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(REVIEW ARTICLE)

THE ROLE OF EARLY DETECTION IN REDUCING MALIGNANT MELANOMA MORTALITY: A SYSTEMIC REVIEW

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ABSTRACT

Malignant melanoma is one of the most aggressive forms of skin cancer, and prognosis is strongly associated with the stage of disease at diagnosis. Early detection plays an important role in improving prognosis and reducing melanoma-related mortality. This systematic review aimed to evaluate the impact of early detection strategies in malignant melanoma. Literature searches were conducted using PubMed, Google Scholar, Wiley Online Library, and ScienceDirect. Retrospective and prospective studies discussing melanoma screening and early detection methods were included. Five studies met the inclusion criteria. Several detection strategies were identified, including whole-body skin examination, the Schleswig-Holstein method, the SCREEN project in Northern Germany, and machine learning–based diagnostic systems. Whole-body skin examination demonstrated benefits in detecting melanoma at earlier stages with thinner Breslow thickness. Machine learning approaches also showed promising diagnostic accuracy ranging from 88–91% in selected studies. Most studies suggested that early detection contributes to improved prognosis and may reduce melanoma mortality. Technological innovations may further enhance melanoma screening accessibility and diagnostic performance in clinical practice.

Keywords: Malignant Melanoma, Early Detection, Screening, Artificial Intelligence, Prognosis, Mortality

1 INTRODUCTION

Malignant melanoma is one of the most aggressive and lethal forms of skin cancer. Prognosis and cure rates are highly dependent on the stage at diagnosis, making early detection crucial for reducing disease-specific mortality. With recent technological advances, a variety of early detection strategies ranging from traditional physical examination to artificial intelligence based approaches are being developed to improve patient outcomes. [1]

Globally, melanoma accounts for an estimated 232,130 new cases and 46,000 deaths annually. It represents the fourth most common cancer in New Zealand and ranks as the seventh leading cause of cancer-related mortality in that country. [2]

Mortality in melanoma is strongly associated with tumor thickness at the time of diagnosis. Patients with thin melanomas (≤1 mm depth) demonstrate approximately 92% survival at 10 years, highlighting the critical role of early detection in improving long-term prognosis. [3]

2 METHODS

A systematic review design was employed to synthesize evidence from retrospective and prospective cohort studies. Literature searches were conducted in PubMed, Google Scholar, Wiley Online Library, and ScienceDirect. The primary outcome, defined according to the PICO framework, was the evaluation of mortality in malignant melanoma. The included articles were further assessed for quality and methodological rigor using the Joanna Briggs Institute (JBI) risk of bias tools.

3 RESULTS

Five studies were found. First, whole-body skin examinations detect malignant melanoma at an earlier stage or thinner Breslow thickness. Using Machine learning Model. Using Schleswig-Holstein Methode, Skin Cancer Research to Provide Evidence for Effectiveness of Screening in Northern Germany (SCREEN), Whole-body skin examination. While these methods all have their pros and cons, nearly all of them aim to reduce MM mortality. Detection of earlier stage melanomas and the possible reduction in mortality, with the use of whole-body skin examinations, is supported by recent population-based and case-control trials. Whole-body skin examination is non-invasive and has been shown to be cost effective. According to the author, low-cost screening can have an impact and set an example for all groups to undergo Melanoma Malignant screening.

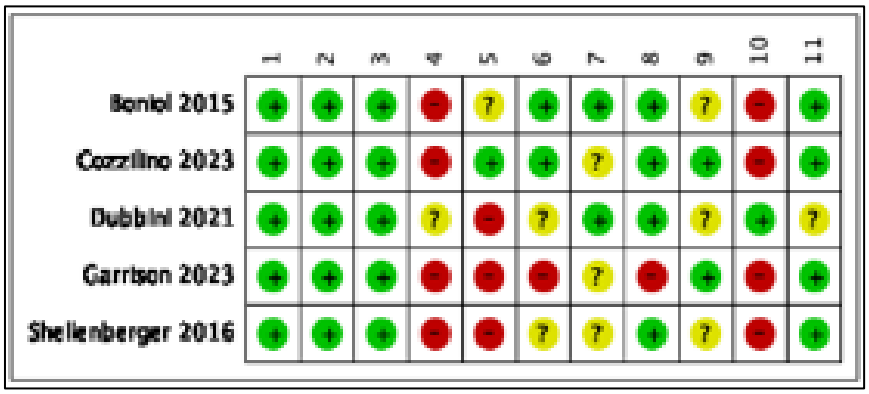

Figure 1: Study bias according to the JBI risk of bias tool, traffic plots created review manager 5.4.1. software.

