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Skin Cancer in Individuals with Oculocutaneous Albinism in Sub-Saharan African Populations: A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)-Based Literature Review

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Abstract

Introduction: Oculocutaneous Albinism (OCA) is an inherited genetic disorder characterized by reduced or absent melanin production. In sub-Saharan Africa, the prevalence of OCA is substantially higher than in most other regions of the world. Melanin deficiency markedly increases susceptibility to the carcinogenic effects of Ultraviolet (UV) radiation, resulting in an exceptionally high burden of skin cancer.

Objectives: To critically review the available literature on the epidemiology, clinicopathological characteristics, risk factors, prevention and management of skin cancer in individuals with oculocutaneous albinism in sub-Saharan Africa.

Methods: A structured narrative review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Observational studies, retrospective and cross-sectional studies, systematic reviews, meta-analyses and clinical case series published in English were identified through a comprehensive search of the PubMed/MEDLINE and Europe PMC databases. Studies investigating skin cancer in individuals with oculocutaneous albinism in sub-Saharan Africa were included.

Results: Squamous Cell Carcinoma (SCC) is the predominant cutaneous malignancy among individuals with albinism in sub-Saharan Africa. A recent systematic review and meta-analysis reported a pooled prevalence of 64% for SCC and 31% for Basal Cell Carcinoma (BCC) among histologically confirmed malignant skin lesions. Tumors occur predominantly on chronically sun-exposed areas, particularly the head and neck and develop at a significantly younger age than in predominantly Caucasian populations. Delayed diagnosis, limited access to specialized healthcare services and inadequate photoprotection substantially contribute to the high disease burden.

Conclusion: Skin cancer remains one of the leading causes of preventable morbidity and mortality among individuals with oculocutaneous albinism in sub-Saharan Africa. Comprehensive prevention strategies-including effective photoprotection, health education, regular dermatological screening and timely access to surgical treatment-are essential to reduce disease burden and improve clinical outcomes. Strengthening healthcare systems and expanding access to specialized dermatological and oncological services should be considered public health priorities throughout the region.

Keywords: Oculocutaneous Albinism; Sub-Saharan Africa; Squamous Cell Carcinoma; Basal Cell Carcinoma; Skin Cancer; Ultraviolet Radiation

Introduction

Oculocutaneous Albinism (OCA) comprises a heterogeneous group of autosomal recessive genetic disorders characterized by a quantitative or qualitative reduction in melanin production. Melanin serves as the primary biological defense against the mutagenic effects of Ultraviolet (UV) radiation. Its deficiency results in increased susceptibility to chronic photodamage and the development of cutaneous malignancies.

Sub-Saharan Africa has one of the highest prevalence of OCA worldwide. In some populations, the prevalence has been reported to range from 1 in 1,000 to 1 in 5,000 individuals, substantially higher than that observed in European and North American populations. OCA type 2 (OCA2) is the most common genetic subtype across the African continent [1].

Skin cancer is one of the most serious medical complications associated with albinism and is a major cause of premature mortality. Numerous studies from Tanzania, Nigeria, South Africa, Zimbabwe and Malawi have documented an exceptionally high incidence of keratinocyte carcinomas among this vulnerable population.

Methodology

Study Design

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A comprehensive literature search was performed using the PubMed/MEDLINE and Europe PMC databases, including indexed scientific literature published through 2025. The search strategy combined the following keywords: "oculocutaneous albinism," "African albinos," "skin cancer," "cutaneous squamous cell carcinoma," "basal cell carcinoma," "sub-Saharan Africa," and "ultraviolet radiation".

Inclusion Criteria

Studies were eligible for inclusion if they met one or more of the following criteria:

- Observational studies
- Cross-sectional studies
- Retrospective studies
- Systematic reviews
- Meta-analyses
- Studies involving African populations with Oculocutaneous Albinism (OCA)

Exclusion Criteria

The following studies were excluded:

- Studies lacking histopathological confirmation
- Isolated case reports
- Articles not relevant to the review topic

Study Limitations

Although the review was conducted according to the PRISMA framework, the available evidence is predominantly derived from observational, retrospective and cross-sectional studies, many of which originate from single institutions or referral centers. Consequently, the overall quality of evidence remains moderate and the potential for selection bias cannot be excluded.

Furthermore, because of the observational nature of the available evidence, causal relationships between specific risk factors and skin cancer outcomes cannot be definitively established. Future prospective multicenter studies, population-based cancer registries and standardized reporting across African countries are needed to improve the quality of evidence and provide more robust epidemiological estimates.

Epidemiology of Oculocutaneous Albinism and Skin Cancer in African Populations

Sub-Saharan Africa has the highest prevalence of Oculocutaneous Albinism (OCA) worldwide. The most recent global systematic review on the epidemiology of albinism, which included 34 original studies from six continents, found that 44% of the available

publications were conducted in African populations. The estimated mean prevalence in African countries with large population-based studies is approximately 1 in 4,264 individuals, with reported values ranging from 1 in 1,755 to 1 in 7,900. However, in genetically isolated populations or communities with a strong founder effect, the prevalence may reach exceptionally high levels, up to 1 in 1,000 individuals (Fig. 1) [1].

Figure 1: Albino mother with her child in Democratic Republic of Congo and Albino mother with her child in Tanzania.

Tanzania

Tanzania is the African country most extensively investigated regarding the dermatological complications of albinism. The prevalence of OCA is estimated at approximately 1 in 2,500 individuals, one of the highest rates reported worldwide. Early epidemiological studies demonstrated that the risk of skin cancer in individuals with albinism may be up to 1,000-fold higher than that of the normally pigmented African population [2,3].

The histopathological study by Kiprono, et al., analyzed 134 skin tumors from 86 individuals with albinism and showed that 56% of tumors occurring in the head and neck region. Squamous Cell Carcinoma (SCC) was more frequent than basal cell carcinoma (BCC), with an SCC-to-BCC ratio of 1.2:1 [2].

An additional clinical series from Bugando Medical Centre reported 64 consecutive cases of skin cancer in individuals with albinism, confirming the high mortality associated with delayed diagnosis and limited access to specialized medical care [4].

