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# Skin cancer-related prevention and screening behaviors: a review of the literature

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**ABSTRACT**
To combat the threat that skin cancer poses to the public's health, primary prevention and early diagnosis remain of the utmost significance. This systematic review's objective was to offer a thorough overview of the prevalence and correlates of health behaviors linked to skin cancer in the general population. 91% of research that was published in international peer-reviewed journals during the last three decades were examined and summarized to accomplish this goal. From 7 to 90%, a wide range of reported estimates of sunscreen usage were found across studies. Self-reports indicate that between 23 and 61% of people self-examine their skin at least once year, whereas the recorded incidence of yearly clinical skin examinations ranges from 8 to 21%. Several variables, such as female gender, UV-sensitive phenotype, higher perceived risk of skin cancer, higher perceived advantages of sun protection or screening, and doctor-recommended screening are linked to adherence to sun protection and screening recommendations. Although there is a lot of variation in results, the research implies that a significant part of the general population uses poor sun protection. The biggest suggestion to come out of this analysis is a demand for additional population-based, multivariate studies as well as the creation and broad usage of standardized assessment scales in future research. To improve the prevalence of preventative and early intervention behaviors for the management of skin cancer, it is also advised that targeted interventions be created.

***Keywords: Skin cancer, Melanoma, Skin self-examination, Clinical skin examination, Sun protection behaviors, Health behavior prediction***

## I. INTRODUCTION

To combat the threat that both malignant melanoma and non-melanoma skin cancer pose to public health, primary prevention and early diagnosis remain of utmost significance. The incidence of skin cancer, which includes malignant melanoma, squamous cell carcinoma, and basal cell carcinoma, has increased significantly over the past century in all populations of European ancestry ***(Jemal et al. 2001; Parkin et al. 2005).*** However, incidence varies with latitude and elevation, with areas nearer the equator and at higher elevations often seeing greater rates of skin cancer ***(Tucker and Goldstein 2003).*** As with all skin cancers, sun exposure is the primary external cause of melanoma. However, other personal risk factors, such as the number and type of benign melanocytic naevi or moles (lesions of pigment-forming skin cells), the nature and degree of skin pigmentation, and skin sensitivity to sunlight, [10] significantly modify this relationship ***(Tucker and Goldstein 2003).***

Numerous of these characteristics have a substantial genetic component, and epidemiological data indicate that distinct clinical melanoma patterns are linked to various contributions from these genetic predispositions and sun exposure ***(Whiteman et al. 2003).*** The cornerstones of skin cancer control at the population level are primary prevention and early detection, with a focus on behavioral tactics like routine sun protection, avoiding the sun during peak ultraviolet light hours, and the detection of skin cancers at an early, curable stage ***(Australian Cancer Network 2008; The Cancer Council Australia 2004) [9].***

Avoiding exposure to the sun's rays, especially between the hours of 10 a.m. and 2 p.m., wearing sun-protective clothing, hats, and sunglasses when in the sun for longer than 15 minutes, and using broad-spectrum sunscreens with a minimum sun protection factor (SPF) of 30 are all examples of sun protection behaviors [8]. The likelihood of finding thinner, more treatable melanoma lesions is thought to increase with routine clinical skin examination (i.e., visual inspection of the entire body performed by a dermatologist or other healthcare provider) and skin self-examination ***(Masri et al. 1990; McPherson et al. 2006).*** There haven't been any controlled studies examining the effect of clinical skin inspection on melanoma mortality, and just one research (Berwick et al. 1996)

has found a connection between skin self-examination and lower melanoma mortality. Some scientific organizations do not advise routine skin cancer surveillance at the community level due to the absence of mortality reduction statistics ***(Australian Cancer Network 2008; Cancer Society of New Zealand 2007; The Cancer Council Australia 2007)***. However, the American Cancer Society encourages routine skin cancer screening for those who have a normal risk of acquiring the disease, either on its own or in combination with general health examinations (Smith et al. 2005). Given that early detection is likely to reduce disease burden and the number of skin cancers diagnosed at advanced stages ***(MacKie et al. 1993; Masri et al. 1990),*** a compelling argument can be made for promoting awareness of and appropriate participation in clinical and self-conducted skin examinations among members of the public, especially those who are at higher risk due to phenotypic, genetic, or environmental factors [4].

