ANNALS OF MEDICAL AND SURGICAL DERMATOLOGY
Jan-Mar 2025, VOL. 3, ISSUE 1, pp. 14-17
https://doi.org/10.61577/amsd.2025.100004

RESEAPRO JOURNALS

MINI REVIEW

OPEN ACCESS

Trends and determinants of skin cancer in diverse populations

Mehwish Akram[1] and Hikmat Ramzan[2]

[1]Department of Dermatology, Najran University, Saudi Arabia
[2]Department of Dermatology, Harvard Medical School, USA

ABSTRACT

Skin cancer, encompassing both melanoma and non-melanoma skin cancer (NMSC), is the most prevalent form of cancer among fair-skinned populations, with global incidence rates steadily rising. This review explores current epidemiological patterns, focusing on geographic variability, demographic disparities, and contributing risk factors such as ultraviolet radiation exposure, aging, and lifestyle habits. While melanoma incidence continues to rise, mortality has remained stable, raising concerns about potential overdiagnosis and increased screening efforts. Conversely, NMSC, although less lethal, imposes a substantial burden due to high treatment costs and morbidity, especially among the elderly. Accurately determining incidence rates is difficult, particularly for NMSC, due to its frequent exclusion from cancer registries and inconsistent reporting practices. The review also highlights the economic impact of skin cancer, with countries like Australia and the United States experiencing significant healthcare expenditures. Primary prevention measures, such as public education and sun protection campaigns, along with secondary efforts like early detection and dermoscopic screening, are emphasized as essential strategies for reducing disease burden. Ultimately, the study calls for improved registration systems, tailored public health policies, and age-specific education to effectively manage the rising trend in skin cancer cases worldwide.

KEYWORDS

Skin cancer; Melanoma; Non-melanoma skin cancer (NMSC); Keratinocyte carcinoma; Epidemiology; Incidence rates

ARTICLE HISTORY

Received 12 February 2025;
Revised 05 March 2025;
Accepted 12 March 2025

Introduction

Epidemiology, derived from the Greek for "study of the people," serves a vital role in understanding the distribution and causes of health conditions across populations. Its core objectives are to describe patterns of diseases and identify contributing factors, thereby offering crucial insights that inform healthcare planning, disease prevention, and treatment strategies [1].

Skin cancer ranks as the most frequently diagnosed malignancy among individuals with fair skin tones. Over recent decades, both melanoma and NMSCs have shown increasing incidence rates globally. This upward trend has sparked significant interest in evaluating their epidemiological characteristics to support more effective public health interventions and early control measures.

Melanoma, a particularly aggressive form of skin cancer, is considerably more prevalent in Caucasians compared to other ethnic groups [2,3]. The lifetime risk is markedly higher in whites, with men generally facing a greater risk than women, especially in older age groups. Geographic location and skin pigmentation play key roles in influencing susceptibility.

On the other hand, NMSCs which include basal and squamous cell carcinomas far outnumber melanomas in incidence but are less frequently included in cancer registries, making it difficult to quantify their true burden accurately. Despite their relatively low mortality, these cancers pose a significant public health issue due to their high treatment costs and potential for disfigurement and recurrence.

This review delves into current global trends in skin cancer, examining demographic patterns, risk factors, and the limitations in existing data collection systems [4]. It also underscores the need for comprehensive cancer registration, particularly for NMSC, and emphasizes the importance of ongoing primary and secondary prevention initiatives to curb the growing burden of skin cancer worldwide.

Melanoma

Melanoma is a malignant tumor originating from melanocytes and is significantly more common in individuals with lighter skin tones. It is far less prevalent among Black and Hispanic populations, with lifetime risk estimates of around 2.4% in Caucasians, 0.5% in Hispanics, and just 0.1% in Black individuals [5]. The likelihood of developing melanoma increases with age, and the average age at diagnosis is approximately 60 years. Men tend to have a higher incidence than women, especially beyond the age of 75, where the rates in males are nearly three times greater.

The occurrence of melanoma is also closely linked to inherent skin pigmentation and geographic location, with higher incidence in regions of intense ultraviolet radiation (UVR) exposure. Epidemiological data from North America and Europe consistently show a steady rise in melanoma cases, though this increase is accompanied by ongoing debate about whether it reflects a true surge in disease or is partially due to improved detection methods, changes in diagnostic criteria, and increased skin cancer awareness [6].