Zimbabwe

Zimbabwe has one of the highest reported prevalences of albinism worldwide. Among the Tonga population of the Zambezi Valley, the prevalence has been estimated at approximately 1 in 1,000 individuals, representing one of the clearest documented examples of a founder effect in human albinism [1,2].

Most affected individuals develop extensive actinic skin damage during the second decade of life and numerous cases of SCC are diagnosed before the age of 40 years.

South Africa

In South Africa, OCA type 2 (OCA2) is the predominant genetic form of albinism. Epidemiological studies reported a prevalence of approximately 1 in 3,900-4,000 individuals among the Black South African population [1,5].

The landmark study by Kromberg, et al., involving 111 Black South Africans with albinism living in Johannesburg, demonstrated an exceptionally high prevalence of chronic actinic damage and skin cancer, highlighting the central role of ultraviolet radiation in cutaneous carcinogenesis within this population [5].

Namibia

Namibia is one of the few African countries with nationwide epidemiological data derived from census-based surveys. The reported prevalence is approximately 1 in 1,755 individuals, representing the highest national prevalence documented in Africa through a population-based study [1].

The country's high annual solar irradiance and desert environment contribute substantially to the severe burden of chronic photodamage observed among individuals with albinism.

Botswana

In Botswana, the prevalence of albinism has been estimated at approximately 1 in 1,307 individuals within an isolated Tswana population and approximately 1 in 4,800 in the general population [1]. In this setting, SCC remains the leading cause of cancer-related morbidity among individuals with albinism.

Nigeria

Nigeria provides the principal epidemiological reference for West Africa. Available data demonstrate marked geographic variation:

- Lagos: approximately 1 in 2,858 individuals
- Benin City: approximately 1 in 7,000 individuals
- East Central State: approximately 1 in 15,000 individuals
- Isolated Igbo populations: approximately 1 in 1,100 individuals [1]

Clinical series consistently demonstrate a marked predominance of SCC. The risk of SCC among African individuals with albinism has been estimated to be up to 1,000-fold higher than that of the general population [6].

Camerun

In Camerun, the prevalence of albinism varies considerably among different ethnic groups. Among the Bamileke population, reported prevalence ranges from approximately 1 in 7,900 to 1 in 11,900 individuals, whereas the estimated national prevalence is approximately 1 in 28,000 [1].

These findings underscore the importance of genetic factors and local population structure in determining the distribution of OCA.

Zambia, Malawi, Kenya, Uganda and Mozambique

For these countries, available evidence is derived primarily from clinical studies and indirect estimates obtained through regional healthcare programs. Although albinism is widely recognized as an important public health issue, robust nationwide prevalence studies remain scarce (Fig. 2) [1,7].

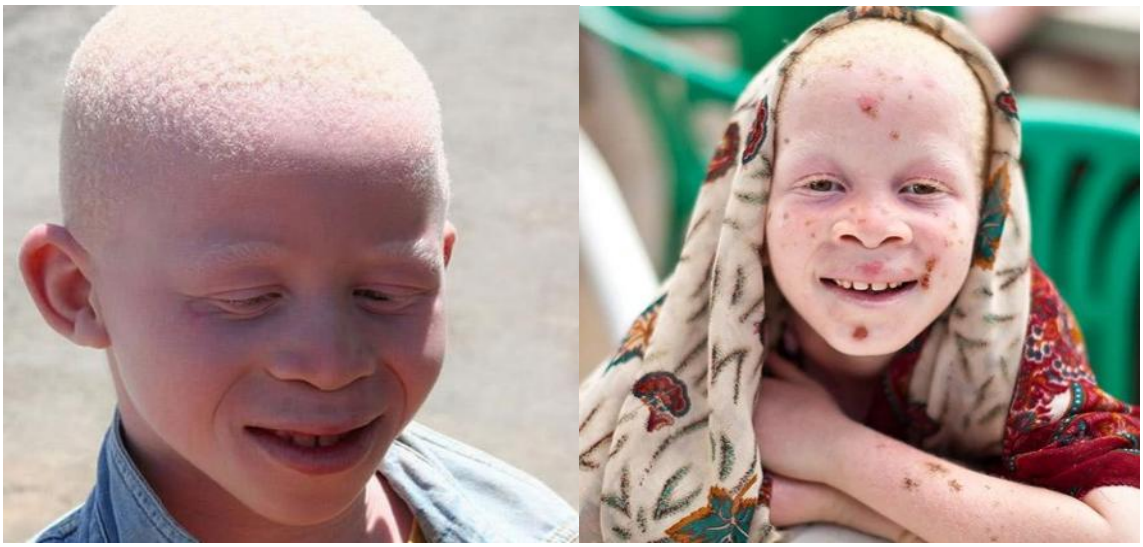

Figure 2: Patient with OCA from Malawi and patient with OCA from Tanzania.

Nevertheless, all available case series consistently report a high prevalence of actinic keratoses, early onset of SCC, frequent involvement of the face, neck and scalp and substantial mortality associated with delayed diagnosis.

Distribution of Skin Cancer Across Sub-Saharan Africa

The most recent meta-analysis, including 695 histologically confirmed skin cancers from 540 African individuals with albinism across multiple sub-Saharan countries, reported:

- 419 squamous cell carcinomas
- 249 basal cell carcinomas
- pooled prevalence of SCC: 64% (95% CI, 50-77%)
- pooled prevalence of BCC: 31% (95% CI, 19-45%) [8]

This distribution differs from that observed in predominantly Caucasian populations, in which basal cell carcinoma is generally the most common cutaneous malignancy.

Age at Onset and Mortality

An important characteristic of skin cancer in African individuals with albinism is its remarkably early onset. Numerous studies from Tanzania, Nigeria and South Africa have reported precancerous lesions developing during adolescence and invasive carcinomas occurring as early as the third or fourth decade of life. In the absence of effective prevention programs and early detection strategies, skin cancer remains one of the leading causes of premature mortality in this vulnerable population [2,5,7].

