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SKIN CANCER PREVENTION

Readiness to change sun-related behaviours

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Sun is bad for you! Everything our parents said was good is bad. Sun, milk, red meat, college … (Alvy in Annie Hall)

Woody Allen and Marshall Brickman

ABSTRACT

The general aim of this thesis was to collect data relevant for skin cancer prevention and to investigate the applicability of the Transtheoretical Model for sun-related behaviour. Also, to assess the readiness to change five different sun-related behaviours in the general population in Stockholm County.

The Transtheoretical Model postulates that behaviour change is not an event but a process that involves a movement through series of stages. Five stages of change have been identified: precontemplation (not thinking of changing), contemplation (considering change), preparation (committed to change), action (initiated a change), and maintenance (sustaining change).

Five populations were investigated using questionnaires: (1) 742 visitors to mobile screening units and 202 beachgoers, age range 18 to 96, (2) 184 students in Stockholm County aged 13 to 14, (3) 52 female nurses attending a course at the Karolinska Institute, (4) a random sample of 1,200 adolescents in Stockholm County aged 18 years, (5) and a random sample of 10,000 residents in Stockholm County aged 13 - 50.

Using sunscreen appeared to be the main sun-protection behaviour for men and women in all age groups in Sweden. However, the present data indicated that sunscreens may be used to extend sun exposure and almost half of the population did not know what the sun protection factor on sunscreen containers indicates. Approximately four out of ten adolescents and three out of ten adults were using no other sun-protection than sunscreen. A majority was in the pre-action stages of change for most sun-related behaviours. A large majority of both adolescents and adults were in the precontemplation stage for avoiding the sun between 11.a.m. and 3 p.m. and giving up sunbathing. Attitudes towards sun exposure had the strongest association with the readiness to change sun-related behaviours. The relations between the stages of change and two other major constructs of the Transtheoretical Model, processes of change and decisional balance, were consistent with data on other health behaviours.

The results suggest that the recommendation to use sunscreen as sun protection needs to be re-evaluated. Motivational efforts to affect both attitudes towards tanning and sun exposure may lead to improved sun-related behaviour. Efforts to increase knowledge of UVR exposure and sun-protection behaviour may be important for those in the precontemplation stage. The results in this thesis give support for the single-item algorithm method to measure the stages of change and using the Transtheoretical Model in the attempt to change sun-related behaviours. The model can provide a more sensitive assessment of the effect of interventions. Progress, e.g. from one stage to the next, is not noted by conventional outcome measures. This provides an added dimension where motivational change due to interventions may be registered.

Key words: Skin cancer, prevention, sun protection, sunscreen, sun exposure, stages of change, Transtheoretical Model, behavioural change.

CONTENTS

LIST OF PUBLICATIONS

The thesis is based on the following papers, referred to by their Roman numerals:

I. Kristjánsson S, Helgason ÁR, Rosdahl I, Holm L-E, & Ullén H. Readiness to change sun-protective behaviour. *European Journal of Cancer Prevention,* 2001, **10**, 289-96.

II. Kristjánsson S, Helgason ÁR, Månsson-Brahme E, Widlund-Ivarson B & Ullén H. "You and Your Skin": a short-duration presentation of skin cancer prevention for teenagers. *Health Education Research*, 2003, **18** *(*1*),* 88-97.

III. Bränström R, Kristjánsson S, Ullén H & Brandberg Y. Stability of questionnaire items measuring behaviors, attitudes, and stages of change related to sun exposure. *Melanoma Research,* 2002*,* **12**, 513-519

IV. Kristjánsson S, Bränström R, Ullén H & Helgason ÁR. Transtheoretical model: investigation of adolescents' sunbathing behaviour. *European Journal of Cancer Prevention,* 2003*,* **12,** 501-508.

V. Kristjánsson S, Ullén H & Helgason ÁR. The importance of assessing the readiness to change sun-related behaviours: A population based study. (Manuscript).

LIST OF ABBREVIATIONS

A	Action
ANOVA	Analysis of variance
BCC	Basal cell carcinoma
C	Contemplation
HBM	Health Belief Model
M	Maintenance
MM	Malignant melanoma
MANOVA	Multivariate analysis of variance
OR	Odds Ratio
P	Preparation
PC	Precontemplation
SCC	Squamous cell carcinoma
SPF	Sun protection factor
TPB	Theory of Planned Behaviour
TSD	Tukey's Honest Significant Difference
TRA	Theory of Reasoned Action
TTM	Transtheoretical Model
UVA	Ultraviolet A radiation
UVB	Ultraviolet B radiation
UVR	Ultraviolet radiation
WHO	World Health Organisation

1 HEALTH BEHAVIOUR CHANGE

Health promotion has been defined as “the science and art of helping people choose their lifestyle to move toward a state of optimal health”[1]. Lifestyle change can be enhanced by increasing awareness of risk factors, changing behaviour and creating environments that support health. Preventive health behaviour is the action people take that they believe is healthy for them, and prevents a disease or the development of a disease.

1.1 MODELS AND THEORIES OF BEHAVIOURAL CHANGE

It can be argued that all research proceeds from theory whether stated or not, because certain attributes are examined and others are not. The purpose of theory in health promotion is to unravel and simplify the complexities of nature in order to understand and explain why people act or do not act to maintain and/or promote health. Theory has been defined as "a set of interrelated constructs (concepts), definitions, and propositions that presents a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting the phenomena" [2]. After the adaptation and development of concepts within a specific theory they become constructs, which are the building blocks of that particular theory. They are usually only understood in the context of that theory. To be in a particular “stage of change” for specific health-related behaviour is an example of a construct from the Transtheoretical Model and can be understood only within the context of that model. Variables are the operational forms and empirical counterparts of constructs. Variables specify what is to be measured, for example, in the evaluation of a theory-based program [3].

Health behaviours and what influences the individual’s choice are far too multifaceted to be explained and predicted by a single unified theory. Models may include a number of theories or constructs in an attempt to understand health behaviour. Four of the most widely used theories or models of individual health behaviour change are the Health Belief Model, Social Cognitive Theory, Theory of Reasoned Action/Planned Behavior and the Transtheoretical Model. The latter is the main focus of this thesis [3]. As theories and models define what to measure, they will be presented by explaining their major constructs.

1.2 TRANSTHEORETICAL MODEL

The Transtheoretical Model (TTM) is a general model of behavioural change. It is a model of intentional change and focuses on the decision making of the individual. The model was developed by James Prochaska and Carlo DiClemente, in the early 80ies, through empirical analysis of people in smoking cessation with and without professional help. Participants reported that they used different strategies (processes) at different time (stages) in their attempt to stop smoking [4]. One of the

advantages of the TTM is that it postulates that the change process takes time and involves progress through a series of stages that characterise different degrees of readiness to change. Other behavioural models tend to ignore this phenomena [5]. Substantial evidence has been gathered regarding the usefulness of the TTM in predicting change in a broad range of health behaviours and in guiding the development of preventive interventions [6-11]. However, few studies on the model's applications to sun-related behaviours have been published [12-15].

The model postulates that people in different stages of change need different interventions to progress in their behaviour change [16]. Health promoters have been developing tailored interventions by matching messages to the individuals readiness to change [16, 17]. During the past decade, there has been a large increase in the use and evaluation of stage-matched interventions for changing a variety of health behaviours [17]. Stage-matched interventions have been more successful inciting behaviour change than other interventions in a broad field of health behaviours, including smoking cessation, increased fruit and vegetable consumption, reduced fat consumption, physical activity, condom adoption and

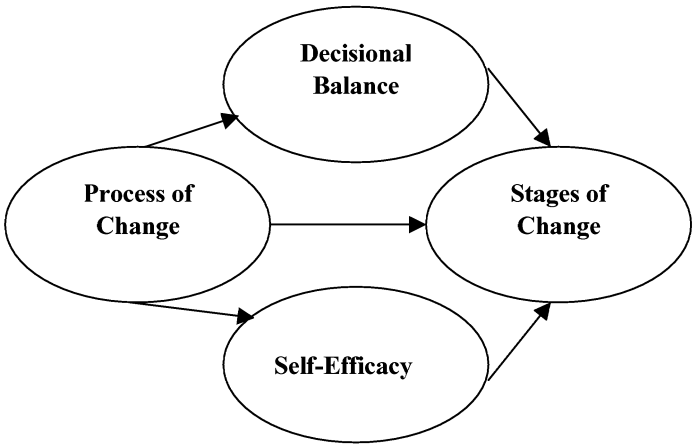

Figure 1. The relation of the main constructs of the TTM

adherence to mammography screening [7, 18-22]. One stage-matched intervention for changing sun-related behaviour reported a increase in both sun protection behaviours and a progression in the stages of change for sunscreen use and reducing unprotected sun exposure [12].

The TTM's four main constructs are: (1) stage of change, (2) processes of change, (3) decisional balance, and (4) self-efficacy [23]. Process of change has both direct and indirect relations to decisional balance, self-efficacy and stages of change. In addition, self-efficacy and decisional balance have a direct effect on the stages of change. The relations of the constructs are illustrated in Figure 1. In the following section the core constructs of the TTM will be discussed together with some of the critical assumptions that

are the fundamental to the model.

1.2.1 Stages of change

The stage of change is the central construct of the TTM. The TTM presumes that behaviour change, for most people, occurs gradually through five different stages, ranging from being unaware or unwilling to make a change (precontemplation) to attempting to maintain a behaviour change. Relapse is almost unavoidable and is a part of the process of establishing a life-long change [16]. The stages are both stable and dynamic, i.e. they can be constant over a longer period but are still open to change.

Precontemplation is a stage where individuals have no intention to stop an unhealthy behaviour or start a healthy one in the near future, usually within 6 months. Individuals in this stage are not thinking of changing their behaviour for many possible reasons. They may not be aware of the risks or they may be unwilling to admit that their behaviour involves a risk. In this stage individuals often defend their behaviour and avoid information about risk. People in this stage are not ready for change and traditional health promotion actions are usually not matched to their needs [5]. Motivational and awareness enhancement are procedures necessary to help people in this stage to consider a behaviour change [24]. Awareness of personal risk behaviour is supposed to be especially important in assisting individuals to move from precontemplation over to the contemplation stage [23].