Research activities aimed at elucidating the correlates of sun protection habits as well as early detection procedures are crucial because the ***American Cancer Society (2007)*** estimates that around 80% of all skin malignancies are avoidable. Even though several studies have looked at the prevalence and correlates of these health behaviors, there isn't a clear and simple summary of the results of this substantial body of work in literature. The purpose of the current systematic review was to give a thorough assessment of the information that was already available about the prevalence and correlates of health behaviors that are associated to skin cancer in the general population [3]. This papers that were examined and aggregated over the course of three decades and published in international peer-reviewed journals were used to accomplish this goal. Future research and intervention programs targeted at enhancing adherence to behavioral guidelines could be guided by knowledge of the elements that influence sun protection and skin monitoring.

## II. LITERATURE SURVEY

The literature search was done using three different methods ***(Cook et al. 1997; NHS Centre for Reviews and Dissemination 2001)***. First, from January 1980 to May 2008, the electronic databases from MEDLINE, Medline In-Process, or other non-indexed citations, and PsycInfo were searched using one or more of the following keywords: Sun protection, sun exposure, sun behavior, prevention, skin cancer screening, skin self-examination, clinical skin examination, and complete cutaneous examination are all terms used to describe skin cancer. The resultant list of publications was then checked for duplicates, non-research papers, and irrelevant references such case reports, letters, comments, conference abstracts, or those that were primarily concerned with clinical concerns. Third, prospective relevant papers that were missing by the original literature search were searched for in the reference lists of all publications that had been found.

Prior to starting the review, the authors decided on inclusion and exclusion criteria. To correspond with the commencement of national sun protection education programs and media campaigns, which were initiated in nations like Australia in the early 1980s, it was decided to examine publications published after 1980 (Marks 1999, 2014). The review was limited to studies that were published in English, involved members of the public, and provided information on behaviors or attitudes relevant to skin cancer prevention and screening. Papers that just evaluated the beliefs and behaviors of people with a personal or family history of skin cancer were eliminated since the current emphasis is on behavioral patterns reported by members of the general community. Those that concentrated on melanoma specifically or those that concentrated on skin cancer more broadly were included. When required, only the data from the biggest study population or the most current publication in these categories were given for articles that appeared to represent overlapping patient populations.

## III. FINDINGS

After duplicates were removed, publications that didn't fit our specified criteria were excluded, and reference lists were manually searched, 91 articles that did were found to be eligible for evaluation. The pertinent information was extracted for organizing and analytic reasons, and it was incorporated into a table that gave a summary of data on methodological features, outcome variables, and major results for each research. The majority of these publications offered Level IVa evidence, or evidence derived from descriptive investigations of people's actions or attitudes, in line with the evidence ranking system created by the National Health and Medical Research Council of Australia in 2000. In this publication, data on the correlates of each skin cancer behavior are provided in a specific order, with the strongest links being presented first, then the less well-established relationships, and finally the associations that seem to be developing from current research. Due to space constraints, only those studies that used multivariate (or regression) analysis to produce data on the correlates of sun protection behavior are shown in Table 1. Instead of

providing a comprehensive list of all research discovered, samples of studies are given throughout the text to highlight conclusions.