Country/Population	Reported Prevalence
Namibia	1:1,755
Zimbabwe (Tonga population)	1:1,000
Botswana (isolated Tswana population)	1:1,307
Tanzania	1:2,500
Nigeria (Lagos)	1:2,858
South Africa	1:3,900-4,000
Cameroon (Bamileke population)	1:7,900-11,900
Nigeria (East Central State)	1:15,000
Cameroon (national estimate)	1:28,000

Table 1: Reported prevalence of oculocutaneous albinism in selected African countries.

Pathogenesis of Cutaneous Carcinoma

Cutaneous carcinogenesis in individuals with Oculocutaneous Albinism (OCA) results from a complex interplay between genetic susceptibility and chronic environmental exposure, particularly to Ultraviolet (UV) radiation. The defining feature of OCA is a marked reduction or complete absence of melanin, the primary pigment responsible for the skin's physiological photoprotection. Under normal conditions, melanin absorbs and scatters a substantial proportion of UV radiation, thereby limiting UV-induced DNA damage in keratinocytes and melanocytes. In individuals with OCA, this protective mechanism is severely compromised, leaving epidermal cells directly exposed to the mutagenic effects of ultraviolet radiation, especially UVB wavelengths [2,6].

Chronic exposure to UV radiation promotes the formation of DNA photoproducts, principally Cyclobutane Pyrimidine Dimers (CPDs) and 6-4 pyrimidine-pyrimidone photoproducts (6-4PPs). When these lesions are not efficiently repaired by the Nucleotide Excision Repair (NER) pathway, they accumulate over time, leading to progressive acquisition of somatic mutations. Concurrently, UVA radiation induces the generation of Reactive Oxygen Species (ROS), which cause oxidative damage to DNA, proteins and cellular membranes. This oxidative stress further exacerbates genomic instability and promotes malignant transformation (Fig. 3) [9,10].

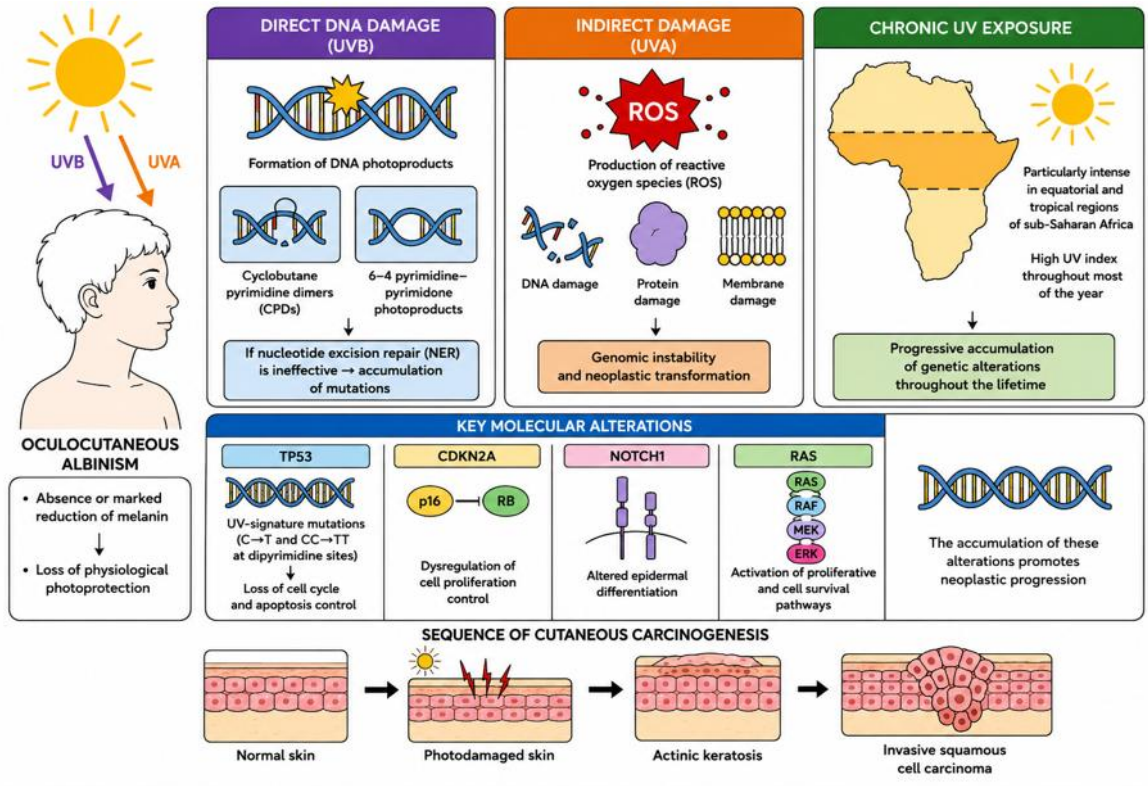

Figure 3: Pathogenesis of cutaneous carcinoma.

Among the molecular alterations implicated in UV-induced carcinogenesis, mutations in the tumor suppressor gene *TP53* represent one of the earliest and most critical events. These mutations typically exhibit the characteristic UV mutational signature, consisting of C→T and CC→TT transitions at dipyrimidine sites. Loss of *TP53* function disrupts cell-cycle control, impairs DNA damage-induced apoptosis and permits the survival and clonal expansion of genetically altered keratinocytes. As a result, *TP53* inactivation is widely recognized as a key initiating event in the multistep progression from chronically photodamaged skin to actinic keratosis and, ultimately, invasive cutaneous Squamous Cell Carcinoma (SCC) [11,12].

Beyond *TP53*, multiple molecular pathways contribute to UV-mediated skin carcinogenesis. Alterations involving *CDKN2A*, *NOTCH1* and members of the *RAS* signaling pathway have been implicated in the dysregulation of cell-cycle progression, epidermal differentiation, cellular senescence and DNA damage responses, thereby facilitating neoplastic transformation and tumor progression. The cumulative acquisition of these genetic alterations is driven by lifelong ultraviolet exposure, a process that is particularly accelerated in equatorial and tropical regions of sub-Saharan Africa, where solar UV radiation remains consistently intense and the UV index is persistently high throughout most of the year [9,11].