Contemplation is the stage in which people are considering a behavioural change but have not yet made a commitment. Contemplators weigh the positive aspects (pros) and the negative aspects (cons) of changing their behaviour. They are aware of the pros of changing their behaviour but are also conscious of the cons of changing. In this stage individuals are often unconvinced of the necessity of changing their behaviour. The pros and cons of change are equally important to them, and this can result in people being stuck in this stage for long time [24]. People in this stage are not ready for action-oriented interventions and need assistance in making a commitment to change a risk behaviour or begin a healthy one [5]. The goal is to assist the contemplators to think about the risks of their behaviour and potential benefits of change. The goal is to tip the decisional balance in favour to change. When this happens they will make a commitment and move to the next stage [25].

Preparation is the stage in which people have made decisions to change their behaviour within a given period (usually within 30 days). Individuals in this stage have a concrete plan for action such as joining an exercise club, buying health education books, or signing up for smoking cessation course. People in the preparation stage are the ones that are ready for action-oriented interventions [24].

Action is the stage where people have changed their behaviour within the past 6 months. It is the period during which the greatest commitment of time and energy is required when changing a behaviour.[24]. Relapse is common in this stage. People in this stage weigh the pros of changing higher then the cons [13]. However, they may need help or support, e.g. to increase their self-efficacy.

Maintenance is the final stage in the change process. People are defined as being in the maintenance stage after sustaining the behaviour change for at least 6 months [16]. In this stage people work for sustaining their new behaviour by strengthening their commitment. Traditional behaviour models may see this stage as a final victory and that a successful behaviour change has been accomplished. However, the TTM views the struggle for behaviour change as a life-long battle that can vary in intensity depending on the environment and the emotional state of the individual [25].

1.2.2 Processes of change

The process of change is the second major dimension of the TTM and tells us how people move between stages. These processes represent internal and external experiences and activities that people use to progress through the stages. These processes derive from several theories and are the transtheoretical element of the TTM. When individuals change their behaviour they use different processes depending on the stage they are in [16]. An understanding of the relationship of the processes of change and stages of change is important in the development of successful intervention programs. Such intervention is appropriate not only for people who are ready to change a problem behaviour but also for the vast majority of people who are neither prepared nor motivated to change.
Studies from a range of behaviours have shown that the 10 processes can be organised into two higher order factors, i.e. five cognitive-affective and five behavioural processes (Table 1) [26].

1.2.2.1 Cognitive-affective processes

Consciousness raising involves seeking information and increasing awareness of the risk behaviour in question, e.g. facts about and consequences of the problem behaviour. It can involve considering the benefits and disadvantages of the safer behavioural alternatives. Campaigns in the media or sending brochures to peoples home may enhance this process.
An example in skin cancer prevention: Information campaigns about the risks of sun exposure and effective sun-protection strategies using brochures and advertising in television, radio and magazines.

Dramatic relief primarily produces increased emotional experiences such as anxiety or fear followed by reduced affect if appropriate action can be taken. For example, to be exposed to the consequences of a problem behaviour and then realise a solution. Interventions may include personal

testimonies, grieving, and media campaigns.
An example in skin cancer prevention: Interviews with skin cancer patients and/or relatives to living or dead cancer patients. Exposing pictures of skin cancer lesions.

Table 1. The Processes of Change and Measurement Items for Sun-related behaviour

Cognitive-affective processes	**Example of measurement items**
Consciousness raising	I seek information regarding the sun and sun protection.
Dramatic relief	I get upset when I read articles on the health risks of sunbathing.
Environmental revaluation	I think that I would be a better role model for others if I didn't sunbathe.
Self-revaluation	I have reflected that if I'm careful in the sun I will be both a happier and healthier person.
Social liberation	I have noticed more and more people avoid being in the sun too long.
Behavioural processes	
Counter conditioning	When it is warm and sunny I sit in the shade instead of in the sun.
Helping relationship	My friends remind me not to stay in the sun too long.
Reinforcement management	I notice that I feel better if I don't sunbathe.
Self-liberation	I tell myself that I don't have to sunbathe if I don't want to.
Stimulus control	I listen to weather reports so I can prepare for a sunny day.

Environmental revaluation involves both emotional and cognitive evaluation of how the presence or absence of a behaviour affects one's social surroundings. It may also include being aware that one can serve as a role model for others. For example, parents who smoke cigarettes in front of their children and start to contemplate quitting. Interventions can include documentaries and family and workplace interventions.

An example in skin cancer prevention: Increasing the responsibility of parents by pointing out that they are role models to their children. Initiating thoughts about their sun-exposing behaviour and/or their sun-protection behaviour.

Self-revaluation contains both cognitive and emotional assessments of how one's self-image fits with changing or not changing the problem behaviour. For example, thoughts and feelings about oneself as an alcohol abuser. Interventions may include clarification of values, healthy role models, and metaphors.
An example in skin cancer prevention: Exposing an image of vain sunbathing fanatics and/or an image of a health behaviour alternative for UVR overexposure.

Social liberation calls for increased social opportunities to engage in alternatives to the problem behaviour. People are encouraged to view change as possible and to acknowledge feasible alternatives as well as noticing changing norms in society. For example, it may be observed that a ban on smoking in some environments does not seem to generate many objections from people.
An example in skin cancer prevention: Placing parasols at the beach and providing shade in parks. Highlighting that norms are changing in the society regarding sun protection and intentional tanning. Promoting alternative activities to sunbathing, e.g. for people vacationing at a sunny seaside resort.

1.2.2.2 Behavioural processes

Counter conditioning strengthens the learning of a healthy behaviour that is an alternative to the problem behaviour. Nicotine replacement can be a substitute for cigarettes. You can eat a gourmet meal instead of drinking alcohol.
An example in skin cancer prevention: Encouraging people to engage in indoor activities between 11 a.m. and 3 a.m. or to enjoy the shade of a tree while reading a good book.

Helping relationship unites sincerity and acceptance as well as support for the healthy behaviour change. Group agreements and "buddy" systems can form the basis of social support. For example, when colleagues at a workplace decide to quit smoking together.
An example in skin cancer prevention: Encourage adolescents to engage in group activities that do not include a risk for overexposure of UVR.

Reinforcement management provides consequences for an action toward a healthier behaviour. This includes the investigation and use of rewards that can be of physical, psychological or social nature. Positive and negative reinforcement may both be appropriate means to increase the probability of repeated healthier behaviour. For example, buying a CD as a reward for

refraining from smoking for a week will increase the likelihood of continued non-smoking behaviour.
An example in skin cancer prevention: Pointing out how nice and rewarding it is to move out of the sun and stay in the shade.

Self-liberation includes a belief that one can change and be committed and recommitted to change. Examples of this process are New Year resolutions and public testimonies.
An example in skin cancer prevention: Emphasise several different strategies to protect oneself against UVR to help people make commitment. Encourage people to make their commitments public.

Stimulus control involves adding cues for healthy alternatives and disposing of cues for unhealthy behaviour. Rearranging the environment can provide stimuli that can incite or sustain a behaviour change. Placing an exercise bicycle at the workplace can stimulate exercise behaviour. Avoiding drinking coffee can help people to resist smoking a cigarette.
An example in skin cancer prevention: Putting up posters at the beach showing recommended sun-related behaviours. Presenting the UV-index in weather reports in television and newspapers. Providing sun protection cues in the form of caps, t-shirts, or magnets that can be placed on the refrigerator.

Table 2. Processes of change across stages of change.

Stage of Change	Processes of Change
Precontemplation/ Contemplation	Consciousness Raising
	Dramatic Relief
	Environmental re-evaluation
	Self-re-evaluation
Preparation	Self- Liberation
Action/Maintenance	Helping relationships
	Social Liberation
	Stimulus Control
	Counter conditioning
	Reinforcement Management

These ten processes have been repeatedly identified across different behaviours, and evidence from cross-sectional and longitudinal studies shows that individuals use these 10 processes depending on the stage they are in [10]. The usual pattern is that cognitive process are used more in the pre-action stages and behavioural processes are more commonly used in the action/ maintenance stages (Table 2) [16].

Study of adolescents' sunbathing behaviour, included in the present thesis, showed a similar pattern, i.e. that cognitive processes peaked in the

preparation stage and the behavioural processes peaked in the action stage [27]. This suggests that a movement from precontemplation to contemplation/preparation stages requires increased use of cognitive-affective processes of change. Furthermore, movement from contemplation/preparation stages to action includes using behavioural processes.

1.2.3 Decisional balance

The decisional balance construct, derived from Janis and Mann's model of decision making, involves weighing the importance of the pros and cons of a behavioural change [10, 28]. Decisional balance is a valuable predictor in the progress of stages of change. Prochaska and colleagues studied the relation between decisional balance and stages of change behaviours for 12 different problem behaviours. The results showed highly predictable patterns where the cons of behaviour change outweighed the pros for individuals in the precontemplation stage and the pros begin to outweigh the cons in the contemplation or preparation stage. For those who were in the action stage, the pros outweighed the cons [13]. This association pattern between the stages and pros and cons was also seen in the study of adolescents' sunbathing behaviour included in this thesis [27]. This suggests that a progression from precontemplation to contemplation is associated with an increase in the pros. Furthermore, interventions aimed at increasing the pros of changing as well as decreasing the cons will lead to movement from contemplation to action.

1.2.4 Self-efficacy

The self-efficacy construct was adapted from Social Cognitive Theory (SCT) [5]. Self-efficacy has been measured among people in different stages of change. It seems to be an important predictor of which individuals are able to sustain the action necessary to maintain the behaviour change over time [29]. Self-efficacy is lowest in the precontemplation stage and highest in the action/maintenance stages [30, 31]. Strategies to increase self-efficacy are described in the section about SCT below.