*Correspondence: Dr. Mehwish Akram, Department of Dermatology, Najran University, Saudi Arabia, e-mail: akrammehwish06@gmail.com

Some experts argue that rising biopsy rates and early detection, particularly of in situ or less aggressive melanomas, may exaggerate the perceived epidemic. However, data also show increasing incidence in more advanced tumors, suggesting that this is not solely a result of overdiagnosis.

Understanding the Melanoma Surge: Myth or Reality?

While a consistent rise in melanoma cases has been reported across multiple countries, there is ongoing debate about the true nature of this increase. Some experts question whether this trend reflects a genuine surge in disease incidence or if it is influenced by factors such as heightened public awareness, increased screening practices, and evolving diagnostic standards [7,8].

One viewpoint suggests that enhanced surveillance and the growing number of skin biopsies have led to more frequent detection of early-stage melanomas especially melanoma in situ which may not have progressed to invasive disease. Additionally, revisions in histopathological classification criteria may have redefined lesions previously considered benign as malignant, further contributing to inflated incidence statistics.

The concept of "overdiagnosis" has emerged in this context, referring to the detection of tumors that, despite meeting diagnostic criteria, might not have led to clinical consequences within a patient's lifetime [9]. This is particularly relevant to slow-growing melanoma subtypes, such as lentigo maligna, which may take years or even decades to become invasive.

However, several population-based studies counter this theory, indicating that melanoma rates have also risen among thicker, more aggressive tumors and across all socioeconomic groups. These findings imply that increased detection alone cannot fully account for the rising numbers and support the argument that the trend represents a real epidemiological shift.

Overall, while diagnostic advancements have contributed to more cases being identified, current evidence suggests that the increase in melanoma incidence is not solely a result of overdiagnosis but likely reflects a true public health concern requiring continued attention.

What Lies Ahead for Melanoma Incidence?

Future projections based on epidemiological modeling suggest that the number of melanoma cases will continue to rise in many parts of the world [10]. Using age-period-cohort analysis, Whiteman and colleagues examined melanoma trends across six populations with moderate to high incidence rates, namely, the United States, United Kingdom, Sweden, Norway, Australia, and New Zealand, drawing on registry data from 1982 to 2011.

Their analysis revealed that melanoma incidence has been increasing annually by over 3% in the US, UK, Sweden, and Norway, a trend expected to persist at least until 2022. Interestingly, Australia, once recording the highest incidence rates, has seen a decline in new cases since 2005, likely reflecting the success of long-standing public health and sun safety campaigns [11]. In contrast, New Zealand continues to experience a rise in melanoma diagnoses, although projections suggest a potential stabilization in the near future.

A key factor influencing future incidence is global aging. As the population continues to grow older, particularly in high-risk demographics, the number of new melanoma cases is expected to rise, given the strong association between age and melanoma risk. This underscores the urgent need for robust prevention and early detection efforts tailored to aging populations.

Keratinocyte Carcinomas: Epidemiology and Clinical Perspectives

NMSC more accurately termed keratinocyte carcinomas, primarily include basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), which account for nearly all cases in this group. Though these cancers are far more common than melanoma occurring up to 20 times more frequently their epidemiology is not as thoroughly investigated.

One major barrier to understanding NMSC trends is the inconsistency in data collection. Many cancer registries do not include NMSC cases or report them incompletely, due to their high volume and comparatively low mortality [12]. This lack of standardized reporting hinders accurate comparisons across regions and over time.

Despite their lower risk of metastasis, BCC and SCC still carry significant health implications. Metastatic BCC and SCC remain rare, with rates between 0.0028–0.05% for BCC and 0.5–16% for SCC. However, these cancers can cause extensive local tissue destruction and require ongoing medical attention, contributing to a notable burden on healthcare systems [13].

Geographically, incidence rates show dramatic variation. Australia reports the highest numbers globally, with over 2,400 BCC cases per 100,000 people in 2011. In contrast, Europe and the U.S. report lower, but still significant, incidence rates. Over the past 30 years, SCC rates have risen by 3–10% annually, while BCC rates in the U.S. have increased by as much as 80%.

keratinocyte carcinomas represent a growing public health issue. Although they are less deadly than melanoma, their sheer frequency, treatment demands, and economic burden make them a critical focus for improved tracking, prevention, and care strategies [14].

Future Outlook for NMSC: Why Is It a Concern?

Looking ahead, several factors suggest that NMSC cases are likely to increase significantly. According to projections by the Dutch National Institute for Public Health and the Environment, the number of skin cancer cases linked to environmental factors, especially ultraviolet (UV) radiation exposure, may rise considerably by 2060.

