used to assess sunbathing as well as in the response alternatives. The way in which data are presented also varies between the studies. The frequency of sunbathing at different ages is also shown in Figure 4. The results are also dependent on the geographical region and the age groups from which the sample is drawn. Figure 4 gives an indication of the prevalence of sunbathing, and shows that sunbathing seems to be dependent on both age and gender.

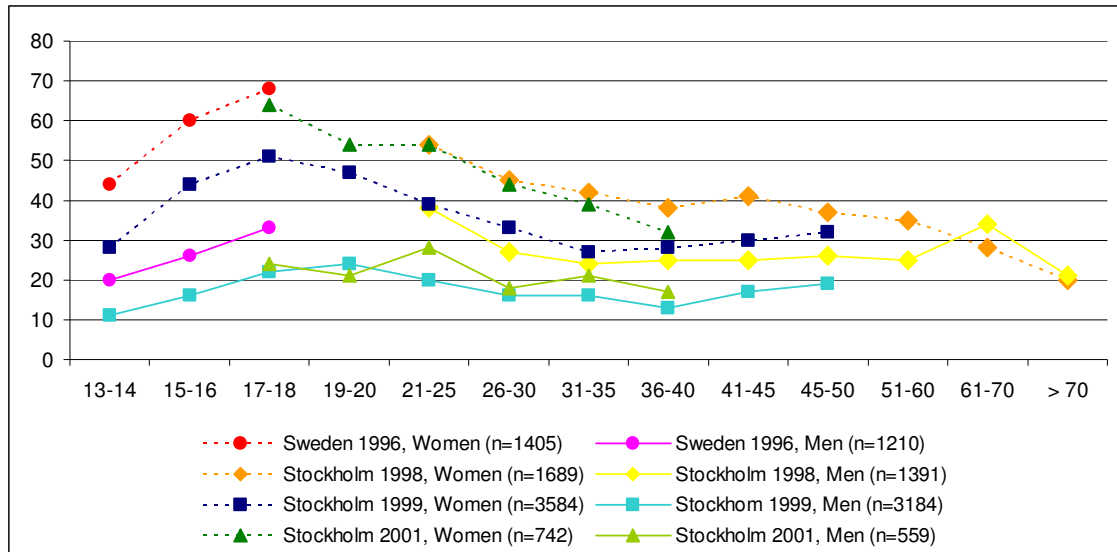


Figure 4. Percentages of excessive sunbathing shown separately for men and women in four Swedish studies (Boldeman et al., 2001; Brandberg, Ullén, Sjöberg, & Holm, 1998; Bränström, Ullén, & Brandberg, 2003b)(Folkhälsoenkät 1998, data not published).

Sunbathing appears to peak in late adolescence and women sunbathe more than men. However, comparisons of prevalence of sunbathing have limitations due to differences in the studied samples, items used for the measurement of sunbathing and the response format. Prospective assessments, using consistent items and response alternatives in various samples, are needed in order to make comparisons between groups possible and to evaluate preventive efforts in the population. A number of Swedish, random population-based studies on the frequency of sun exposure (Boldeman et al., 2001; Brandberg et al., 1998; Bränström et al., 2003b)(Folkhälsoenkät 1998, data not published) are presented in Table 1.

1.6.2.2 Variables associated with outdoor sunbathing

A large number of studies have been conducted with the aim of finding relevant factors associated with sunbathing. The most important factors have been demographic, i.e. gender, age and skin sensitivity, although attitudinal and personality factors have also been found relevant in explaining sunbathing.

Gender is the most important factor relevant to sun exposure through sunbathing. Numerous studies have found that women sunbathe to a greater extent than men (Boldeman et al., 2001; Bränström et al., 2001; Mawn & Fleischer, 1993; McGee & Williams, 1992; Robinson, Rigel, & Amonette, 1997; Stott, 1999; Vail-Smith & Felts, 1993; Wichstrøm, 1994). However, considering gender differences in UV-exposure, it is very important to distinguish between sunbathing with the intention to tan and outdoor activities that lead to sun exposure. When sun

exposure is measured as a combination of intentional and unintentional exposure, women do not receive a higher UV-dose. On the contrary, it has been found that men's exposure to the sun is greater than women's (Campbell & Birdsell, 1994; Keesling & Friedman, 1987; Mermelstein & Riesenber, 1992).

Several studies have examined the relationship between *age* and sunbathing (Brandberg et al., 1998; Bränström et al., 2001; Wichstrøm, 1994). A 1999 survey of 6,800 residents in Stockholm County, aged 13 – 50 years, found a curvilinear relationship between age and sunbathing (Boldeman et al., 2001). Women seemed to sunbathe the most in late teens with a peak at the age of 17 – 18, and men sunbathed the most in early adulthood with a peak somewhere between the ages of 19 – 25, see Figure 4. Studies of younger children's sunbathing habits has not been conducted in Sweden, but an European multicentric study led by the European Organization for Research Treatment of Cancer (EORTC) Melanoma Cooperative Group examined prospectively the sun habits of children in the age range 0-6 years in Belgium, Germany, France and Italy. This study found a steady increase of sun exposure with age (Severi et al., 2002).

Skin sun-sensitivity, or ability to tan and risk of burning when exposed to solar radiation is associated with sunbathing frequency. Studies have generally shown that those with sensitive skin sunbathe less frequently than those with "higher" skin types (Bränström et al., 2001; Wichstrøm, 1994). However, some studies have found no difference in sunbathing between skin types (Hillhouse et al., 1997; Mermelstein & Riesenber, 1992). These studies, however, categorised people as sun-sensitive or not sun-sensitive instead of using the more differentiated skin type classification.

Socio-economic status, educational level and school grades have been suggested as predictors of sunbathing. Studies from other countries suggest that higher socio-economic status, higher educational level, and high school grades are associated with higher frequency of sunbathing (Severi et al., 2002; Wichstrøm, 1994). One study of Swedish adults, aged 18-37 years, showed no significant increase in tanning among the highly educated (Bränström, Ullén, & Brandberg, 2003a).

Knowledge about the risks of sunbathing, knowledge of solar radiation and risk factors for skin cancers have been found to be related to sunbathing. Several studies indicate a positive association between a high level knowledge and sunbathing (Broadstock, Borland, & Hill, 1996; Bränström et al., 2001; Jerkegren, Sandrieser, Brandberg, & Rosdahl, 1999). A possible explanation of this is that these studies have been conducted among young people. Women in their late adolescence or young adulthood had the most knowledge and women of that age are also most likely to sunbathe frequently. People who like sunbathing and tanning seem more inclined to search for information about it. Other studies have found no relation between knowledge and sunbathing (Arthey & Clarke, 1995; Hillhouse, Stair, & Adler, 1996; Keesling & Friedman, 1987).

Table 1. Studies on frequency of sun exposure in Sweden.

Author	Year	Sample	Items asked about sunbathing	Response alternatives	Frequent sunbathers ¹	Comments
Bränström R., Ullén H., Brandberg Y. (Bränström et al., 2003a)	2001	Random population-based sample (n=3.200) aged 18-37 years in Stockholm County	'How often do you sunbathe in the summer with the intention of obtaining a tan?'	'Very often'*; 'Often'*, 'Sometimes', 'Seldom', 'Never'	Men: 22% Women: 44%	Response rate 55%
			'How often do you stay in the sun during the summer?'	'Very often'*; 'Often'*, 'Sometimes', 'Seldom', 'Never'	Men: 74% Women: 80%	
			'How much time do you usually spend outside in the sun between 11 a.m. and 3 p.m. a normal work-free day during the summer (June- August)?'	'< 30 min', '30 min – 1 hr', '1 – 2 hr', '2 – 3 hr'*; '> 3 hr'*	Men: 48% Women: 54%	
Boldeman C. Et al (Boldeman et al., 2001)	1999	Random population-based sample (n=10.000) aged 13-50 years in Stockholm County	'How often do you sunbathe in the summer?' with sunbathing defined as intentional tanning	'Often'*; 'Sometimes', 'Seldom', 'Never'	Men: 17% Women: 33%	Response rate 68%.
Unpublished data from survey in Stockholm County	1998	Random population-based sample (n=5.000) aged 21-86 years in Stockholm County	'How often do you sunbathe in the summer?'	'Often'*; 'Rather often'*, 'Sometimes' 'Seldom', 'Never'	Men: 27% Women: 36%	Response rate 64%
Brandberg Y. et al. (Brandberg et al., 1998)	1996	Random population-based sample (n=4.020) aged 15, 17 and 19 years in Sweden	'How often do you sunbathe in the summer?' with sunbathing defined as intentional tanning	'Often'*; 'Rather often'*, 'Sometimes' 'Seldom', 'Never'	Men: 26% Women: 57%	Response rate 65%

¹ 'Frequent sunbathers' are defined as percentage of people indicating the response alternatives marked with *

Numerous studies have reported a relation between the *pros and cons* of sunbathing and the pros and cons of being tanned and sunbathing (Brandberg et al., 1998; Bränström et al., 2001; Hillhouse et al., 1997; Jackson & Aiken, 2000; Mermelstein & Riesenber, 1992; Wichstrøm, 1994). The most obvious motivator for sunbathing seems to be the positive effects of sunbathing on *appearance* (Brandberg et al., 1998; Grob et al., 1993; Hillhouse et al., 1996; Vail-Smith & Felts, 1993). People generally judge themselves and others as more attractive if they are tanned. This seems to be a very strong motivator, as one study showed that even people with a high hereditary risk of contracting skin cancer stated appearance as one motive for sunbathing frequently (Bergenmar & Brandberg, 2001). Another reported reason to sunbathe is that people experience sunbathing as *relaxing* (Brandberg et al., 1998; Hillhouse et al., 1996). *Positive effects* of sun exposure on certain *skin conditions* such as psoriasis and acne have also been documented (Horio, 1998; Wharton & Cockerell, 1998). Perceptions of *susceptibility* and *severity of skin cancer* are related to sunbathing (Hillhouse et al., 1997; Hillhouse et al., 1996; Jackson & Aiken, 2000; Mermelstein & Riesenber, 1992; Vail-Smith & Felts, 1993; Wichstrøm, 1994). Those who believe that they are more susceptible to skin cancer and those that consider skin cancer to be a serious disease are less likely to sunbathe frequently.

Perceptions of *other people's sunbathing* and the prevailing *social norms* are also important predictors of sunbathing (Jackson & Aiken, 2000; Keesling & Friedman, 1987; Miller, Ashton, McHoskey, & Gimbel, 1990; Wichstrøm, 1994). Tolerating norms and other people's frequent sunbathing are related to own sunbathing. People belonging to health clubs and those spending more hours exercising were more likely to sunbathe according to a US study (Keesling & Friedman, 1987). A study in France found children's sun exposure to be related to mothers' sun protective habits (Grob et al., 1993). Mothers with good sun protective habits were more restrictive in exposing their children to the sun.

One study of Swedish adolescents showed associations between sunbathing and *self-image* (Brandberg et al., 1998). Boys who were satisfied with themselves and girls who were not satisfied with themselves sunbathed the most. It has also been suggested that people with a higher degree of *appearance motivation* engage more in sunbathing (Jones & Leary, 1994; Koblenzer, 1998; Leary, Saltzman, & Georgeson, 1997). A few studies have shown an increased frequency of sunbathing among people who have a general positive *attitude towards risk taking* and low *need for achievement* (Beech, Sheehan, & Barraclough, 1996; Keesling & Friedman, 1987). In one study, excessive tanning was positively related to *obsessive-compulsive tendencies* (Leary et al., 1997). Frequent sunbathing has been found to be associated with other health risk behaviours such as *tobacco smoking* (Wichstrøm, 1994) and a less frequent *use of car seatbelts* (Keesling & Friedman, 1987).

A study in Norway showed a negative association between *latitude* and sunbathing frequency, probably due to less opportunity to sunbathe in the northern area (Wichstrøm, 1994). A study in the US showed that people residing in areas with a lower *number of sunny days* were more likely to sunbathe intentionally (Robinson, Rigel et al., 1997).

1.6.2.3 Theoretical models applied to sunbathing

A few attempts have been made to create comprehensive models of sunbathing and the relation between sunbathing and other relevant factors. Various kinds of social-psychological theories

have been used in trying to explain as much variance as possible in the measurement of the behaviour. The most fruitful of these studies will be presented below.

Some studies using the theories of Reasoned Action and Planned Behaviour (Hillhouse et al., 1997; Jackson & Aiken, 2000) have shown that attitudes towards sunbathing, e.g. enhancing appearance, positive mental and physical reinforcements, were the most important predictors of intentions to sunbathe and actual sunbathing. Perceived susceptibility to skin cancer and photoaging were highly predictive of intentions to sunbathe less. Social norms positive to sunbathing also significantly contributed to the prediction of sunbathing behaviour. The sun-related behaviour of friends and important others seemed more important than norms from the fashion and movie industries. Perceived behavioural control moderated the effects of attitudes on intentions to sunbathe. The relationship between attitude and intention was weaker for those who perceived themselves to have low degree of control over their behaviour.

Jaccard (1981) has described a theory of alternative behaviours as a model for explaining decision-making. A study using his theory was conducted on a sample of university students (Turrisi, Hillhouse, Gebert, & Grimes, 1999). It showed that being appearance oriented, having friends that sunbathe, liking outdoor life, believing that everyone sunbathes at some time in their life, and not being health oriented all contributed to the attitude towards sunbathing. Actual sunbathing was predicted by attitudes towards alternative concurrent behaviours such as shopping, working-out, and going to the cinema. Recommendations for future research should include attitudes towards alternative behaviours in models predicting sunbathing.

1.6.2.4 A comprehensive model of sunbathing

The following model (see Figure 5) is an attempt to integrate the variety of models and explanatory factors related to sunbathing. The purpose is to clarify important elements relevant for preventive interventions and factors important to assess in order to evaluate such interventions. The model is derived mainly from the Theory of Planned Behaviour although efforts have been made to integrate aspects from the Health Belief Model, the Theory of Alternative Behaviours, the Transtheoretical Model of Behaviour Change, and the Social Cognitive Theory.

1. Sunbathing habits are associated with several *demographic and cultural factors* (e.g. gender, latitude, frequency of sunny days, cultural tradition, etc). These factors are important predictors of sunbathing but are difficult to change. They are therefore not helpful in the development of interventions. It is important to conduct studies within a specific cultural setting and to consider the cultural variables when developing interventions. Consequently, it is not possible to adopt a preventive strategy developed in Australia without considering differences in demographics and cultural factors.
2. *Outcome expectations* are shaped by personal history e.g. earlier experiences of sunburn after sunbathing, positive feedback about a nice tan, family history of skin cancer etc. Perceived pros and cons associated with sunbathing include four main categories of aspects or beliefs:
 - a) *Health beliefs* include beliefs about the severity of skin cancer and other negative health effects of sun exposure such as photoaging. Perception of risk associated with sunbathing, perception of own susceptibility to skin cancer, the treatability of skin

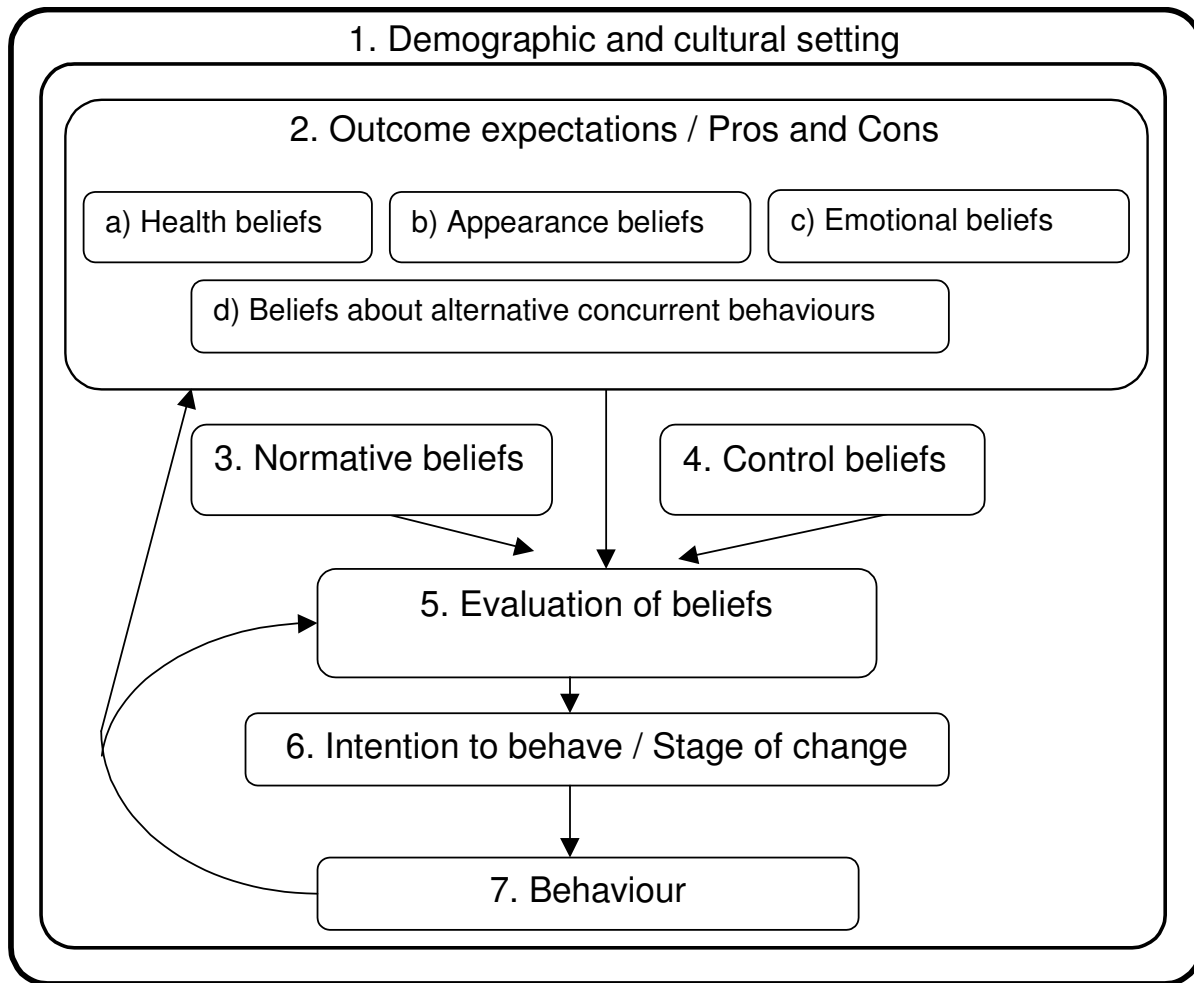


Figure 5. A model of health behaviour applied to sunbathing.

cancer, as well as awareness of the incidence of skin cancer and photoaging can be included within the element *Health beliefs*.

b) *Appearance beliefs* encompass beliefs about enhanced attractiveness when tanned, a healthier glow when tanned, and relief from skin problems.

c) *Emotional beliefs* relate to feelings of relaxation and comfort when sunbathing, and relief from depressed moods.

d) *Beliefs about alternative concurrent behaviours* are attitudes towards doing other things instead of sunbathing.

