Effectiveness of skin cancer prevention Interventions in melanoma survivors: a systematic review

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Background & Rationale

- Melanoma is the **17th most common cancer** worldwide (331,647 new cases; 58,645 deaths in 2022).
- Incidence continues to rise; mortality projected to increase by ≈**68 %** between 2020 and 2040.
- **Survivors and their relatives** are at increased risk of subsequent skin cancers.
- Simple behavioral changes (sunscreen, protective clothing, sun avoidance, skin self-examination) can significantly **reduce risk**, yet real-world uptake remains limited.
- RCTs evaluating prevention interventions in these high-risk populations exist but are **highly heterogeneous** in endpoints, populations, and intervention types.

Objectives:

1. Examine the effectiveness of prevention interventions from RCTs targeting melanoma survivors and their relatives.
2. Identify which outcomes benefit most from intervention.
3. Explore the role of intervention type and control-arm engagement on observed effects.

Methods

Study design: Systematic review and meta-analysis (PRISMA 2020; registered on OSF).

Search & selection:

- PubMed and Embase searched up to October 2025.
- **3,761 records** identified; **17 RCTs** included after screening.
- Inclusion: RCTs of primary or secondary skin cancer prevention in melanoma survivors or their relatives.

Intervention types:

- *Educational* — telephone/in-person sessions, letters, emails, interactive websites (majority of studies).
- *Device-based* — wearable UVR sensors with mobile-app feedback (2 studies).

Outcomes: SSE, TCE, sunscreen use, limiting time outdoors, head/body protection, shade-seeking, partner-assisted examination, sunburn incidence, UVR dose.
SSE: Self-Screening Examination
TCE: Total Cutaneous Examination (complete examination by a doctor/dermatologist)

Statistical analysis:

- Random-effects models; Summary Odds Ratio (SOR) with 95 % CI.
- Heterogeneity: I^2 statistic; leave-one-out and subgroup analyses; meta-regressions.
- Risk of bias: Cochrane RoB 2 tool.
- Publication bias: funnel plots, Egger's and Begg's tests.

References

[1] Robinson JK, Reavy R, Mallett KA Turrisi R. Remote skin self-examination training of melanoma survivors and their skin check partners. Cancer Med. 2020;9:7301–7309.

[2] Bray F et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74:229–263.

International Agency for Research on Cancer

World Health Organization

Results – Study Selection & Summary

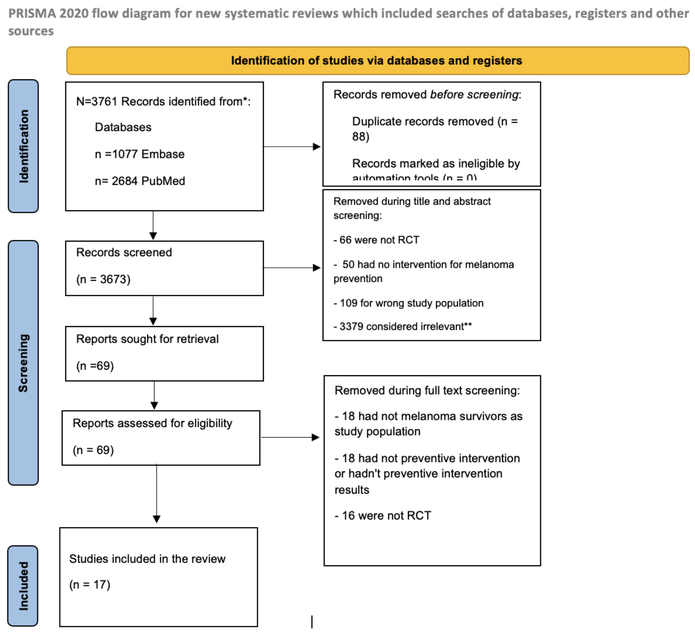

Figure 1. PRISMA flow diagram

Table 1, Summary of pooled estimates:

Outcome	N studies	SOR [95 % CI]	I^2
SSE†	10	**2.05 [1.21; 3.48]**	90 %
TCE (by doctor)	6	1.63 [0.96; 2.76]	82 %
Limit time outdoors†	6	**1.65 [1.07; 2.53]**	95 %
Head protection†	4	**1.89 [1.13; 3.16]**	70 %
Staying in shade	5	1.54 [0.93; 2.56]	90 %
Sunscreen use	7	0.98 [0.77; 1.26]	61 %
Partner skin exam	3	1.82 [0.87; 3.79]	64 %
Sunglasses	4	1.13 [0.59; 2.13]	83 %
Sunburn incidence	3	1.04 [0.72; 1.50]	0 %
Long sleeves	3	0.91 [0.68; 1.22]	0 %

† Statistically significant ($p < 0.05$).
SSE: skin self-examination; TCE: total cutaneous examination.

