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# Clinical and clinicopathological characteristics of basal cell carcinoma and their association with tumor localization

Nermina Kurtalic<sup>1</sup>, Alim Samardzic<sup>2</sup>, Sadat Kurtalic<sup>1</sup>, Lejla Hodzic<sup>2</sup>, Eldina Malkic Salihbegovic<sup>3</sup>, Dinela Sejdinovic<sup>4</sup>

<sup>1</sup> Cantonal Hospital “Dr. Irfan Ljubijankic”, Bihac, Bosnia and Herzegovina,

<sup>2</sup> University of Bihac, Faculty of Health Studies, Bihac, Bosnia and Herzegovina,

<sup>3</sup> Health Medical Center, Zivinice, Bosnia and Herzegovina,

<sup>4</sup> Health Medical Center, Lukavac Bosnia and Herzegovina.

## Abstract

**Background:** Basal cell carcinoma (BCC) is the most common malignant skin tumor and is strongly associated with chronic exposure to ultraviolet radiation. The relationship between clinicopathological features and anatomical localization remains incompletely defined.

**Research objective:** To assess the association between demographic and clinical characteristics and tumor localization in patients with BCC.

**Subjects and methods:** This prospective cross-sectional observational study included 56 subjects with histologically confirmed BCC. Demographic and clinical variables were analyzed, including sex, age group, living and working environment, skin type, sun exposure, clinical tumor subtype, and presence of precancerous lesions. Tumor localization was classified as photo-exposed or non-photo-exposed. Chi-square test and binary logistic regression were used.

**Results:** The majority of subjects were women, older than 65 years, and had tumors in photo-exposed areas. No significant association was found between tumor localization and sex, age group, living environment, work environment, skin type, sun exposure, or clinical tumor subtype. The presence of precancerous lesions was significantly associated with localization, with tumors occurring more frequently in photo-exposed areas in these subjects. In logistic regression, patients with precancerous lesions had higher odds of photo-exposed tumor localization, whereas sex and age group were not significant predictors.

**Conclusion:** Precancerous lesions were the only factor significantly associated with light-exposed tumor localization in this cohort, supporting the clinical significance of chronic photodamage in the distribution of basal cell carcinoma.

**Keywords:** *basal cell carcinoma, BCC, tumor localization, photo-exposed areas, precancerous lesions, ultraviolet radiation, clinical and epidemiological characteristics*

## Introduction

Basal cell carcinoma (BCC) is the most common malignant skin tumor and is the most common malignancy among fair-skinned populations worldwide [1,2]. Its incidence has been continuously increasing in recent decades, especially among the elderly, making BCC an important public health and dermatological problem [2,3]. Although BCC rarely metastasizes, its locally invasive growth pattern can lead to significant tissue destruction, functional impairment, and cosmetic morbidity if not recognized and treated promptly [2].

Ultraviolet (UV) radiation is considered a major etiological factor in the development of BCC [1,4]. Chronic cumulative sun exposure contributes to DNA damage, immunosuppression, and molecular changes involved in cutaneous carcinogenesis [4]. Consequently, BCC most commonly occurs in photo-exposed anatomical areas, particularly the head and neck [2,5]. However, tumors can also develop in non-photo-exposed areas, suggesting that additional environmental, genetic, and host-related factors contribute to tumor distribution and clinical presentation [6].

Several demographic and clinical characteristics are associated with the occurrence of basal cell carcinoma, including older age, male sex, lighter skin phototype, occupational exposure to UV radiation, and the presence of precancerous skin lesions [2,4,7]. Precancerous lesions, particularly actinic keratoses, are considered markers of chronic photodamage and may indicate increased susceptibility to UV-induced skin carcinogenesis [8]. In addition, the different histopathological subtypes of BCC demonstrate variable anatomical distribution patterns and biological behavior [2].

Despite the large number of studies investigating BCC risk factors and epidemiology, relatively limited data are available on the association between clinical and epidemiological characteristics and tumor localization, especially in regional populations. A better understanding of these associations may contribute to better identification of high-risk patients, earlier diagnosis, and more effective preventive strategies targeting chronically sun-exposed areas.