3. *Normative beliefs* concern perceptions of other people's sunbathing, trends in society, images promoted by the fashion and movie industries, and social pressure to sunbathe and to have a tan.

4. *Control beliefs* concern ability to sunbathe and capability of confronting barriers to successful sunbathing. This is also dependent on the actual possibility of sunbathing. Even if the evaluation of fundamental variables towards sunbathing is positive, it is difficult to sunbathe outdoors in Sweden in the winter.

5. The individual evaluates outcome expectations and normative beliefs. The *evaluation of beliefs* is affected by earlier experiences and personality factors such as self-efficacy,

appearance motivation, health orientation, orientation towards outdoor life, having a sporty lifestyle, a risk-taking personality, self-esteem, and social desirability.

6. The evaluation of beliefs results in an *intention to behave* in a certain manner or change behaviour. The behavioural intention can beneficially be categorised in the *stages of change* derived from the Transtheoretical Model of Behaviour Change.
7. The behaviour performed results in new experiences which interact with other elements of the decision making process.

1.6.2.5 Implications for interventions

According to the suggested model on page 21, interventions to decrease sunbathing should focus on those factors that are possible to change. As pointed out, most demographic and cultural aspects are resistant to change. Many studies have tried risk-information as a way to change outcome expectations. The results in terms of behavioural change have been limited (Melia, Pendry, Eiser, Harland, & Moss, 2000). It is well established that long-term consequences of certain behaviour are less powerful in motivating people to alter their behaviours than short-term consequences. Concerning sunbathing, short-term consequences such as increased immediate attractiveness, a healthier glow and fewer skin-problems compete with the relatively small risk of developing skin cancer in the distant future. In addition, the positive consequences have previously been experienced on a personal level, whereas few people have personal experience of skin cancer. Emotional beliefs are probably also difficult to address, because they are based on personal experiences, e.g. feeling relaxed in the sun.

One possible way to work with prevention is to focus on normative beliefs. An intervention targeting parents with small children, stressing the importance of protecting their children and their role as models for their children is one example. It may be possible to instil the attitude that parents who do not protect their children are careless. Collaboration with the fashion and movie industries to inform them of their significant impact on social norms concerning tanning and sunbathing is also important. In addition, alternative recreational activities should be reinforced.

1.6.3 Outdoor activities involving sun exposure

Sailing, fishing, canoeing, outdoor sports, hiking, gardening, etc. are all activities that are enjoyed in Sweden during the summer. All these activities include some degree of sun exposure. The frequency of people's participation in them has so far been poorly investigated. There is no reason to believe that unintentional sun exposure, or sun exposure during other outdoor activities than sunbathing, should be less damaging than intentional tanning. This type of exposure can include intermittent as well as cumulative or total sun exposure and thus probably contribute to the incidence of all forms of skin cancer. This might be one reason why women, who report more frequent tanning than men, have a lower incidence of skin cancer than men (The National Board of Health and Welfare, 2003).

1.6.3.1 Variables associated with outdoor activities involving sun exposure

In Sweden, sun exposure has generally been measured by survey questions about intentional sun exposure or tanning. Measurement of sun exposure in terms of hours in the sun, unintentional as well as intentional sun exposure, has been more common in countries with higher ambient solar radiation and a higher incidence of skin cancer. The studies reported below are therefore mostly from countries other than Sweden.

When sun exposure is measured as a combination of intentional and unintentional exposure, e.g. as hours spent outside, no *gender* differences have been found. Studies indicate that men are more exposed to the sun than women (Davis, Cokkinides, Weinstock, O'Connell, & Wingo, 2002; Keesling & Friedman, 1987; Mermelstein & Riesenber, 1992; Robinson, Rademaker, Sylvester, & Cook, 1997). In one study 'having a tan last summer' was more common among men than women even though sunbathing was not (McGee & Williams, 1992). Time spent in the sun seems also to increase during adolescence (Davis et al., 2002) and peak at early adulthood. A study of 18 – 37 year old persons randomly selected in Stockholm County found no significant *age* difference in number of hours spent in the sun during a typical work-free day in June – August (Bränström et al., 2003a). *Skin sun-sensitivity* does not seem to be connected to time spent outside (Davis et al., 2002; Mermelstein & Riesenber, 1992). A negative association has been found for *knowledge about skin cancer* and hours spent outside (Keesling & Friedman, 1987).

1.6.3.2 Implications for interventions

UV exposure during outdoor activities may be unintentional, as opposed to sunbathing. Information about the amount of exposure during these activities may increase people's awareness of the dangers involved and the importance of protection against excessive sun-exposure in these settings. In interviews about recreational activities, it has been found that 'reading a book on the lawn' and 'sailing' are considered to be less harmful activities than sunbathing with the intention of obtaining a tan (Bergenmar & Brandberg, 2001). In relation to the model in Figure 5, outcome expectations may be less of a determinant of UV exposure during outdoor activities since the UV exposure involved is considered unintentional. If it is intentional, prevention efforts should be analysed parallel to sunbathing behaviour. It is important to inform people that it is the amount of UV radiation per se that is detrimental, regardless of the motives for being in the sun. Information could also be directed at people engaging in specific activities, e.g. protection information for people on boat vacations at frequently visited harbours or in shops selling recreational equipment.

1.6.4 Occupational and medical UV exposure

Outdoor workers expose themselves to a large amount of UV radiation during the summer months, and outdoor work has been found to be associated with an increased risk of non-melanoma skin cancers (Koh & Lew, 1995). UV exposure, both natural and artificial, is recommended for certain medical conditions. Many different skin disorders improve when treated with UV radiation, e.g. acne, psoriasis (Wharton & Cockerell, 1998). Phototherapy is one of the most important methods in dermatology (Horio, 1998; Roelands, 2002). However, the beneficial effect of UV radiation is restricted to certain wavelengths, and in controlled settings the benefits can be maximised and the detrimental effects of UV radiation minimised.

1.6.4.1 Variables associated with occupational sun exposure

There is a paucity of Swedish studies of sun exposure during outdoor work. A few international studies are therefore mentioned below. Studies of Canadian adults and US adolescents found that men were much more likely to work outside than women (Campbell & Birdsell, 1994; Davis et al., 2002). In a US study, weekday exposure was positively associated with *lower education*, male *gender*, living in areas with *lower sunshine levels*, and *working outdoors* (Robinson, Rigel et al., 1997).

1.6.4.2 Implications for interventions

It is necessary to collect data on outdoor workers' knowledge about the risks of sun exposure and about sun protective behaviour. Interventions to promote sun protection among outdoor workers are probably needed in order to prevent BCC and SCC. These should include protective measures that avoid encumbering the individual with extra costs, i.e. protective clothing (hats, t-shirts etc.) for outdoor workers should be provided by employers. Interventions aiming at altering norms among these workers regarding 'dress code' and UV protection are probably also warranted.

1.6.5 Vacations at sunny resorts

Since the sixties and seventies, vacations at sunny resorts abroad have become increasingly popular among the Swedish population. The number of people making international trips has doubled during the past ten years (Swedish Institute for Transport and Communication Analysis, 2000). Today more than 1 million people in Sweden take vacations abroad with chartered flights every year, and the most popular destinations are at lower latitudes with sunnier and warmer climates (Swedish Institute for Transport and Communication Analysis, 2000). More than half (55%) of the Swedish holidaymakers choose a resort by the sea and the most popular countries are Spain (12%) and Greece (10%) (European Commission, 1998). Apart from the data reported above, information on sun exposure in the Swedish population during vacations abroad is scarce and therefore most of the results reported below are from a survey of sunbathing habits conducted in Stockholm County in 1999 with 6,800 respondents. Among these, 45% reported that they had travelled to a sunny resort during the past year (Boldeman et al., 2001).

1.6.5.1 Variables associated with vacations at sunny resorts

There is no apparent gender difference in frequency of vacations spent at sunny resorts (Boldeman et al., 2001). Adolescents and young adults were somewhat more likely to have travelled abroad during the past year than older persons. As expected, the number of lifetime vacations to sunny resorts increased with age, see Figure 6.

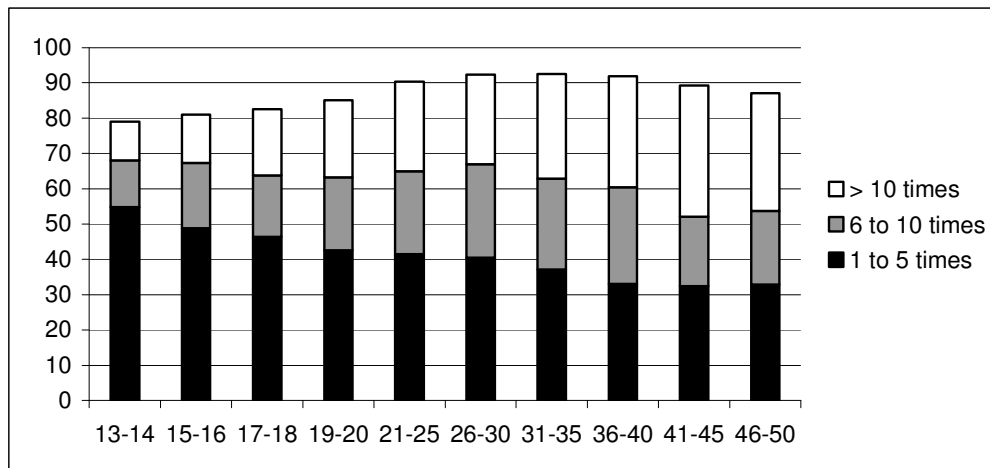


Figure 6. Percentages of respondents that have travelled to a sunny resort 1 to 5 times, 6 to 10 times, and more than 10 times, during their lifetime, in different age groups (Figure not published)(Boldeman et al., 2001).

In a study of people living in Stockholm County, there was no difference in frequency of travel depending on *educational level* (Bränström et al., 2003a). *Skin sun-sensitivity* or *skin types* were related to frequency of vacations abroad, with those with less sensitive skin being more likely to have travelled (Bränström et al., 2003a).

1.6.5.2 Implications for interventions

In order to be able to provide adequate information and develop effective interventions, more knowledge has to be gathered about specific behaviours during vacations and factors promoting travelling to sunny resorts. Is sun protection used at the beach or by the swimming pool? Are children being exposed to the sun? How extensive are the sunburns? There is reason to believe that Swedish people take their values and sun-related habits with them abroad and tan in the same manner as they do on vacations in Sweden, i.e. intensive sunbathing in the middle of the day resulting in sunburn. One suggestion is that the travel agencies provide information on the plane to the destination about how to minimise risk behaviour in the sun. Such advice given in connection to the situation in which the behaviour is elicited would increase the likelihood of the advice being followed. One problem, however, is that the travel agencies have 'sunbathing' and 'tans' as selling points. Therefore, to date there has been a conflict of interest in providing advice about the dangers of too much sun. However, it might be possible to interest commercial companies in promoting responsible protection and care for their customers' children and this might also work as a sales argument.

1.6.6 UV exposure in artificial tanning devices

Since the seventies people have added to their amount of UV exposure by using sunbeds. Even though the detrimental effects of UV exposure in sunbeds is still not fully understood, studies indicate an increased risk of skin cancer from their use (Chen et al., 1998; Swerdlow & Weinstock, 1998; Westerdahl, Ingvar, Masback, Jonsson et al., 2000). The Swedish Radiation Protection Authority in Sweden has made recommendations regarding the usage of sunbeds. They discourage their use by adolescents younger than 18 years and advise sunbed users to limit their usage to 10 sessions per year. Nothing is known about the level of the public's knowledge of these recommendations or the degree of adherence. However, an interview study in 1997 found that 86% of people over 15 years of age in Sweden thought that using a sunbed contributed to both the risk of getting skin cancer and premature ageing of the skin (INRA (EUROPE) European Coordination Office, 1997).

In addition to artificial tanning devices there are medical sunbeds that are used in the treatment of e.g. psoriasis. The use of these devices will not be discussed here.

1.6.6.1 Prevalence

Random population-based surveys of people's sunbed use have been conducted in Sweden a few times during the past decade, Table 2. The various questions used to assess frequency of sunbed use are more similar than those used to assess sunbathing frequency, and the response alternatives are also more comparable. Nonetheless, fluctuations between different studies exist. Even though the overall measurements of sunbed use are quite similar, sunbed use by age, as illustrated in Figure 7, differs quite significantly between different studies. There is therefore a need for regular prospective surveys of sunbed use in the population, using similar questions for assessment.

The first study included a random sample of adolescents from the total population (Brandberg et al., 1998), whereas the other two studies are surveys of people from Stockholm County (Boldeman et al., 2001; Bränström et al., 2003b)(Folkhälsoenkät 1998, data not published). The differences between the young women could probably be due to different social norms in the capital city and in other parts of the country. However, it can also reflect a change in behaviour and attitude over time. Similarly, the peak for women in Stockholm aged 21-25 could reflect the current fashion in this group at that time. A corresponding peak was found among men but not of the same magnitude.

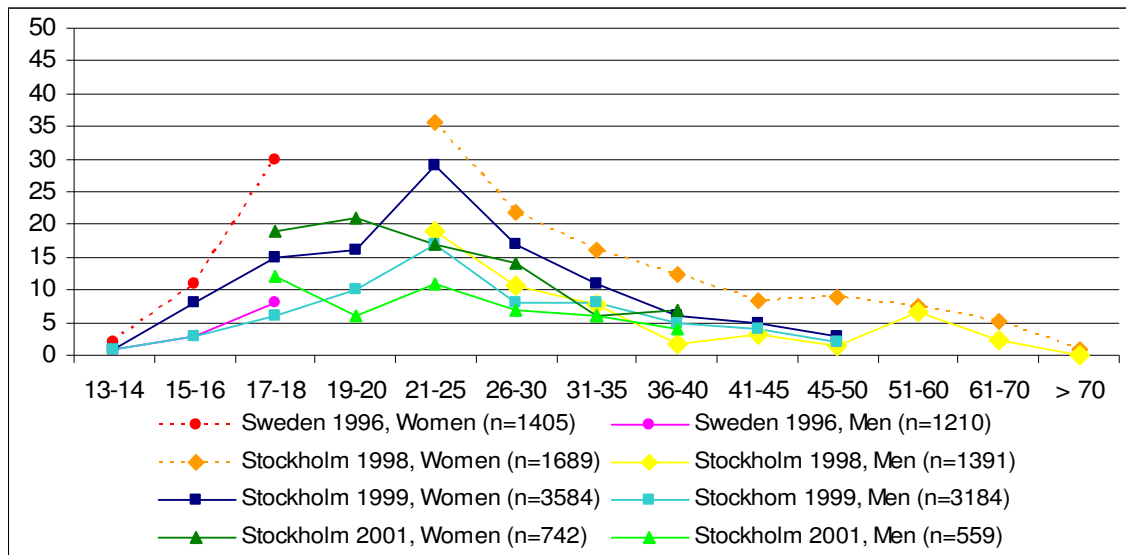


Figure 7. Percentage of people in Sweden using sunbeds at least once a month at different ages – results from three studies (Boldeman et al., 2001; Brandberg et al., 1998; Bränström et al., 2003b)(Folkhälsoenkät 1998, data not published).

1.6.6.2 Variables associated with sunbed use

There are gender differences in sunbed use with women using them more frequently (Amir, Wright, Kernohan, & Hart, 2000; Boldeman et al., 2001; Boldeman, Jansson, Nilsson, & Ullen, 1997; Brandberg et al., 1998; Mawn & Fleischer, 1993; Rhainds, De Guire, & Claveau, 1999). Sunbed use seems to increase during adolescence (Boldeman et al., 2001; Boldeman et al., 1997; Brandberg et al., 1998). A 1999 survey of 6,200 residents in Stockholm County aged 13 – 50 years, found a curvilinear relationship between age and sunbed use (Boldeman et al., 2001). Both men and women seemed to use sunbeds the most in early adulthood with a peak during the ages 21 – 25, see Figure 7.

Table 2. Studies of frequency of sunbed use in Sweden.

Author	Year	Sample	Items for measuring sunbed use	Response alternatives	Frequent sunbed users ¹	Comments
Bränström R., Ullén H., Brandberg Y. (Bränström et al., 2003a)	2001	Random population-based sample (n=3.200) aged 18-37 years in Stockholm County	'Do you use a sunbed?'	'Yes', 'No'	Men: 23% Women: 45%	Response rate 54%.
			'How often do you use a sunbed?'	'Once a week or more'*, 'Every other week'*, 'Once a month'*, 'A few times a year', 'Never'	Men: 8% Women: 13%	
Boldeman C. Et al. (Boldeman et al., 2001)	1999	Random population-based sample (n=10.000) aged 13-50 years in Stockholm County	'How often do you use a sunbed?'	'Often'*, 'Sometimes'*, 'Seldom', 'Never'	Men: 7% Women: 16%	Response rate 68%.
			'How often do you use a sunbed during October - April?'	'Once a week or more'*, 'Every other week'*, 'Once a month'*, 'A few times', 'Never'	Men: 6% Women: 11%	
Unpublished data from survey in Stockholm County	1998	Random population-based sample (n=5.000) aged 21-86 years in Stockholm County	'How often do you use a sunbed?'	'Once a week or more'*, 'Every other week'*, 'Once a month'*, 'A few times a year', 'Never'	Men: 6% Women: 11%	Response rate 64%
Brandberg Y. et al. (Brandberg et al., 1998)	1996	Random population-based sample (n=4.020) aged 15, 17 and 19 years in Sweden	'How often do you use a sunbed?'	'Once a week or more'*, 'Every other week'*, 'Once a month'*, 'I have only done it a few times', 'Never'	Men: 4% Women: 15%	Response rate 65%.