## IV. SUN PROTECTION BEHAVIOUR

Since 1980, many countries have contributed to the available literature on individuals' sun protection practices, with most of the research carried out in Australia or the United States, as shown in Table 1. Sun protection behaviors have been studied in a wide range of samples including the general adult population (e.g., Hall et al.2003), children (e.g. Hall et al. 2001), adolescents and young adults (e.g. McGee and Williams 1992; Sjoberg et al. 2004), parents (e.g. Glanz et al. 1999), beachgoers (e.g. Maddock et al. 2007), outdoor workers (e.g. Lewis et al. 2006), childcare workers (e.g. Glanz et al. 1999), university students (e.g. Savona et al. 2005), community skin cancer screening attendees (e.g. Berwick et al. 1992), health care professionals ***(e.g. Guile and Nicholson 2021)***, and patients with dermatological disorders other than skin cancer ***(Garbe and Buettner 2022).***

Between 7 and 90% of the population is said to use sunscreen, according to various reports (e.g., Banks et al. 1992; Wichstrom 1994). It is not unexpected to see that sunscreen consumption rates in this nation look greater than in other countries, given that Australia has the highest incidence of skin cancer in the world (Pruim et al.1999). However, factors including frequency and completeness of sunscreen application, reapplication, and sunscreen choice (i.e., usage of sunscreens with a high vs a low UV protection factor) might confound reported sunscreen use ***(Jones et al. 2000; Pincus et al. 2020).***

Studies that report on regular sunscreen use—defined as "always," "often," or "most of the time"—during sun exposure over an extended period—typically between 30 and 60 minutes—provide estimates of regular sunscreen use ranging from 7 to 72%. According to studies (e.g., Douglass et al. 1997; Newman et al. 1996), between 9 and 61% of research participants "seldom" or "never" use sunscreen when they are outside and in the sun. Additionally, 75% of teenage boys do not wear sunscreen.

## V. METHODOLOGY

### *5.1: AVAILABLE INTERVENTION*

A total-body skin examination should be performed routinely on all patients seen in a primary care setting. Alternatively, all patients should have their skin cancer risk evaluated, and those who are found to be at high risk should then undergo a total-body skin examination. These tactics' main goal is the early diagnosis of melanoma because a thorough inspection of just exposed skin is likely to overlook a significant share of potentially fatal tumors. We looked for studies using these first tests to screen in the general population or in the elderly and then validated positive screening test findings with skin biopsy data to evaluate the accuracy of these approaches, both for melanoma and for nonmelanoma skin cancer.

