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HARNESSING THE ROLE OF SOCIAL AWARENESS IN MELANOMA DETECTION

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Harnessing the Role of Social Awareness in Melanoma Detection

Synopsis:

Our study's focus is to identify effective strategies based on existing facts for raising social awareness about melanoma, leveraging existing technologies and mobile applications. By analyzing recent data on melanoma cases, deaths, and their distribution across races, age groups, and ethnicities, we aim to advocate for early detection methods. These detection methods play a pivotal role, prompting us to investigate how advanced technologies can be integrated into personal healthcare to facilitate early detection and treatment.

An integrated approach such as increased awareness of personal health practices, advancements in melanoma diagnosis technologies, and the availability of skilled healthcare professionals, could significantly reduce the impact of melanoma on both individuals and communities.

Harnessing the Role of Social Awareness in Melanoma Detection

***Abstract*—Cancer, characterized by the World Health Organization (WHO), encompasses a wide range of diseases that can manifest in any part of the body. Commonly known as malignant tumors, cancer involves the rapid proliferation of abnormal cells that exceed their usual boundaries. These cells have the ability to infiltrate neighboring tissues and organs, and can even metastasize to distant parts of the body, posing a serious consequence to personal health. Our focus shifts to melanoma, according to the WHO's 2020 report, melanoma ranks as the fifth most prevalent cancer globally, with 1.09 million new cases reported annually. Alarmingly, the incidence of melanoma continues to rise each year. It is a type of skin cancer, the main contributing factors such as exposure to ultraviolet (UV) radiation and family history. The focus of our study is to identify effective strategies, based on existing evidence, for raising social awareness about melanoma, leveraging available technologies and mobile applications. By analyzing recent data on melanoma cases, mortality rates, and their distribution across different races, age groups, and ethnicities, we plan to advocate for early detection methods. This approach is an important in prompting investigations into how advanced technologies can be seamlessly integrated into personal healthcare to identify early signs and symptoms. Our study intends to explore how advanced technologies can be harnessed to facilitate early detection and treatment. An integrated approach, involving heightened awareness of personal health practices, advancements in melanoma diagnosis technologies, and the presence of skilled healthcare professionals, holds the potential to significantly mitigate the impact of melanoma on both individuals and communities.**

***Index Terms*—melanoma, malignant, pigment, awareness, mortality**

I. Introduction

Melanoma, a malignant form of skin cancer originating from pigment-producing melanocytes, presents a significant global health challenge [1]. It ranks among the most common cancers in terms of new cases, as indicated by the WHO report in 2020, with a total of 1.20 million cases worldwide. However, the mortality rate due to skin cancer remains comparatively low compared to other cancers. The numbers of new cases and deaths (in 2020 according to WHO) are presented in Table I. This challenge is also pronounced in the United States, where we have observed melanoma cases over the past five years since 2020. The estimated number of new cases has slightly varied from 2020 to 2024, with around 100,000 new cases reported each year according to American Cancer Society. In contrast, the number of deaths has shown an upward trend: 6,850 deaths in 2020, increasing to 7,180 in 2021, 7,650 in 2022, 7,990 in 2023, and American Cancer Society project projected to reach 8,290 in 2024. We have also analyzed the distribution of new cases (of melanoma) between males and females each year. In 2020, there were 60,190 new cases in males and 50,160 in females, reflecting a male-to-female ratio of approximately 3:2 [2]. The number of new cases fluctuates slightly each year shown in Fig. 2. However, the mortality rate among males is consistently twice that among females (a 2:1 ratio) in each year, as detailed in Fig. 3. This data underscores the gender disparity in melanoma mortality rates, with males experiencing a higher burden of mortality from this disease compared to females over the specified period.

Early detection plays an important role in enhancing treatment outcomes across various medical conditions, including melanoma. Monitoring moles for any alterations using the ABCDE rule serves as a fundamental strategy for melanoma. There is a standardized checklist known as the ABCDE rule and corresponding meaning of each character: Asymmetry ('A'), irregular Borders ('B'), varying Colors ('C'), a Diameter ('D') exceeding 6mm, although some melanomas may manifest in smaller sizes, and Evolving ('E') characteristics, such as changes in size, shape, color, or the emergence of symptoms like bleeding or itching [3]–[5]. In addition to these rules, it's important to watch for additional indicators such as dark spots, moles that become painful or itchy, sores that resist healing, and peculiar dark streaks beneath the nails, which could indicate acral lentiginous melanoma, more prevalent in individuals with darker skin tones. Therefore, regular self-examinations of the skin are crucial for personal care. If any of the aforementioned symptoms or other anomalous skin changes are observed, seeking prompt consultation with a dermatologist can significantly bolster treatment outcomes through timely detection and intervention [6], [7].