1.2.5 Summary

The TTM presents an alternative way to think about behavioural change and to develop public health interventions. Most traditional models or theories assume that the same intervention may fit the whole population. The TTM postulates that interventions should be matched to the individual's readiness to change. The matching may begin at the stages of change level and then proceed by matching the other constructs of the model such as decisional balance, self-efficacy and processes of change. The TTM suggests that health promotion programs should involve different interventions aiming to enhance progression in the change process: for example, movement from precontemplation to contemplation, from contemplation to preparation, from preparation to action and from action to

maintenance. These different interventions should involve those constructs of the model that have been found important for the particular stage transition. In the planning of a health promotion program it is important to assess the stages of change distribution in the population where the interventions are to take place. This can help the health promoters to optimally distribute their resources.

1.3 HEALTH BELIEF MODEL

The Health Belief Model (HBM) is one of the most commonly used models in research on health behaviour, health promotion and education [32]. The HBM attempts to explain and predict preventive health behaviour. The model postulates that the motivation to perform a health behaviour is an interaction between health beliefs [32]. The major elements of the Health Belief Model are shown in Figure 2.

Perceived susceptibility is the individual's subjective perception of the likelihood of contracting a specific disease. Individuals vary in their perception of susceptibility to a disease or condition. The range is from those who deny the possibility of contracting a given disease to those who feel there is real danger that they will catch the disease [32].

Perceived severity is the measure of the individual's feelings concerning the seriousness of developing a given disease. The individual may consider the problems that a disease would result in, i.e. pain and discomfort, financial burdens and social restrictions. Susceptibility and severity have been categorised together as *perceived threat* [32].

Perceived benefits of taking preventative action is the next step to expect after an individual has accepted being susceptible to a disease and has recognised its seriousness. This means that individuals who have optimal beliefs regarding both susceptibility and severity of a disease are not likely to comply with any recommended health actions unless they believe that the action is potentially effective for preventing the disease [32].

Perceived barriers refers to the individual's perception of the negative aspects of particular action, i.e. pain, inconvenience or financial burden. This means that action may not take place, although an individual may believe that the benefits of acting are effective. This component of the HBM has been shown to be the most predictive compared with the other components of the model [32].

*Cues to action***.** Individuals are ready for action when the perception of the levels of susceptibility and seriousness provide enough force to act and the perceived benefits are optimal. However, it may require a 'cue to action' for the desired behaviour to occur. These cues may be internal or external, e.g. media publicity or personal experience [32, 33].

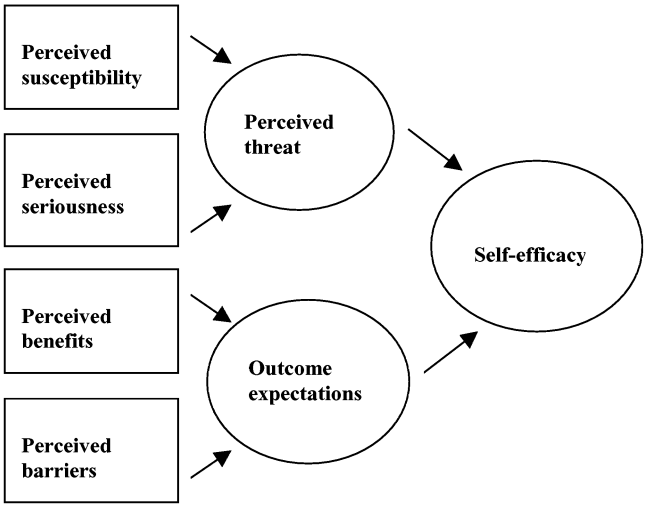

Figure 2. Health Behaviour Model (Adapted from Nutbeam and Harris, 1999)

The HBM postulates that the perceived threat is influenced by how interested and concerned an individual is regarding health, specific beliefs about vulnerability for the given health threat and beliefs about the consequences of the health problem. If an individual perceives a threat to his health and is simultaneously cued to action, and perceives that the benefits outweigh the perceived barriers, then that individual is most likely to undertake the recommended preventive health action. Variables such as demographics, socio-psychological factors, e.g. attitude and knowledge, and structural aspects, e.g. what situation people are in, can influence the individual's decision [32, 33].

Self-efficacy "refers to beliefs in one's capabilities to organise and execute the course of action required to produce given attainments" [34]. Self-efficacy was not incorporated into the HBM in the beginning perhaps because the model was most frequently used to explain simple behaviour such as accepting screening or immunisation [32]. The importance of the self-efficacy construct grew when the model became more frequently used by practitioners challenged with changing lifestyles that required changing long-established habits such as eating, drinking, smoking and exercising [35].

The HBM has been repeatedly used in research and the development of skin cancer interventions [36, 37]. Results of the predictability of the HBM constructs in sun-related behaviour have been complex. Perceived susceptibility to both skin cancer and ageing have been shown to have a strong relation, no relation or negative relation to intention [37-41]. Perceived severity has been shown to have, strong, weak or no association to the intention to sunbathe or engage in sun-protection behaviours, while perceived benefits have a strong relation [42-45]. However, regarding

young women, both sun protection and sunbathing behaviour could be predicted from social norms [40, 43]. Perceived barriers have been shown to have a strong negative relation with the intention to use sun protection [36, 45].

1.4 SOCIAL COGNITIVE THEORY

Social Cognitive Theory (SCT), previously called Social Learning Theory, addresses both the psychosocial dynamics affecting health behaviour and the methods that may be used to promote behavioural change. The theory explains human behaviour in terms of triadic, dynamic, and reciprocal interaction of personal factors, behaviour and the environment [46]. The SCT emphasis the mind's active roll in constructing one's reality, selectively encoding information, performing behaviour on the basis of values and expectations, and imposing structure on its own actions [46]. According to the SCT, people perform behaviours when they are confident they can and that the behaviour will produce desired consequences. In terms of the theory, confidence and consequences are represented by the constructs of self-efficacy and outcome expectancy, respectively

According to the SCT the environment and people have a subtle and complex relation. For example, if someone who normally likes to sunbathe is surrounded by people who do not sunbathe then there is a likelihood that the individual will modify his behaviour. The non-sunbathers have influenced the sunbather's perceptions of the situation through social influence. This has been called *reciprocal determinism*, which means that behaviour and environment have a constant interaction, i.e. can influence each other [33].

Three cognitive factors have been identified as important when endorsing health behaviour through interventions. *Observational learning,* or the ability to learn by observing others performing certain behaviours and being rewarded for it, is the basis mechanism of peer influence and social norms on health behaviour, i.e. sun-protection. This highlights the position and potential of significant others (e.g. parents, friends and celebrities) in behaviour modification, e.g. children copy their parents and teenagers will imitate their idols' behaviour.

Outcome expectancy refers to the ability to predict and appreciate the consequences of different behaviour. This stresses the need for taking into account the personal beliefs and motivations for behaviour in question and the importance of short-term and real effects of behaviour or negative consequences of behaviour or behaviour change. For example, young girls' sun-protection behaviour may respond more to messages about sun-induced damage to facial skin than risks of developing skin cancer in the future.

Self-efficacy is defined in the discussion of the HBM. It is considered the most important construct in SCT. Those who are more efficacious will try new behaviours more often, expend more effort on those behaviours, and persevere longer when they encounter challenges, than those who are less efficacious [34]. Self-efficacy is strengthened when people successfully perform a behaviour, observe others successfully perform the behaviour, and/or receive positive verbal statements from competent others. Therefore, when health promoters are trying to increase peoples self-efficacy, it is important to divide the behaviour into small steps in order to increase the chances of attaining the final goal [46].

The SCT has been utilised in skin cancer prevention [47, 48]. The self-efficacy construct has been shown to have a major effect on both sun-protection and sun-exposing behaviour [48]. However, outcome expectancy has been shown to be a less important construct for sun-related behaviour [48]. The importance of significant others as roll models for sun-protection behaviours for children has been reported from several studies [48-51].

1.5 THEORY OF REASONED ACTION / PLANNED BEHAVIOUR

The Theory of Reasoned Action (TRA) that explains and predicts a volitional behaviour was developed by Martin Fishbein and Icek Ajzen. The TRA proposes that most important determinant of behaviour is the individual's *behavioural intention* [52]. The individual's intention is influenced by two factors, i.e. *attitudes* and *subjective norms*. The individual's attitude toward the behaviour is affected by his/her behavioural beliefs and evaluations of behavioural outcome. The subjective norm is based on the individual's beliefs about how significant others think he or she should act (*normative beliefs*) and the degree of motivation to comply with these beliefs [53].

In the development of the Theory of Planned Behaviour (TPB) Ajzen and colleagues added a third factor by including factors outside of people's control that may affect intention and behaviour [52]. Figure 3 shows the main constructs of the TPB. The major difference between the TRA and TPB is the addition of a third determinant of behavioural intention namely *perceived behavioural control*. Perceived Behavioural control refers to the individual's perception of his/her control over the behaviour. (*Control Beliefs and Perceived Power*).

Perceived behavioural control indicates that a person's motivation is influenced by how difficult the behaviours are judged to be, as well as the perception of the individual's ability to perform the activity. If people possess strong control beliefs about the existence of factors that will facilitate a given behaviour, they will have a high-perceived level of control over the behaviour. On the other hand, people will have low perception of control if they hold strong control beliefs that hinder the behaviour.

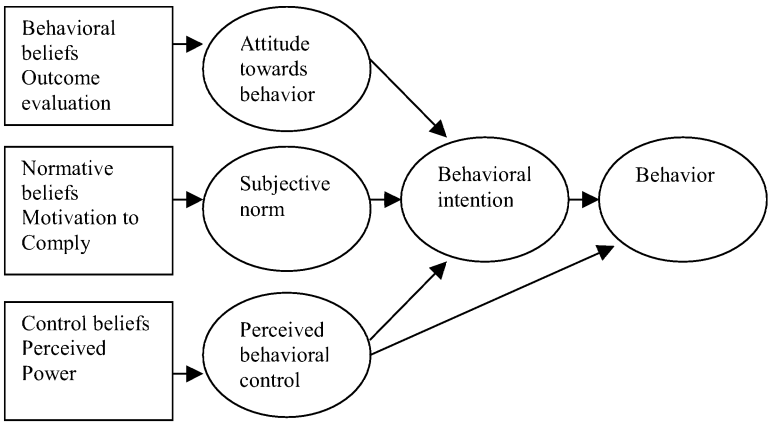

Figure 3. Theory of Planned Behaviour (Adapted from Nutbeam and Harris, 1999)

The TPB has been used as a framework for gathering data for developing interventions to decrease sun exposure in a Swedish population. Three of the major constructs, i.e. attitude, subjective norm and perceived behavioural control have been seen to be related to sun-related behaviours [54]. Several studies have reported an association between attitude and sun exposure and sun-protection behaviours [43, 55-59].