From a histopathological perspective, cutaneous carcinogenesis generally follows a well-recognized sequence characterized by the development of solar elastosis and multiple actinic keratoses, which are regarded as premalignant lesions capable of progressing to invasive SCC. This process is markedly accelerated in individuals with albinism, in whom actinic lesions may develop during childhood or adolescence, while invasive carcinomas are frequently diagnosed during the third or fourth decade of life-approximately two to three decades earlier than in fair-skinned Caucasian populations exposed to comparable levels of solar radiation [2,4].

The combination of intense ultraviolet radiation, complete or near-complete absence of melanin, predominantly outdoor occupations and limited access to effective photoprotective measures makes African individuals with albinism one of the human populations at the highest risk of cutaneous carcinogenesis described in the medical literature [4,6].

Types of Skin Cancer

Squamous Cell Carcinoma

Squamous Cell Carcinoma (SCC) is the most common cutaneous malignancy among individuals with Oculocutaneous Albinism (OCA) in sub-Saharan Africa and is responsible for the majority of skin cancer-related morbidity and mortality in this population. A recent systematic review and meta-analysis, which included 695 histologically confirmed skin cancers diagnosed in 540 African individuals with albinism, reported a pooled prevalence of 64% for SCC. These findings confirm the clear predominance of SCC over Basal Cell Carcinoma (BCC) in this population, a distribution that contrasts sharply with that observed in predominantly fair-skinned Caucasian populations, where BCC represents the most frequent keratinocyte carcinoma [4].

SCC typically arises in chronically photodamaged skin and often develops through a well-established sequence of precancerous changes involving multiple actinic keratoses, keratinocytic dysplasia and carcinoma in situ before progressing to invasive disease. The most commonly affected sites are chronically sun-exposed areas, including the face, scalp, ears, neck, shoulders and dorsal aspects of the hands, where cumulative ultraviolet radiation promotes the progressive accumulation of genetic alterations in keratinocytes [2,8].

Clinically, SCC most commonly presents as an indurated erythematous plaque or an ulcerated nodular lesion with raised margins, frequently covered by crusts and prone to spontaneous bleeding. In many African settings, diagnosis is often delayed until the tumor has reached an advanced stage, with extensive infiltration of soft tissues and, in severe cases, invasion of the underlying bone.

Compared with immunocompetent Caucasian patients, SCC in African individuals with albinism exhibits a more aggressive biological behavior, characterized by increased local invasiveness, a higher risk of local recurrence and a greater propensity for regional lymph node metastasis. This aggressive course reflects not only continuous ultraviolet exposure but also delayed diagnosis, limited availability of specialist care and restricted access to surgical treatment, all of which contribute substantially to the high mortality reported in numerous African case series [2,8,13].

Basal Cell Carcinoma

Basal Cell Carcinoma (BCC) is the second most common cutaneous malignancy in individuals with Oculocutaneous Albinism (OCA) in sub-Saharan Africa. A systematic review and meta-analysis by Onyishi and Ohayi, which included 695 histologically confirmed skin cancers from 540 African individuals with albinism, reported a pooled prevalence of 31%, confirming that BCC occurs substantially less frequently than Squamous Cell Carcinoma (SCC) in this population. This distribution contrasts markedly with that observed in predominantly fair-skinned Caucasian populations, in whom BCC is the most common keratinocyte carcinoma (Fig. 4) [4].

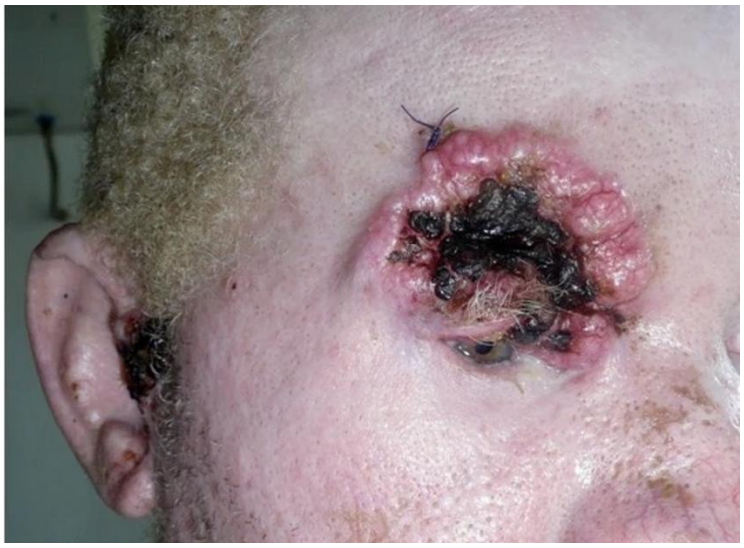

Figure 4: Supraorbital ulcerated, nodular basal cell carcinoma and an ulcerated preauricular squamous cell carcinoma in a 23 years old African albino (Kiprono, S.K. et al.)

Similar to SCC, the development of BCC is strongly associated with cumulative Ultraviolet (UV) radiation exposure and tumors arise predominantly on chronically sun-exposed sites, including the face, nasal dorsum, periorbital region, cheeks, forehead, ears and neck. Clinically, BCC typically presents as a slowly enlarging translucent papule or pearly nodule with rolled borders and superficial telangiectasias. Depending on the histological subtype, lesions may be pigmented, ulcerated or both. If left untreated, some tumors progress to an infiltrative ulcerative form, historically referred to as *ulcus rodens*, characterized by progressive local tissue destruction.

Although BCC has a very low metastatic potential, it is characterized by marked local invasiveness and can progressively infiltrate the dermis, subcutaneous tissue, cartilage, and, in advanced cases, the underlying facial bones. Among African individuals with OCA, this destructive behavior is frequently compounded by delayed diagnosis, inadequate photoprotection and limited access to specialized dermatological and surgical care, allowing tumors to attain considerable size before definitive treatment.