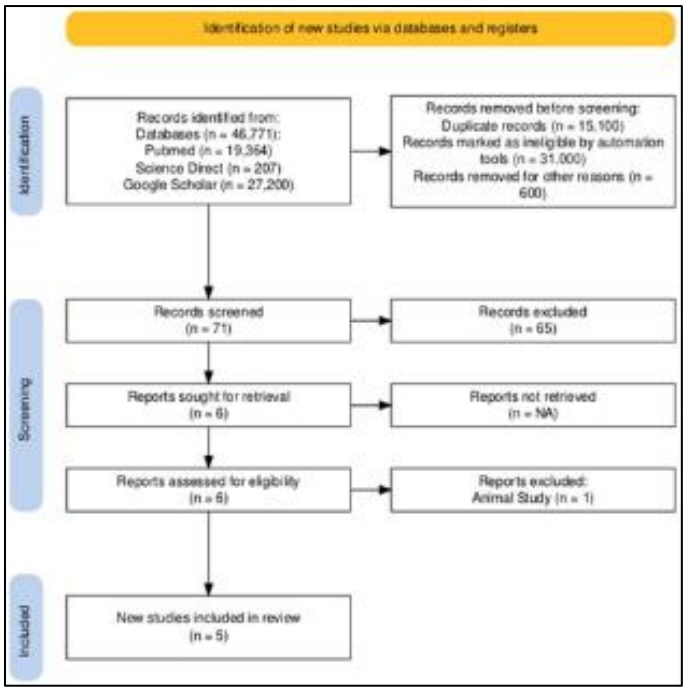

Figure 2: PRISMA 2020 flow diagram of literature selection.

4 DISCUSSION

Five studies met the inclusion criteria. Several early detection methods demonstrated potential benefits in identifying melanoma at earlier stages and improving clinical outcomes. Whole-body skin examination was shown to detect melanoma with thinner Breslow thickness and earlier disease stages. This method is considered non-invasive, relatively cost-effective, and applicable in routine clinical practice. Population-based screening approaches, including the SCREEN project in Northern Germany and the Schleswig-Holstein method, demonstrated positive contributions to early melanoma recognition and potential reduction in melanoma mortality. Machine learning and artificial intelligence-based diagnostic systems also showed promising performance, with diagnostic accuracy reaching approximately 88–91% in selected studies. These technologies may improve clinicians' ability to differentiate malignant lesions from benign lesions and support more efficient screening processes.[4–7]

Most methods aim to reduce malignant melanoma (MM) mortality. Whole-body skin examination is a non-invasive, cost-effective approach, while the 7CPL system aids in distinguishing benign from malignant lesions and recommends referral for scores ≥3. With advancing technology, smartphone-based AI and machine learning have enhanced early detection and may contribute to mortality reduction[8] , though limited access remains a challenge.

Table 1: Summary of included studies

No	Author (years)	Early detection methods	Accuracy rate of the method	Mortality rate	Patient Characteristics
1	Cozzilino, 2023	Machine learning Model	88-91% accuracy	-	Age: approximately <60 years Size: 1.5mm – 2 mm Location: Trunk (n: 1273); Lower limb (n: 508); Head (n: 284) Ulceration: (n:505)
2	Boniol, 2015	Schleswig-Holstein Method	not mentioned	Reduce mortality by 45 %	Age: 35-85 years Size: 1 mm – 1.5 mm Location: plantar foot
3	Shellenberger, 2016	Wholebody skin examinations	77 % accuracy	Reduce mortality by 49 %	Age: Approximately > 60 years Location: Not mentioned

					Size: less than 1 mm
4	Dubbini, 2021	Occasional short screening	<50 % accuracy	Reduce mortality by 47,9 %	Age: Approximately > 65 years old Location: Not mentioned Size: -
5	Garrison, 2023	Sequential Digital Dermoscopy	not mentioned	not mentioned	Age: Approximately > 65 years old Location: Not mentioned Size: -

Table 2: Based Characteristic of Melanoma [1].

Letter	Characteristic
A	Asymmetry—benign moles typically have symmetric or uniform shapes, while cancerous moles are often asymmetric or irregular.
B	Border—benign moles have round and distinct borders, whereas cancerous moles often have asymmetric or jagged borders.
C	Color—benign moles tend to be a single color, while cancerous moles are often composed of multiple shades or colors at different parts of the mole.
D	Diameter—cancerous moles are typically over six millimeters in diameter. This is approximately the diameter of a common pencil.
E	Evolving—Unlike benign moles, cancerous moles often change in size, shape, and color over time.

5 CONCLUSION

Early detection has been shown to be crucial for improving prognosis and reducing mortality from melanoma, with technological innovation playing a major role in expanding access to diagnosis.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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The authors declare that they have no conflict of interest.

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