1.6 DISCUSSION

Population interventions or campaigns, designed to enhance a lifestyle change to prevent a disease, depend on health promoters assembling the most appropriate theory and strategies for a given task [3]. No theoretical framework predominates in the field of health promotion or prevention. A theory may be appropriate for one situation but not for another. For example, the HBM may not be the best framework for cigarette cessation because the difference of perceived threat between those who smoke and those that have quit or never smoked is minimal. This may mean that the central construct of the HBM is not appropriate in smoking research [3]. This may also be true for sun-related behaviour.

The theories mentioned above often overlap. It is also evident that more than one theory may be needed in the development or evaluation of an intervention. This is especially true for extensive health promotion programs. The challenge for health promoters is to learn to analyse which theory or model is the most appropriate for the health behaviour they are dealing with. Understanding the most commonly used theories and how they have been applied is valuable for both researchers and health promoters. A theoretical framework may facilitate the enhancement of practical skills and technologies that will increase the probability of a successful intervention. It can provide the basis for critical assessment of what has been, and what has not been, accomplished in the intervention.

Theories and models have their weak and strong points. The construct of perceived barriers has been considered to be the strongest single predictor in the HBM, and perceived severity the weakest, across a variety of studies and behaviours [32]. The greatest value of the TPB may be in the examination of why people behave in the way they do, i.e. which factors influence health behaviour. For example, positive attitudes, perceived control and positive subjective norms have been shown to predict intention to exercise and sun-related behaviour [54, 60, 61].

The TTM's strength lies in demonstrating the importance of matching interventions to people's needs and situations instead of assuming that all individuals need the same intervention. Assessing readiness to change helps setting realistic goals, i.e. progression to the next stage of change. In addition, the model provides advantages in health promotion by focusing on the change process. The TTM can provide a more sensitive assessment of effects of an intervention. Progress, e.g. from one stage to the next, is not noted by conventional outcome measures. This provides an added dimension whereby motivational change due to interventions may be registered. Finally, the TTM can incorporate behaviour-specific variables. For sun-related behaviour, such variables might be skin type and heredity or a family history of skin cancer.

2 CANCER AND UVR EXPOSURE

2.1 CANCER PREVENTION

The global burden of cancer is enormous and is still increasing. In the year 2000 more than 10 million new cases were diagnosed, 6 million deaths were registered and 22 million persons were living with cancer (excluding non-melanoma skin cancers). It is predicted that the number of new cancer cases in the world will rise to 12.3 million in the year 2010 [62].

In the year 2002, nearly 40,000 new cancer patients were diagnosed in Sweden. Approximately 20,000 people die every year of cancer, thus making cancer the second most common cause of death in Sweden. [63]. Epidemiological evidence indicates that a large fraction of cancer mortality and morbidity can be prevented by health promotion aiming at changing lifestyles and screening activities [64].

Cancer prevention activities include validating new primary and/or secondary prevention methods and promoting the diversity of proven cancer control methods. A further activity is monitoring eventual changes that might be occurring in the population because of interventions or prevention programs. Public health initiatives may reduce both the incidence and mortality of cancers [65-68]. Cancer prevention is usually divided into three levels where preventive efforts can be effective, i.e. primary, secondary and tertiary prevention (Figure 4).

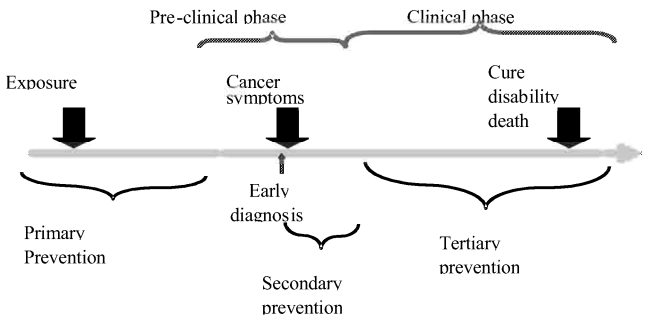

Figure 4. Cancer Prevention Strategies
(From Storm, AH and Olsen, J, 2002)

Aims of primary prevention are to identify risk factors for the onset and development of diseases and reduce or eliminate them. Health promotion programs are often at the primary prevention level and involve behavioural researchers in increasing knowledge, changing attitudes and health behaviour in specific groups or in the general population. In secondary prevention, the goal is to detect the disease process at an early stage with

the purpose of starting early intervention or prevention initiatives and improving the long-term prognosis of the disease. Tertiary prevention occurs when the disease has been diagnosed. It not only focuses on preventing the condition from deteriorating but also on making it possible for the patient to recover physically and mentally so that he/she can return to as a great a degree of social functioning as is possible [69].

2.2 SKIN CANCER

Skin cancer, including malignant melanoma (MM), squamous cell carcinoma (SCC) and basal cell carcinoma (BCC) is the most frequent cancer among white-skinned people world-wide as well as in Sweden [62-64, 70]. The incidence of non-melanoma skin cancer in the Swedish cancer register mainly refers to SCC as BCC is excluded. Therefore, in this thesis non-melanoma means mainly SCC. The incidence is higher in people with fair and sensitive skin than in people with darker and less sensitive skin [71]. Both intermittent and accumulative sun exposures are related to skin cancer. For MM and BCC intermittent sun exposure is more important, and for SCC it is accumulative sun exposure that is most relevant [71]. It has been estimated that 80 per cent of all skin cancer is caused by ultraviolet radiation (UVR) from the sun [72, 73]. In the year 2002 a total of 2,767 men and 2,132 women were registered as having skin cancer (excluding BCC) [63].

2.2.1 Melanoma

MM is the most severe form of skin cancer. It is estimated that world-wide a total 133,000 new cases were diagnosed in the year 2000 [64]. Intermittent or acute intensive sun exposure (usually measured as sunburn) is thought to be a more important risk factor for MM than total sun exposure [71, 74-76].

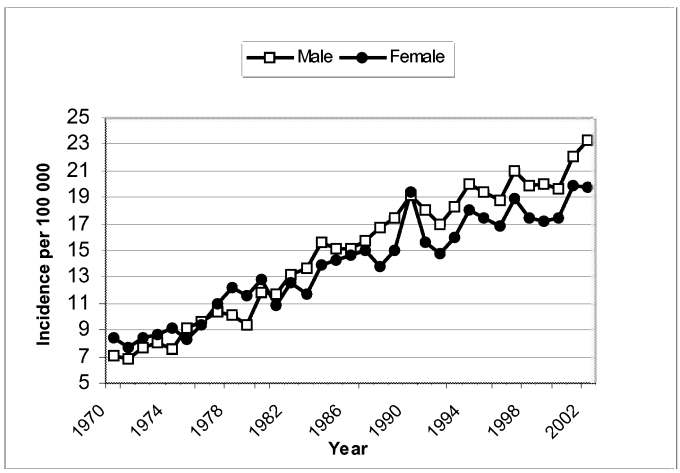

Figure 5. Age-standardised incidence of cutaneous malign melanoma Sweden from 1970 –2002 (using the population of Sweden year 2000) (The National Board of Health and Welfare, 2003)

Childhood sun exposure is important in determining the risk of developing MM [77]. Other known risk factors are large numbers of common nevi, presence of dysplastic nevi, poor tanning ability, MM in the family and a history of non-melanoma skin cancers [78-80].

In Sweden, MM has been increasing 2.3 per cent for men and 2.0 per cent for women during the period 1982-2002. It is one of the most rapidly increasing malignant tumours in Sweden [63]. There have been some indications that incidence and mortality of MM in both sexes in Stockholm and Sweden are levelling off during the 1990s [81-84]. However, between the years 2000 and 2002, the increase of new cases was greater than in recent years or from 803 to 971 for men and 824 to 930 for women. The age- standardised incidence per 100,000 increased between 2000 and 2002 from 19.6 to 23.3 for men and 17.5 to 19.7 for women (Figure 5). The incidence in Stockholm County increased from 21.8 to 24.6 for men and 15.5 to 17.3 for women [63].

2.2.2 Squamous cell carcinoma

No figures are available regarding the world incidence or mortality of non-melanoma skin cancer because of the difficulties of measurement and insufficient data [85]. Non-melanoma skin cancer (mainly SCC) is the most rapidly increasing cancer form in Sweden, for both men and women, during the period 1992 to 2002 with an annual increase of 3.4 for men and 3.8 for women (Figure 6). In the year 2002, 1,796 men and 1,202 women were diagnosed with non-melanoma skin cancer. The age-standardised incidence was 49.2 for men and 22 for women per 100 000 [63].