The most frequently encountered histological subtypes of BCC are nodular, superficial and infiltrative, with the infiltrative subtype exhibiting a more aggressive growth pattern, a higher propensity for deep tissue invasion and an increased risk of local recurrence following surgical excision. Prognosis is generally excellent when tumors are diagnosed early and completely excised with histologically tumor-free margins. However, despite its low metastatic potential, BCC remains a significant cause of cosmetic disfigurement and functional impairment in individuals with oculocutaneous albinism living in sub-Saharan Africa, where intense year-round ultraviolet radiation, delayed diagnosis and limited access to specialized care often contribute to the development of locally advanced disease (Fig. 5) [2,6,8,18].

Figure 5: Albino patient with an ulcerated BCC.

Melanoma

Cutaneous melanoma is uncommon among individuals with Oculocutaneous Albinism (OCA) in sub-Saharan Africa and accounts for only a small proportion of skin cancers reported in this population. Despite their extreme susceptibility to Ultraviolet (UV)-induced DNA damage, African case series consistently demonstrate a marked predominance of keratinocyte carcinomas, whereas melanoma has been documented only in isolated cases or small clinical series [2,4]. This apparent paradox is thought to reflect the profound reduction in melanocyte function and melanin synthesis that characterizes OCA. While melanin deficiency markedly increases the susceptibility of keratinocytes to UV-induced carcinogenesis, it may also alter melanocyte biology in ways that reduce the incidence of melanoma. However, the molecular mechanisms underlying melanomagenesis in individuals with albinism remain poorly understood, largely because available evidence is limited to case reports and small retrospective studies [6].

When melanoma does occur, it most frequently arises on acral sites, including the palms, soles and subungual regions, where it typically presents as acral lentiginous melanoma, a histological subtype that is largely independent of chronic UV exposure and occurs more commonly in African than in European populations [19]. Nevertheless, melanomas arising on chronically sun-exposed sites, including the face and trunk, have also been reported, suggesting that ultraviolet radiation may contribute to the malignant transformation of residual melanocytes in individuals with OCA [20].

Clinically, melanoma in individuals with albinism often differs from conventional pigmented melanoma by presenting as hypopigmented or completely amelanotic lesions. The absence of characteristic pigmentation may delay both clinical recognition and dermoscopic diagnosis, increasing the risk of misdiagnosis as keratinocyte carcinoma, chronic ulceration or other benign or malignant dermatological conditions [6,20].

Although melanoma contributes far less to the overall burden of skin cancer than Squamous Cell Carcinoma (SCC) or Basal Cell Carcinoma (BCC), prognosis remains highly dependent on early detection and complete surgical excision. In sub-Saharan Africa, delayed presentation, limited access to specialist dermatological services and the lack of structured skin cancer screening programs frequently result in diagnosis at more advanced stages, adversely affecting clinical outcomes. Consequently, any new pigmented, hypopigmented or amelanotic lesion demonstrating progressive enlargement, ulceration, spontaneous bleeding or other suspicious clinical features should undergo prompt biopsy with histopathological examination to exclude melanoma [2,20].

Histopathological Evidence

The histopathological characteristics of skin cancer in individuals with Oculocutaneous Albinism (OCA) have been comprehensively described in a retrospective study conducted by Kiprono and colleagues at the Regional Dermatology Training Centre (RDTC) in Moshi, Tanzania, one of the principal referral centers for dermatological diseases in sub-Saharan Africa. Over a 10-year period, the investigators analyzed 134 biopsy specimens obtained from 86 individuals with albinism and histologically confirmed skin cancer, constituting one of the largest clinicopathological series reported from the region [2].

Histopathological analysis demonstrated a clear predominance of Squamous Cell Carcinoma (SCC), with Basal Cell Carcinoma (BCC) representing the second most frequent malignancy. This distribution is consistent with findings from multiple studies across sub-Saharan Africa and contrasts sharply with that observed in predominantly fair-skinned populations, in whom BCC is the most common keratinocyte carcinoma. Melanoma was exceptionally uncommon and identified only in isolated cases, further highlighting the distinctive epidemiological profile of skin cancer in African individuals with OCA [2,4].

The anatomical distribution of tumors closely reflected patterns of cumulative Ultraviolet (UV) exposure. More than half of all lesions (56%) occurred within the head and neck region, including the scalp, forehead, face, ears and neck. The remaining tumors were located predominantly on other chronically sun-exposed sites, particularly the shoulders, dorsal aspects of the hands and forearms. This distribution provides further evidence for the central role of chronic solar UV radiation in the pathogenesis of skin cancer among individuals with OCA [2].

Histologically, most SCCs were well differentiated, characterized by abundant keratinization and prominent keratin pearl formation, indicating preservation of squamous differentiation. Despite these relatively favorable histological features, many tumors exhibited extensive local invasion at the time of diagnosis, reflecting prolonged delays in presentation and limited access to specialist care. In advanced cases, neoplastic infiltration extended beyond the deep dermis into the subcutaneous tissue and occasionally, involved underlying cartilage and bone [2,8].

Collectively, these findings provide compelling histopathological evidence that chronic ultraviolet radiation is the principal etiological driver of skin cancer in African individuals with OCA. The near-complete absence of melanin-mediated photoprotection, combined with lifelong exposure to intense equatorial and tropical solar radiation, promotes the cumulative accumulation of UV-induced DNA damage, leading to the development of multiple premalignant lesions and invasive keratinocyte carcinomas. The clinicopathological observations reported by Kiprono, et al., therefore offer strong evidence supporting chronic photocarcinogenesis as the fundamental pathogenic mechanism underlying skin cancer in this highly vulnerable population [2,4,8].