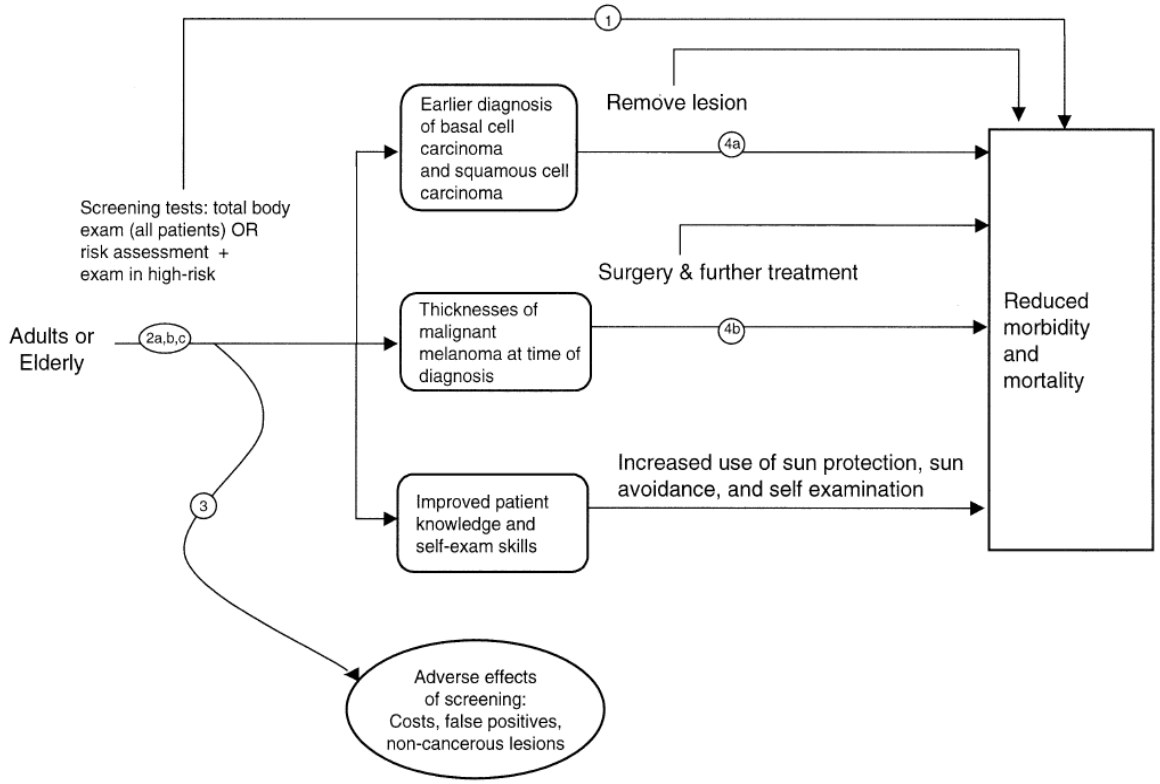


***Figure No. 1: Analytical Framework***

The demographics, interventions, and outcome metrics that we looked at are depicted in Figure 1. Direct evidence of the impact of screening on health outcomes (Arrow 1) including death and quality of life could not be found in controlled trials. We looked at how screening affected the identification of squamous cell carcinoma, basal cell carcinoma, and malignant melanoma (Arrow 2a, 2b). We specifically looked at how frequently skin cancer is discovered in patients, how frequently suspected skin cancer is confirmed by biopsy, and at what stage cancer is discovered. The impact of screening on patients' health attitudes and behaviours on the prevention of skin cancer, such as increased use of sun protection, sun avoidance, and self-examination (Arrow 2c), as well as the negative effects of screening were all something we looked for data about.

### *5.2: ACCURACY OF TEST*

The "gold standard" for melanoma diagnosis is microscopic examination of a biopsy specimen. It might be challenging to make a pathologic diagnosis of worrisome, pigmented lesions, particularly for borderline and in situ neoplasms. Four histopathologists reviewed 140 slides in recent research and labeled each lesion as "melanoma" or "other pigmented lesion"; they agreed on the diagnosis for 74% (kappa50.61) of the slides. Similar results were found when 37 slides were categorized as "benign," "malignant," or "indeterminate" by eight experienced pathologists (selected based on publications and reputations), who reached a consensus on 62% (kappa50.50) of the cases or had only one disagreement.

How reliable are risk assessment tools as a skin cancer screening test? Many common moles is one of the recognized risk factors for melanoma. as well as the existence of unusual moles.24 With more common moles, the chance of developing malignant melanoma increases. The relative risks are 1.7 to 1.9 for those with 11 to 50 moles, 3.2 to 3.7 for those with 51 to 100 moles, and 7.6 to 7.7 for those with more than 100 moles. Comparing individuals with one to four atypical moles versus those with none, the odds ratio (OR) range for developing melanoma rises many times, from 1.6 to 7.3 With sensitivity ranging from 0.57 to 0.79 and specificity ranging from 0.88 to 0.97, a well-informed patient may count the number of moles on the trunk or the entire body. Untrained patients, however, are unable to differentiate abnormal moles from others with accuracy.

***5.3 : How accurate is total-body skin examination in the detection of skin cancer?***

Five recent prospective studies on the reliability of skin inspection in screening programs are summarized in Table 1. Each study's participants were chosen voluntarily after responding to an advertising that would have highlighted skin cancer risk factors. In some research, all participants underwent full-body skin inspections; in other studies, the focus of the examination was on certain lesions that the patient had recognized. The accuracy of skin examinations performed by primary care physicians was the subject of one research (36); dermatologists performed the examinations in the other studies.

Only one of the studies in Table 1 tracked down patients to find out how frequently screening skin exams returned false negative results. The initial examination's overall sensitivity and specificity were 94% and 98%, respectively. The likelihood of not having skin cancer during a follow-up examination for a patient with a negative first skin examination was 0.998.