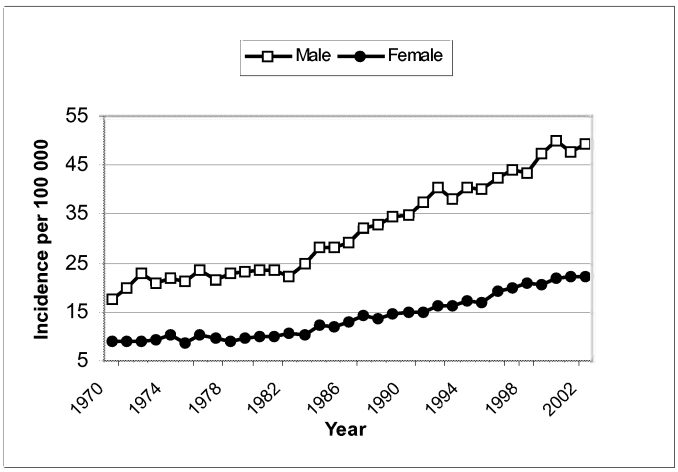

Figure 6. Age-standardised incidence of non-melanoma skin cancer in Sweden from 1970 -2002 (using the population of Sweden year 2000)
(The National Board of Health and Welfare, 2003)

2.2.3 Basal cell carcinoma

BCC has only recently been included in the cancer register in Sweden. Due to this absence of quality documentation on a national level, it is only possible to estimate the incidence in Sweden. BCC has been registered in Finland since 1964. For the year 2001, the incidence was 53.7 for men and 45.9 for women per 100,000 adjusted for age to the world standard population [86]. If the ratio of BCC to SCC and MM is about the same in Sweden as in Finland then the estimated incidence for BCC in Sweden is somewhere between 75 and 99 per 100,000 for men and 69 and 78 for women. This means that new cases of BCC in the year 2001 in Sweden, can be estimated to be in the range of 13,000 to 15,000. This estimate is slightly lower than a previous one of 13,000 to 25,000 new cases every year [63]. However, this is consistent with reports from a study in Stockholm County in which the incidence 1996-1997 was estimated to be 108 per 100,000 for men and 96 for women [87].

2.3 SKIN CANCER PREVENTION

It may sound paradoxical that skin cancer, although the most common cancer, may also be the most preventable cancer form by modifying lifestyle. Major skin cancer prevention efforts have been reported from Australia and USA although there has been an increase in efforts in Europe and other countries around the world [88]. The long-term goals of skin cancer campaigns are to reduce incidence, morbidity and mortality of skin cancer. In a shorter perspective, the aim is often to increase knowledge of sun-related behaviours and the risks of UVR exposure, and influence attitudes in such way as to lead to a behaviour change. Furthermore, increased awareness of skin cancer will lead to earlier detection of pre-mal lesions or small tumours thus improving the long-term prognosis of the disease.

Even for very sensitive, fair-skinned people, the risk of overexposure to the sun is limited when UVR is low and under normal circumstances there is no need for sun protection. In Sweden, the need to be careful in the sun is not necessary during the winter months owing to low UVR (Figure 7). An exception to this may be if people are out in the snow on a bright sunny day because the UVR reflects about 80% from newly fallen snow [89, 90].

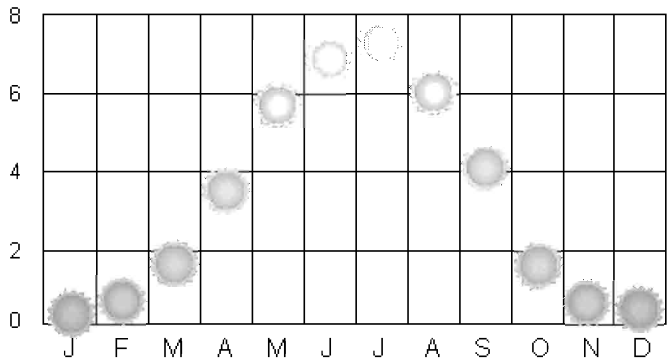

Figure 7 The variation of the UV-index throughout the year in Sweden
(Taken from the Swedish Radiation Protection Authority's website.)

2.4 SUN-RELATED BEHAVIOUR

If the increase in skin cancer incidence is caused solely by the increase of UVR exposure then it can only be reduced by changes in lifestyle towards more UVR protection [88]. Sun exposure and the use of tanning beds are the two sources of UVR exposure. The present thesis focuses on sun-related behaviours. Sun-related behaviours can be divided into sun-protection and intentional sun seeking. Sun-protection behaviour is when people employ protection strategies to minimise UVR. Sun seeking includes the behaviour of exposure to UVR from the sun with the purpose of attaining a suntan, i.e. intentional tanning. Improvements in both kinds of sun-related behaviours are important for decreasing UVR exposure in the general population.

2.4.1 Sun-protection behaviour

The World Health Organisation's (WHO) recommendations include sun-protection behaviours such as wearing clothes, staying in the shade, avoiding the sun in the middle of the day and using sunscreen with a sun protection factor (SPF) of 15 or higher [64].

Table 3. Skin cancer prevention messages

Avoid intentional tanning
Avoid the sun when the UVR is at its strongest, between 11a.m. and 3p.m.
Seek shade from the midday sun
Wear clothing and hats when exposed to the sun
Use sunglasses to protect the eyes
Avoid tanning beds
Protect babies and young children from direct sun-light
Apply sunscreen with SPF>15 to parts of the body that remain exposed to the sun

The goals of skin cancer prevention programs should be to enhance a lifestyle change that does not include intentional tanning and to increase the use of different sun-protection strategies (Table 3). It is important that the public makes use of as many sun-protection strategies as possible. Motivating parents to protect their children in the sun, particularly during holidays, may be essential in the fight against skin cancer because of cumulative evidence that sunburn in childhood is a strong determinant of both MM and BCC risk [77, 91-95]. In a recent study, included in this thesis, it was shown that approximately, 40% of the adolescents and nearly 30% of the adults used no sun protection other than sunscreen. Only about 7% of the adolescents and 16% of the adults used all sun protection strategies, i.e. clothing, seeking shade and avoiding the midday sun [57].

2.4.2 Avoiding the sun between 11 a.m. and 3 p.m.

About 50% to 60% of the total amount of daily UVR occurs in the middle of the day, i.e. between 11 a.m. and 3 p.m. [89]. This is also the period when the UVR is strongest and the risk for sunburn the greatest [89] (Figure 8). Thus, the best way of reducing UVR exposure is to avoid outdoor exposure between 11 p.m. and 3p.m. at the time of the year when UVR is high. By doing so the risk of getting sunburn is reduced considerably. If it is not possible or desirable to avoid the midday sun, then wearing clothes or staying in the shade are the best means of protecting oneself [89]. Sunburn has been associated with staying in the sun during the middle of the day with or without sunscreen [96, 97]. The relation between being in the action/maintenance stages for the sun-related behaviours to sunburn is shown in table 4 (unpublished data).

Table 4. The associations of five different sun-related behaviours with sunburn in the population of 13 to 50 year old residents in Stockholm County 1999.

Sun-protection strategies	PC and C* (n/N)	A and M (n/N)	Odds Ratio	CI (95%)
Using clothes as sun protection	55% (1864/3384)	54% (1643/3027)	0.9	0.7 - 1.0
Using the shade as sun protection	58% (1454/2610)	56% (2076/3808)	0.9	0.8 - 1.1
Avoiding the sun between 11 and 15	56% (3094/5519)	48% (410/842)	0.8	0.7 - 0.9
Giving up sunbathing	58% (3267/5599)	32% (277/864)	0.4	0.3 - 0.4
Using sunscreen	42% (707/1688)	60% (2777/4648)	1.8	1.6 - 2.1

Note: PC= Precontemplation; C= Contemplation: A= Action; M= Maintenance; CI= Confidence interval *= reference group

In a study in Stockholm County, in the summer of 2003, parents reported that 40% of their one-year old babies were in the sun for longer than an hour between 11 a.m. and 3 p.m. on a typical summer day. Furthermore, nearly 20% of the babies had experienced at least one episode of sunburn (unpublished data). Another Swedish study showed that the majority of a high risk group for MM sunbathed between 11 a.m. and 3 p.m. and 61% of sunbathers reported sunburn [98]. Less than 15% of the total participants, aged 13 to 50 years old, in the study included in the present thesis reported avoiding the sun between 11 a.m. and 3 p.m. as a sun-protection strategy [56, 57, 99].

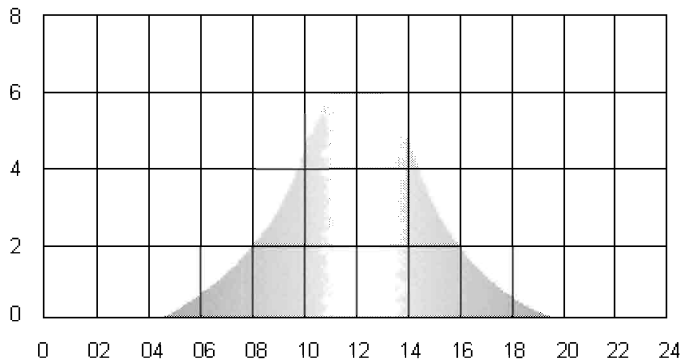

Figure 8. The variation of the value of UV-index throughout a summer day (15th of June in Lund, Sweden)(Taken from the Swedish Radiation Protection Authority's website.)

2.4.3 Sunscreen

Sunscreen was developed predominantly to protect people against acute, intense UVR, i.e. sunburn. Some researchers have suggested that sunscreen used during childhood can reduce the lifetime risk of non-melanoma skin cancer considerably [100]. WHO and other major health organisations include sunscreen in their sun protection behaviour recommendations [101]. However, several studies have shown that people do not use sunscreen as recommended and often with the intention of prolonging UVR exposure [102-104].

Seventy-three per cent of the participants in a large scale survey in Stockholm County reported using sunscreen, which makes sunscreen the most commonly used sun-protection strategy [57]. However, 30% of the females and 20% of the males reported using sunscreen to acquire a more beautiful tan (unpublished data). Furthermore, 53% of the adolescents and 35% of the adults did not know what the SPF number on sunscreen containers indicated [57]. Finally, sunscreen users reported sunburn more often than those who did not use sunscreen, 60% and 42% respectively, and sunscreen use is more common among sunbathers than those who do not sunbathe, 75% and 57% respectively [57].

Other studies have also reported association of sunscreen use with prolonged time spent in the sun as well as increased risk for melanoma [104, 105].

The controversial results of the relation between sunscreen use and skin cancer risk put health promoters in a challenging situation. Consequently, the International Agency for Research on Cancer (IARC) has amended their recommendation for sunscreen as follows:

"Sunscreens probably prevent squamous-cell carcinoma of the skin when used mainly during unintentional sun exposure. No conclusion can be drawn about the cancer-preventive activity of topical use of sunscreens against basal-cell carcinoma and cutaneous melanoma. Use of sunscreens can extend the duration of intentional sun exposure, such as sunbathing. Such an extension may increase the risk for cutaneous melanoma" [106].