A major contributor to this anticipated rise is the global trend of increasing life expectancy. Data from the United Nations show that the global population is aging at an unprecedented rate. By 2050, approximately one-third of the world's population is expected to be over the age of 60 [15,16]. Since keratinocyte carcinomas, such as basal and squamous cell carcinomas, are much more common in older adults, the aging demographic is likely to drive up incidence rates of NMSC.

In addition to age and environmental exposure, other factors such as enhanced diagnostic capabilities and more comprehensive reporting systems may also play a role in the

https://doi.org/10.61577/amsd.2025.100004

observed and expected increase in NMSC cases. These improvements mean that more cases are being identified and documented, which contributes to the rising figures.

Given these trends, there is a clear need for proactive measures. Without effective prevention and monitoring strategies, the growing number of cases will place even greater pressure on healthcare resources [17]. This emphasizes the importance of strengthening public health initiatives aimed at reducing UV exposure and enhancing early detection and treatment of NMSC, especially in aging populations.

Economic Consequences of Keratinocyte Carcinomas

NMSC, despite its relatively low mortality, imposes a significant financial strain on healthcare systems due to its high incidence and treatment requirements. The combination of frequent diagnoses and long-term management needs leads to substantial direct and indirect costs. Direct costs include expenses related to diagnosis, surgical procedures, histopathological examinations, and follow-up care [18]. Indirect costs are tied to productivity loss and reduced quality of life, especially when the disease leads to disfigurement or repeated interventions.

In Australia, with a population of just over 23 million, the total healthcare expenditure for NMSC was estimated at $511 million in 2010 and was projected to rise to $703 million by 2015. Similarly, in the United States, the annual cost of medical care for NMSC reached an estimated $650 million, reflecting the large population and high case volume.

Studies comparing treatment settings have shown that physician-office-based treatments tend to be the most cost-effective. Among the various therapies, radiotherapy and Mohs micrographic surgery are among the most expensive, while destruction techniques like cryotherapy or topical medications such as imiquimod and 5-fluorouracil are generally more economical. These findings highlight the importance of optimizing cost-efficient treatment pathways, especially in light of the increasing number of cases.

Overall, the economic impact of NMSC is substantial and growing. As incidence continues to rise, managing the financial burden will require strategic investment in prevention, early detection, and the use of cost-effective therapeutic options.

Etiological Factors Associated with NMSC

Understanding the risk factors for NMSC is essential for designing effective prevention strategies. These risk factors can broadly be divided into two categories: personal (intrinsic) and environmental (extrinsic).

Among personal factors, age is one of the most significant. The risk of developing SCC increases more sharply with age than BCC. Gender also plays a role, while incidence is fairly equal in younger individuals, men over the age of 45 are 2–3 times more likely to develop keratinocyte carcinomas compared to women. Genetic predisposition is another key factor; people with fair skin, light hair, and limited tanning ability are at greater risk due to lower melanin protection [19].

Environmentally, exposure to UVR stands out as the leading factor contributing to the development of non-melanoma skin cancer. Prolonged exposure to sunlight or artificial UV sources, such as indoor tanning beds, significantly increases the risk. The pattern of exposure matters as well SCC is closely associated with long-term, cumulative sun exposure, while BCC is more commonly linked to intermittent, intense exposure, particularly during childhood and adolescence.

Histological studies support these associations, showing that signs of sun damage are more prevalent in the skin surrounding SCC tumors than BCCs [20]. Recent findings indicate a concerning increase in basal cell carcinoma among young women, potentially linked to the prevalence of indoor and outdoor tanning practices (Figure 1).

These findings reinforce the importance of limiting UV exposure and promoting sun-safe behaviors, especially in vulnerable populations, to reduce the incidence of NMSC.

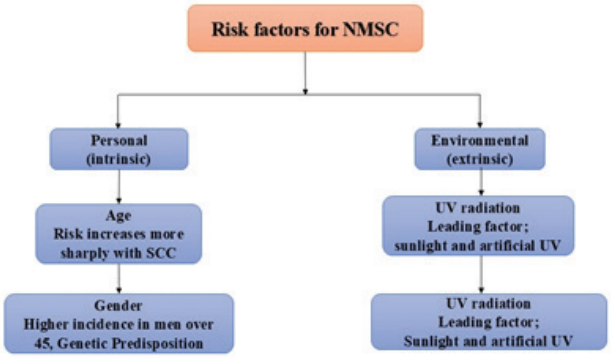

Figure 1. Etiological factors associated with non-melanoma skin cancer (NMSC).