¹ 'Frequent sunbed users' was defined as percentage of people indicating the response alternatives marked with *

Skin sun-sensitivity is related to sunbed use since *skin type* III ('Sometimes burns, always tans') (Fitzpatrick, 1988) is predominant among sunbed users (Boldeman, Beitner, Jansson, Nilsson, & Ullén, 1996). In a study of Swedish adolescents, respondents with acne/seborrhoea, eczema or psoriasis used sunbeds more than those without *skin diseases* (Boldeman et al., 1996). *Appreciation of a tan* and the belief that *sunbed use relieves acne* problems are positively associated with sunbed use (Boldeman et al., 1997). Indifference to a tan is negatively linked to sunbed use. The belief that tanning in a *sunbed is safer than outdoor sunbathing* is positively associated with sunbed use (Amir et al., 2000). The belief that *a tan improves appearance* and contributes to *feelings of healthiness* is positively related to sunbed use (Amir et al., 2000; Rhainds et al., 1999). Being more *knowledgeable* about the long-term effects of UV exposure has been found to be positively associated with sunbed use (Mawn & Fleischer, 1993). Having a *family history of skin cancer* is negatively associated with sunbed use (Amir et al., 2000). One study found single persons to be more likely to use sunbeds (Rhainds et al., 1999). Studies of Swedish adolescents showed associations between sunbed use and *self-image* or *perceived physical attractiveness* (Boldeman et al., 1997; Brandberg et al., 1998). Adolescents who were not satisfied with themselves used sunbeds the most. The frequency of sunbed use is much higher in countries with a *lower degree of ambient solar radiation*. A study conducted in the European Union in 1996 revealed a much higher use of sunbeds in Sweden compared with countries in southern Europe e.g. Italy, France, Greece, and Spain (INRA (EUROPE) European Coordination Office, 1997). Frequent sunbed use has been found associated with other health risk behaviours such as excessive *exposure to natural sun* and *tobacco smoking* (Amir et al., 2000; Boldeman et al., 1997; Brandberg, Sjoden, & Rosdahl, 1997; Jerkegren et al., 1999).

1.6.6.3 Theoretical models applied to sunbed use

A study using appearance motivation, self-monitoring and the Theory of Planned Behaviour has been conducted among university students in the US (Hillhouse et al., 2000). This study showed that the most influential predictor of sunbed use was intention to use a sunbed and perceived behavioural control. Intention was predicted by attitudes, social norms, and perceived behavioural control. Appearance motivation had no direct or interaction effect on sunbed intention but predicted attitudes favourable to sunbed use. Self-monitoring, defined as tendency to be guided in life predominantly by situational cues, interacted with subjective norms in the prediction of intention to use sunbeds. High self-monitors presented a stronger relationship between subjective norms and intention to use sunbeds than did low self-monitors.

1.6.6.4 Implications for interventions

The difficulties associated with reducing sunbed use are mainly the same as those for intentional tanning in natural sunlight. The major motivator is enhanced appearance when tanned. However, using a sunbed differs somewhat from sunbathing in natural sunlight, e.g. it offers greater possibilities for control both for the individual him / herself and for society. It is possible to use it all the year round and whatever time of day. Further, it costs money and there are financial interests involved. Information aimed at reducing sunbed use is probably not welcome at places where they are used. The Swedish Radiation Protection Authority has imposed regulations on sunbeds, stating that information about the risks associated with their use should be provided by those who supply these tanning devices (The Swedish Radiation Protection Authority, 1998). Young people under 18 are recommended not to use sunbeds.

More information could be provided to increase the awareness of the dangers of sunbed use and increase knowledge about how to behave in relation to sun tanning devices. Increased taxation of sunbeds and sunbed use could be a way to reduce their use. This strategy has earlier been successfully applied to alcohol and tobacco use. Alternative behaviours that could be promoted instead of sunbeds are sunless tanning lotions, lamps with natural light and perhaps saunas. These could be useful depending on whether it is skin colour, relief from depressed mood due to darkness, or relaxation and warmth that motivate the sunbed use.

1.7 SUNBURN

Sunburn or sun induced erythema is the result of excessive UV exposure and it is considered to be a good proxy of too much UV exposure. There are various definitions of sunburn in the literature and no superior definition has yet been constructed. However, in 1998, a group of public health practitioners and researchers in Canada developed several recommendations on measuring self-reported sunburn (Shoveller & Lovato, 2001). They concluded that sunburn was an indirect measure of sun exposure and protection, important in the aetiology of melanoma and basal cell carcinoma, and a relatively memorable and distinct event. Thus, sunburn was identified as the most important outcome to assess in surveys and intervention program evaluations.

One important aspect of sunburn is severity. As most data in skin cancer research are based on self-reports, the public's own definition of sunburn is of major importance. In the Swedish study, in 2001, (Bränström et al., 2003a), people were asked to report the degree of their sunburn. Thirty-one per cent reported redness without pain, 12% reported severe redness without pain, 53% reported redness and pain, and 4% reported severe burns with blisters (unpublished data). These results indicate that when sunburn is self-reported a majority of the responders have experienced severe erythema, and that 'sunburn' has to be clearly defined in each survey.

1.7.1 Prevalence

In a survey from 1999 (Boldeman et al., 2001), 38% of the population in Stockholm had been sunburned during the past year (defined as redness and smarting skin) after sunbathing in Sweden and 29% had been sunburnt in the past year during a vacation at a sunny resort. Taken together, 54% of all respondents had experienced painful sunburns the past year. Another study in 2001 in Stockholm among people aged 18 – 37, showed that 80% of the women and 73% of the men had experienced sunburn during the past year (defined as redness after sun-exposure). Twenty-eight per cent of the women and 20% of the men had experienced sunburn three or more times during the past year (unpublished data). Studies of sunbed users indicate that almost half of them experience sunburn after sunbed use (Boldeman et al., 1996). In Table 3 studies of sunburn are summarised and the results in different age groups is presented in Figure 8. In these studies sunburn is defined as red and smarting skin after sun exposure.

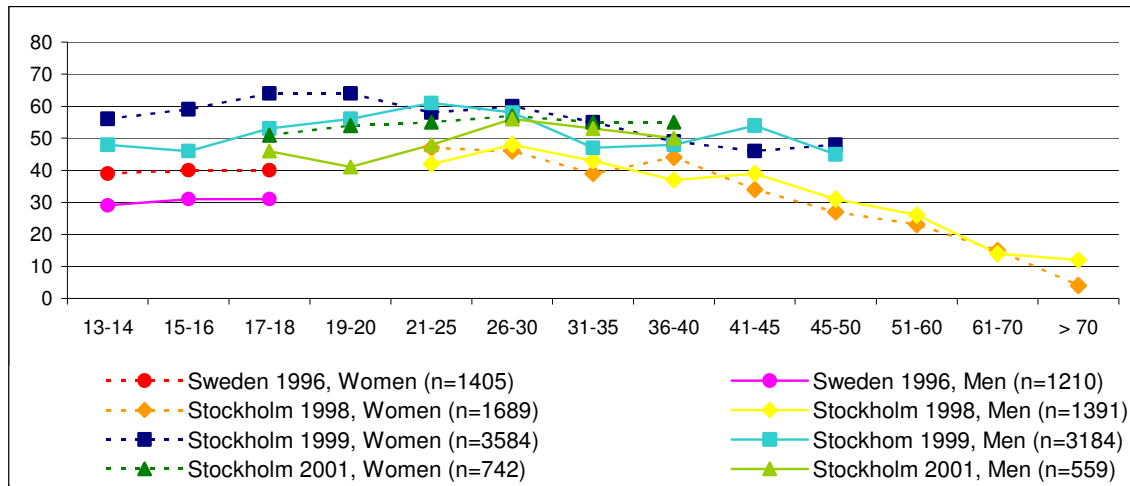


Figure 8. Percentages of people in Sweden who experienced sunburn at least once the preceding year – results from four studies (Boldeman et al., 2001; Brandberg et al., 1998; Bränström et al., 2003b)(Folkhälsoenkät 1998, data not published).

1.7.2 Variables associated with sunburn

Some studies have found that men become sunburned more often than women (Hill et al., 1992; Robinson, Rigel et al., 1997; Saraiya, Hall, & Uhler, 2002; Stott, 1999). However, data from one study in Stockholm County showed that women become sunburned more often than men (Boldeman et al., 2001). Other studies have also found that women sunburn more frequently (Davis et al., 2002; Geller et al., 2002).

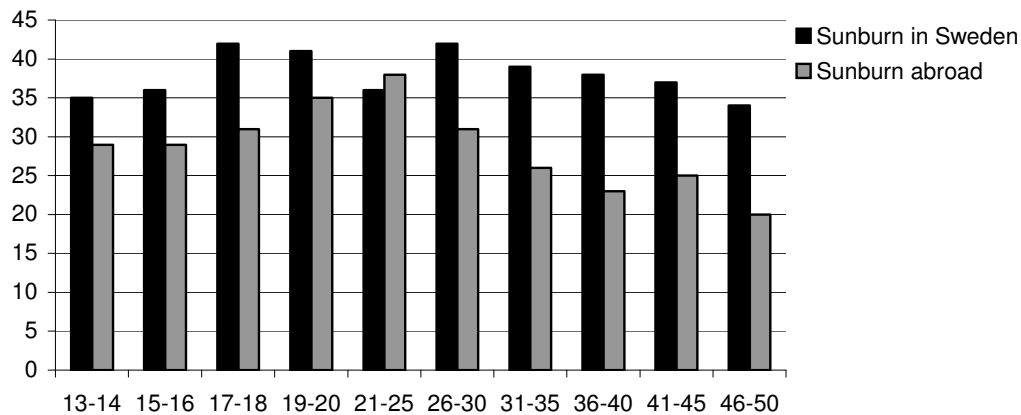


Figure 9. Percentages of the respondents, according to age, being sunburnt in Sweden and abroad the past year. Data from a survey in 1999 (Boldeman et al., 2001)(Figure not published).

In a study in Stockholm County, there was a curvilinear relationship between sunburn and age regarding both sunburn in Sweden and sunburn abroad, with sunburn frequency peaking during late adolescence and early adulthood (Boldeman et al., 2001), see Figure 9.

Table 3. Studies of frequency of sunburn among the population in Sweden.

Author	Year	Sample	Items about sunburns	Response alternatives	'Sunburners' ¹	Comments
Bränström R., Ullén H., Brandberg Y. (Bränström et al., 2003a)	2001	Random population-based sample (n=3.200) aged 18-37 years in Stockholm County	'How many times during the past year did your skin burn and turn red after you had been in the sun?'	'Never', '1 -2 times'*; '3 - 5 times'*; '6 - 10 times'*; 'More than 10 times'*	Men: 73% Women: 80%	Response rate 54%.
			'If you were sunburnt, how did your skin react?'	'Redness', 'Severe redness without pain', 'Redness and pain'*; 'Severe redness and pain'*; 'Redness, pain and blisters'*	69% (of which 50% of the men and 55% of the women sunburnt with redness and pain)	
Boldeman C. Et al. (Boldeman et al., 2001)	1999	Random population-based sample (n=10.000) aged 13-50 years in Stockholm County	'How many times during the past year did your skin burn (red or smarting) after you had been in the sun in Sweden?'	'I have never sunbathed', 'Never', '1 -2 times'*; '3 - 5 times'*; '6 - 10 times'*; 'More than 10 times'*	Men: 35% Women: 41%	Response rate 68%.
			'How many times during the past year did your skin burn (red or smarting) on a vacation abroad?'	As above.	Men: 28% Women: 30%	
			'How often have you been sunburned when sunbathing in Sweden?'	'Every year'*; 'A few times, but not every year', 'A couple of times', 'Never', 'I have never sunbathed'	Men: 11% Women: 15%	
Unpublished data from survey in Stockholm County	1998	Random population-based sample (n=5.000) aged 21-86 years in Stockholm County	'How many times during the past year did your skin burn (red or smarting) after you had been in the sun in Sweden?'	'Never', '1 -5 times'*; '6 - 10 times'*; 'More than 10 times'*	Men: 30% Women: 29%	Response rate 64%
Brandberg Y. et al. (Brandberg et al., 1998)	1996	Random population-based sample (n=4.020) aged 15, 17 and 19 years in Sweden	'How many times during the past year did your skin burn (red or smarting) after you had been in the sun in Sweden?'	'I have never sunbathed', 'Never', '1 -2 times'*; '3 - 5 times'*; '6 - 10 times'*; 'More than 10 times'*	Men:34% Women: 41%	Response rate 65%.

¹ 'Sunburners' were defined as percentage of people indicating the response alternatives marked with *

Not surprisingly, *skin sun-sensitivity* is associated with sunburn as those with sensitive skin are more likely to become sunburned (Broadstock et al., 1996; Davis et al., 2002; Geller et al., 2002; Hill et al., 1992; Jerkegren et al., 1999; Stott, 1999). However, data from the Swedish study in 1999, referred to above, indicate a negative linear relationship between skin type and sunburn frequency in Sweden but a curvilinear relationship between skin type and sunburn frequency abroad, with a peak for people with Skin type III who were sunburned the most, see Figure 10. This could be because people with more sensitive skin less often spend their vacations at sunny resorts (Bränström et al., 2003a).

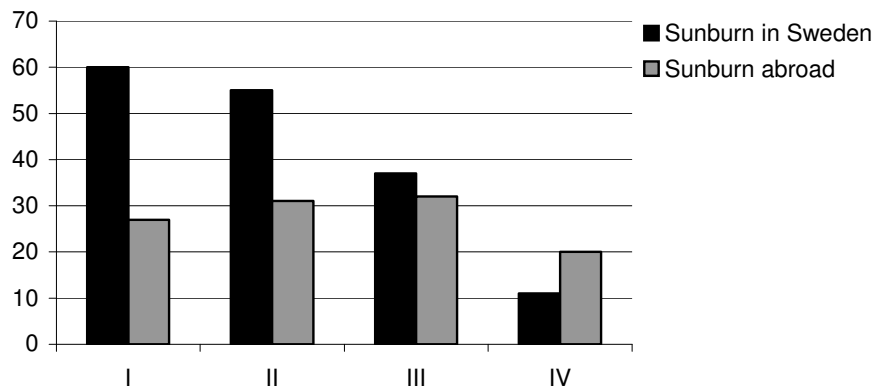


Figure 10. Percentages of people with different skin types (I –IV) becoming sunburnt in Sweden and abroad (Boldeman et al., 2001).

Sunburn has been found to be related to *time spent outside* in the sun and to an *intention to acquire a tan* (Davis et al., 2002; Stott, 1999). As expected, higher *desirability of a tan* is positively related to sunburn among both adolescents and adults (Davis et al., 2002; Stott, 1999). Having the opinion that it is *worth becoming burnt to tan* is more common among those who become sunburned frequently (Geller et al., 2002). Having a *preference for natural or paler skin* is negatively related to sunburn (Geller et al., 2002). Having many *friends who sunbathe* is positively related to sunburn (Geller et al., 2002).

1.7.3 Implications for interventions

Sunburns occur because of prolonged sun exposure and insufficient protection. Thus, interventions targeting sunburns must include actions aimed at reducing sunbathing and increasing protection, see sections above. The large number of people in Sweden becoming sunburnt indicates that people's evaluation of the dangers with excessive sun exposure is low.

Information campaigns concerning skin cancer prevention often target reducing people's sunburns rather than decreasing the total amount of sun exposure. For example, campaigns named 'Sola smart' and 'Sola sakta' seem to suggest a safe way to sunbathe without the risk of developing skin cancer. Another example is the development of an internationally standardised ultraviolet index, the UV index, giving people a daily prognosis of the intensity of the ambient UV radiation. The expectation is that people will use these daily prognoses in the planning of their outdoor activities and thus avoid sunburn. A third example is devices, constructed to signal risk for sunburn when sunbathing, that give recommendations for safe time in the sun. The approach of promoting 'safe' behaviour in the sun involves a few

difficulties that have to be addressed. Firstly, the aetiological research of skin cancer development does not support the recommendation of moderate sunbathing without sunburn. Sunburn is clearly a sign of extensive sunbathing, but probably even lower levels of sun exposure could be involved in the development of skin cancers. Secondly, sunburn is highly related to skin type and people have to be able to both correctly identify their own skin type and obtain the information relevant for their exact skin type. Probably the best information to give to the public is to avoid sunbathing all together during peak hours and to use clothes as protection if being in the sun is unavoidable.

1.8 SUN PROTECTION

One major concern in primary prevention of skin cancer is how to persuade people to protect themselves from sun exposure. The most important messages for sun-protection can be summarised as follows:

- Use protective clothing, including a hat
- Avoid sun exposure during peak hours (i.e. 11 a.m. to 3 p.m.)
- Stay in the shade
- Use sunscreen with high SPF (sun protection factor), i.e. $SPF \geq 15$ as a compliment to clothes
- Children under the age of one should not stay in the sun
- Use sunglasses to protect the eyes

In Sweden, long dark winters and an overall low temperature make people seek the sun for the warmth and light. It is not clear how the public benefits from sun protective messages. For some people it might be an incentive to avoid the sun. However, the majority of people in Sweden like to sunbathe and desire a tan, and thus, the efforts of prevention are to reduce active sun seeking behaviour. A random sample of the population in Stockholm County showed that using sunscreen was the most popular way to protect oneself from the sun, followed by covering up with clothes and using the shade. The two latter behaviours increased somewhat with age (data not published)(Boldeman et al., 2001). Percentages of respondents using different kinds of sun protective behaviour are presented in Figure 11. More women than men used sunscreen. Avoiding the sun during peak hours was seldom used as a way to protect oneself from the sun. This behaviour was however more common among women. In one Swedish study, DNS patients, with familial risk for melanoma, used diaries to record sun-related behaviours during one summer month. Sunbathing occurred mainly during peak hours despite the fact that these patients had received individual information about how to behave in the sun (Brandberg, Jonell, Broberg, Sjoden, & Rosdahl, 1996). An interview study conducted by the European Commission in 1998 showed that people in Sweden were the most aware in Europe of the importance of keeping young children away from the sun. Only 5% thought that children should be exposed to the sun at an early age (INRA (EUROPE) European Coordination Office, 1997).