Risk Factors

The development of skin cancer in individuals with Oculocutaneous Albinism (OCA) results from a complex interplay of biological, environmental and socioeconomic factors that collectively drive cutaneous carcinogenesis. The principal biological determinant is the marked reduction or complete absence of epidermal melanin resulting from the genetic defects underlying OCA. Melanin serves as the skin's primary physiological defense against Ultraviolet (UV) radiation by absorbing and scattering incident UV photons, thereby limiting the formation of UV-induced DNA damage in epidermal cells. In individuals with OCA, this protective mechanism is profoundly compromised, rendering keratinocytes highly susceptible to the mutagenic effects of chronic solar exposure [3,6]. Their extremely fair phototype, minimal tanning capacity and heightened susceptibility to sunburn further increase the risk of UV-induced carcinogenesis. Although OCA is not classified as a hereditary cancer predisposition syndrome, the genetically determined deficiency of melanin constitutes the fundamental biological substrate upon which environmental carcinogenic factors exert their effects.

Among environmental determinants, chronic exposure to ultraviolet radiation is the predominant risk factor. Across much of sub-Saharan Africa, the UV index remains consistently high throughout the year, resulting in substantial cumulative UV exposure beginning in early childhood. This risk is further amplified by the predominantly outdoor occupations of many individuals with OCA, including farming, livestock rearing, fishing, construction work and street vending, all of which entail prolonged daily exposure to intense sunlight with little or no effective photoprotection. Over time, cumulative UV exposure promotes the progressive accumulation of DNA damage and somatic mutations in keratinocytes, accelerating the transition from actinic keratoses and other premalignant lesions to invasive keratinocyte carcinomas [2,4].

Socioeconomic determinants further amplify both the incidence and adverse outcomes of skin cancer in this population. In many countries across sub-Saharan Africa, poverty substantially limits access to broad-spectrum high-Sun Protection Factor (SPF) sunscreens, UV-protective clothing and wide-brimmed hats, all of which are essential components of primary prevention. These challenges are compounded by the limited availability of specialized dermatological services, particularly in rural and underserved areas, where shortages of trained healthcare professionals, diagnostic facilities and pathology services frequently delay the diagnosis and treatment of premalignant lesions and early-stage skin cancers. Consequently, many patients present with locally advanced disease requiring extensive surgical resection, which is associated with increased morbidity, a greater likelihood of local recurrence, and, in the case of squamous cell carcinoma, an elevated risk of regional metastasis.

The convergence of profound biological susceptibility, lifelong exposure to intense solar ultraviolet radiation and substantial disparities in access to preventive measures and healthcare places African individuals with OCA among the populations at highest risk of skin cancer worldwide. These observations underscore the need for comprehensive public health strategies that integrate photoprotection, community education, regular dermatological surveillance and timely access to specialized diagnostic and therapeutic services in order to reduce the burden of skin cancer in this highly vulnerable population [1,3,8].

Clinical Features

The clinical manifestations of chronic photodamage in individuals with Oculocutaneous Albinism (OCA) encompass a continuous spectrum ranging from early actinic injury to invasive cutaneous malignancy. In sub-Saharan Africa, the earliest signs of chronic photodamage frequently appear during childhood or adolescence, considerably earlier than in normally pigmented populations. Initial manifestations include solar elastosis, characterized by reduced skin elasticity, coarse wrinkling and thickening of chronically sun-exposed skin. These changes are commonly accompanied by multiple actinic keratoses, the principal precursor lesions of cutaneous Squamous Cell Carcinoma (SCC). Actinic cheilitis of the lower lip is also frequently observed and presents with epithelial atrophy, persistent scaling and fissuring, leukoplakia and chronic ulceration that fails to respond to conventional therapy, warranting prompt histopathological evaluation because of its well-recognized potential for malignant transformation [2,6,8]. With continued Ultraviolet (UV) exposure, invasive skin cancers progressively develop, typically presenting as enlarging ulcerated nodules, indurated infiltrative plaques with irregular margins, exophytic friable masses or extensive necrotic lesions that are frequently complicated by secondary bacterial infection. Tumors arise predominantly on chronically sun-exposed sites, particularly the face, scalp, ears, neck and dorsal aspects of the hands. Owing to delayed diagnosis, many lesions have already reached a locally advanced stage at presentation, with invasion of the dermis, subcutaneous tissue, cartilage, and, in severe cases, the craniofacial skeleton, necessitating extensive ablative surgery followed by complex reconstructive procedures [2,4].

Delayed diagnosis remains one of the most important determinants of prognosis in African individuals with OCA. In many rural regions of sub-Saharan Africa, the absence of organized dermatological surveillance programs, limited availability of dermatologists and pathology services, inadequate diagnostic infrastructure and restricted access to healthcare facilities contribute to presentation at advanced stages of disease. These healthcare limitations are further compounded by poverty, transportation costs, inadequate transport infrastructure, limited awareness of the early clinical manifestations of skin cancer and the persistent social stigma associated with albinism in some communities. Together, these factors substantially delay medical consultation and treatment, adversely affecting clinical outcomes [1,3].

Although several countries have implemented programs that provide free sunscreen, promote photoprotection through public education and offer skin cancer screening, these initiatives remain fragmented and are largely concentrated in urban areas, leaving many rural populations underserved. Consequently, primary and secondary prevention strategies remain insufficient to address the substantial burden of skin cancer among individuals with OCA, contributing to persistent disparities in access to dermatological, surgical and oncological care [1,3,22].

Within this context, humanitarian medical missions organized by non-governmental organizations, academic institutions and international professional societies have assumed an increasingly important role in the delivery of skin cancer care. In collaboration with local healthcare providers, these initiatives facilitate large-scale dermatological examinations, skin cancer screening, diagnostic biopsies, surgical treatment, distribution of photoprotective resources and educational programs for patients, families and healthcare workers. Experiences from Tanzania, Malawi, Mozambique and other countries in East Africa have demonstrated that such missions enable the identification and treatment of numerous premalignant lesions and early-stage skin cancers that might otherwise remain undiagnosed until they become locally advanced. Nevertheless, the literature consistently emphasizes that humanitarian missions cannot substitute for adequately resourced national healthcare systems. Rather, they should be regarded as complementary interventions that strengthen local clinical capacity, support continuing professional education and facilitate the development of sustainable programs for skin cancer prevention, early detection, treatment and long-term dermatological surveillance [1,3,22,23].