Strategies for the Prevention of Melanoma and Keratinocyte Carcinomas

Preventive approaches for melanoma and NMSC are typically categorized into two key types: primary and secondary prevention. Primary prevention aims to minimize the risk of developing skin cancer by promoting protective behaviors, while secondary prevention focuses on early detection to reduce morbidity and mortality.

Primary strategies are most effective when they lead to long-term behavioral change, particularly in reducing exposure to UV radiation. These strategies include encouraging the consistent use of sunscreen, wearing protective clothing, avoiding sunbathing, and discouraging the use of indoor tanning devices [21]. Tailoring these messages to different age groups can enhance effectiveness. For example, highlighting cosmetic concerns like premature aging may resonate more with teenage girls, while emphasizing the prevention of painful sunburns may be more effective with teenage boys. Educating parents and implementing sun safety policies in schools also play a crucial role.

Mass media campaigns have proven to be powerful tools in shifting public behavior. For instance, studies from Australia demonstrate that skin cancer awareness campaigns yield strong returns on investment by reducing disease burden and healthcare costs. Secondary prevention focuses on identifying skin cancer early through routine skin checks, especially in high-risk populations [22]. Encouraging self-examinations,

https://doi.org/10.61577/amsd.2025.100004

supporting partner-assisted checks, and promoting physician-led screenings are critical components. Tools like dermoscopy and total body skin examinations are especially valuable in detecting suspicious lesions among individuals with multiple moles or extensive sun damage.

Together, these prevention strategies are vital for curbing the rising rates of melanoma and NMSC and reducing their overall impact on public health systems.

Conclusions

Considering the global rise in both melanoma and non-melanoma skin cancer, it is evident that coordinated and proactive efforts are urgently needed to manage the growing public health burden. The steady increase in incidence, particularly among aging populations and high-risk groups, underscores the importance of timely intervention.

Improving the accuracy and consistency of cancer registration especially for non-melanoma skin cancers, which are often underreported is a critical step toward understanding the true scope of the issue. Reliable data will enhance the planning and evaluation of prevention and treatment strategies.

Equally important are comprehensive prevention programs. These should include effective primary prevention, such as public education on UV protection and behavioral change campaigns, and secondary prevention through early detection efforts, including regular skin screenings and use of dermoscopy in high-risk individuals.

Ultimately, tackling the skin cancer epidemic requires a multifaceted approach that integrates public health policy, clinical practice, and community awareness. Through enhanced surveillance, education, and early intervention, it is possible to reduce both the incidence and the long-term impact of skin cancers on individuals and healthcare systems alike.

Disclosure Statement

No potential conflict of interest was reported by the authors.