Sunscreens are not always used for UV protection. Several studies have found a positive association between sunscreen use and time spent in the sun, sometimes called *the sunscreen paradox* (Autier et al., 1999; Autier et al., 2000; McCarthy, Ethridge, & Wagner, 1999). Instead of using sunscreen as a complement to other means of avoiding excessive sun exposure, sunscreens are used to make it possible to spend more time in the sun. Strikingly, an association has been found between sun protective factor (SPF) and time spent in the sun. Further, sunscreen use on children has been linked to a higher number of melanocytic nevi

indicating a higher degree of sun exposure among children using sunscreens (Autier et al., 1998). Some studies have also found an increased risk of skin cancer among sunscreen users (Westerdahl, Ingvar, Masback, & Olsson, 2000), although the overall epidemiological data does not support such an association (Huncharek & Kupelnick, 2002).

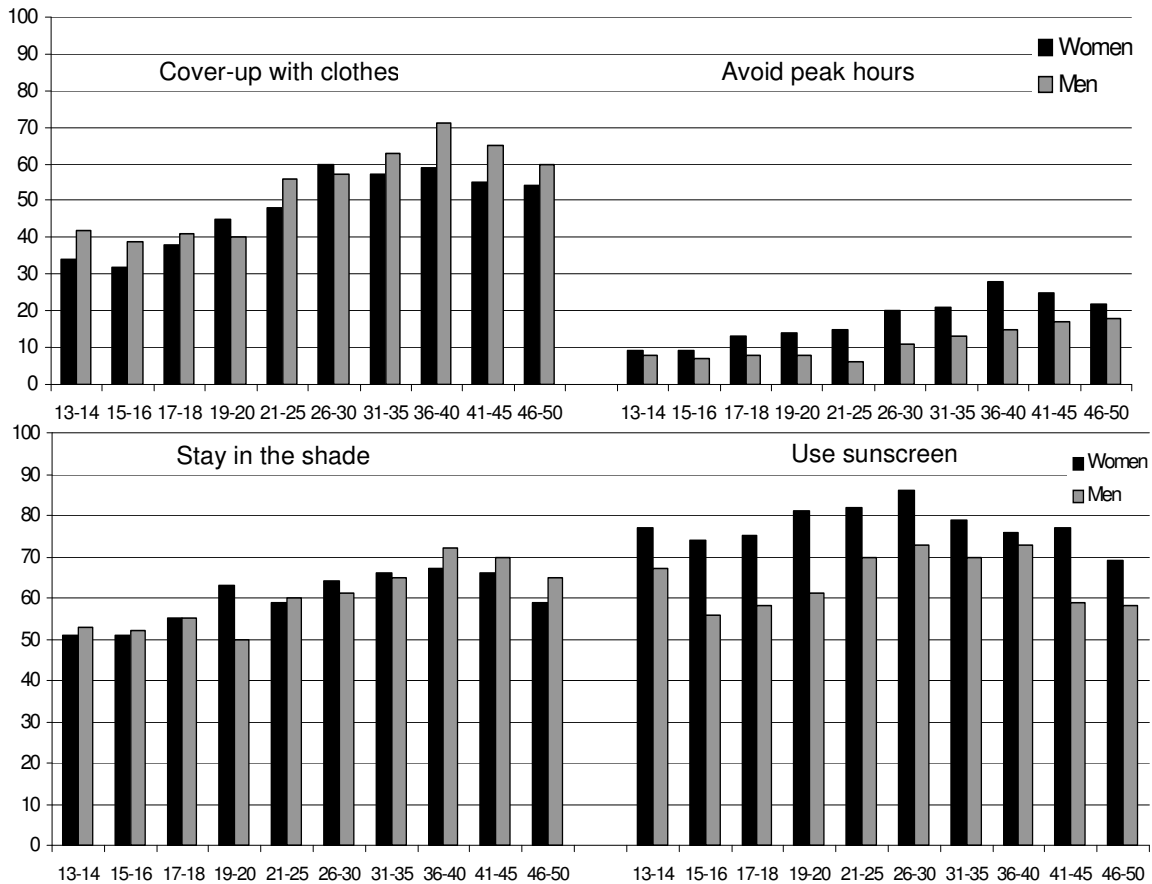


Figure 11. Percentages of the Stockholm population, according to age group, using different means of protection from the sun. Men and women are presented separately (data not published)(Boldeman et al., 2001).

In the study of sun-related behaviours among people in Stockholm County, referred to above, motivations to use sunscreen were measured. The results showed that 88% of those using sunscreen applied it as protection from the sun, 25% as a way to obtain a nicer looking tan, and 9% as a way to obtain a quicker tan. ‘Protection’, however, may imply increasing the time spent sunbathing without becoming burned. Subsequently, to ‘protect’ could actually result in an increased UV exposure. Thus, the ‘protection’ gained by using sunscreens may be questioned. These results make analysis of predictors of sun protective behaviour very complicated. Sometimes the means of sun protection are not specified in the studies and sometimes only sunscreen use is measured as an indicator of sun protective behaviour.

1.8.1 Variables associated with sun protective behaviour and sunscreen use

Most studies of sun protective behaviour have used some kind of index of protective behaviour. These indices are calculated as a sum of the use of sunscreen, clothing (hat and shirt), shade, and avoiding the sun as means of protection from the sun. However, some studies have tried to compare different kinds of sun protection behaviour. Measuring sunscreen use is difficult as it involves a number of different issues such as amount of sunscreen applied, SPF number, and frequency of application. Many studies use a general question about how often sunscreen is used when staying in the sun.

Several studies have found *gender* differences in sun protective behaviour (Bränström et al., 2001; Cockburn, Hennrikus, Scott, & Sanson-Fisher, 1989; Coogan, Geller, Adams, Benjes, & Koh, 2001). Women protected themselves more than males (Mawn & Fleischer, 1993; Mermelstein & Riesenber, 1992; Wichstrøm, 1994). Subsequently, use of sunscreen is related to *gender*, women seem to use it more. Studies of US and Australian children and adolescents have found a decreasing frequency of sunscreen use with *age* (Geller et al., 2002; Lowe et al., 2000). A study of white adults in the US found that people between 26 – 40 years of age used sunscreen more than persons aged 16 – 25 (Koh et al., 1997). A similar pattern can be seen among residents of Stockholm County, see Figure 11. *Skin sun-sensitivity* is related to use of sunscreen. Those who burn easily are more likely to use sunscreen (Banks, Silverman, Schwartz, & Tunnessen, 1992; Bränström et al., 2003a; Geller et al., 2002; Mawn & Fleischer, 1993; Mermelstein & Riesenber, 1992; Wichstrøm, 1994). *Educational level* has also been found to be associated with sunscreen use, i.e. the higher the level of education the greater the use of sunscreen (Koh et al., 1997). However, this association was not found in a study of 18-37 year-olds living in Stockholm, Sweden (Bränström et al., 2003a). Many studies have found a relationship between *age* and sun protective behaviour. Most studies find a decreasing use of sun protection with age, i.e. from childhood up to young adulthood (Balanda, Stanton, Lowe, & Purdie, 1999; Bränström et al., 2001; Coogan et al., 2001; Severi et al., 2002). A positive linear relationship was found between sun protective behaviour and *skin sun-sensitivity* in a study of Swedish adolescents (Bränström et al., 2001). Those with blond or red *hair colour* have been found to be somewhat keener on engaging in protective behaviour than people with dark hair (Campbell & Birdsell, 1994).

Those *playing down the risk* of sunbathing or those who think it is *worth becoming burnt* to obtain a tan used less sunscreen (Geller et al., 2002; Wichstrøm, 1994). In contrast, adolescents with better *knowledge* and a higher awareness about skin cancer, and those who perceive themselves as being *at risk of contracting skin cancer* are more inclined to use sunscreen and other sun protection measures (Mermelstein & Riesenber, 1992). Common reasons not to use sunscreen are that its application is time consuming and that it prevents tanning (Harth, Schemer, & Friedman-Birnbaum, 1995). People with *positive attitudes towards sun protective behaviour* and less *negative attitudes towards using sunscreen* are more likely to use sunscreen (Hillhouse et al., 1996). Among women, those with more knowledge of sunscreens and those not experiencing sunbathing as relaxing are more likely to use a sunscreen with a high SPF (Hillhouse et al., 1996). In a study of Swedish university students, no association was found between sun protection and *knowledge about the risks of sunbathing*, *knowledge of solar radiation*, and *risk factors for skin cancers* (Jerkegren et al., 1999). Children and adolescents *preferring a natural or light skin colour* are more inclined to

use sunscreen (Geller et al., 2002). Knowledge about skin cancer and knowing someone who has had skin cancer were associated with sunscreen use in one study (Keesling & Friedman, 1987). Adolescents who believe that they can avoid developing skin cancer are more likely to take sun protective action (Lowe et al., 2000). Measurements of *perceived behavioural control* and *self-efficacy* have been linked to sun protective behaviour (Hillhouse et al., 1997; Jackson & Aiken, 2000). *Other people's use of sunscreen* seems important as the number of friends who usually use sunscreen is positively associated with sunscreen use (Wichstrøm, 1994) as well as best friend's use of sunscreen (Banks et al., 1992). Also, *parental insistence* on use of sunscreen increases its use among teenagers (Banks et al., 1992). Other people's use of sun protection, e.g. *parent's use of sun protection* and *parental tanning behaviours*, is associated with children's sun protective behaviour (Balanda et al., 1999). Financial reasons for not using sunscreen have not been reported in Sweden, but perhaps this aspect also contributes to less use of sunscreens. A study in Norway showed a negative association between *latitude* and use of sunscreen, probably due to weaker sun in the north (Wichstrøm, 1994). The same study found a positive association between frequency of *sunbathing* and *vacations at sunny resorts* and sunscreen use. A study of Swedish adolescents found that those who sunbathe often were less likely to protect themselves from the sun (Bränström et al., 2001).

1.8.2 Theoretical models applied to use of sunscreen

The health belief model has been used to predict sun protective behaviour (Cockburn et al., 1989). This study showed inconsistent support for the Health Belief Model in explaining sun protection behaviour. Susceptibility to skin cancer was negatively associated with sun protection use among males, contrary to theoretical expectations, and no association was found between susceptibility and sun protection among women. Perceived benefits with sun protection and perceived barriers to sun protection were, however, connected with actual sun protection. The complexity of 'sun protection', i.e. if it is used to be able to stay longer in the sun or if it is used as 'real' protection, may account for the inconsistent support for the model.

1.8.3 Implications for interventions

Sunscreens are effective in decreasing sunburns but the effects on skin cancer development have not been fully clarified. The World Health Organisation's International Agency for Research on Cancer (IARC) has created a consensus report concerning sunscreens (International Agency for Research on Cancer, 2001). They conclude that sunscreens are effective in reducing sunburns but there is inadequate evidence for a protective effect of sunscreens against cutaneous melanoma and basal cell carcinoma. However, sunscreens might prevent squamous-cell carcinoma of the skin when used during unintentional sun exposure. Further research will provide more knowledge on the protective aspects of sunscreen use. Based on current knowledge, sunscreens should only be recommended as a complement to other methods of protection. It is primarily clothes and shade that should be used to avoid the sun. The message to the public should therefore be that prolonged sunbathing, by the use of sunscreens, could be hazardous. The financial interests involved in the manufacture and marketing of sunscreens are relevant to prevention. The companies who produce sunscreens often stress that their products reduce the risk of sunburn and result in a deeper more long-lasting tan without making the skin dry. These messages are what people want to hear, also people who are health-oriented, i.e. 'How to obtain a nice tan without the risk of developing

skin cancer'. This kind of message, which is likely to increase sun exposure, should be challenged.

There is a need for more studies on the use of sunscreens and other protective measures in Sweden. It is of great importance to study the use of protective clothing among people who are exposed to the sun in the course of their work. The use of protection in connection with leisure activities and work is another area of intervention. The pros and cons involved in these situations have to be investigated in order to ensure the use of protective clothing, e.g. protective work clothing for use on warm summer days should be provided by the employer. Additional costs for the worker should be avoided. Increasing knowledge about the amount of UV received at work is also important, thus stressing the need to "cover-up".

1.9 SCREENING ATTENDANCE, SKIN SELF-EXAMINATIONS AND EARLY DETECTION OF CUTANEOUS MALIGNANT MELANOMA

Early detection of CMM is associated with a much better prognosis (Sahin et al., 1997). Early detection, by skin self-examination or having someone else check one's skin for suspicious lesions, is therefore an essential way to improve secondary prevention of melanoma. Even though the benefits of skin self-examination have not been established, one case-control study suggested that it is possible to reduce mortality from melanoma by 63% through self-examination of the skin (Berwick, Begg, Fine, Roush, & Barnhill, 1996). The most common histogenetic type of malignant melanoma of the skin is superficial spreading melanoma (SSM) and it also accounts for the largest increase in incidence (Thorn, Ponten, Bergstrom, Sparen, & Adami, 1994). Approximately half of the reported cases of malignant melanoma are detected by the patients themselves (Brady et al., 2000; Koh et al., 1992). In a Swedish interview study of patients with melanomas (with a tumour thickness of ≤ 2 mm), 61% were detected by the patients themselves (Bergenmar, Hansson, & Brandberg, 2002), but as many as 32% were diagnosed during a medical appointment made for other reasons. Another Swedish study reported that 27% of patients with thick melanomas (> 2 mm) had their tumour detected by a relative and 24% by a physician (Bergenmar, Ringborg, Mansson Brahme, & Brandberg, 1998). The ability of laymen to recognise early melanomas and atypical nevi has been found to be low (Miles & Meehan, 1995; Titus-Ernstoff et al., 1996). In addition, discovering changes in skin lesions requires regular self-examination of the skin or regular visits to a physician. Studies examining the ability of lay people to identify early melanomatous skin changes found that it was very difficult for people to detect changes in skin lesions (Hanrahan, Hersey, Menzies, Watson, & D'Este, 1997; Muhn, From, & Glied, 2000). The main reason for this was difficulty in remembering the appearance of the lesions. Photographic records may be required for the detection of changes at longer intervals.

In the US, the ABCD (A-asymmetry, B-border irregularity, C-colour variegation, and D-diameter greater than 5 mm) criteria have been used to increase the early detection of melanoma. These criteria were introduced by the American Cancer Society (R. J. Friedman et al., 1985) and have become an important tool for clinical diagnosis of dysplastic nevi and melanomas in medical settings (Bono et al., 1999). The ABCD criteria have also been used in information campaigns in the United States to enhance the public's ability to distinguish benign lesions from melanoma. However, these criteria apply primarily to SSM, whereas NM may have other features, such as being smaller in diameter (Bergenmar et al., 2002).

The United Kingdom's Cancer Research Campaign has adopted the revised seven-point checklist to help people recognise pigmented lesions. The seven-point checklist includes three major signs: change in size, change in shape, and change in colour, and four minor signs: inflammation, crusting or bleeding, sensory change or itch, and diameter ≥ 7 mm (McKie, 1990). The problem with discovery of changes in pigmented lesions suggests that the static features of a pigmented lesion might be better criteria for judging malignancy, as suggested by the ABCDs. Few studies have attempted to determine whether or not these criteria are useful in guiding laymen.

The daily press has promoted skin self-examination extensively every year during the past decade. Among the main recommendations to the public are to be vigilant of increased diameter, irregular shape, irregular coloration and changes. Along with these recommendations, pictorial examples of malignant lesions are often shown. It seems important to increase the public's knowledge concerning the typical appearance of pigmented skin lesions. The health care system must also be organised in such a way that persons that have detected a suspicious lesion easily can be examined by a physician.

1.9.1 Screening attendance

Population screening as a way to reduce melanoma mortality has been debated, and its potential cost-effectiveness value questioned (Helfand, Mahon, Eden, Frame, & Orleans, 2001). Nevertheless, various forms of screening have been carried out. The Cancer Society in Sweden has provided skin check-ups in conjunction with skin cancer prevention campaigns during the summer, and many dermatological clinics in Sweden have participated in the annual 'Melanoma Monday' on which people can receive a skin check-up. 'Melanoma Monday' was an initiative taken by dermatological clinics in Europe, with participating clinics organising skin examinations on a special Monday in May-June each year. The organisation of this initiative differs between clinics. Some hold an 'open house' whereas others invite people to make an appointment for examination.

1.9.1.1 Variables associated with screening attendance

A Swedish study comparing screening attenders with the general population found attenders to be more concerned about nevi, having more often been in contact with physicians about skin lesions (Brandberg, Bolund et al., 1996). However, they did not perceive themselves to be at greater risk of developing melanoma than the general population. Attenders were better informed about risk factors for skin cancer and were more knowledgeable of melanoma. Another study comparing attenders and non-attenders in a population-based melanoma-screening programme found no difference in knowledge of risk factors for melanoma (Bergemar, Törnberg, & Brandberg, 1997). Non-attenders scored lower on perceived susceptibility to melanoma. They also reported 'lack of time' and 'no need for examination' as the primary barriers to attendance. Most of the recommended improvements for increasing screening attendance suggested by the non-attenders concerned reduction of practical barriers.

1.9.2 Skin self-examination and early detection

Early detection involves several steps that can be analysed separately.

1. Detection of the lesion by the individual (many lesions are detected coincidentally, while others are detected after skin self-examination)
2. Medical examination and subsequent procedures
3. Removal of the lesion

A decision to move to the next step or do nothing has to be made in each of the three steps. In Sweden there is a paucity of surveys of the general population's knowledge about the signs of melanoma, the source of their information, and the frequency skin self-examinations. More studies have been conducted internationally, and even though their results might not be typical of the situation in Sweden, the relationships between variables might be similar. The term 'skin self-examination' is rather vague and has been defined in different ways in different studies, which makes comparisons difficult. The term includes behaviours ranging from causally examining one's skin to methodical and systematic scrutinising of the skin. The studies reviewed below have generally defined skin self-examination as regular systematic examination of the skin.