2.4.4 Sunbathing, intentional tanning and sunburn

Sunbathing behaviour or intentional tanning is a 20-century phenomenon. In the 19th century, it was common, particularly among the upper class, to avoid sun exposure [107]. Public health messages in the beginning of the 20th century were "sunbathe for your health". Between the 1920s and 1930s sunbathing's popularity exploded and suntan was seen as a sign of health and beauty [108]. At the beginning of the century, sunbathing behaviour was mainly practised by people who were well off financially and had time to spare. With growing prosperity in the whole population it became a leisure activity that everybody could indulge in. Today sunbathing is a common behaviour and the most frequent reason given for sunbathing is the positive effect on appearance, i.e. tanning and relaxation [59, 109].

Sunburn is an indication of a high level of intermittent sun exposure and has been associated with both MM and BBC [71, 110-113]. Intentional tanning is in general more frequently reported by females than males and by younger people more than older [114]. However, studies repeatedly report that male adults sunburn more often than females adults [115-118]. Sunburn among female and male adolescents is a more complex issue, i.e. some studies show that either females or males adolescents sunburn more often and others show no differences between the genders [119-121]. A Danish study reported that 29% of sunbathers that did not use sunscreen and 22% of sunscreen users had got sunburned whilst sunbathing on the previous day [122]. Another study reported that 45% of sunbathers were sunburned at least once during their vacation [104].

Numerous international and Swedish studies, have shown that sunburn is frequent among both adolescents and adults and is often associated with the desire to tan [55, 97, 109, 117, 119, 123, 124]. Approximately 80% of the total responders aged 13 to 50 years in a large Swedish population study reported practising intentional tanning by sunbathing outdoors. The study

also showed that nearly 40% of the total population became sunburned while sunbathing in Sweden during the past 12 months. In this study female adolescents reported sunburn more frequently than male adolescents but there was no difference between the genders in the adult population [123]. In addition, nearly 50% reported travelling abroad for a sunny holiday at a seaside resort during the past 12 months and 61% became sunburned during their stay (unpublished data). The same study showed that 59% of adolescent sunbathers experienced sunburn the previous year compared with only 37% of those who had not sunbathed. Fifty-seven per cent of adult sunbathers experienced sunburn compared to only 26% of those who had not sunbathed (unpublished data). Finally, 41% of females and 25% of males reported indoor tanning, i.e. using tanning beds[123].

2.4.5 Conclusion

With respect to the results above, there is a need for preventive activities aimed to increase awareness and acceptance of the risk of UVR, and to change sun-related and sun bed use behaviours in the general population. It is important that the public can utilise as many sun-protection strategies as possible. It is particularly vital to inform and motivate people who spend their holidays at a sunny seaside resort to use a variety of sun-protection strategies. In addition, it may be important to inform and motivate parents, e.g. at the regular follow-up visit to the child health care centre. Skin cancer prevention programs should emphasise that sunscreen should never be the first choice of sun-protection and never the only agent. Sunscreen should never be used to extend the duration of sun exposure or intentional tanning.

3 AIMS OF THE THESIS

The general aim of this thesis was to collect data relevant for skin cancer prevention and to investigate the applicability and feasibility of the Transtheoretical Model for sun-related behaviour. Also, to assess the readiness to change five different sun-related behaviours in the general population in Stockholm County and to identify variables related to the stage-of-change distribution. All studies were a part of a skin cancer prevention project run by the Stockholm Center of Public Health, Unit for Cancer Prevention in Stockholm County.

The specific aim of each paper was as follows:

3.1 PAPER I

To investigate the readiness to change sun-related behaviours in two groups: visitors to mobile screening units for skin cancer, and beachgoers. Also, to test a single-item algorithm in assessing the stage of change in sun-related behaviour.

3.2 PAPER II

To evaluate the effectiveness of a brief presentation of the skin cancer prevention kit "You and Your Skin" in a school environment where one of the outcome variable was readiness to change sun-related behaviours.

3.3 PAPER III

To assess the test-retest reliability of questionnaire items measuring sun-related issues including behaviour, attitude towards sun exposure and the readiness to change.

3.4 PAPER IV

To investigate the applicability of the TTM for sun-related behaviour and to examine adolescents' sunbathing behaviour. Additionally, to assess the construct validity of three major constructs of the TTM by studying the association of the processes of change and the pros and cons of sun exposure with the stages of change.

3.5 PAPER V

To assess the stages of change distribution for five different sun-related behaviours in a sample of 6,000 adolescents and 4,000 adults. Also, to analyse the association of the stages of change with age, gender, educational level, skin type, attitude and knowledge.

4 METHODS

In all of the studies, the readiness to change sun-related behaviour was measured by assessing the stages of change according to the TTM. The stages of change were assessed by the single-item algorithm method without the customary time frames, since the risk for UVR overexposure is seasonal in Sweden, the summer lasting only 3 to 4 months. In this method, only one item is used to classify participants according to the stages of change for each sun-related behaviour. The sun-related behaviours assessed were (1) giving up sunbathing, (2) using clothes for protection from the sun, (3) avoiding the sun between 11 a.m. and 3 p.m., (4) using the shade, and (5) using sunscreen. The exception was Study IV where readiness to give up sunbathing was the only sun-related behaviour assessed. Questionnaires were used to measure variables in all the studies. The majority of the questions in the questionnaire have been used in several studies of sun protection behaviour and skin cancer prevention in Sweden [41, 55, 109, 125]. The SPSS statistical package was used in the statistical calculations for all the papers [126].

4.1 PAPER I

In the summer of 1998, three mobile screening units visited 39 camping sites (or a nearby square) along the Swedish coast providing information about skin cancer and sun-related behaviour and a free skin examination by a dermatologist. Differences in sun-related issues were investigated in two groups.

4.1.1 Participants

The first 20 visitors to the mobile screening units at each of the 39 sites and up to 20 sunbathers on nearby beaches were asked to complete a questionnaire. Of 944 participants aged from 18 to 96 years, 742 constituted the visitor group and 202 the beachgoer group.

4.1.2 Questionnaire

The questionnaire contained 12 questions assessing skin type, attitudes, demographic information and readiness to change five different sun-related behaviours. Skin type was categorised into four categories using the self-assessment method of Fitzpatrick [127]. Three questions assessed attitude towards sun exposure using a Likert-type scale (range 1 to 5). An attitude index for sun exposure was calculated by adding up the answers from the three items (range 3 to 15).

4.1.3 Statistical Analysis

The participants were divided into two age groups (18-46 and 47-96 years of age). When comparing visitors to the mobile screening units with the beach-going group, the 47-96 age group was excluded owing to the limited number in the beach-going group. To compare the groups for readiness to

change and attitudes, we calculated a ratio of proportion with 95% confidence intervals based on the method of Mentel and Haenszel using Fisher's exact test for significance testing [128]. A Chi-square test was used to analyse the relationship between skin type and readiness to change. Spearman's rank correlation coefficients were calculated for the correlation between stages of change and attitude to sun exposure [129].

4.2 PAPER II

The efficacy of an educational kit for skin cancer prevention among junior high school students was evaluated. The intervention kit included information on sun protection and provided facts about the consequences of UVR overexposure and skin cancer. The emphasis was on positive messages using humour to capture the attention of the students. Material that might upset the students (fear propaganda) was avoided. The intervention was intended to decrease sun-exposing behaviour and increase sun-protection behaviour.

4.2.1 Design and Recruitment

Four municipalities in Stockholm County were selected on the basis of size and socio-economic status. Five schools from the municipalities participated in the study. An equal number of classes were randomly assigned to intervention and control. The design was that of a non-equivalent control group with pretest and posttest. An equal number of seventh-grade classes (aged 13 to 14 years) and eighth-grade classes (aged 14 to 15 years) totalling 16 classes completed the pretest and one week later the educational kit was implemented in the intervention classes. Three months after the intervention, the posttest was given to both the intervention and the control classes.

4.2.2 Intervention

The intervention was defined as the application of the educational material with instructions and recommendations implemented by the student's normal teacher or the school nurse, during one lesson (45 min). The educational kit contained: (1) a manual for teachers, (2) 10 overhead transparencies, (3) a video tape (7 min), and (4) recommendations and instructions on how to behave in the sun (it was suggested that they be photocopied and given to the students to take home).

4.2.3 Assessments

To assess the equivalence of the groups, the questionnaire collected demographic information, skin type, hair colour, and sun-related behaviour. To measure the effect of the intervention, the questionnaire included questions that quantified items in the following categories: (1) Knowledge of the risk factors for skin cancer, UVR exposure, and sun protection behaviour was assessed using 15 statements. (2) Attitudes toward sunbathing and tanning were assessed using five statements with responses

on a five-point Likert-type scale (from totally agree to totally disagree). (3) Readiness to change, which was measured by assessing the stages of change for five different sun-related behaviours.

4.2.4 Data Analysis

The effect of the intervention was analysed by comparing mean scores on knowledge and attitude at pretest and posttest, using a paired samples t-test. A gain score analysis was made to assess the change in knowledge, using the independent samples t-test. This analysis will show if the intervention group has increased their knowledge score relatively more than the control group, by comparing the mean change between the groups. Furthermore, we compared the groups regarding the number of participants who had increased their knowledge and/or attitude scores between the pretest and the posttest, using a Chi-square test. The effect of the intervention on readiness to change sun protection behaviours was assessed by counting "advancers" (those who progressed 1 or more stages) and comparing the groups by calculating the ratio of proportion (relative risk) with 95% confidence intervals based on the method of Mantel and Haenszel [128].

4.3 PAPER III

The reliability of some common items measuring sun-related variables was assessed using the test-retest method. The participants were 52 female nurses attending a post-graduate course at the Karolinska Institute, Stockholm, Sweden. The course was not related to the issues addressed in the study.