The final study in Table 1 focuses on melanoma detection in self-selected people.38 The study showed that only a very tiny percentage of people had lesions doctors suspected as being melanoma. Without considering their skin cancer risk factors, 282,555 people of the general population were enrolled in this study and given free exams. Clinical suspicion was categorized as either "rule out melanoma" or "suspected melanoma." Among the participants, only 0.3% (n5763) received a clinical diagnosis of probable melanoma; of these, 679 underwent a biopsy, and 130 were found to have the disease (positive predictive value: 50.19). A lower cut-off, "rule out melanoma," detected 234 more individuals with the disease, but 2316 more patients without the disease underwent biopsies (positive predictive value, 50.09). It is interesting to note that the compliance with biopsy was much lower in participants with a diagnostic of "rule out melanoma," 0.69, compared to 0.89 in patients with a diagnosis of "suspected melanoma."

**Table 1.** Skin cancer screening accuracy

| Author | Study sample and setting | Recruitment focus | Patients *n* | Index test | PCP or d | Defn. of susp. lesion |
|---|---|---|---|---|---|---|
| **Screening for all skin cancer**[e] | | | | | | |
| de Rooij et al.[45] Rampen et al.[37] | Volunteers for skin cancer screening in the Netherlands | Patient with skin cancer risks | 1961 | Lesion-specific exam or TSE | d | Skin cancer |
| Limpert[36] | Free skin cancer clinic at family physician's office | NR | 247 | TSE | PCP | Skin cancer |
| de Rooij et al.[46] | Volunteer melanoma screenings in the Netherlands following a public campaign on melanoma and risk factors | Patients with melanoma risks | 4,146 | Lesion-specific exam or TSE | d | Skin cancer |
| Jonna et al.[43] | Free skin cancer screening in San Diego for self-selected high risk | Patients with skin cancer risks | 464 | TSE | d | Skin cancer |
| **Screening for melanoma** | | | | | | |
| Koh et al.[38] | Volunteer skin cancer education and screenings by the American Academy of Dermatology | Not targeted | 282,555 | NR | d | Suspected melanoma |
| Koh et al.[38] | Volunteer skin cancer education and screenings by the American Academy of Dermatology | Not targeted | 282,555 | NR | d | Rule out melanoma |

According to a well-planned British prospective study on the accuracy of total-body skin assessment, skin cancer experts make far more sensitive and focused judgments for biopsy than general practitioners do.41 In a region of Australia, 109 selected individuals underwent total-body skin examinations by 63 randomly chosen general practitioners and four skin cancer specialists, 43 of whom had previously been identified with worrisome, pigmented lesions by a skin specialist. For the GPs vs the four skin experts, the sensitivity of the total-body skin examination for identifying

worrisome lesions was 0.72 versus 0.97. The GPs' positive predictive value was 0.39. Of the 43 individuals with worrisome lesions, 12 (or 28%) developed melanomas. Although the GPs' diagnosis for melanomas were quite sensitive (0.97), they identified about 11 benign tumors.

## VI. RESULTS

We looked at the screening-related effects mentioned in 24 recent papers on screening programs.33,36 -38,42-63 In these investigations, rates of suspected melanoma in population-based screening, case-finding, and mass screening vary from 0 to 9 per 100 screened individuals, with 1 to 3 per 100 being the most typical findings. In many investigations, 2 to 10 probable nonmelanoma skin malignancies were discovered for every 100 screens. With two exceptions, rates of confirmed melanoma and melanoma in situ were typically between 1 and 4 per 1,000 persons tested. In a high-risk population-focused Australian study48, there were 8 confirmed melanomas for every 100 persons tested. In the other, population-based research in Sweden55, out of 1654 participants examined, there were 152 probable melanomas but no confirmed melanomas. In the biggest screening trial, 282,555 participants had 38,213 confirmed melanomas detected, 4458 of whom had lesions that may have been melanoma.