The International Skin Imaging Collaboration (ISIC) is the first public benchmark foundation that has been organizing melanoma detection competitions since 2016 [8]. The ISIC dataset has emerged as a primary resource for researchers in the domain of medical image analysis using machine learning and deep learning techniques, particularly in the area of skin cancer detection and malignancy evaluation. These datasets comprise thousands of dermoscopic images accompanied by gold-standard lesion diagnosis metadata and some melanoma images and corresponding segmentations shown in Figure 1.

The annual challenges associated with these datasets have led to significant advancements in the field of dermoscopic image analysis, with research papers reporting performance metrics surpassing those of human experts [9].

There has been extensive research progress in dermoscopic image analysis, and researchers have used different learning algorithms (both machine learning and deep learning) to improve melanoma detection. Researchers have investigated methods of identifying visual similarity within the large melanoma dataset, and Hu et al. proposed the use of a deep constrained siamese hash coding network [10]. Convolutional Neural Network (CNN) is the best and also extensively used algorithm in melanoma image analysis by many researchers [11]–[13]. Some researchers have focused on extracting color and texture features from segmented lesion region for melanoma classification [14], [15] and employing feature selection techniques [16]–[18]. Each technique aims to refine melanoma detection and minimize the false positive rate.

Our objectives is to investigate the social ramifications of melanoma rather than focusing on algorithm development or design for its detection. Beginning with a comprehensive report of global melanoma statistics, we then narrow our focus to United States data from 2020 onwards. We explore into melanoma statistics both male and female cases and fatalities and shown in Figure 2 and 3. The data indicates a higher susceptibility to melanoma and mortality rates among males compared to females. We also highlight the correlation between age and melanoma risk, showcasing a notable increase in risk with advancing age for both genders (illustrated in the Figure 6 and 7). Race constitutes another critical aspect of our study, where we analyze melanoma impacts across different racial groups. Among these groups, non-Hispanic individuals exhibit significantly higher melanoma incidence rates and mortality (as depicted in the Figure 4 and 5). At the meantime, we explore potential awareness strategies to mitigate melanoma prevalence within the population.

This paper is structured into several sections to comprehensively explore melanoma. We begin by presenting facts and figures regarding melanoma. In Section III, we discuss the survival rate of melanoma, followed by an exploration of various awareness techniques for melanoma, including the use of apps for preliminary checks, protection from ultraviolet rays, documentation of variations, and consulting healthcare professionals or dermatologist in the skin in Section IV. Finally, we conclude the article in Section V.

TABLE I: Cancer Statistics: WHO report on the most common cancers and leading causes (left) of cancer death (right) in 2020.

Rank	Most common cancer	New cases per year in millions	Common causes of cancer death	Death in million
1	Breast	2.26	Lung	1.800
2	Lung	2.21	Colon & Rectum	0.916
3	Colon	1.93	Liver	0.830
4	Prostate	1.41	Stomach	0.769
5	Skin	1.20	Breast	0.685

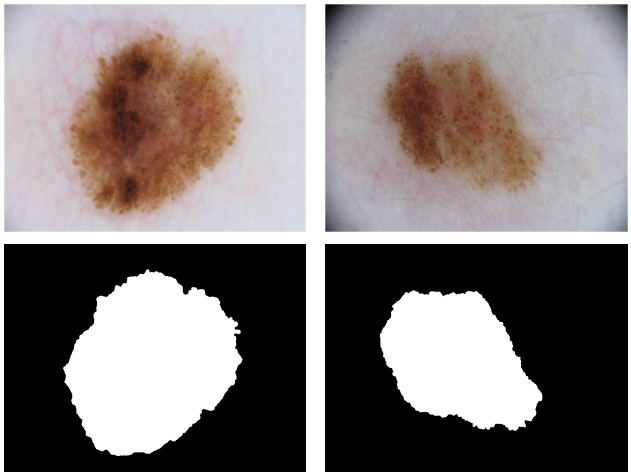

Fig. 1: ISIC 2016 melanoma image samples in the first row and corresponding segmented images in the second row.