4.3.1 Assessments and Data Analysis

All participants completed the questionnaire on two occasions with a three week interval, in a classroom environment. The topics that were assessed and analysed were the following. 1) Present and future sunbathing habits. 2) Use of sunscreen. 3) Vacation at sunny resorts during the past year and during one's whole life. 4) Skin type. 5) Sunburn in Sweden and abroad. 6) Readiness to change sun-related behaviour measured by assessing the stages of change derived from the TTM. 7) Attitudes towards sunbathing and tanning. 8) Perception of risk concerning sunbathing. 9) Self-efficacy regarding protection from UVR. Weighted kappa statistics were used to calculate the association between test and retest scores for all individual items. Values of weighted kappa (K_W) over 0.75 indicate excellent agreement, values between 0.4 and 0.75 represent fair to good agreement and values less than 0.4 poor agreement [130]. Further, the Pearson *r* was used to calculate the correlation between test and retest scores for the attitude index [129].

4.4 PAPER IV

From May to August 2000 the Stockholm Center of Public Health, Unit for Cancer Prevention, conducted an information and awareness campaign on

sun protection behaviour targeting teenagers, aged 16 to 20. The campaign concentrated on teenagers' interest for fashion, health and appearance. A cross-sectional survey was used to evaluate the effect and process of the campaign as well as to examine the sunbathing behaviour of adolescents. Further, the applicability of the TTM was investigated by analysing the association of the processes of change and the pros and cons of sun exposure with the stages of change.

4.4.1 Procedures and Participants

A random sample of 1,200 eighteen-year olds living in Stockholm County was selected from the national census registry. A questionnaire, along with a letter informing about the study, was sent to them at the end of July. One reminder was sent to those who had not returned the questionnaire after 10 days.

4.4.2 Questionnaire

The questionnaire contained 60 items assessing sun-related issues. Readiness to change sunbathing behaviour was measured by assessing the stages of change. The stages were assessed by the single-item algorithm method without using time frames. The processes of change were assessed with 30 items, three for each process, adopted from the questionnaire measuring the processes of change for exercise retrieved from the Cancer Prevention Research Center, University of Rhode Island website [131, 132]. Eighteen items were used to assess the pros and cons of sun exposure. The majority of the items have been used to assess the positive and negative sides of sun exposure in previous skin cancer prevention research [109, 123].

4.4.3 Statistical Analysis

Differences in the stage of change distribution between men and women were assessed using a Chi-square test. Multivariate analysis of variance (MANOVA) was conducted to assess the main effect of stage membership on the variation of processes and how the teenagers weighed the pros and cons of sun exposure. A univariate analysis of variance (ANOVA) was executed for each process and the pros and cons of sun exposure. The Tukey Honest Significant Difference (TSD) post hoc test was then conducted. Omega squared (Ω) was calculated to assess the effect size [133].

4.5 PAPER V

This was a survey gathering baseline data for future interventions and information to aid in the development of skin cancer prevention programs. The survey comprised 41 questions concerning background, sunbathing, sunbed use, sun protection, skin type, sunburn, attitude, knowledge and readiness to change sun-protection behaviour.

4.5.1 Procedures and Participants

A random sample of 10,000 residents registered in Stockholm County was selected from the national census registry. The sample consisted of 6,000 adolescents aged 13–19 years and 4,000 adults 20-50 years of age. A questionnaire and a letter informing about the study were sent in May 1999. A reminder letter was sent to those who had not returned the questionnaire after 10 days and a second reminder together with a new copy of the questionnaire was sent after an additional 10 days. A non-response study was conducted by telephone in December 1999.

4.5.2 Questionnaire

The questions in this study have been frequently used in surveys of sun-related issues and were developed by a multidisciplinary group including specialists in dermatology, oncology, psychology and the social sciences [55, 109, 123, 134, 135]. Sunbathing was defined in the questionnaire as exposing oneself to the sun, totally or partly undressed, with the intention to tan. In this study, the focus was on readiness to change sun-related behaviours, attitudes towards sun exposure and knowledge of sun-related issues. Background variables comprised gender, age and education. Phenotype characteristics were gathered using Fitzpatrick's self-assessment method, which divides people into skin types according to their tendency to get sunburned and their ability to tan [127]. Readiness to change five different sun-related behaviours was measured by assessing the stages of change. Twelve items assessed attitudes towards sun exposure using a Likert-type scale (range 1 to 5). The attitude index was computed by adding the score on each item (range 12 to 60). An assessment of the reliability of the attitude index was found to be satisfactory [136]. The respondents' knowledge of UVR exposure and sun-protection behaviour was assessed by 8 items. Participants were asked to answer each statement by checking one of three response choices (Yes - No - Don't know). The scores were computed by counting correct responses. Sunburn experienced during the past 12 months was assessed for two locations, i.e. Sweden and abroad at a sunny seaside resort.

4.5.3 Data analysis

Differences in the stage of change distribution between genders, age groups and educational levels were conducted using the Chi-square test. ANOVA analyses were conducted to assess differences in attitude and knowledge between genders and age groups. Logistic regression was used to examine the association of being in the action/maintenance stages for sun-related behaviours, with gender, age, attitude, knowledge, skin type and education. For these analyses, the following categorising was carried out. Adolescents were divided into two age groups, using secondary (age 13-16 year) and upper secondary school (age 17-19 year) as criteria. The adults were divided into age groups according to decades (20-29, 20-39 and 40-50 year). Attitude scores were dichotomised by dividing participants into three equally sized groups: low score (12-33), medium score (34-39) and, high

score (40-60). Knowledge scores were dichotomised by dividing the population into two equally sized groups based on the number of correct answers: low score (1-6) and high score (7-8). Regarding education, we created two categories, university education versus less than university education. One-way ANOVA was used to test for statistically significant differences in the mean attitude across the stages of change. Tukey's post hoc tests were performed to find out where the attitude means scores differed across the stages. A Chi-square test was used to examine differences in sunburn experience between sunscreen users and those who did not use sunscreen.

5 RESULTS AND CONCLUSIONS

5.1 PAPER I

This study showed that attitudes towards sun exposure were related to the stages of change for sun-related behaviour. This finding supports the notion that an important step in a successful primary prevention program for skin cancers is a change in attitudes towards sun exposure, which leads to increased readiness to adopt sun-protective behaviours. The differences in stage distribution between the visitors to the mobile screening units and the beach-going group were interpreted as support for using a single-item algorithm to assess stages of change in sun-related behaviour.

5.2 PAPER II

The majority of the adolescents participating in this study reported positive attitudes towards tanning and sunbathing but also relatively good knowledge of the risks of skin cancer, UVR exposure and sun protection behaviour. The majority of the adolescents were in the pre-action stage prior to the intervention, although an exception was sunscreen use where a large majority was in the action or maintenance stages. The educational kit "You and Your Skin" increased skin cancer knowledge but had only a marginal effect on the students' attitude towards sunbathing and tanning. Students in the intervention group progressed more often from one stage to another than the students in the control group. The educational kit "You and Your Skin" can be used to improve general knowledge of skin cancer prevention among teenagers in school settings. A more extensive intervention is probably needed to affect attitudes and to change sun protection behaviours among adolescents. Therefore, it is important to emphasise the necessity of using the educational kit as a multi-lesson program with its several group exercises. The positive attitude towards tanning and sunbathing in this age group is an indication that there may be good reason to start skin cancer prevention education before adolescence.

5.3 PAPER III

Items regarding sunbathing behaviour had high agreement value ($K_W >$ 0.70). An exception from this was future sunbathing and systematic sunbathing ($K_W = 0.39$ and 0.57). The item assessing skin type showed fair to good reliability ($K_W = 0.62$). This was also true for the three items measuring frequency of sunburn ($K_W = 0.52$ to 0.58). The reliability of the items on readiness to change sun-protective behaviours was fair to good ($K_W = 0.47$ to 0.62). The highest agreement was for the item "giving up sunbathing". Attitude towards sunbathing that was assessed as an index of 12 items showed a sufficient reliability. The Pearson correlation coefficient was 0.80. The items measuring risk perception regarding sunbathing and developing skin cancer had fair to good agreement ($K_W = 0.47$ and 0.58). The item assessing self-efficacy had insufficient agreement ($K_W = 0.21$). There is a need for a more stable measure of self-efficacy because it may be

an important subject in skin cancer prevention.

The general recommendation for future studies in the field of skin cancer prevention is to take great care in the construction of reliable survey items. In our study, the items on behaviour in the sun were sufficiently reliable. Attitude or beliefs concerning sunbathing should be measured as an index of items. Items assessing the stages of change for sun-related behaviours may be used to decide interventions strategies and/or as outcome variables.

5.4 PAPER IV

The distribution of the stages in this population showed that a large majority of teenagers sunbathed and nearly 60% were not even considering giving up sunbathing. Boys were more likely than girls to have given up sunbathing. There were lower scores on all processes in the precontemplation stage compared with the contemplation stage. The cognitive-affective processes peaked in the preparation stage and decreased in the action and maintenance stages. The scores on the behavioural processes peaked in the action stage and decreased slightly in the maintenance stage. Consequently, it may be wise to involve both cognitive-affective and behavioural processes in the attempt to facilitate a stage progression. Behavioural processes should be emphasised for individuals in other stages.

Differences in pros and cons scores were significant across the stages The pros score was highest in the precontemplation stage. It then decreased across the stages and was lowest in the maintenance stage. The con score was lowest in the precontemplation stage and highest in the action stage. The con score began to overweigh the pro score in the contemplation stage. The relations of the stages of change with processes of change and decisional balance were consistent with data on other health behaviours. The results support the use of the stages of change measurement used in this study and the appropriateness of utilising the TTM in skin cancer prevention.

5.5 PAPER V

Less then 50 per cent of the population reported being in the maintenance stage for all sun-related behaviours except sunscreen use where six out of ten reported being in the maintenance stage. Fifty per cent of the participants were in the precontemplation stage for giving up sunbathing and avoiding the sun between 11 a.m. and 3 p.m. Seventy three per cent of all participants were in the action/maintenance stages for using sunscreen, which was the most frequent sun-protection strategy reported. Those in action/ maintenance stages for sunscreen use had the most positive attitude towards sun exposure compared with the actors/maintainers for the other sun-related behaviours. Only approximately half of the total participants knew that the sun protection factor (SPF) does not indicate how many hours one can stay in the sun. Finally, sunscreen users reported sunburn

more often than those who did not use sunscreen, 60% and 42% respectively, and sunscreen use was more common among sunbathers than those who did not sunbathe, 75% and 57% respectively.