Treatment

The management of skin cancer in individuals with Oculocutaneous Albinism (OCA) is based on the same oncological principles applied to the general population but presents unique challenges related to the high burden of multiple lesions, frequent delays in diagnosis and the limited healthcare resources available in many countries of sub-Saharan Africa. Optimal management requires a multidisciplinary approach involving dermatologists, plastic surgeons, surgical oncologists, pathologists, radiation oncologists and medical oncologists, with the goals of achieving local disease control, preserving function and minimizing the risk of recurrence [2,6].

Surgical excision remains the treatment of choice for most non-melanoma skin cancers. Complete excision with histologically tumor-free margins is the standard of care for both Squamous Cell Carcinoma (SCC) and Basal Cell Carcinoma (BCC), providing definitive treatment for the majority of patients when tumors are diagnosed at an early stage. However, among African individuals with OCA, skin cancers are frequently diagnosed at an advanced stage, often requiring extensive resections involving the ears, nose, eyelids, lips or scalp. In such cases, complex reconstructive procedures using local or regional flaps or split-thickness skin grafts, are often necessary to restore both function and acceptable cosmetic outcomes. In patients with high-risk SCC, careful clinical and radiological evaluation of the regional lymph nodes is recommended, as nodal involvement is one of the strongest adverse prognostic factors [2,8,21].

Radiotherapy is an important therapeutic option for patients with locally advanced tumors that are unsuitable for curative surgical resection, for tumors with positive surgical margins that cannot be re-excised or as adjuvant treatment in the presence of perineural invasion, deep tissue infiltration or regional lymph node metastasis. It may also be administered with palliative intent to control pain, bleeding and ulceration in patients with advanced disease. However, access to radiotherapy remains severely limited in many African countries, resulting in substantial geographic disparities in the availability of this treatment modality [24].

Recent advances in medical oncology have significantly expanded the therapeutic options available for advanced skin cancers. Patients with metastatic or unresectable locally advanced SCC who are not candidates for surgery or radiotherapy may benefit from systemic therapy, including conventional chemotherapy and, more importantly, immune checkpoint inhibitors targeting programmed cell Death Protein 1 (PD-1), such as cemiplimab and pembrolizumab, which have demonstrated significant improvements in objective response rates, progression-free survival and overall survival. For patients with locally advanced or metastatic BCC, inhibitors of the Hedgehog signaling pathway, including vismodegib and sonidegib, constitute the standard systemic treatment, whereas immunotherapy may be considered in selected patients with disease that is refractory to Hedgehog pathway inhibition or other conventional therapies [25-27].

Despite these major therapeutic advances, access to modern oncological treatments remains extremely limited throughout much of sub-Saharan Africa. The high cost of novel anticancer agents, the limited availability of specialized oncology centers, shortages of pathology and molecular diagnostic services and the challenges associated with establishing multidisciplinary cancer care pathways represent major barriers to the implementation of contemporary treatment strategies. Consequently, surgery remains the cornerstone of skin cancer management in routine clinical practice across most African settings. This reality underscores that improving outcomes for individuals with OCA depends not only on advances in cancer therapy but also on strengthening prevention programs, promoting early diagnosis, expanding access to specialized care and reinforcing local healthcare systems-interventions that are likely to be both more effective and more sustainable than reliance on advanced oncological therapies alone [6,24,27].

Prevention

Prevention represents the cornerstone of clinical management for individuals with Oculocutaneous Albinism (OCA) and remains the most effective strategy for reducing the incidence of skin cancer, cancer-related mortality and the need for extensive surgical interventions. Unlike many other malignancies, the major risk factor in this population is a modifiable environmental exposure-Ultraviolet (UV) radiation-making primary prevention achievable through consistent and effective photoprotective measures [3,6].

Photoprotection should begin in early childhood and include the daily use of broad-spectrum sunscreen with a Sun Protection Factor (SPF) of 50 or higher, with reapplication throughout the day, particularly after sweating or prolonged outdoor exposure. Sunscreen use should be combined with additional protective measures, including wide-brimmed hats, tightly woven long-sleeved clothing, UV-protective sunglasses and avoidance of direct sunlight during peak UV radiation hours. The consistent adoption of these behaviors can substantially reduce chronic photodamage and the development of premalignant lesions [2,6].

Health education is an essential component of prevention and represents one of the most sustainable long-term interventions in sub-Saharan Africa. In many rural communities, limited sunscreen use reflects not only financial barriers but also insufficient awareness of its medical importance. In some settings, sunscreen continues to be perceived primarily as a cosmetic product rather than as an essential preventive intervention for individuals with albinism. Furthermore, even when photoprotective products are available, their use is often inconsistent, with application restricted to periods of intense sun exposure rather than maintained as a lifelong daily practice. Educational initiatives should therefore involve individuals with albinism, their families, teachers, healthcare professionals and community leaders to reinforce the role of photoprotection as a fundamental component of skin cancer prevention [1,3].

School-based educational programs for children and adolescents with albinism can promote the early adoption of sun-protective behaviors while contributing to the reduction of stigma associated with the condition. In parallel, strengthening the ability of primary healthcare providers to identify premalignant lesions and early skin cancers is essential for timely referral and treatment. Regular dermatological surveillance, including at least annual skin examinations and more frequent assessments for individuals at particularly high risk, facilitates the early detection of actinic keratoses and skin cancers, when treatment is generally less invasive and associated with better outcomes [2,8].

The effectiveness of integrated prevention programs has been demonstrated in community-based initiatives in Tanzania and South Africa, where the combination of sunscreen distribution, educational interventions and regular dermatological assessments improved the detection of premalignant lesions and early-stage cancers. Although these programs have generally

been implemented on a limited geographical scale, they demonstrate that relatively simple and cost-effective strategies can substantially improve outcomes in populations with albinism [1,8].

Based on current evidence, skin cancer prevention among individuals with OCA should be considered a public health priority throughout sub-Saharan Africa. National strategies should promote access to high-SPF sunscreen, support free or subsidized distribution programs where feasible and prioritize sustainable education initiatives focused on lifelong photoprotection. When integrated with regular dermatological surveillance, early diagnosis programs and strengthened primary healthcare systems, these measures have the potential to significantly reduce the burden of skin cancer in this highly vulnerable population [1-3,6,8].