II. Facts and Figures of Melanoma

We have presented the impact of melanoma in terms of new cases per 100,000 individuals across various racial groups and sexes in Figure 4. The data reveals notable differences in new melanoma cases between males and females across all racial categories. Particularly striking is the disparity in the Non-Hispanic White population, where the rate of new cases in males is nearly three times higher than in females. The disparity in melanoma death cases between males and females is evident across various racial groups, as illustrated in Figure 5. For Hispanic, all races, Non-Hispanic American Indian/Alaska Native, and Non-Hispanic White individuals, the incidence of melanoma is double (or more) in males compared to females. In contrast, Non-Hispanic Asian/Pacific Islander and Non-Hispanic Black populations show similar rates of melanoma (death cases) between males and females. These findings suggest a higher mortality rate of melanoma in certain racial groups compared to others.

We analyzed the percentage of new melanoma cases and death rates across different age groups, revealing a consistent increase in risk with age. The data illustrates a significant rise in risk factors between ages 45 and 84, with the highest risk observed in the 65 to 74 age group (22.30% of new cases). Similarly, the death rate escalates with age, peaking in the 65 to 74 age group (25.30%). These findings underscore the elevated risk of melanoma among older age groups, highlighting the importance of awareness and early detection, as depicted in Figures 6 and 7.

III. Survival Rates of Melanoma

The relative survival rate provides an estimate of the percentage of patients expected to survive the effects of melanoma of the skin, excluding the risk of dying from other causes [23]. It's important that survival statistics are based on large groups of people and cannot predict individual outcomes. Each patient's situation is unique, and responses to treatment can vary significantly. In general, if it is found only in the part of

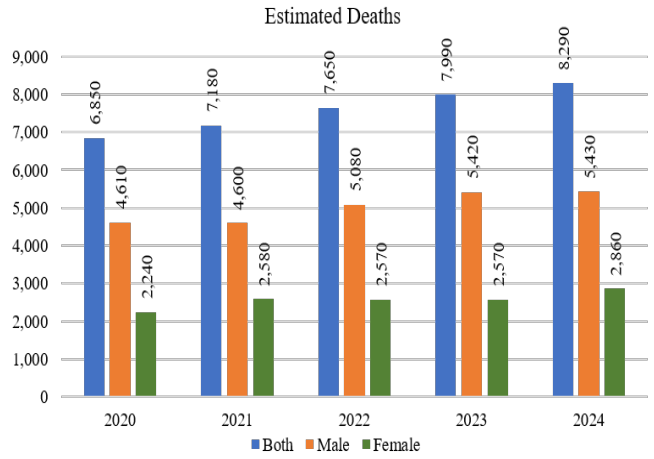

Fig. 2: Estimated new cases of Melanoma of both, male, and female from 2020 to 2024.

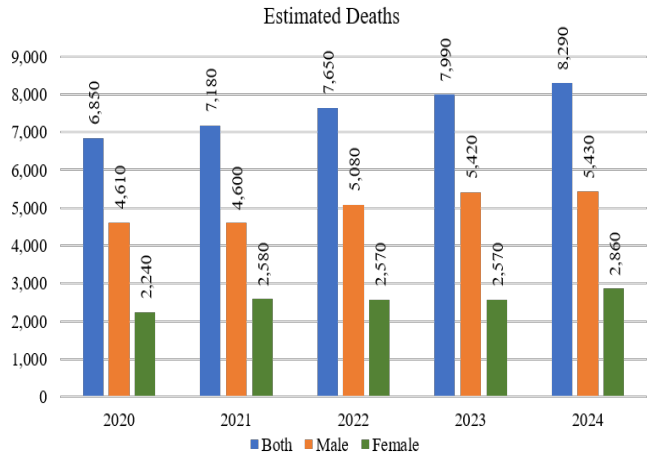

Fig. 3: Estimated motility cases of Melanoma of both, male, and female from 2020 to 2024.

the body where it started it is called localized (stage 1). If it spread beyond the skin where it started to nearby structures is called regional, and the cancer has spread to distant parts of the body, such as the lungs, liver and other parts of the body is called distant. Table II refers to the overall 5-year relative survival rate across all stages of cancer as classified by the Surveillance, Epidemiology, and End Results (SEER) staging system. This combined rate (94%) accounts for the relative survival across localized, regional, and distant stages of cancer collectively. It provides an average survival estimate across all stages, considering the proportion of patients diagnosed at each stage and their corresponding survival rates [24].