1.9.2.1 Variables associated with skin self-examinations and early detection

A telephone survey in the US in 1996, found skin self-examination to be correlated to *gender, age, educational level, perceived own risk of developing melanoma* or other skin cancer, *own history of skin cancer, and discussions with physician or nurse about sun protection* (Robinson, Rigel, & Amonette, 1998). Older women, with a high level of education, who perceived themselves at greater risk of developing melanoma, who had a personal history of skin cancer, and who recalled a discussion with a physician or nurse about sun protection were more likely to perform skin self-examinations. Another study from the US analysed factors related to self-examination separately for men and women. Men were more likely to perform self-examinations if they had *a family history of skin cancer, had had a physician examine their skin, or had changed their diet to decrease their cancer risk* (Oliveria et al., 1999a). Women were more likely to perform skin self-examination if they *previously had removed a pigmented nevi, had an abnormal mole, or had light hair colour*. Older age or higher education were associated with a decreased likelihood of performing self-examinations. A telephone survey from Rhode Island, examining factors associated with thorough skin self-examinations in the population, found an increase in skin self-examination among women and those who *had been advised to conduct examinations* by their health care provider (Weinstock et al., 1999). A study of Gold Coast residents in Australia found a positive association between skin self-examinations and *individual primary preventive behaviour* (Anderson, Lowe, Stanton, & Balanda, 1994). Another Australian study found skin self-examination to be related to *examination by a doctor and recommendations from a doctor to examine oneself* (Borland & Meehan, 1995).

A few studies have examined the field of early detection of skin cancers by studying factors related to delay in seeking medical attention for a malignant skin lesion, or tumour thickness at diagnosis. There are a number of difficulties with studies of delay. First, is delay measured from the time when a lesion was noticed or from the time when it was perceived to have changed? Secondly, are patients whose melanoma was coincidentally diagnosed excluded?

Thirdly, do melanoma patients underestimate the extent of delay due to increased awareness of the seriousness of the disease?

One study in the US examined factors related to a 3-month delay in seeking medical attention for a lesion later diagnosed as malignant (Oliveria et al., 1999b). The study found that those patients who were *aware of skin changes*, had a *history of skin cancer*, practised *skin self-examination*, and who were *knowledgeable about two or more signs or symptoms of melanoma* were less likely to delay in seeking a professional opinion. Skin awareness and knowledge of signs of melanoma were also positively associated with the likelihood of being diagnosed with a thinner melanoma. Knowledge that bleeding or a scab not healing is a sign of malignancy was not associated with a delay in diagnosis. Another study found that *females* were more likely to detect malignant skin lesions themselves and that people with a *family history of skin cancer* were almost three times more likely to present themselves with a thin tumour compared with people without such a family history (Brady et al., 2000). A study in Germany found delay in treatment for melanoma to be related to the patient's own detection, and found a difference in this respect between melanomas on head and neck and melanoma detected on other parts of the body (Blum et al., 1999).

1.9.2.2 Theoretical models applied to skin self-examination and early detection

We were unable to find any studies of skin self-examination in which a social psychological theory was used. However, some of the concepts from the Health Belief Model have been used in some of the studies (L. C. Friedman, Webb, Bruce, Weinberg, & Cooper, 1995). The Health Belief Model is probably the best-suited model for explaining and promoting skin self-examination. The model emphasises personal susceptibility to a disease, the perceived severity, and the perceived benefits of preventive behaviour.

1.9.2.3 Implications for interventions

There is a need to collect sufficient data to be able to develop effective interventions for early detection and an increased performance of self-examinations. There are, however, reasons to believe that there is room for improvement concerning the public's knowledge of signs of malignancy and how to successfully perform skin self-examinations. However, the most important aspect to change is probably the public's perception of the severity and risk of skin cancer. If people were more aware of the risk of contracting skin cancer, and of the great benefits of early detection, as those with a family history of skin cancer are, they would probably be more likely to perform skin self-examinations and present with thinner tumour lesions at diagnosis. The encouragement of health care providers seems also to be an important motivational factor concerning skin self-examinations. It is thus important to inform health care personnel that they should encourage patients to regularly check their skin for suspicious lesions, especially individuals at high risk. General practitioners might benefit from training in examining skin lesions, in order to minimise the risk of over-diagnosing.

The provision of open skin-examination clinics, where people can 'drop in' free of charge for examination of a suspected lesion appears to be an effective way to promote early detection. This approach minimises practical barriers and makes it relatively easy to have one's lesions checked. Studies of non-attenders suggest that practical barriers are the most important reason for not attending. Experiences from 'open-houses for skin examinations' suggest a great

interest among the public. Barriers such as opening hours, cost and travelling time reduce the likelihood of attending, as does not knowing where to turn.

There are also psychological barriers involved in both skin self-examination and in seeking medical advice. In self-examination one is looking for something one does not wish to find. The immediate consequence, i.e. finding a suspected lesion – cancer, is often more influential on behaviours than later consequences, i.e. better prognosis. Thus, the individual may hesitate to perform skin-examination despite the benefits of early detection. The same principles apply with regard to seeking medical advice. Worry about a cancer diagnosis may override the benefits associated with early detection. If, in addition, other practical barriers are experienced this can lead to delay in seeking medical advice.

The public view of melanoma might be too negative and frightening for people to seek medical attention. A greater emphasis on the generally good prognosis of melanoma and the relatively small surgical procedure involved with early detection might reduce the psychological barriers to seeking help. Such a message might benefit secondary prevention, but has quite the opposite effect on primary prevention. Thus, different messages should be directed at different groups. Younger people should be targeted with messages to reduce sun exposure, e.g. emphasising the risk of developing skin cancer. Older people should be targeted with messages about good prognosis at early detection in order to increase professional skin examinations of elderly people.

1.10 MEASUREMENT OF SUN-RELATED VARIABLES

Sun-related variables have to be measured effectively in order to follow the development of people's exposure for skin cancer risk factors, and to study the effects of preventive efforts. A prerequisite for effective assessment is valid and reliable measures, i.e. measures with a low degree of systematic and random errors. A number of different methods have been used, e.g. self-report questionnaires, diaries and personal dosimeters.

1.10.1 Questionnaires

The most frequently applied method of measuring sun-related variables has been self-report questionnaires used in telephone interviews or delivered by post. In Sweden, a number of studies using such self-report questionnaires have been conducted. However, these questionnaires have defined some of the variables measured somewhat differently, e.g. sun exposure and sunburn. In some studies sun exposure is defined as 'frequency of sunbathing with the intention to tan' and in other studies as 'frequency of sunbathing' without specifying the motive for sunbathing. 'Sunburn' is most often defined as 'sunburn after sun exposure with red and smarting skin'. A further problem when comparing the different studies is that they use different response alternatives. The lack of standardised approaches to measure self-reported amount of sun exposure and frequency of sunburn has impeded advancement in this area. To improve program planning, research, and evaluation of interventions in the area of skin cancer prevention, it is important to be able to make meaningful comparisons between studies.

1.10.2 Diaries

Diaries have been used in one Swedish study to increase the validity of questionnaire items and assessments of sun exposure and sunburn (Brandberg et al., 1997). This study supported the use of questionnaire items to distinguish respondents frequently exposed to the sun from those not frequently exposed (Brandberg et al., 1997).

1.10.3 Recall period

There is a wide variety in recall periods in studies measuring sun exposure and sunburn (Shoveller & Lovato, 2001). In aetiological studies, respondents are often asked to indicate amount of sun exposure and sunburn at different times in their lives, often with long recall periods. Other epidemiological studies, with the aim of describing the amount of exposure to the sun in the population or monitoring the effects of an intervention, use shorter recall periods, sometime as short as one or two days (Baade, Balanda, & Lowe, 1996). The variety of recall periods used makes comparisons between studies difficult.

1.10.4 Non-response bias

A problem in all studies using postal surveys is how to deal with non-response bias. In studies published in medical journals only approximately 60% of postal questionnaires are returned (Asch, Jedrzejewski, & Christakis, 1997). There is always reason to believe that those not responding to a questionnaire differ in some way from those who respond, thus making the results difficult to generalise to the population from which the sample is taken. Studies have shown that women, older persons, persons with higher education, better health status and more positive health behaviour are usually more likely to return questionnaires (Etter & Perneger, 1997; Korkeila et al., 2001). The response rates seem to be decreased when using random population-based samples and anonymous respondents (Asch et al., 1997). There are a number of techniques for increasing response rates. A systematic review of studies using postal questionnaires found many potential ways to increase response rates: monetary incentives, short questionnaires, personalised questionnaires and letters, questionnaires in coloured ink, stamped return envelope, sending questionnaires by first-class post and by recorded delivery, contacting participants before sending questionnaires, sending a reminder with a second copy of the questionnaire, and having telephone contact with non-responders. Questionnaires from universities were more likely to be returned and questionnaires containing questions of a sensitive nature were less likely to be returned.

There are different opinions about the importance of high response rates. Some researchers claim that the concern with response frequency is exaggerated, and suggest that it is more important to further examine the extent of non-response bias. One study of alcohol consumption, smoking, and physical activity found that even though non-response led to bias in prevalence data, the association found between variables was not biased by non-response (Van Loon, Tjihuis, Picavet, Surtees, & Ormel, 2003). Further, one study comparing the responses from responders with non-responders in a survey of sun-related variables found no significant difference in two of the most important variables, i.e. frequency of sun exposure and sunburn (Boldeman et al., 2001). In this study, the non-responders were contacted by telephone at the end of the survey period.

1.11 SKIN CANCER PREVENTIVE INTERVENTIONS

1.11.1 Educational programs

Many of the attempts to alter sun-related behaviours have focused on education to increase knowledge about the dangers of the sun and of ways to reduce exposure (Baum & Cohen, 1998). As children and adolescents have been a primary target for skin cancer preventive interventions, school programs and programs targeted at people working with children have been run frequently (Baum & Cohen, 1998). The main objective of these interventions has been to increase skin cancer knowledge and develop attitudes and skills for the prevention of skin cancer. Although there are difficulties associated with the evaluation of these types of program, e.g. short follow-up time and unreliable assessment of sun-related behaviours, some of the programs have led to increased knowledge of skin cancer, more appropriate attitudes, and to a lesser extent, changed behaviour. Educational programs targeting children and adolescents have also been run in Sweden (Boldeman, Jansson, & Holm, 1991; Boldeman, Ullén, Månsson-Brahme, & Holm, 1993).

Educational programs have also been run for different professions such as outdoor workers. These programs have had some success in changing sun-related behaviour (Baum & Cohen, 1998). One randomised intervention study in Australia, using a 30 minute education and skin cancer screening session as in intervention for outdoor workers, succeeded in increasing sun protective behaviour measured with diaries one month after the intervention (Girgis, Sanson-Fisher, & Watson, 1994).

1.11.2 Interventions using media communication

Most of the studies evaluating media campaigns have been carried out in Australia and the US. These campaigns have used radio, television, newspapers, magazines, leaflets, and posters to spread the message of sun awareness and knowledge of the risks of exposure. These types of campaign have been broadly recognised by the population and seem to have had some effect on sun exposure and behaviours related to sun exposure (Baum & Cohen, 1998). Examples of interventions in Sweden are the 'Sola Smart' campaign targeting adolescents in the Stockholm area using radio, magazines and the Internet, and the national 'Sola Sakta' campaign using radio, television and beach activities to inform people about the negative effects of excessive sun exposure.

1.11.3 Brochures and pamphlets

Brochures, pamphlets or other types of printed materials are used extensively in the area of cancer prevention and control (Paul, Redman, & Sanson-Fisher, 2003). Material with information about the negative effects of excessive sun exposure as well as information about the characteristics of melanoma have been used in Sweden at least since the late eighties (Bergenmar, 2001). Even though the knowledge of the effects of information brochures on health outcomes is limited, it has been an important part of public and patient education. A review from Australia examining the effectiveness of printed materials found that brochures could be effective in changing knowledge, attitudes and behaviour related to many different health issues (Paul & Redman 1997 in (Paul et al., 2003)). The authors of the review also found information material to be more effective in patient populations than with the general population. Further, brochures were more effective if combined with other methods of intervention. There are a number of guidelines on content and design characteristics that

should be considered when constructing information material. However, a recently published paper comparing different information pamphlets, some with many and some with few of the recommended characteristics, showed no difference regarding outcome variables (Paul et al., 2003). A recent survey of Swedish information material concerning sun-related behaviours and sunbed use produced between 1990 and 2002, showed inconsistencies in the messages. Terms like 'sunburn' and 'safe sunbathing' were also not consistently defined. Thus, there seems to be room for improvement with respect to public information material related to these issues (Bergenmar & Brandberg, 2003).

1.11.4 The UV index

During the eighties it was recognised that the ozone layer, that protects earth from UV radiation, was becoming thinner. In the beginning of the nineties, a measure of the intensity of the ambient UV radiation was constructed, i.e. the UV index. When calculating the UV index, both cloud cover and the thickness of the ozone layer are taken into consideration. In Sweden, the Swedish Meteorological and Hydrological Institute has calculated the UV index since the summer of 1993. In 1994, the UV index was internationally standardised at a meeting organised by the World Meteorological Organisation. The UV index has been used, e.g. in the US, for the purpose of increasing the proportion of people who protect themselves in the sun, by giving guidance on how they should plan their outdoor activities (Coldiron, 1998; Geller et al., 1997). The World Health Organisation has disseminated a practical guide with recommended graphical presentations of the UV index to national and local authorities and non-governmental organisations active in the area of skin cancer prevention and media outlets involved with presentation of the UV index. The purpose is to use the index as a tool for prevention. The effects on behaviour and attitudes are, however, difficult to estimate. The UV index is presented as a number, from '1' to '11+', where less than '2' is considered low and '11' or higher is considered extremely high. Depending on the strength of the UV radiation different protection measures are recommended.

1.11.5 Interventions to promote early detection

Early detection and treatment of malignant skin lesions probably increase survival and decrease medical costs associated with skin cancer (Weinstock, 2000). Interventions including skin screening and surveillance have been tested in general populations and groups with elevated risk of contracting melanoma. However, there is little scientific evidence supporting the effectiveness of screening as a way to reduce mortality and decrease health costs at a population level (Edman & Klaus, 2000). Nevertheless, increased screening publicity and the availability of skin check-up clinics have probably contributed to the increased percentage of thin tumours detected. This has resulted in decreased mortality rates in Sweden. In 1960, the five year survival rate was about 50 % and in 1999 it was around 84 % for men and 91% for women (The National Board of Health and Welfare, 2002a). To assess the potential effectiveness of population screening for melanoma, a large scale randomised trial has been initiated in Australia with the aim of increasing thorough skin self-examination, and early detection of melanoma (Aitken et al., 2002). The follow-up period of this study is 15 years, and the primary outcome measure is mortality from melanoma. The intervention includes community education, education of general practitioners, promotion of self-screening, whole body examination by GPs, and skin cancer screening clinics. Initially, the study has shown an increase in participation in screening in the intervention communities but not in the control

communities. Until stronger evidence for the effectiveness of skin cancer screening is available, large scale screening interventions should probably not be recommended in Sweden, a country with lower incidence rates than Australia and the US. In Sweden, skin cancer screening is used among high risk groups. Since 1987 people with dysplastic nevus syndrome (DNS), with increased risk of developing melanoma, have been encouraged to visit a skin cancer screening clinic regularly (Bergenmar, 2001). As these individuals have a very high risk of developing skin cancer the screening initiative could be potentially very effective. Other screening initiatives conducted in Sweden are, e.g. regular skin check-ups at dermatological clinics one Monday each year, called 'Melanoma Monday'. The Swedish Cancer Association has also organised free skin check-ups in conjunction with prevention campaigns at beaches all around Sweden during the summer.

2 AIMS

The overall aim of this thesis was to explore factors of relevance in the effort to change UV-related behaviour and factors of relevance for the early detection of malignant melanoma in the population. These factors were examined using questionnaires and interviews, and their consequences for preventive efforts were discussed.

The specific aim of each paper was:

Paper I

To examine the test-retest reliability of questionnaire items measuring UV-related behaviour and attitudes. The questionnaire items have been used in study II-IV.

Paper II

To examine the associations between UV exposure, knowledge, risk perception, and attitudes among adolescents 13, 15 and 17 year of age.

Paper III

To examine the associations between a number of different UV related behaviours and attitudes, social norms, and perceived behavioural control, among people aged 18-37 years.

Paper IV

To examine, in a randomised study, the effects of four different information packages about UV radiation directed at young adults on a number of sun related variables.

Paper V

To explore, by means of interviews, the motives of three different patient groups in seeking medical attention for their pigmented skin lesions.

Paper VI

To explore differences in ability to make adequate assessments of skin lesions between different patient groups and a population sample, and the possibility of enhancing laymen's proficiency in making such judgements by means of brief instruction in the use of the ABCD criteria for skin lesions.

3 METHODS

3.1 PAPER I

The sample comprised 52 female Swedish nurses attending a post-graduate course in research methodology. They completed a questionnaire, with items related to UV exposure, on two occasions spaced three weeks apart in the winter of 2000. The response rate was 100%. The participants received a free cinema ticket as compensation for participation.

3.2 PAPER II

In 1996, a random national population sample of 4,020 adolescents (13, 15 and 17 year of age) was sent a questionnaire with items related to UV exposure with a stamped addressed envelope. Two reminders were sent to non-responders and a total of 2,615 (65%) returned the questionnaire. No compensation was given for participation.

3.3 PAPER III

See paper IV below, the study was based on the material from the first measurement.

3.4 PAPER IV

A random population-based sample (n = 3,200, 18 - 37 years of age) in Stockholm County, Sweden, was selected from the Swedish Census Registry. In May 2001, they were sent a baseline questionnaire together with an invitation to participate in the study. Those who agreed to participate, a total of 1,743 persons (54%), were randomly assigned to receive one of four different information packages, see Table 4. A second follow-up questionnaire was sent in the autumn of 2001. Seventy-five per cent (n = 1,301) returned the second questionnaire. No compensation was given for participation.

Table 4. Information packages sent to the four randomised groups.

	Brochure with general information about the sun and sun protection	Brochure with information about the UV index	An individual UV radiation intensity indicator
Group A	×	×	×
Group B	×		×
Group C	×	×	
Group D	×		

3.5 PAPER V

Interviews were conducted with 90 persons (18 to 79 years of age). Thirty patients with malignant melanoma, 30 patients with dysplastic nevi, and 30 who had visited a physician because of worry about a pigmented skin lesion were recruited consecutively from the Department of Dermatology and the Department of Oncology at the Karolinska Hospital in Stockholm, Sweden in 1999. The interviews were carried out by RB using a semi-structured interview guide and covered reasons for seeking medical assistance, circumstances surrounding the visit and the features the interviewee deemed significant for malignant skin lesions. No compensation was given for participation.