Public Health Implications

Oculocutaneous Albinism (OCA) is a complex genetic condition whose impact extends far beyond its clinical manifestations, representing a major public health challenge with medical, social, cultural and human rights implications. In sub-Saharan Africa, individuals with albinism face not only an exceptionally high risk of skin cancer but also profound social vulnerabilities that can adversely affect quality of life, access to healthcare and long-term outcomes. Consequently, addressing the burden of OCA requires a multidisciplinary and intersectoral approach integrating medical care with educational, social and human rights interventions [3,6].

In many African communities, persistent cultural beliefs and misconceptions continue to associate albinism with supernatural or mystical meanings. These beliefs contribute to discrimination, stigmatization and social exclusion, often beginning during childhood. Children with albinism may encounter significant barriers to education due to both the visual impairment associated with the condition and experiences of bullying, marginalization and discrimination. Reduced educational attainment can subsequently limit employment opportunities, reinforce socioeconomic disadvantage and further restrict access to preventive measures and healthcare services [1,3,28].

Occupational exposure represents another important public health challenge. In many socioeconomic contexts across sub-Saharan Africa, employment opportunities are concentrated in outdoor occupations, including agriculture, construction, fishing and informal commerce, which involve prolonged exposure to Ultraviolet (UV) radiation. Limited access to alternative employment opportunities may compel many individuals with albinism to remain in occupations associated with increased UV exposure and a higher risk of developing actinic damage and skin cancer. These risks are further amplified by inadequate social protection systems and limited vocational inclusion initiatives tailored to their specific needs [1,6].

Healthcare disparities further contribute to the burden of disease. In many African countries, dermatological, oncological and surgical services remain concentrated in urban areas, leaving rural populations with limited access to specialized care. The absence of organized skin cancer surveillance programs, insufficient pathology infrastructure, financial barriers and transportation challenges contribute to delayed diagnosis and treatment, resulting in increased morbidity and mortality from skin cancer [2,8].

In recent years, international organizations, advocacy groups and United Nations agencies have increasingly recognized albinism not only as a rare inherited condition but also as a matter requiring dedicated public health strategies and human rights protection. Addressing OCA as a public health priority requires integrated policies that combine sustainable skin cancer prevention programs, access to sunscreen and photoprotective resources, health education, regular dermatological surveillance, low-vision rehabilitation, educational support and measures to prevent discrimination, violence and social exclusion. Public awareness campaigns are also essential to improve understanding of albinism and challenge harmful misconceptions that persist in some communities across sub-Saharan Africa [3,28,29].

Overall, reducing the burden of disease among individuals with albinism requires more than advances in medical treatment alone. Sustainable improvements depend on integrated models of care that combine skin cancer prevention and early detection with social inclusion, equitable access to education, protection of fundamental rights and strengthened healthcare systems. Only through such a comprehensive and multidimensional approach can meaningful improvements be achieved in the health, survival and quality of life of individuals with albinism throughout sub-Saharan Africa.

Conclusion

The available evidence indicates that skin cancer remains one of the leading causes of preventable morbidity and mortality among individuals with Oculocutaneous Albinism (OCA) in sub-Saharan Africa. Squamous Cell Carcinoma (SCC) represents the predominant histological subtype and typically develops at a substantially younger age than in the general population, reflecting the combined effects of impaired melanin-mediated photoprotection, lifelong Ultraviolet (UV) exposure and the progressive accumulation of UV-induced cellular damage. Delayed diagnosis, limited access to specialized dermatological services and insufficient availability of oncological care remain major contributors to the substantial burden of disease observed in this highly vulnerable population.

This review emphasizes that a large proportion of skin cancers associated with OCA can be prevented or detected at an early stage through the implementation of effective, affordable and sustainable interventions. Comprehensive photoprotection strategies, including access to high-SPF sunscreen, protective clothing, behavioral sun avoidance and health education initiated during childhood, can substantially reduce chronic actinic damage and the development of premalignant lesions. Similarly, structured dermatological surveillance programs should be considered a public health priority, as early detection of actinic keratoses and skin cancers enables less invasive treatment approaches, greater preservation of function and excellent rates of cure in appropriately managed cases.

Strengthening primary healthcare capacity represents another essential component of disease control. Training primary care physicians, nurses and community healthcare workers to identify suspicious lesions can facilitate earlier referral to specialist services and reduce the proportion of patients presenting with locally advanced disease. In parallel, investment in pathology infrastructure, dermatological expertise and surgical oncology capacity is crucial for improving outcomes and reducing disparities in access to care.

In many sub-Saharan African countries, humanitarian medical missions have played an important role in providing skin cancer screening, diagnostic biopsies and surgical treatment for individuals with albinism. Experiences from several African settings demonstrate that these initiatives can facilitate the detection and management of premalignant lesions and early-stage cancers while reducing the need for extensive ablative procedures. In addition to direct patient care, such programs contribute to the training of local healthcare professionals, the transfer of technical expertise and the development of collaborative networks between African institutions and international partners.

However, humanitarian initiatives should be viewed as complementary measures rather than substitutes for sustainable national healthcare systems. Long-term improvements require the integration of these efforts into comprehensive public health strategies that strengthen local services, establish dedicated dermatological care pathways for individuals with albinism, ensure continuous access to photoprotective resources and develop reliable epidemiological surveillance systems to monitor disease burden and evaluate preventive interventions.

The management of albinism should therefore be recognized as a public health priority requiring a comprehensive, multidisciplinary and multisectoral approach. Cancer prevention, early diagnosis, timely treatment, health education, protection of human rights and international collaboration must be addressed as interconnected components of a unified strategy. Through the implementation of these integrated measures, the substantial burden of skin cancer among individuals with albinism in sub-Saharan Africa can be significantly reduced, improving survival, quality of life and social inclusion while transforming a preventable cause of mortality into a manageable and treatable health condition.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Authors' Contributions
All authors contributed equally to this paper.

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