IV. Awareness

We can find ample information about skin cancer on the internet. The American Academy of Dermatology (AAD) is one resource that provides insights to help protect our skin. The AAD also offers information to assist in detecting skin cancer. AAD encourages everyone to adopt the habit of monitoring their skin by performing self-examinations: thoroughly examine your body using a mirror, check underarms, forearms, palms, legs, between toes, and the soles of your feet. When outdoors, it's important to protect our skin. Seek shade, wear sun-protective clothing, and apply sunscreen that offers broad-spectrum protection against ultraviolet rays, water resistance, and a Sun Protection Factor (SPF) of 30 or higher [19].

TABLE II: Survival Rates by SEER Stage: 5-year relative survival rates for melanoma skin cancer based on people diagnosed with melanoma between 2013 and 2019

SEER Stage	5-year Relative Survival Rate
Localized	>99%
Regional	74%
Distant	35%
All SEER stages combined	94%

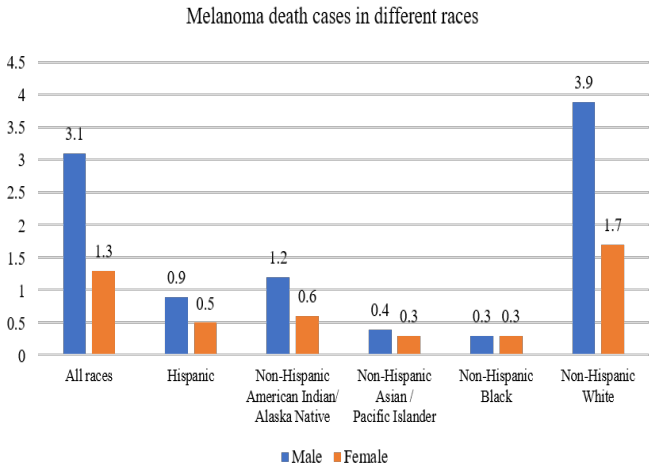

Fig. 4: Rate of new melanoma cases per 100 thousand individuals across different races and sex (from 2016 to 2020 [24]).

A. Examine the Scar:

Start by closely examining the scar for any irregular features. Use the ABCDE rule as your checklist.

- **Asymmetry** ('A'): If one half of the scar differs from the other.
- **Border** ('B'): Look for edges that are irregular, blurred, or ragged.
- **Color** ('C'): Check if the scar has multiple shades such as brown, black, red, white, or blue, and if these colors are unevenly distributed.
- **Diameter** ('D'): Notice if the scar is larger than 6mm, roughly the size of a pencil eraser.
- **Evolving** ('E'): Observe any changes in the scar's size, shape, or color over time.

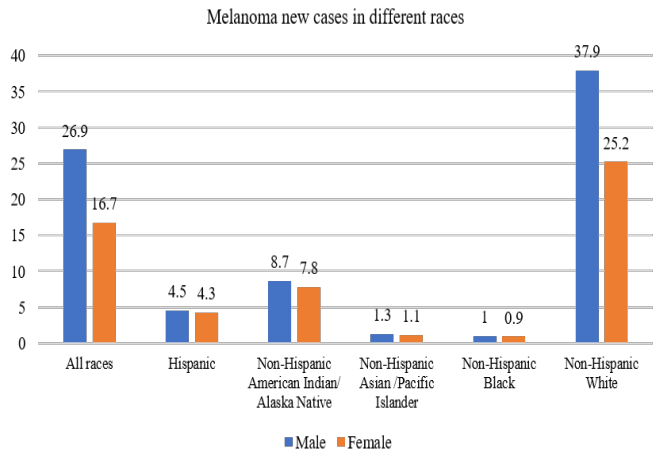

Fig. 5: Rate of new melanoma deaths per 100 thousand individuals across different races and sex (from 2016 to 2020 [24]).

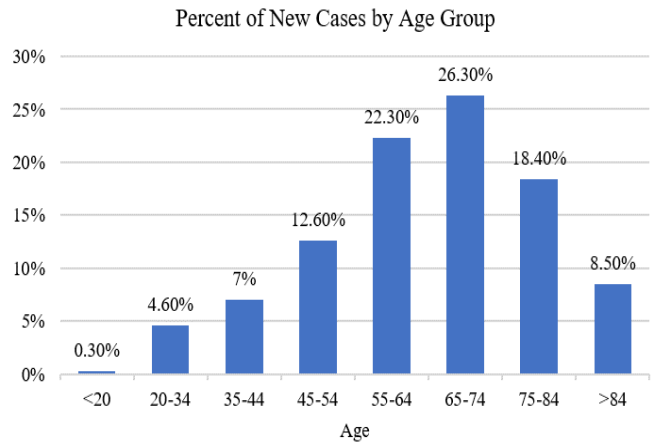

Fig. 6: Percent of new cases by different age group (from 2016 to 2020 [24])

B. Document Changes in the Skin:

Maintain a record of the scar's appearance, noting any variations in size, shape, or color. Taking periodic photographs is a helpful way to track these changes.