3.6 PAPER VI

Interviews were conducted with 120 persons (18 to 79 years of age): 30 patients with malignant melanoma, 30 patients with dysplastic nevi, 30 persons who had visited a physician because of worry over a pigmented skin lesion (the same sample as in paper V), and 30 randomly selected persons from the Swedish Census Registry living in Stockholm County. The interviewee judged photographs of six pigmented skin lesions. The pictures were shown both as slides exposed on a white screen and in natural size on a transparent piece of plastic exposed close to the interviewee's own skin. The skin lesions were assessed, using a five point scale, regarding how to behave on finding a similar lesion oneself. No compensation was given to the patients for participation, but the randomly selected participants received two free cinema tickets.

3.7 INSTRUMENTS

3.7.1 Questionnaire items

In study I to IV, questionnaires were used to collect information from the respondents. The variables measured by the questionnaires used in the different studies are shown in Table 5 below.

Table 5. Variables measured by the different questionnaires in the studies.

Study:	I	II	III	IV
Sun exposure				
Frequency of intentional tanning	×	×	×	×
Frequency of unintentional sun exposure				×
Time spent in the sun			×	×
Systematic tanning	×			
Future sunbathing habits	×	×		
Use of sunbeds	×		×	
Use of sun protection	×	×	×	×
Frequency of vacation to sunny resorts	×		×	
Skin sun sensitivity	×	×	×	
Frequency of sunburn	×		×	×
Beliefs about sunbathing				
Pros and cons of sunbathing	×	×	×	×
Perception of risk with sun exposure	×	×	×	×
Social norms concerning sunbathing			×	
Self-efficacy/perceived behavioural control	×		×	×
Knowledge about solar radiation and sun protection		×		×
Knowledge of risk factors for skin cancer		×		
Readiness to change sun-related behaviour	×		×	×

Sun exposure was measured in several ways in study I to IV. A question on intentional tanning was used in all four studies, even though the response alternatives differed somewhat. This question had been developed and used in previous studies (Boldeman et al., 2001; Brandberg et al., 1998). In study I, the response alternatives for frequency of intentional tanning were: 'Often', 'Sometimes', 'Seldom', and 'Never'. In study II, the response

alternatives were: 'Often', 'Rather often', 'Sometimes', 'Seldom', and 'Never'. In study III and IV the response alternatives were: 'Very often', 'Often', 'Sometimes', 'Seldom', and 'Never'. In study I, the respondent was asked how he/she usually sunbathed, i.e. if they tanned both the front and back of the body. This question was not used in the other studies included in this thesis but has been used in previous studies (Boldeman et al., 2001). In study III and IV, one additional question about the approximate amount of time spent in the sun during a typical work-free day during peak hours in the summer was used to assess amount of sun exposure. The response categories for this question were: '< 30 minutes', '30 minutes to 1 hour', '1-2 hours', '2-3 hours', and '> 3 hours'. Study V, included a question about the frequency of unintentional sun exposure, with response categories: 'Very often', 'Often', 'Sometimes', 'Seldom', and 'Never'. The two last questions were constructed especially for these studies and were used to obtain clearer knowledge of the extent of sun exposure, including unintentional exposure to solar radiation.

In study I, *use of sunbeds* was measured with the question: 'How often do you use a sunbed?' and the response categories were: 'Often', 'Rather often', 'Seldom', 'I have stopped using sunbeds', and 'I have never used a sunbed'. In study III, use of sunbed was measured with one question: 'Do you use a sunbed?' with the response categories: 'Yes' and 'No'.

In study I, *use of sun protection* was measured with a question about sunscreen use. In study II, III and IV questions also concerned minimising exposure to the sun through avoiding direct sunlight, using clothing, hat and shade as protection, as well as avoiding being in the sun at peak hours. The questions in study II have previously been used (Brandberg et al., 1998).

Frequency of vacations at sunny resorts was measured with two questions in study I: 'How many times have you been to a sunny resort on vacation during the past year?' and 'How many times have you been to a sunny resort on vacation during your whole life?'. These questions were constructed for, and used in, a previous study (Boldeman et al., 2001). In study III and IV, a new question was constructed: 'How many weeks during a year do you normally travel to a sunny resort on vacation?' with the response categories: '> 4 weeks', '3-4 weeks', '1-2 weeks' and 'I do not usually travel to sunny resorts for my vacation'.

Skin sun sensitivity was measured with one question derived from Fitzpatrick's classification of skin types (Fitzpatrick, 1988). The same question was used for study I to III and classified the respondents into four skin types: I ('Always burns, never tans'), II ('Always burns, sometimes tans'), III ('Sometimes burns, always tans'), and IV ('Never burns, always tans'). In study III a fifth category was added i.e. skin type V ('Nothing happens').

In Study I, *frequency of sunburn* was measured with three previously constructed and used questions (Boldeman et al., 2001). The first question was: 'How many times have you been sunburnt (redness and smarting pain) during the past year in Sweden?', with six response categories ('More than 10 times', '6-10 times', '3-5 times', '1-2 times', 'I have not been sunburnt', and 'I have not sunbathed'). The second item: 'How many times have you been sunburnt (redness and smarting pain) abroad during the past year?', with four response alternatives ('More than 5 times', '3-5 times', '1-2 times', and 'I have not been sunburnt'). The

third item: 'How often have you been sunburnt (redness and smarting pain) in Sweden during your whole lifetime?', with five response alternatives ('Every year', 'Sometimes, but not every year', 'A few times', 'Never', and 'I have never sunbathed'). Lastly, study III and IV contained two questions concerning frequency and severity of sunburns during the past year. These questions were constructed especially for these studies taking into account recommendations from a Canadian review on the construction of items measuring sunburn (Shoveller & Lovato, 2001). The first question was: 'How many times during the past year did your skin burn and turn red after being exposed to the sun?', and the second question was: 'If you were sunburnt during the past year, how did your skin react? (If you were sunburnt several times, describe the time you were sunburnt the most)' with the response categories: 'Redness', 'Severe redness without pain', 'Redness and pain', 'Severe redness and pain', 'Redness, pain and blisters'.

Beliefs about sunbathing were measured with somewhat different items in the studies. In study II, pros and cons of sunbathing were measured by one item about the general attitude towards sunbathing, i.e. the perceived benefits and disadvantages of sunbathing. Risk perception was measured with a general question about whether or not the respondent thought sunbathing to be healthy or harmful. These items were constructed for a previous study (Brandberg et al., 1998). In study I, III and IV a number of statements expressing beliefs about sunbathing and having a tan were used. The respondents were asked to judge these statements on a five (study I) or four (study III and IV) point scale. In study I, 15 statements were used expressing beliefs about having a tan, sunbathing, perception of risk with sunbathing, medical consequences of sun exposure, and perception of self-efficacy/behavioural control. In study III and IV, the same statements were used for beliefs about having a tan, sunbathing, risk perception and self-efficacy, but the item on medical consequences of sun exposure was omitted. On the other hand, three statements about social norms concerning sunbathing were added, along with a few more statements about having a tanned skin. The additional statements were especially constructed for these studies. In study III a factor analysis was used to explore underlying factors among the items. Six factors with eigenvalue over 1 were extracted from the principal component analysis. The first factor, explaining 30% of the variance, had a high loading on 11 of the items. All 11 items concerned attitudes towards sunbathing or having a tan. The next factor explaining an additional 11% of the variance had a high loading on two items regarding perception of risk with sunbathing. The third factor explaining 9% of the variance had the highest loading on an item concerning attitudes towards having a tan. Factor four explained 7% of the variance and had a high loading on two items concerning social norms for sunbathing. The last two factors explaining 6% each had a high loading on only one item. The first concerned perceived behavioural control and the other social norm for sun protection. The total explained variance of the factors was 69%.

Study II, and IV, included questions concerning *knowledge* about skin cancer, UV radiation and sun protection. These questions were intended to measure knowledge related to skin cancer prevention. The questions were first used and constructed with the purpose of evaluating an information program concerning melanoma (Brandberg et al., 1998). The questions about risk factors for skin cancer were omitted in study IV.

Questions about *readiness to change* sun-related behaviours have been used in several of the studies. These questions have been constructed using the transtheoretical model of behaviour change (Prochaska et al., 1994). The questions enable a categorisation of respondents into six stages of readiness to change sun-related behaviours: precontemplation, contemplation, preparation, action, maintenance and termination.

3.7.2 Interview questions

In study V and VI, interviews were conducted with respondents using a semi-structured interview manual. The questions in the manual concerned reasons for seeking medical attention for a skin check-up, circumstances surrounding the visit, perceptions of the characteristics of malignant skin lesions, and earlier experiences of skin cancer. The interviews were tape-recorded and lasted approximately 30 to 45 minutes. The interviews were analysed by coding the respondents' answers to each question in different themes. The process was conducted with minimal analytic or interpretive intrusion from the researcher (RB). Initially, main themes were identified, such as 'concern about a specific skin lesion', and subsequently subthemes were formed e.g. 'a strange looking skin lesion' or 'itching skin lesion'.

3.7.3 Pictorial examples of skin lesions

A number of pictures were used for the purpose of assessing the respondent's ability to correctly decide an adequate behavioural response to three types of skin lesions. Pictures of two malignant melanoma, three dysplastic or atypical nevi, and three benign nevi were used. The pictures were initially judged by a panel of dermatologists. They were to decide individually, the most adequate course of action if confronted with a similar lesion on one's own skin ('do nothing', 'keep an eye on it', 'show someone else', 'show doctor at next visit', 'show doctor immediately'). The dermatologist's responses were later compared with those of the respondents in order to calculate an index of adequate assessment of the skin lesions.

3.8 STATISTICAL METHODS

The statistical methods used in the different studies are presented in Table 6. In study I, weighted kappa statistics, a calculation of absolute agreement, and the Pearson correlation coefficient were used. The weighted kappa statistics are an extension of the kappa statistics applicable for items with more than two response categories. In study II, III and IV, a Chi-square test was used to calculate group differences on sun related variables. In study II and III, logistic regressions were also used to examine the possibility of a number of independent variables in predicting group membership or outcome, e.g. frequent sunbather, user of sun protection. In study III, a factor analysis was made to examine factors within a number of sun-related items. In study IV and VI, Student's t-test, Analysis of variance (ANOVA), and Tukey's post-hoc test were used to compare group differences on a number of variables. In study IV, a non-parametric statistical test, the Wilcoxon Signed Ranks test, was also used to compare group differences.

Table 6. Statistical methods used in the different studies.

Study:	I	II	III	IV	V	VI
Weighted kappa statistics	x					
Pearson product moment correlation coefficient	x					
Chi ² -test		x	x	x		
Logistic regression analysis		x	x			
Factor analysis			x			
Students t-test				x		x
ANOVA				x		x
Wilcoxon Signed Ranks test				x		
Tukey's post-hoc test				x		x

4 RESULTS

4.1 PAPER I

The reliability study showed that items on sun-related behaviours and sunbed use were sufficiently reliable. The items on skin type and sunburn showed moderate stability. Stage of change related to sunlight exposure, items measuring beliefs about sunbathing together with items assessing self-efficacy and risk perception with regards to sunbathing showed lower stability.

4.2 PAPER II

Among Swedish adolescents more than half of the girls and 26% of the boys sunbathed frequently. Eighteen per cent of the respondents thought that they would sunbathe more in the future and 22% thought that they would sunbathe less often. Twenty-eight per cent of the boys and 18% of the girls did nothing to protect themselves from the sun. Girls, older adolescents, those with sun sensitive skin, those with better knowledge about skin cancer and those with a positive attitude towards sunbathing, sunbathed more often. Younger adolescents that sunbathe moderately today and those with sun sensitive skin were more likely to think that they would sunbathe more often in the future. Those who thought that sunbathing was damaging were more likely to report that they would sunbathe less often in the future. Boys, who did not have sun sensitive skin and those who sunbathed frequently, were least likely to use sun protection.

4.3 PAPER III

Adults in Sweden (18-37 years of age) expose themselves for a lot of UV radiation and many get sunburnt. A positive attitude towards sunbathing and being tanned was highly related to time spent in the sun, frequency of sunbathing, use of sunbeds, and vacations at sunny resorts. Those having these attitudes were also less likely to report use of recommended sun protection. Those perceiving sunbathing to be risky and those perceiving control over the risks with sunbathing were equally likely to spend time in the sun but were more likely to use sun protection. Having people around oneself who frequently sunbathe was primarily related to intentional tanning and vacations at sunny resorts.

4.4 PAPER IV

The study found no support for the use of an individual UV radiation indicator or the UV index in information brochures to the public. There were no differences between the groups receiving information about the UV index and those receiving general information about sun exposure and sun protection. However, sun exposure and sunburns decreased, and knowledge about sun exposure and radiation increased at the second assessment point compared with the first.

4.5 PAPER V

The most frequently mentioned reason for seeking medical assistance for a skin check-up was worry about a specific skin lesion. Most often the patient mentioned a change in size, very dark pigmentation, and ugly strange looking lesions as an incentive to visit a doctor. Another reason for a skin check-up was encouragement from a relative or a friend. Patients with dysplastic nevi usually mentioned a large number of skin lesions and a hereditary risk for

melanoma as a reason for their visit. More than one-third of the patients with malignant melanoma had been visiting a physician for another reason when their melanoma was identified. There were no systematic differences between how patients with different types of skin lesions described their skin lesions, except that patients with melanoma often described them as very dark. Health care personnel seem to have an important role in early detection of melanoma.

4.6 PAPER VI

All patient groups made adequate judgements of melanoma but they exaggerated the danger of benign skin lesions. Information about the ABCD criteria ('asymmetry', 'border irregularity', 'colour variegation' and 'diameter > 5 mm') enhanced the laymen's ability to make adequate judgements of skin lesions.

5 GENERAL DISCUSSION

5.1 SURVEYS OF SUN-RELATED BEHAVIOURS

During the past ten years a number of surveys have been conducted in Sweden using questionnaire items about current sun-related behaviours and beliefs. Both the items used and the samples studied have varied. Few attempts have been made to assess the stability of these items. Valid and reliable measures for the assessment of sun-related variables are necessary in research on skin cancer prevention. The test-retest reliability study presented in this thesis is an attempt to examine the stability of some of the commonly used questionnaire items on sun-related variables in Sweden. The results supported the use of questionnaires in measuring sun-related behaviours.

5.2 PREDICTORS OF SUN-RELATED BEHAVIOURS

As there are no strong indications of a decrease in UV exposure in the Swedish population, there is still a great need to develop skin cancer preventive interventions. The results from paper II and III give valuable information for the construction of preventive interventions aiming at behaviour change. Paper II indicated that preventive interventions to increase knowledge about solar radiation and skin cancer are insufficient to change sun-related behaviour. The fact that knowledge may be a prerequisite but not enough to alter behaviours has previously been found for both skin related behaviours and other health behaviours as well (Buller & Borland, 1998; Glanz et al., 1997). However, it is an important finding, as interventions to increase people's knowledge are frequently used preventive actions in Sweden. Positive attitudes towards being tanned and being in the sun were by far the most strongly associated variables with almost all sun-related behaviours, i.e. time spent in the sun, intentional tanning, sunbed use, going on vacation to sunny resorts, intention to decrease sunbathing and use of protection against the sun. This has also been found in a number of previous studies, as reported in section 1.6 above. These attitudes together with the positive social norm regarding sun exposure should therefore be the major target for preventive action.

Perceiving sunbathing as risky was associated with using different ways to protect oneself and intending to reduce sun exposure, but not with time spent in the sun or frequency of intentional tanning. Perceived behavioural control was associated with use of sunscreen and use of other ways of protecting oneself from the sun. These results indicate the necessity of new strategies to increase people's sun protection behaviour. In particular, interventions to increase awareness of the risks with sun exposure should be used.

Even though the studies of predictors in this thesis suffer from the same problems with representativeness as other population based survey studies, e.g. substantial amount of non-responders, they indicate variables of importance for preventive action. Stronger predictive models of sun-related behaviours could probably be developed using more behaviour specific attitudes and beliefs. In these studies there were no behaviour specific items on attitudes and beliefs about sun protective behaviour, going on vacations to sunny resorts, and use of sunbeds.

5.3 THE UV INDEX

Study IV, investigated the possibility of using information about the UV index in altering sun-related behaviours and attitudes. Positive attitudes towards being in the sun, knowledge of UV radiation as well as tanning and sunburn frequencies, and use of sun protection changed during the study period. However, information about the Ultraviolet Index or a personal UV radiation intensity indicator did not decrease sunbathing and sunburn more than general written information about sun-protection. These are important findings for future preventive efforts. Even though these results indicate difficulties in educating people about the UV index, the effects of widespread media broadcasting of the UV index are not known. The World Health Organisation (WHO) has constructed and distributed recommendations for the spreading of the UV index. Recommendations for graphic illustrations of both the UV index and recommendations for how people should behave are included. It is, however, difficult to use the same information and recommendations for everyone, because of geographical differences in the amount of UV radiation and cultural aspects. Further, one increasing area of research in public health education today is concerned with tailored interventions (Glanz et al., 1997). Tailored advice, specially constructed for individual use, is believed to have a stronger effect in changing behaviours than general information. The concept of the UV index as a universal instrument for behaviour change might need to be refined so as to consider individual recommendations.

5.4 SECONDARY PREVENTION

Study V and VI examines the reasons people have for seeking medical attention for a skin check-up and the ability of laymen to successfully examine skin lesions. The overall aim of secondary prevention is to increase early detection of malignant melanoma and subsequently reduce mortality. The aims of the studies included in this thesis were to make new contributions to our general knowledge about how recommendations should be formulated in order to be helpful to laymen. In study V, patients with malignant melanoma and those with benign skin lesions mentioned almost the same features as the incentives to seek medical consultation. This might indicate a need to educate the public about the features of benign skin lesions. This conclusion is also supported in study VI, where most people make an adequate assessment of malignant skin lesion but have difficulty in judging benign ones. However, another important issue not addressed in these studies is how to induce people to examine their skin regularly for suspicious lesions.

5.5 METHODOLOGICAL CONSIDERATIONS

5.5.1 Samples

Study I should ideally have been conducted on the population for which the questionnaire had been constructed, i.e. a population based sample. The use of student nurses most certainly influenced the result. The students were probably more careful and systematic than the general population in completing the questionnaires, and therefore the reliability of the questions might be exaggerated. Further studies of the systematic error of using these questions to measure sun-related behaviours are needed.

Studies II – IV are random population-based questionnaire studies with response rates of 65% to 54%. The large number of non-responders was a limitation in these studies. However, the major research question in these studies has not been to describe the prevalence of sun-related

behaviours in the population but rather to examine associations between variables. Studies of associations are not always affected by non-response (Van Loon et al., 2003).