These findings may be problematic for skin cancer prevention because they show that sunscreen may be used to prolong sun exposure and even increases the risk of becoming sunburned. Consequently, it may be debatable as to whether sunscreen use should be included in sun protection behaviour indexes.

Attitude had the strongest association with being in the action/maintenance stages for all sun-related behaviours. Participants in the precontemplation stage for all protection behaviours, except for using sunscreen, had higher attitude scores than those in other stages. This highlights the need for interventions to change attitudes towards sun exposure. Females were more knowledgeable about UVR exposure and sun-protection behaviour than males in all age groups. More than 90 per cent of the participants knew that getting sunburn increased the risk of getting skin cancer and that the greatest risk of getting sunburn is in the middle of the day. However, only 16% of the participants were in the action/maintenance stages for avoiding the sun between 11 a.m. and 3 p.m. Those in the precontemplation stage for all sun-related behaviours had a lower knowledge score than those in the contemplation stage. Intervention for precontemplators should therefore aim to increase knowledge and awareness of the risk of UVR with the goal of helping people to start contemplating about sun protection.

6 GENERAL DISCUSSION

6.1 IMPLICATIONS FOR INTERVENTION

The present thesis supports the applicability of the TTM for sun-related behaviour. Several factors, including attitude, skin type, age and gender are associated with the readiness to change sun-related behaviour. These factors should be kept in mind when designing intervention programs. Both adolescents and adults in Stockholm County report positive attitude to sun exposure and relatively good knowledge of the risks. The majority is in the pre-action stages of change for most sun-related behaviours (figure 9 and 10). This calls for motivational efforts to change attitudes towards tanning and sun exposure that in turn may lead to improved sun-related behaviour. Educational efforts to increase knowledge of UVR exposure and sun-protection behaviour might be important for those in the precontemplation stage. Behavioural strategies may be more suitable for adults than adolescents.

Avoiding the midday sun and giving up intentional tanning may be the most effective ways of minimising UVR exposure [89]. Unfortunately, a large majority of the adolescent and adults was not ready to change these behaviours [57]. To change these behaviours may be the greatest challenge for skin cancer prevention programs. Approximately 30 to 40 per cent of the study population was in the contemplation/preparation stages for most sun-related behaviours. People in these stages of change usually recognise and accept the need to change. Consequently, individuals in these stages need to learn more about what they can do to reduce sun exposure and to be motivated to act. To motivate adolescents to use the shade and clothes as sun protection, both cognitive-affective and behavioural strategies should be employed, whereas behavioural strategies such as stimulus control should be highlighted for adults.

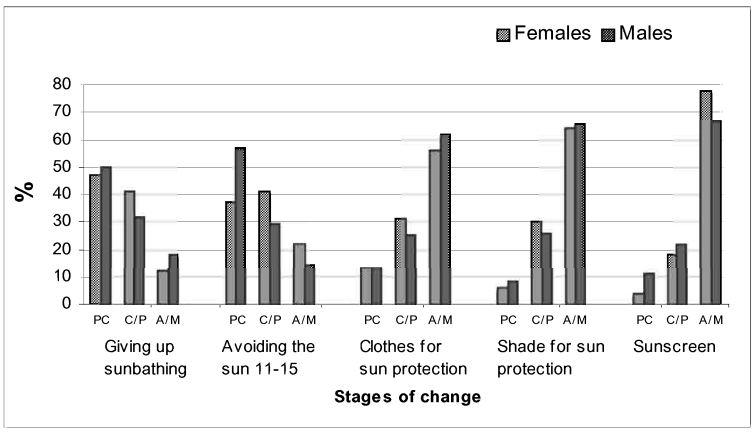

Figure 9. Stages of change for sun-related behaviours of 13 to 19 year old adolescents in Stockholm County 1999 (*Note*: PC=Precontemplation: C/P=Contemplation/Preparation; A/M=Action/Maintenance

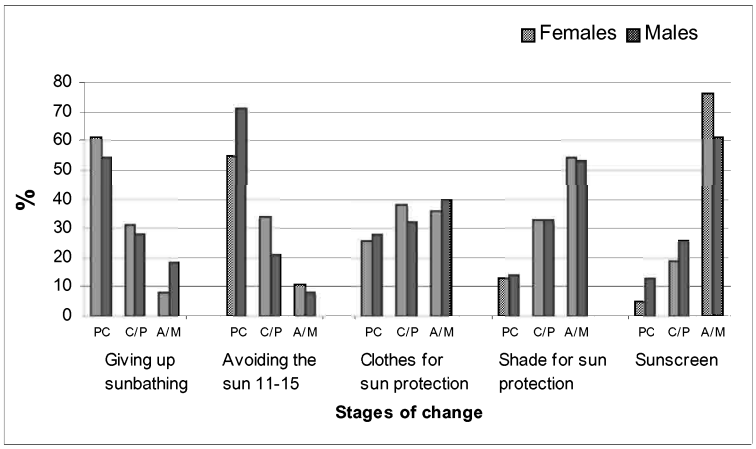

Figure 10. Stages of change for sun-related behaviours of adults 20 to 50 year old in Stockholm County 1999 (*Note*: PC= Precontemplation: C/P= Contemplation/Preparation; A/M= Action/Maintenance

Sunscreen is the sun protection strategy used by a large majority of the population. However, as mentioned above, several studies including the studies in the present thesis indicate that people may use sunscreen incorrectly and that it may be used to prolong the time in the sun [56, 57, 104, 105]. Consequently, it should be emphasised that sunscreen use may be a questionable method to prevent MM and should only be used as a complement to other sun protection strategies.

Population interventions for skin cancer have been shown to be most effective in improving knowledge and attitudes, but few have succeeded in changing sun-related behaviour [15, 97, 137]. There is growing agreement among behavioural scientists that successful health promotion should involve both an individual and a social-environmental approach. The importance of multi-level interventions is also stressed [138]. In addition, it is suggested that interventions should include motivational strategies. Interventions based on established behavioural models tend to be the most effective [3]. Therefore, public health workers may gain from using a theoretical framework when planning interventions and evaluating their effectiveness.

Community interventions or campaigns aimed at changing sun-related behaviours should take into account that individuals in a population may differ in their readiness to change their health behaviour [23]. Health messages should be tailored to match the readiness to change in the target population. Different strategies are needed to enhance people's stage progression, e.g. to move from precontemplation to contemplation or from preparation to action [16, 139, 140]. People in the precontemplation and contemplation stages need to know why they should change their risk

behaviour. People who are ready to change or have begun to change behaviour need to be encouraged to maintain their new lifestyle.

Utilising the TTM in skin cancer prevention may add to the effect of intervention efforts. One practical implication of the present results would be to include a variety of messages in skin cancer prevention campaigns that may affect people differently depending on their readiness to change their sun-protection behaviour. Another way may be to develop interactive interventions in which people in different stages would receive feedback that is matched with their readiness to change. Finally, including the stages of change and decisional balance as outcome variables provides a sensitive evaluation of the effectiveness of skin cancer interventions.

Not until the majority of the population applies sufficient sun protection and perceives intentional tanning as "unfashionable", a waste of time and only the pastime of vain individuals, can we expect to see a large decrease in the incidence of skin cancers.

6.2 METHODOLOGICAL CONSIDERATION

The investigations in this thesis were all of cross-sectional design with the limitations inherent in such studies. All measures were self-reported and are subject to the bias common to such studies. However, bias owing to social desirability is probably small since sun-related behaviour may have a low charge. There is a need for longitudinal or intervention studies to further validate the applicability of the TTM for sun-related behaviour. The single item algorithm method was applied to assess the stages of change in all the studies in the present thesis. The method was used without the customary time frames since the risk of sun overexposure in Sweden is seasonal and the summer lasts only 3 to 4 months. The single item method was chosen because it may be the most preferable for both interactive matched interventions and large-scale measures in the population. Comparison between assessments from personal interviews and questionnaires might give further support for using this method for sun-related behaviour. It has been shown that a personal interview has high congruence with a singe item measure for the stages of change for physical activity [141]. Sun protection factor of sunscreens was not specified in any of the studies in the present thesis but should be included in future studies. Further methodological issues are discussed in the papers.

6.3 CONCLUSION

Using sunscreen appears to be the main sun-protection behaviour for men and women in all age groups in Sweden. However, the present data indicate that it may being used to extend sun exposure and that almost half of the population does not know what the sun protection factor on sunscreen containers stands for. This suggests that recommendations about using sunscreens as sun protection need to be re-evaluated.

The most important goals of skin cancer programs may be to inform and motivate the population to give up intentional tanning, avoid sun exposure between 11 a.m. and 3 p.m. when UVR is high and to use clothes and shade for sun protection.

Adolescents' frequent sunbathing and positive attitude towards tanning show that it may be wise to start skin cancer prevention education before adolescence.

People travelling to sunny seaside resorts should be a target group for skin cancer prevention.

The results in this thesis give support for the single-item algorithm method to measure the stages of change and using the Transtheoretical Model in the attempt to change sun-related behaviour.

7 FUTURE RESEARCH

- An investigation of the association between the major constructs of the Transtheoretical Model regarding sun-related behaviour, involving the stages of change, processes of change, self-efficacy and decisional balance using a random sample from the general population.

- There is a need for longitudinal studies to examine how well self-reported readiness to change sun-related behaviours predicts behaviour. For example, to see if those in the contemplation or preparation stages have progressed to action or maintenance stages more often than those in the precontemplation stage.

- There may be a need for further validation of the single item measure for sun-related behaviours by comparing assessments from personal interviews or focus groups and questionnaires items.

- Comparison of the effectiveness between a stage-matched intervention and a "one fits all" intervention is warranted.

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