C. Use Apps for Preliminary Checks:

Since 2016, the International Skin Imaging Collaboration (ISIC) has initiated a platform for a global competition focused on skin cancer detection and has established a freely accessible archive containing standard clinical and dermoscopic images of skin lesions. ISIC has provided the open plateform and researchers significantly expanded the use of computer vision in melanoma detection [20]. Beside this, there are several existing mobile applications available for skin lesion evaluation on both Apple and Android devices, including Miiskin [21], MoleMapper, MoleScope, SkinVision, and UMSkinCheck [22]. These

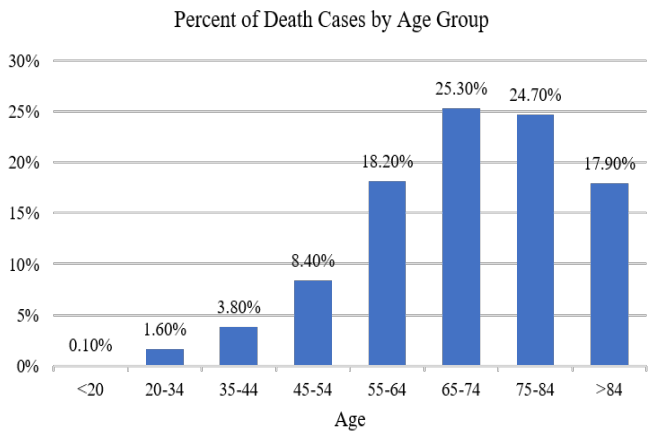

Fig. 7: Percent of death cases by different age group (from 2016 to 2020 [24]).

tools enable users to capture images of their skin or moles and identify any signs of distortion, UV burn, asymmetric mole shapes, or abnormalities. Then, receiving alerts from apps (to user end) can prompt users to seek further dermatological assessment. Understanding the current condition of moles and skin is highly beneficial, as early-stage melanoma has a survival rate exceeding 99%.

D. Consult a Healthcare Professional:

If the scar meets any of the ABCDE criteria or shows other signs of change, or if you have any concerns, see a dermatologist or healthcare provider without delay. They can conduct a thorough examination and may use tools such as dermoscopy to closely examine the skin's microstructures.

E. Follow-Up:

If a biopsy or further examination is necessary, it's important to ensure that we keep all our appointments and adhere to any treatment plans. Early detection and appropriate treatment are crucial in managing and potentially preventing life-threatening conditions from melanoma.

V. Conclusion

Our objective is to raise awareness about melanoma by presenting various scenarios and investigating its impact on different races and sexes within our community, particularly focusing on new cases and mortality rates. In this technological era, advanced technologies play an important role in enabling users to capture and analyze skin images using mobile apps. These apps promptly provide information to the users based on algorithms, alerting them to any skin abnormalities and offering recommendations to consult healthcare professionals if necessary. Therefore, apps serve as effective tools to raise awareness about melanoma in society. The data highlight that new cases and mortality rates due to melanoma are higher for males than for females across all races, with the exception of

Non-Hispanic Black individuals. We also explore the percentage of new melanoma cases by age group, specifically focusing on melanoma of the skin. By analyzing new estimated cases and examining impacts on sexes, races, and age groups since 2020, we try to enhance melanoma awareness and facilitate early treatment, ultimately improving patient survival rates. To achieve this, we incorporate various awareness techniques from different resources, including examining the scar, utilizing existing mobile apps to analyze skin images, documenting changes in the skin, protecting from UV rays, and consulting healthcare professionals or dermatologists. Our study aims to minimize melanoma cases by enhancing awareness and promoting early treatment.

Our immediate plan is to utilize generative adversarial networks for melanoma detection in imbalanced datasets. We goal to demonstrate how this approach can enhance melanoma detection and minimize the false positive rate in the landscape of dermoscopic image analysis.

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