The samples in studies III – IV are taken from Stockholm County. The possibility to generalise these results to the rest of the Swedish population is therefore somewhat limited. The characteristics of the population in Stockholm and other larger cities in Sweden are somewhat different from those of the populations in smaller cities and rural areas.

The respondents in study V and VI were consecutively recruited to the study. However, the uneven inclusion rate in the different groups made comparisons between the groups difficult. For example, the inclusion rate in the melanoma patient group was 71% and the rate in the healthy population group was only 33%. Further, the healthy population group was not completely ‘healthy’, as one patient was diagnosed with melanoma and six patients had dysplastic nevi. This resulted in a dispersion of differences between the groups.

5.5.2 Use of questionnaires in data collection

Most questionnaires used in the studies of this thesis were posted to the respondents, and the items used were items with predetermined response alternatives. There are always a number of drawbacks in using this type of questionnaire in data collection. Firstly, someone else can answer the questionnaires or it can be completed under the supervision, and/or with the assistance, of someone else. Secondly, the locked response alternatives force the respondent to answer in categories, and thus, fine distinctions in responses might be lost. Lastly, the wording and phrasing of items in the questionnaire might be differently understood by different respondents. One way of examining the comprehensibility of questionnaires is through pre-testing in smaller samples of the population. The questionnaire used in study III and IV was pre-tested in a small group and the questionnaire was adjusted according to the comments received.

5.5.3 Face-to-face interviews

There are a number of problems when using interviews to collect data. First, interviews are sensitive to how the respondent wishes to be perceived by the interviewer. There is always a danger that the interviewer is given the answer he/she desires. The interviews in the studies included in this thesis were not conducted at the hospital at which the skin check-up had been carried out, but in a separate building close by, and by an interviewer without medical training. This might have reduced the respondents’ feeling that he/she should reply in a certain way. Another problem is that interview data are difficult to interpret. It is difficult to avoid bias due to subjective interpretation of the respondent’s answers. To avoid this type of bias the answers were coded with minimal analytic interpretation of the material. However, validation of the coding by a second independent investigator was not carried out. The use of interviews also makes it necessary to restrict the number of respondents included in the studies. This limits the possibility to generalise the findings.

5.5.4 Statistical considerations

In study I weighed kappa statistics were used to assess level of agreement between test and retest. The use of the kappa coefficient has been very popular but in later years there has been increasing criticism of its use. The advantages of using the kappa statistics are that they are

easily calculated and are appropriate for testing whether or not agreement exceeds chance levels. The use of kappa statistics to assess level of agreement is more difficult and it is difficult to categorise ranges of kappa as “good” and “poor”. Kappa is dependent on the distribution of the studied characteristic and the kappa can be low even though the agreement is high. In study I, we used the kappa statistics as a complement to proportion of direct agreement, to take into account the agreement by chance alone. Weights were used as the variables had more than two categories. For some variables, Spearman rank correlation might have been the most appropriate to use in the analysis, as they were clearly ordered category data.

In study II and III, logistic regression analysis was used to examine multiple associations between a number of independent variables and different dependant variables. The goal was to identify variables that predict group membership, e.g. frequent sun tanners. Logistic regression was chosen instead of linear regression, as the assumptions of distribution of the predictor variables were not met. Even though the independent variables in logistic regression analysis do not have to be discrete, the ordered variables were dichotomised to facilitate interpretation. All variables were entered simultaneously into the equation as they all were considered potential predictors of group membership. This method presents the contribution of each predictor over and above that of other predictors (Tabachnick & Fidell, 2001). One could argue that a linear regression model would have been more suitable for the analysis of associations between these variables. However, linear regression assumes continuous normally distributed variables and homogeneity of variances (Tabachnick & Fidell, 2001). The variables used in study II and III did not meet these assumptions. The choice between parametric and non-parametric statistics is not clear-cut, however. Some researchers claim that a scale with more than 11 levels, even though based on ordinal variables, can be regarded as continuous (Nunnally, 1994). Further, there are a number of ways to adjust and compensate for deviations from the assumptions necessary for the use of parametric statistics. For example, violation against homogeneity can be compensated by a more stringent α level (Tabachnick & Fidell, 2001). For these reasons student's t-test and ANOVA were used to compare group differences in study IV and VI.

The strength of association was calculated for the randomised study in paper IV. Strength of association assesses the proportion of variance in the dependant variable that is associated with different levels on the independent variable (Tabachnick & Fidell, 2001). Partial η^2 (eta squared) was used to assess the proportion of variance attributed to each independent variable separately. One negative aspect of using η^2 is that it does not take into account systematic variance in the population. It is, however, the default option for calculation of strength of association in the SPSS statistical package.

6 CONCLUSIONS

- People in Stockholm and adolescents in Sweden expose themselves to a large amount of UV radiation and a majority does not intend to decrease their sun exposure
- Questions used in surveys and evaluations to measure sun-related behaviours, i.e. habitual sunbathing, sunbed use and frequency of sunburn, have sufficient stability.
- Sunscreen was found to be a frequently used way to protect oneself from the sun, and thus, information about sun protection should emphasise the importance of using other ways to protect oneself from the sun.
- Positive attitudes towards sunbathing and having a tan, together with social norms seem to be the most important variables associated with UV exposure.
- Risk perception and perceived behavioural control were strongly associated with sun protection behaviour, in addition to attitudes.
- An individual UV radiation intensity indicator and information about the UV index do not seem to influence sun-related behaviour more than general written information.
- Health care providers seem to have an important role in early detection of malignant skin lesions, as one third of the melanoma patients interviewed reported that their melanoma was found during a visit to a health care provider for a reason other than the skin lesion.
- The ABCD criteria seem to increase laymen's ability to make adequate judgements of skin lesions and could therefore be recommended for use in secondary preventive interventions.
- Information about the features of benign or common skin lesions might be beneficial to laymen's ability to successfully distinguish malignant from benign nevi.

6.1 RECOMMENDATIONS

- A positive attitude towards sunbathing and having a tan is the most important target for primary prevention of skin cancer, even though it might be the most difficult to change.
- Interventions to increase the awareness of the risks with sun exposure are also needed to enhance sun protective behaviour.
- Primary skin cancer preventive interventions should target unintentional sun exposure as well as intentional tanning.
- Avoiding the sun (especially during peak hours) and using clothes as protection should be recommended rather than the use of sunscreen.
- Information about the features of malignant and benign skin lesions should be used in public education interventions for early detection of malignant lesions.
- Behavioral models should be used in planning and implementing prevention strategies aimed at behavior change.

6.2 FUTURE RESEARCH

- More validity and reliability studies for measuring sun exposure and related factors.
- Regular monitoring of sun exposure and sunburn in the population over time using standardised measurements.
- Study of predictors of sun-related behaviours using behavioural models and behaviour specific attitudes and beliefs.
- Construction and evaluation of innovative skin cancer preventive interventions targeting both reduced UV exposure and early detection.

ACKNOWLEDGEMENTS

I wish to thank all those who have helped and supported me in completing this thesis, and especially I want to acknowledge:

Yvonne Brandberg, my supervisor, for her knowledge, excellent research skills and valuable support both in my research and in my work with cancer patients

Henrik Ullén, my co-supervisor, for his knowledge of oncology and prevention, and valuable help in the writing of this thesis

Regina Wredling and Ingvar Krakau for introducing me to research at the Karolinska Institutet

Sveinbjörn Kristjansson for good collaboration, friendship, and many interesting discussions

My other co-authors Mari-Anne Hedblad, Lars-Erik Holm and Lennart Sjöberg

Members of my research group Mia Bergenmar and Helena Mickelsson

All former co-workers at the Department of Cancer Prevention (CPE) and our neighbours in the M8 pavilion, in particular Bjöörn Fossum and Karin Gullbrandsson

Jessica Lindholm, Katja Brandberg and Johan Lager for practical help in carrying out the studies included in this thesis

I would like to thank my family and friends for their support, and especially Hilding Lundkvist for sharing his life with me during this period with patience and encouragement

I also wish to thank the Swedish Cancer Society, the Cancer Society in Stockholm and the King Gustaf V Jubilee Fund for financially supporting this research

REFERENCES

- Aitken, J. F., Elwood, J. M., Lowe, J. B., Firman, D. W., Balanda, K. P., & Ring, I. T. (2002). A randomised trial of population screening for melanoma. *J Med Screen*, 9(1), 33-37.
- Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behaviour. *J Appl Soc Psychol*, 32(4), 665-683.
- Amir, Z., Wright, A., Kernohan, E. E., & Hart, G. (2000). Attitudes, beliefs and behaviour regarding the use of sunbeds amongst healthcare workers in Bradford. *Eur J Cancer Care*, 9(2), 76-79.
- Anderson, P. J., Lowe, J. B., Stanton, W. R., & Balanda, K. P. (1994). Skin cancer prevention: a link between primary prevention and early detection? *Aust J Public Health*, 18(4), 417-420.
- Armitage, C., & Conner, M. (2001). Efficacy of the Theory of Planned Behaviour: a meta-analytic review. *Br J Soc Psychol*, 40(4), 471-499.
- Armstrong, B. K., & Kricger, A. (1996). Epidemiology of sun exposure and skin cancer. In *Skin cancer* (Vol. 26, pp. 133-135). Canberra: Imperial Cancer Research Fund.
- Armstrong, B. K., & Kricger, A. (2001). The epidemiology of UV induced skin cancer. *J Photochem Photobiol*, 63(1-3), 8-18.
- Arthey, S., & Clarke, V. A. (1995). Suntanning and sun protection: a review of the psychological literature. *Soc Sci Med*, 40, 265-274.
- Asch, D. A., Jedrzejewski, M. K., & Christakis, N. A. (1997). Response rates to mail surveys published in medical journals. *J Clin Epidemiol*, 50(10), 1129-1136.
- Augustsson, A., Stierner, U., Rosdahl, I., & Suurkula, M. (1990). Common and dysplastic naevi as risk factors for cutaneous malignant melanoma in a Swedish population. *Acta Derm Venereol*, 71, 518-524.
- Autier, P., Dore, J. F., Cattaruzza, M. S., Renard, F., Luther, H., Gentiloni-Silverj, F., et al. (1998). Sunscreen use, wearing clothes, and number of nevi in 6- to 7-year-old European children. European Organization for Research and Treatment of Cancer Melanoma Cooperative Group. *J Natl Cancer Inst*, 90(24), 1873-1880.
- Autier, P., Doré, J.-F., Négrier, S., Liénard, D., Panizzon, P., Lejeune, F. J., et al. (1999). Sunscreen use and duration of sun exposure: a double-blind, randomized trial. *J Natl Cancer Inst*, 91(15), 1304-1309.
- Autier, P., Doré, J.-F., Reis, A. C., Grivegnée, A., Ollivaud, L., Truchetet, F., et al. (2000). Sunscreen use and intentional exposure to ultraviolet A and B radiation: a double blind randomized trial using personal dosimeters. *Br J Cancer*, 83(9), 1243-1248.
- Baade, P. D., Balanda, K. P., & Lowe, J. B. (1996). Changes in skin protection behaviors, attitudes, and sunburn: in a population with the highest incidence of skin cancer in the world. *Cancer Detect Prev*, 20(6), 566-575.
- Balanda, K. P., Stanton, W. R., Lowe, J. B., & Purdie, J. (1999). Predictors of sun protective behaviors among school students. *Behav Med*, 25, 28-35.
- Bandura, A. (1977). *Social learning theory*. Englewood Cliffs: Prentice-Hall.
- Banks, B. A., Silverman, R. A., Schwartz, R. H., & Tunnessen, W. W. (1992). Attitudes of teenagers towards sun exposure and sunscreen use. *Pediatrics*, 89(1), 40-42.
- Baum, A., & Cohen, L. (1998). Successful behavioral interventions to prevent cancer: the example of skin cancer. *Ann Rev Public Health*, 19, 319-333.
- Beech, J. R., Sheehan, E., & Barraclough, S. (1996). Attitudes towards health risks and sunbathing behavior. *J Psychol*, 130(6), 669-677.
- Berg, D., & Otley, C. C. (2002). Skin cancer in organ transplant recipients: epidemiology, pathogenesis, and management. *J Am Acad Dermatol*, 47(1), 1-20.

- Bergenmar, M. (2001). *Cutaneous Malignant Melanoma: Aspects on Prevention*. Karolinska Institute, Stockholm.
- Bergenmar, M., & Brandberg, Y. (2001). Sunbathing and sun-protection behaviors and attitudes of young Swedish adults with hereditary risk for malignant melanoma. *Cancer Nurs*, 24(5), 341-350.
- Bergenmar, M., & Brandberg, Y. (2003). *Kartläggning av informationsmaterial om sol och hudcancer*. Stockholm: Swedish Radiation Protection Authority.
- Bergenmar, M., Hansson, J., & Brandberg, Y. (2002). Detection of nodular and superficial spreading melanoma with tumour thickness ≤ 2.0 mm--an interview study. *Eur J Cancer Prev*, 11(1), 49-55.
- Bergenmar, M., Ringborg, U., Mansson Brahme, E., & Brandberg, Y. (1998). Nodular histogenetic type -- the most significant factor for thick melanoma: implications for prevention. *Melanoma Res*, 8(5), 403-411.
- Bergenmar, M., Törnberg, S., & Brandberg, Y. (1997). Factors related to non-attendance in a population based melanoma screening program. *Psycho-oncology*, 6, 218-226.
- Berwick, M., Begg, C. B., Fine, J. A., Roush, G. C., & Barnhill, R. L. (1996). Screening for cutaneous melanoma by skin self-examination [see comments]. *J Natl Cancer Inst*, 88(1), 17-23.
- Blum, A., Brand, C. U., Ellwanger, U., Schlagenhauff, B., Stroebel, W., Rassner, G., et al. (1999). Awareness and early detection of cutaneous melanoma: an analysis of factors related to delay in treatment. [see comments]. *Br J Dermatol*, 141(5), 783-787.
- Boldeman, C., Beitner, H., Jansson, B., Nilsson, B., & Ullén, H. (1996). Sunbed use in relation to phenotype, erythema, sunscreen use and skin diseases. A questionnaire survey among Swedish adolescents. *Br J Dermatol*, 135, 712-716.
- Boldeman, C., Bränström, R., Dal, H., Kristjansson, S., Rodvall, Y., Jansson, B., et al. (2001). Tanning habits and sunburn in a Swedish population aged 13-50 years. *Eur J Cancer*, 37, 2441-2448.
- Boldeman, C., Jansson, B., & Holm, L.-E. (1991). Primary prevention of malignant melanoma in a Swedish urban preschool sector. *J Cancer Educ*, 6(4), 247-253.
- Boldeman, C., Jansson, B., Nilsson, B., & Ullén, H. (1997). Sunbed use in Swedish urban adolescents related to behavioral characteristics. *Prev Med*, 26(1), 114-119.
- Boldeman, C., Ullén, H., Månsson-Brahme, E., & Holm, L.-E. (1993). Primary prevention of malignant melanoma in the Stockholm Cancer Prevention Programme. *Eur J Cancer Prev*, 2, 441-446.
- Bono, A., Tomatis, S., Bartoli, C., Tragni, G., Radaelli, G., Maurichi, A., et al. (1999). The ABCD system of melanoma detection: a spectrophotometric analysis of the Asymmetry, Border, Color, and Dimension. *Cancer*, 85(1), 72-77.
- Borland, R., Marks, R., & Noy, S. (1992). Public knowledge about characteristics of moles and melanomas. *Aust J Publ Health*, 16, 370-375.
- Borland, R., & Meehan, J. W. (1995). Skin examination for signs of cancer. *Aust J Public Health*, 19(1), 85-88.
- Brady, M. S., Oliveria, S. A., Christos, P. J., Berwick, M., Coit, D. G., Katz, J., et al. (2000). Patterns of detection in patients with cutaneous melanoma. *Cancer*, 89(2), 342-347.
- Brandberg, Y., Bolund, C., Michelson, H., Månsson-Brahme, E., Ringborg, U., & Sjöden, P.-O. (1996). Perceived Susceptibility to and knowledge of malignant melanoma: screening participants vs the general population. *Prev Med*, 25, 170-177.
- Brandberg, Y., Jonell, R., Broberg, M., Sjöden, P. O., & Rosdahl, I. (1996). Sun-related behaviour in individuals with dysplastic naevus syndrome. *Acta Dermato-Venereologica*, 76(5), 381-384.