References

1. Martin R, Fall IS. Field Epidemiology Training Programs to accelerate public health workforce development and global health security. Int J Infect Dis. 2021;110:S3-5. https://doi.org/10.1016/j.ijid.2021.08.021
2. Apalla Z, Lallas A, Sotiriou E, Lazaridou E, Ioannides D. Epidemiological trends in skin cancer. Dermatol pract concept. 2017;7(2):1. https://doi.org/10.5826/dpc.0702a01
3. Leiter U, Keim U, Garbe C. Epidemiology of skin cancer: update 2019. Sunlight, vitamin D and skin cancer. 2020:123-139. https://doi.org/10.1007/978-3-030-46227-7_6
4. Perera E, Gnaneswaran N, Staines C, Win AK, Sinclair R. Incidence and prevalence of non-melanoma skin cancer in Australia: A systematic review. Aust J Dermatol. 2015;56(4):258-267. https://doi.org/10.1111/ajd.12282
5. Garnett E, Townsend J, Steele B, Watson M. Characteristics, rates, and trends of melanoma incidence among Hispanics in the USA. Cancer Causes & Control. 2016;27:647-659. https://doi.org/10.1007/s10552-016-0738-1
6. You W, Henneberg R, Coventry BJ, Henneberg M. Cutaneous malignant melanoma incidence is strongly associated with European depigmented skin type regardless of ambient ultraviolet radiation levels: evidence from Worldwide population-based data. AIMS Public Health. 2022;9(2):378. https://doi.org/10.3934/publichealth.2022026
7. Muzumdar S, Lin G, Kerr P, Grant-Kels JM. Evidence concerning the accusation that melanoma is overdiagnosed. J Am Acad Dermatol. 2021;85(4):841-846. https://doi.org/10.1016/j.jaad.2021.06.010
8. Conforti C, Zalaudek I. Epidemiology and risk factors of melanoma: a review. Dermatol pract concept. 2021;11(S1):e2021161S. https://doi.org/10.5826/dpc.11S1a161S
9. Kutzner H, Jutzi TB, Krahl D, Krieghoff-Henning EI, Heppt MV, Hekler A, et al. Overdiagnosis of melanoma–causes, consequences and solutions. J Dtsch Dermatol Ges. 2020;18(11):1236-1243. https://doi.org/10.1111/ddg.14233
10. Whiteman DC, Green AC, Olsen CM. The growing burden of invasive melanoma: projections of incidence rates and numbers of new cases in six susceptible populations through 2031. J Investig Dermatol. 2016;136(6):1161-1171. https://doi.org/10.1016/j.jid.2016.01.035
11. Arnold M, Singh D, Laversanne M, Vignat J, Vaccarella S, Meheus F, et al. Global burden of cutaneous melanoma in 2020 and projections to 2040. JAMA Dermatol. 2022;158(5):495-503. https://doi.org/10.1001/jamadermatol.2022.0160
12. Yang DD, Borsky K, Jani C, Crowley C, Rodrigues JN, Matin RN, et al. Trends in keratinocyte skin cancer incidence, mortality and burden of disease in 33 countries between 1990 and 2017. Br J Dermatol. 2023;188(2):237-246. https://doi.org/10.1093/bjd/ljac064
13. Rogers HW, Weinstock MA, Feldman SR, Coldiron BM. Incidence estimate of nonmelanoma skin cancer (keratinocyte carcinomas) in the US population, 2012. JAMA dermatol. 2015;151(10):1081-1086. Available at: https://pubmed.ncbi.nlm.nih.gov/25928283/
14. Ragaini BS, Blizzard L, Newman L, Stokes B, Albion T, Venn A. Temporal trends in the incidence rates of keratinocyte carcinomas from 1978 to 2018 in Tasmania, Australia: a population-based study. Discov Oncol. 2021;12(1):30. https://doi.org/10.1007/s12672-021-00426-5
15. Hu W, Fang L, Ni R, Zhang H, Pan G. Changing trends in the disease burden of non-melanoma skin cancer globally from 1990 to 2019 and its predicted level in 25 years. BMC cancer. 2022;22(1):836. https://doi.org/10.1186/s12885-022-09940-3
16. Artosi F, Costanza G, Di Prete M, Garofalo V, Lozzi F, Dika E, et al. Epidemiological and clinical analysis of exposure-related factors in non-melanoma skin cancer: A retrospective cohort study. Environ Res. 2024;247:118117. Available at: https://pubmed.ncbi.nlm.nih.gov/38218521/
17. Xiang F, Lucas R, Hales S, Neale R. Incidence of nonmelanoma skin cancer in relation to ambient UV radiation in white populations, 1978-2012: empirical relationships. JAMA dermatol. 2014;150(10): 1063-1071. Available at: https://pubmed.ncbi.nlm.nih.gov/25103031/
18. Duarte AF, Sousa-Pinto B, Freitas A, Delgado L, Costa-Pereira A, Correia O. Skin cancer healthcare impact: A nation-wide assessment of an administrative database. Cancer Epidemiol. 2018;56:154-160. https://doi.org/10.1016/j.canep.2018.08.004
19. Mazzilli S, Chiara P, Costanza G, Petruzzellis A, Orlandi A, Bianchi L, et al. Overview of germline and somatic genetic alterations in basal and squamous cell carcinoma: a review of the current literature. Eur J Dermatol. 2021;31:447-456. https://doi.org/10.1684/ejd.2021.4092
20. Savoye I, Olsen CM, Whiteman DC, Bijon A, Wald L, Dartois L, et al. Patterns of ultraviolet radiation exposure and skin cancer risk: the E3N-SunExp study. J Epidemiol. 2018;28(1):27-33. https://doi.org/10.2188/jea.JE20160166
21. Guy GP, Holman DM, Watson M. The important role of schools in the prevention of skin cancer. JAMA dermatol. 2016;152(10): 1083-1084. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC6048593/
22. LoConte NK, Gershenwald JE, Thomson CA, Crane TE, Harmon GE, Rechis R. Lifestyle modifications and policy implications for primary and secondary cancer prevention: diet, exercise, sun safety, and alcohol reduction. Am Soc Oncol Educ Book. 2018;38:88-100. https://doi.org/10.1200/EDBK_200093

https://doi.org/10.61577/amsd.2025.100004