Results – Forest Plots

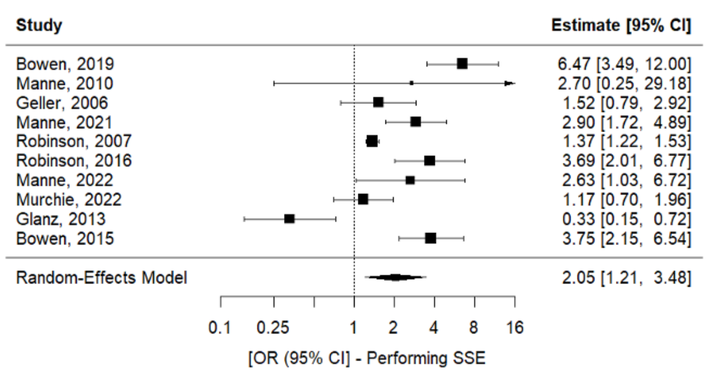

Figure 1A. Forest plots for the four principal outcomes.
A) SSE (I^2=90 %)

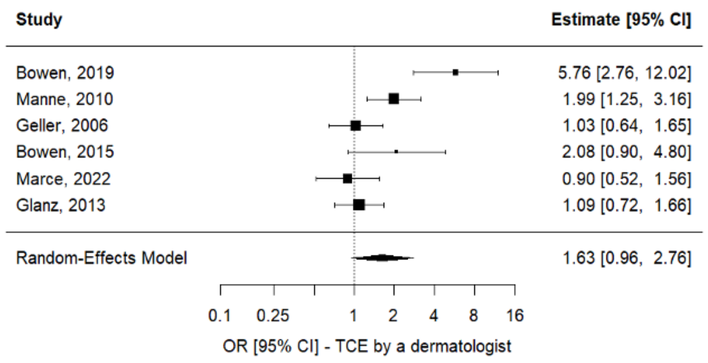

Figure 1B.
B) TCE (I^2=82 %)

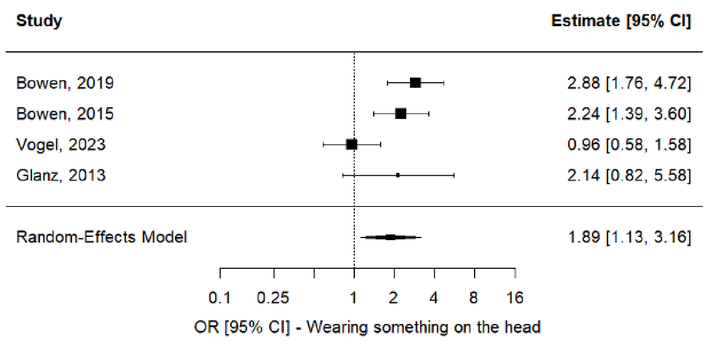

Figure 1C.
C) Head protection (I^2=70 %)

Interventions significantly improved SSE, limiting time outdoors, and wearing head protection.

Results – Subgroup & Sensitivity Analyses

Control-arm engagement moderates effect sizes:

Outcome / Subgroup	SOR [95 % CI]	I^2
SSE — some-engagement control (n=4)	**1.39 [1.24; 1.55]**	0 %
Staying in shade — zero-engagement control (n=3)	**2.52 [1.84; 3.44]**	0 %
Staying in shade — some-engagement control (n=2)	0.98 [0.91; 1.05]	0 %
Limit outdoors — zero-engagement (n=3)	**2.79 [2.02; 3.86]**	0 %
Limit outdoors — some-engagement (n=3)	1.02 [0.96; 1.09]	0 %
Head, excl. Vogel 2023	**2.48 [1.80; 3.43]**	0 %
TCE, excl. Marcè 2022	**1.84 [1.02; 3.39]**	83 %
Partner exam, excl. Geller 2006	**2.81 [1.52; 5.22]**	0 %

Removing non-engaging controls substantially reduces heterogeneity and clarifies true effect sizes — a key methodological insight for future trial design.

Discussion

- **SSE** showed the most consistent effect (>2-fold increase), likely because it is accessible, low-cost, and amenable to skills-based training.
- **TCE** effects were uncertain, partly due to reliance on healthcare access and social factors.
- Significant effects on **limiting time outdoors** and **head protection** were concentrated in studies with non-engaging controls.
- **Device-based interventions** (UVR sensors) showed no significant impact on any outcome, suggesting technology alone is insufficient without behavioral counseling.
- **Sunscreen use** the most commonly promoted behavior, showed no significant intervention effect, highlighting the complexity of habitual sun protection.
- **Composite sun-protection scores** were unaffected, reflecting inconsistent effects across individual components.

Limitations: self-reported outcomes (recall/social desirability bias); small number of eligible RCTs; wide variation in follow-up duration (21 days–24 months); limited standardization of outcome measures across trials.

Conclusions

1. Interventions **significantly improved** SSE, limiting time outdoors, and wearing head protection.
2. Effects on TCE, shade-seeking, and partner skin examination were **positive but not significant**.
3. **Control-arm design** strongly influences observed effect sizes and heterogeneity.
4. Future trials need **larger samples, standardized outcomes**, and clinically meaningful endpoints (melanoma incidence, stage at diagnosis).

Melanoma survivors represent an ideal population for integrated prevention strategies combining education, digital health tools, and personalized risk communication.

Scan Me

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