- Brandberg, Y., Sjoden, P. O., & Rosdahl, I. (1997). Assessment of sun-related behaviour in individuals with dysplastic naevus syndrome: a comparison between diary recordings and questionnaire responses. *Melanoma Res*, 7(4), 347-351.
- Brandberg, Y., Ullén, H., Sjöberg, L., & Holm, L. E. (1998). Sunbathing and sunbed use related to self-image in a randomized sample of Swedish adolescents. *Eur J Cancer Prev*, 7(4), 321-329.
- Broadstock, M., Borland, R., & Gason, R. (1992). Effects of suntan on judgements of healthiness and attractiveness by adolescents. *J Appl Soc Psychol*, 22, 157-172.
- Broadstock, M., Borland, R., & Hill, D. (1996). Knowledge, attitudes and reported behaviours relevant to sun protection and suntanning in adolescents. *Psychol Health*, 11, 527-539.
- Bränström, R., Brandberg, Y., Holm, L.-E., Sjöberg, L., & Ullén, H. (2001). Beliefs, knowledge and attitudes as predictors of sunbathing habits and use of sun protection among Swedish adolescents. *Eur J Cancer Prev*, 10, 337-345.
- Bränström, R., Ullén, H., & Brandberg, Y. (2003a). Attitudes, subjective norms and perception of behavioural control as predictors of sun related behaviour in Swedish adults. *Prev Med*, Submitted.
- Bränström, R., Ullén, H., & Brandberg, Y. (2003b). A randomized population-based intervention to examine the effect of the UV index on tanning behavior. *Eur J Cancer*, 39(7), 968-974.
- Buller, D. B., & Borland, R. (1998). Public education projects in skin cancer prevention: child care, school, and college-based. *Clin Dermatol*, 16(4), 447-459.
- Burton, R. C. (2000). Malignant melanoma in the year 2000. *Cancer J Clin*, 50, 209-213.
- Campbell, H. S., & Birdsell, J. M. (1994). Knowledge, beliefs, and sun protection behaviors of Alberta Adults. *Prev Med*, 23, 160-166.
- Carlsson, L., Eklund, L.-O., Dal, H., & Ullén, H. (2001). Hälsoekonomisk bedömning. In *Solvanor Hudcancer*. Stockholm: Alfa offsetproduktion AB.
- Chen, Y. T., Dubrow, R., Zheng, T., Barnhill, R. L., Fine, J., & Berwick, M. (1998). Sunlamp use and the risk of cutaneous malignant melanoma: a population-based case-control study in Connecticut, USA. *Int J Epidemiol*, 27(5), 758-765.
- Cockburn, J., Hennrikus, D., Scott, R., & Sanson-Fisher, R. (1989). Adolescents use of sun-protection measures. *Med J Aust*, 151(136-49).
- Coldiron, B. M. (1998). The UV Index: a weather report for the skin. *Clin Dermatol*, 16(4), 441-446.
- Conner, M., & Norman, P. (1995). *Predicting health behaviour*. Buckingham: Open University Press.
- Coogan, P. F., Geller, A., Adams, M., Benjes, L. S., & Koh, H. K. (2001). Sun protection practices in preadolescents and adolescents: a school-based survey of almost 25,000 Connecticut schoolchildren. *J Am Acad Dermatol*, 44(3), 512-519.
- Davis, K. J., Cokkinides, V. E., Weinstock, M. A., O'Connell, M. C., & Wingo, P. A. (2002). Summer sunburn and sun exposure among US youths ages 11 to 18: national prevalence and associated factors. *Pediatrics*, 110(1 Pt 1), 27-35.
- Edman, R. L., & Klaus, S. N. (2000). Is routine screening for melanoma a benign practice? *JAMA*, 284(7), 883-886.
- Etter, J. F., & Perneger, T. V. (1997). Analysis of non-response bias in a mailed health survey. *J Clin Epidemiol*, 50(10), 1123-1128.
- European Commission. (1998). *Fact and Figures on the Europeans on Holidays*. Brussels.
- Fitzpatrick, T. B. (1988). The validity and practicality of sun-reactive skin types I through VI. *Arch Dermatol*, 124(6), 869-871.

- Friedman, L. C., Webb, J. A., Bruce, S., Weinberg, A. D., & Cooper, H. P. (1995). Skin cancer prevention and early detection intentions and behavior. *Am J Prev Med*, *11*(1), 59-65.
- Friedman, R. J., Rigel, D. S., & Kopf, A. W. (1985). Early detection of malignant melanoma: the role of physician examination and self-examination of the skin. *Ca: Cancer J Clin*, *35*(3), 130-151.
- Geller, A. C., Colditz, G., Oliveria, S., Emmons, K., Jorgensen, C., Aweh, G. N., et al. (2002). Use of sunscreen, sunburning rates, and tanning bed use among more than 10 000 US children and adolescents. *Pediatrics*, *109*(6), 1009-1014.
- Geller, A. C., Hufford, D., Miller, D. R., Sun, T., Wyatt, S. W., Reilley, B., et al. (1997). Evaluation of the Ultraviolet Index: media reactions and public response. *J Am Acad Dermatol*, *37*(6), 935-941.
- Girgis, A., Sanson-Fisher, R. W., & Watson, A. (1994). A workplace intervention for increasing outdoor workers' use of solar protection. *Am J Public Health*, *84*(1), 77-81.
- Glanz, K., Lewis, F. M., & Rimer, B. K. (1997). *Health Behaviour and Health Education* (2nd Edition ed.). San Francisco: Jossey-Bass Publishers.
- Grob, J. J., Guglielmina, C., Gouvernet, J., Zarour, H., Noe, C., & Bonerandi, J. J. (1993). Study of sunbathing habits in children and adolescents: application to the prevention of melanoma. *Dermatology*, *186*(2), 94-98.
- Gundestrup, M., & Storm, H. H. (1999). Radiation-induced acute myeloid leukaemia and other cancers in commercial jet cockpit crew: a population-based cohort study. *Lancet*, *354*(9195), 2029-2031.
- Hanrahan, P. F., Hersey, P., Menzies, S. W., Watson, A. B., & D'Este, C. A. (1997). Examination of the ability of people to identify early changes of melanoma in computer-altered pigmented skin lesions. *Arch Dermatol*, *133*(3), 301-311.
- Harth, Y., Schemer, A., & Friedman-Birnbaum, R. (1995). Awareness to photodamage versus the actual use of sun protection methods by young adults. *J Eur Acad Dermatol Venereol*, *4*, 260-266.
- Helfand, M., Mahon, S. M., Eden, K. B., Frame, P. S., & Orleans, C. T. (2001). Screening for skin cancer. *Am J Prev Med*, *20*(3 Suppl), 47-58.
- Hemminki, K., & Vaitinen, P. (1999). Familial cancers in a nationwide family cancer database: age distribution and prevalence. *Eur J Cancer*, *35*(7), 1109-1117.
- Hill, D., White, V., Marks, R., Theobald, T., Borland, R., & Roy, C. (1992). Melanoma prevention: behavioral and nonbehavioral factors in sunburn among an Australian urban population. *Prev Med*, *21*(5), 654-669.
- Hillhouse, J. J., Adler, C. M., Drinnon, J., & Turrisi, R. (1997). Application of Ajzen's theory of planned behavior to predict sunbathing, tanning salon use, and sunscreen use intentions and behaviors. *J Behav Med*, *20*(4), 365-378.
- Hillhouse, J. J., Stair, A. W., 3rd, & Adler, C. M. (1996). Predictors of sunbathing and sunscreen use in college undergraduates. *J Behav Med*, *19*(6), 543-561.
- Hillhouse, J. J., Turrisi, R., & Kastner, M. (2000). Modeling tanning salon behavioral tendencies using appearance motivation, self-monitoring and the theory of planned behavior. *Health Educ Res*, *15*(4), 405-414.
- Horio, T. (1998). Skin disorders that improve by exposure to sunlight. *Clin Dermatol*, *16*(1), 59-65.
- Huncharek, M., & Kupelnick, B. (2002). Use of topical sunscreens and the risk of malignant melanoma: a meta-analysis of 9067 patients from 11 case-control studies. *Am J Public Health*, *92*(7), 1173-1177.
- INRA (EUROPE) European Coordination Office. (1997). *Eurobarometre 46.0 - Les Européens et le Soleil*. Brussels.

- International Agency for Research on Cancer. (2001). *Sunscreens* (No. 5). Lyon: World Health Organisation.
- Jackson, K. M., & Aiken, L. S. (2000). A psychosocial model of sun protection and sunbathing in young women: the impact of health beliefs, attitudes, norms, and self-efficacy for sun protection. *Health Psychol*, 19(5), 469-478.
- Jerkegren, E., Sandrieser, L., Brandberg, Y., & Rosdahl, I. (1999). Sun-related behaviour and melanoma awareness among Swedish university students. *Eur J Cancer Prev*, 8(1), 27-34.
- Jones, J. L., & Leary, M. R. (1994). Effects of appearance-based admonitions against sun exposure on tanning intentions in young adults. *Health Psychol*, 13(1), 86-90.
- Karagas, M. R., Stanned, V. A., Mott, L. A., Slattery, M. J., Spencer, S. K., & Weinstock, M. A. (2002). Use of tanning devices and risk of basal cell and squamous cell skin cancers. *J Natl Cancer Inst*, 94(3), 224-226.
- Keesling, B., & Friedman, H. S. (1987). Psychosocial factors in sunbathing and sunscreen use. *Health Psychol*, 6, 477-493.
- Koblentz, C. S. (1998). The psychology of sun-exposure and tanning. *Clin Dermatol*, 16(4), 421-428.
- Koh, H. K., Bak, S. M., Geller, A. C., Mangione, T. W., Hingson, R. W., Levenson, S. M., et al. (1997). Sunbathing habits and sunscreen use among white adults: results of a national survey. *Am J Public Health*, 87(7), 1214-1217.
- Koh, H. K., & Lew, R. A. (1995). Skin Cancer: Prevention and Control. In Greenwald, Kramer & Weed (Eds.), *Cancer Prev Control* (pp. 611-640). New York: Dekker.
- Koh, H. K., Miller, D. R., Geller, A. C., Clapp, R. W., Mercer, M. B., & Lew, R. A. (1992). Who discovers melanoma? Patterns from a population-based survey. *J Am Acad Dermatol*, 26(6), 914-919.
- Korkeila, K., Suominen, S., Ahvenainen, J., Ojanlatva, A., Rautava, P., Helenius, H., et al. (2001). Non-response and related factors in a nation-wide health survey. *Eur J Epidemiol*, 17(11), 991-999.
- Leary, M. R., Saltzman, J. L., & Georgeson, J. C. (1997). Appearance motivation, obsessive-compulsive tendencies and excessive suntanning in a community sample. *J Health Psychol*, 2(4), 493-499.
- Lindelof, B., & Gabel, H. (2000). [Great risk of skin cancer in patients with transplanted organs. Sun is the most dangerous enemy]. *Lakartidningen*, 97(43), 4822-4824.
- Lowe, J. B., Borland, R., Stanton, W. R., Baade, P., White, V., & Balanda, K. P. (2000). Sun-safe behaviour among secondary school students in Australia. *Health Educ Res*, 15(3), 271-281.
- Mansson Brahme, E. (2002). *Cutaneous Malignant Melanoma - Aspects on Prognostic Factors and Time-Trends in a Swedish Population*. Karolinska Institutet, Stockholm.
- Mawn, V. B., & Fleischer, A. B., Jr. (1993). A survey of attitudes, beliefs, and behavior regarding tanning bed use, sunbathing, and sunscreen use. *J Am Acad Dermatol*, 29(6), 959-962.
- McCarthy, E. M., Ethridge, K. P., & Wagner, R. F. (1999). Beach holiday sunburn: the sunscreen paradox and gender differences. *Cutis*, 64, 37-42.
- McGee, R., & Williams, S. (1992). Adolescence and sun protection. *N Z Med J*, 105, 401-403.
- McKie, R. M. (1990). Clinical recognition of early invasive malignant melanoma. *Bri J Dermatol*, 301(3), 1005-1006.
- Melia, J., Pendry, L., Eiser, J. R., Harland, C., & Moss, S. (2000). Evaluation of primary prevention initiatives for skin cancer: a review from a U.K. perspective. *Br J Dermatol*, 143, 701-708.

- Mermelstein, R. J., & Riesenber, L. A. (1992). Changing knowledge and attitudes about skin cancer risk factors in adolescents. *Health Psychol*, *11*, 371-376.
- Miles, F., & Meehan, J. W. (1995). Visual discrimination of pigmented skin lesions. *Health Psychol*, *14*(2), 171-177.
- Miller, A. G., Ashton, W. A., McHoskey, J. W., & Gimbel, J. (1990). What price attractiveness? Stereotype and risk factors in suntanning behavior. *J Appl Social Psychol*, *20*, 1272-1300.
- Muhn, C. Y., From, L., & Glied, M. (2000). Detection of artificial changes in mole size by skin self-examination. *J Am Acad Dermatol*, *42*(5 Pt 1), 754-759.
- Nunnally, J. C. (1994). Elements of statistical description and estimation. In *Psychometric theory*. New York: McGraw-Hill.
- Nutbeam, D., & Harris, E. (1999). *Theory in a nutshell: a guide to health promotion theory*. Sydney: McGraw-Hill Australia.
- Oliveria, S. A., Christos, P. J., Halpern, A. C., Fine, J. A., Barnhill, R. L., & Berwick, M. (1999a). Evaluation of factors associated with skin self-examination. *Cancer Epidemiol Biomarkers Prev*, *8*(11), 971-978.
- Oliveria, S. A., Christos, P. J., Halpern, A. C., Fine, J. A., Barnhill, R. L., & Berwick, M. (1999b). Patient knowledge, awareness, and delay in seeking medical attention for malignant melanoma. *J Clin Epidemiol*, *52*(11), 1111-1116.
- Paul, C. L., Redman, S., & Sanson-Fisher, R. W. (2003). Print material content and design: is it relevant to effectiveness? *Health Educ Res*, *18*(2), 181-190.
- Platz, A., Ringborg, U., & Hansson, J. (2000). Hereditary cutaneous melanoma. *Sem Cancer Biol*, *10*(4), 319-326.
- Prochaska, J. O., Velicer, W. F., Rossi, J. S., Goldstein, M. G., Marcus, B. H., Rakowski, W., et al. (1994). Stages of change and decisional balance for 12 problem behaviors. *Health Psychol*, *13*(1), 39-46.
- Rhainds, M., De Guire, L., & Claveau, J. (1999). A population-based survey on the use of artificial tanning devices in the Province of Quebec, Canada. *J Am Acad Dermatol*, *40*(4), 572-576.
- Ringborg, U., & Lagerlöf, B. (1998). Maligna hudtumörer. In *Oncologi*. Stockholm: Liber.
- Robinson, J. K., Rademaker, A. W., Sylvester, J. A., & Cook, B. (1997). Summer sun exposure: knowledge, attitudes, and behaviors of Midwest adolescents. *Prev Med*, *26*(3), 364-372.
- Robinson, J. K., Rigel, D. S., & Amonette, R. A. (1997). Trends in sun exposure knowledge, attitudes, and behaviors: 1986 to 1996. *J Am Acad Dermatol*, *37*(2 Pt 1), 179-186.
- Robinson, J. K., Rigel, D. S., & Amonette, R. A. (1998). What promotes skin self-examination? *J Am Acad Dermatol*, *38*(5 Pt 1), 752-757.
- Roelands, R. (2002). The history of phototherapy: something new under the sun. *J Am Acad Dermatol*, *46*(6), 926-930.
- Sahin, S., Rao, B., Kopf, A. W., Lee, E., Rigel, D. S., Nossa, R., et al. (1997). Predicting ten-year survival of patients with primary cutaneous melanoma: corroboration of a prognostic model. *Cancer*, *80*(8), 1426-1431.
- Saraiya, M., Hall, H. I., & Uhler, R. J. (2002). Sunburn prevalence among adults in the United States, 1999. *Am J Prev Med*, *23*(2), 91-97.
- Severi, G., Cattaruzza, M. S., Baglietto, L., Boniol, M., Dore, J. F., Grivegnee, A. R., et al. (2002). Sun exposure and sun protection in young European children: an EORTC multicentric study. *Eur J Cancer*, *38*(6), 820-826.
- Severi, G., Giles, G. G., Robertson, C., Boyle, P., & Autier, P. (2000). Mortality from cutaneous melanoma: evidence for contrasting trends between populations. *Br J Cancer*, *82*(11), 1887-1891.

- Shoveller, J. A., & Lovato, C. Y. (2001). Measuring Self-reported sunburn: challenges and recommendations. *Chronic Dis Can*, 22(3/4).
- Stott, M. A. (1999). Tanning and sunburn: knowledge, attitudes and behaviour of people in Great Britain. *J Public Health Med*, 21(4), 377-384.
- Swedish Institute for Transport and Communication Analysis. (2000). *Transport and communications. Yearbook 2000/2001*. Stockholm: Swedish Institute for Transport and Communication Analysis, SIKÅ.
- Swerdlow, A. J., & Weinstock, M. A. (1998). Do tanning lamps cause melanoma? An epidemiologic assessment. *J Am Acad Dermatol*, 38(1), 89-98.
- Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics*. Boston: Allyn & Bacon.
- The National Board of Health and Welfare. (2001). *Malignt hudmelanom - State of the Art*. Stockholm.
- The National Board of Health and Welfare. (2002a). *Cancer incidence in Sweden 2000*. Stockholm.
- The National Board of Health and Welfare. (2002b). *Causes of death 2000*. Stockholm.
- The National Board of Health and Welfare. (2003). *Cancer incidence in Sweden 2001*. Stockholm.
- The Swedish Radiation Protection Authority. (1998). *Regulatory Code concerning Sunbeds*. Stockholm.
- Thorn, M., Ponten, F., Bergstrom, R., Sparen, P., & Adami, H. O. (1994). Trends in tumour characteristics and survival of malignant melanoma 1960-84: a population-based study in Sweden. *Br J Cancer*, 70(4), 743-748.
- Titus-Ernstoff, L., Thorn, M., Tosteson, T. D., Brahme, E. M., Yuen, J., Baron, J. A., et al. (1996). The accuracy of skin self-examination for atypical nevi. *Epidemiol*, 7(6), 619-623.
- Turrisi, R., Hillhouse, J., Gebert, C., & Grimes, J. (1999). Examination of cognitive variables relevant to sunscreen use. *J Behav Med*, 22(5), 493-509.
- Vail-Smith, K., & Felts, W. M. (1993). Sunbathing: college students' knowledge, attitudes, and perceptions of risks. *College Health*, 42, 21-26.
- Van Loon, A. J., Tijhuis, M., Picavet, H. S., Surtees, P. G., & Ormel, J. (2003). Survey Non-response in the Netherlands. Effects on Prevalence Estimates and Associations. *Ann Epidemiol*, 13(2), 105-110.
- Wang, S. Q., Setlow, R., Berwick, M., Polsky, D., Marghoob, A. A., Kopf, A. W., et al. (2001). Ultraviolet A and melanoma: a review. *J Am Acad Dermatol*, 44(5), 837-846.
- Weinstock, M. A. (2000). Early detection of melanoma. *JAMA*, 284(7), 886-889.
- Weinstock, M. A., Martin, R. A., Risica, P. M., Berwick, M., Lasater, T., Rakowski, W., et al. (1999). Thorough skin examination for the early detection of melanoma. *Am J Prev Med*, 17(3), 169-175.
- Westerdahl, J., Ingvar, C., Masback, A., Jonsson, N., & Olsson, H. (2000). Risk of cutaneous malignant melanoma in relation to use of sunbeds: further evidence for UV-A carcinogenicity. *Br J Cancer*, 82(9), 1593-1599.
- Westerdahl, J., Ingvar, C., Masback, A., & Olsson, H. (2000). Sunscreen use and malignant melanoma. *Int J Cancer*, 87(1), 145-150.
- Wharton, J. R., & Cockerell, C. J. (1998). The sun: a Friend and Enemy. *Clin Dermatol*, 16, 415-419.
- Wichstrøm, L. (1994). Predictors of Norwegian adolescents' sunbathing and use of sunscreen. *Health Psychol*, 13, 412-420.
- Østerlind, A. (1992). Epidemiology on malignant melanoma in Europe. *Acta Oncologica*, 31(8), 903-908.