The number of nonmelanoma skin malignancies with histological confirmation was reported in eight investigations. Many cases were reported between 0.01 and 0.05, however the frequency ranged significantly from 0.05 of those who were tested to 0.0004. Rates of referral for follow-up care of worrisome lesions ranged from 2 to 34 per 100 persons examined in the 24 screening trials. Per 100 persons who were tested, 4 to 31 biopsies were carried out. 0% to 17% of individuals with suspected melanoma received a melanoma diagnosis in the end. About 3% of patients who had a biopsy all had melanoma, with a range of 0% to 4%.

Total-body skin inspection, as opposed to partial or patient-identified lesion-focused examinations, did not appear to increase the prevalence of confirmed melanomas. In one research, 4146 participants were evaluated, and 2910 (70%) reported having at least one skin lesion. After these lesions were evaluated, a biopsy revealed 44 nonmelanoma skin malignancies and 13 melanomas. These patients, who had first been presented with lesions, were given the option of a second full-body skin assessment. There were three basal cell carcinomas and no malignant melanomas found in the 1356 individuals who had a full-body skin examination.

### *6.1 : HARM OF SCREENING*

Most lesions sent for biopsy in skin cancer screening programs turn out to be false positives for the disease. There are no studies available to evaluate the severity of any damage associated with these tests. Misdiagnosis is yet another unfavorable consequence of screening. Finding insurance may be quite challenging, even when melanoma is very thin and has a favorable prognosis. The diagnosis of melanoma has a significant emotional and financial effect.8 Critics are concerned that if screening becomes more popular, pathologists may lower the bar for classifying borderline lesions as melanoma because doing so carries a significant risk to the patient and the possibility of legal liability.

However, there is no information available about the likelihood of misdiagnosis in community practice settings. Numerous benign skin disorders, particularly seborrheic keratoses, which are prevalent in the elderly, are found during screening. If the discovery of these abnormalities results in more biopsies and pointless or expensive operations, it may be deemed a "adverse effect" of screening. Although it has been demonstrated that this happens in routine care, none of the screening investigations looked at how frequently this happened.

### *6.2: COST EFFECTIVENESS*

According to a cost-effectiveness study on malignant melanoma screening, the average estimated discounted life expectancy was 15.0963 without screening and 15.0975 with screening. This discrepancy corresponds to an increase of around 9 hours per person tested or 337 days for each melanoma patient.

The incremental cost-effectiveness (CE) ratio was $29,170 for every year of life saved, assuming a dermatological screening examination costs $30. The CE ratio was disappointingly low since most of the screening expenses were covered by savings from preventing late-stage melanomas in the model. Thus, one of the model's primary underlying assumptions was that the proportion of late-stage melanomas would drop from 6.1% without screening to 1.1% with screening, having an impact on both efficacy and cost calculations. The model also projected that melanomas thicker than 1.5 mm would decline from 20.1% to 12.6% of invasive melanomas, and that invasive malignancies would decrease from 70.3% to 58.1%. These presumptions are based on a comparison of cross-sectional data on the stages of melanoma in people who participated in mass screening programs run by the American Academy of Dermatology and data on usual care from the SEER registry.

## VII. CONCLUSION

Australia is already conducting community screening studies, but it will take a long time to complete. Observational studies should focus on screening's possible drawbacks in the interim, such as inaccurate labeling, pointless biopsies, and the direct and indirect expenses of screening initiatives. It's important to fill in any knowledge gaps about how thick melanoma develops in older patients. Since there is minimal indication that deadly tumors in this population might be discovered while still in a treatable stage, further knowledge about the natural history of thick nodular melanoma, the kind frequently prevalent in the elderly, is required.

Future studies are also required to assist clinicians in identifying individuals in primary care who are at high risk of developing melanoma. The most promising approach to reducing the excessive burden of illness in the elderly is skin cancer screening utilizing a risk assessment tool to identify high-risk people. Observational studies should evaluate the feasibility, validity, and reliability of the quick, standardized risk assessments that are utilized to find these patients. The best-established risk factors for the subsequent development of melanoma should be taken into account in these evaluations, including age, mole counts, and a count of atypical moles. More information is required about the accuracy of skin examinations performed by specialists and primary care doctors in ordinary clinical practice, as well as trials of validated risk assessment programs in the primary care setting.

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