Therefore, the aim of this study was to analyze the association between demographic and clinical characteristics of patients with basal cell carcinoma and tumor localization, with special emphasis on photo-exposed and non-photo-exposed anatomical areas.

## Respondents and methods

This study was designed as a prospective cross-sectional observational study conducted during 2024. A total of 56 subjects with histologically confirmed basal cell carcinoma were included. Subjects were consecutively recorded during routine dermatological examinations at the specialist dermatology clinic of the Cantonal Hospital “Dr. Irfan Ljubijankić” and the private dermatology outpatient clinic “Dr. Kurtalić”. Data were collected during a three-month period, from May to August 2024.

Demographic and clinical data were collected directly during the clinical examination of the subjects and included sex, age group, living environment, work environment, skin type, sun exposure, tumor localization, clinical subtype of BCC, and presence of precancerous lesions.

Age was categorized into three groups (<60 years, 60–69 years, and  $\geq 70$  years). Tumor localization was classified as photo-exposed or non-pho-

to-exposed. Clinical tumor subtypes were grouped into superficial, nodular, and other types.

Statistical analysis was performed using SPSS 31.0 (IBM Corp., 2026) software. Categorical variables were presented as frequencies and percentages. Associations between variables were assessed using the chi-square test. Additionally, binary logistic regression was performed to assess independent associations with tumor localization. Statistical significance was set at  $p < 0.05$ .

The study was conducted in accordance with ethical standards and approved by the relevant institutional ethics committee.

## Results

### Demographic characteristics

Female respondents dominated (75.0%), while males made up 25.0% of the sample. The majority of respondents were aged  $\geq 70$  years, followed by those aged 60 to 69 years, while the smallest proportion was younger than 60 years.

Most of the respondents were from urban areas, and slightly more than half worked indoors. Lighter skin phototype was present in most of the respondents. Sun exposure was reported in most cases.

*Table 1. Demographic characteristics of the study population (n = 56)*

Characteristics	Category	n	%
Sex	Female	42	75.0
	Male	14	25.0
Age group (years)	<60	8	14.3
	60–69	18	32.1
	$\geq 70$	30	53.6
Living environment	Urban	37	66.1
	Rural	19	33.9
Working environment	Indoor	30	53.6
	Outdoor	26	46.4
Skin type	Lighter	38	67.9
	Darker	18	32.1
Sun exposure	Yes	46	82.1
	No	10	17.9

### Clinical characteristics

- The most common clinical type of BCC was the superficial subtype, followed by nodular, while other types were less common. Most tumors were located in photo-exposed areas.

Precancerous lesions were present in more than half of the subjects.

Table 2. Clinical characteristics of the study population (n = 56)

Characteristics	Category	n	%
Clinical type of BCC	Superficial	31	55.4
	Nodular	11	19.6
	Other types	14	25.0
Precancerous lesions	Yes	34	60.7
	No	22	39.3

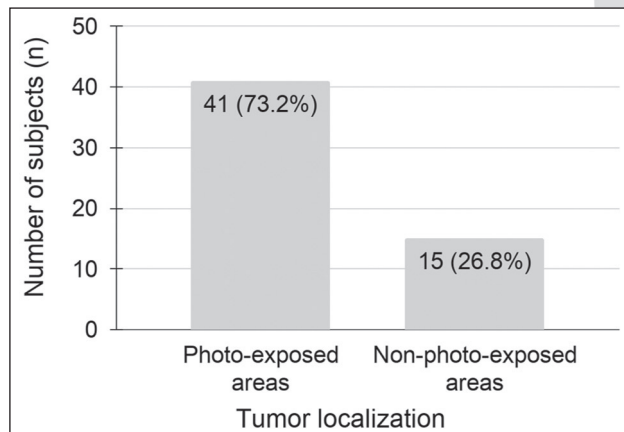


Figure 1. Tumor distribution according to localization

Association analysis

No statistically significant association was found between tumor localization and demographic variables, including sex, age group, living environment, working environment, skin type, and sun exposure ( $p > 0.05$ ).

No significant association was observed between the clinical type of tumor and its localization.

However, the presence of precancerous lesions showed a statistically significant association with tumor localization ( $p = 0.011$ ), with tumors in these subjects being more frequently located in photo-exposed areas.

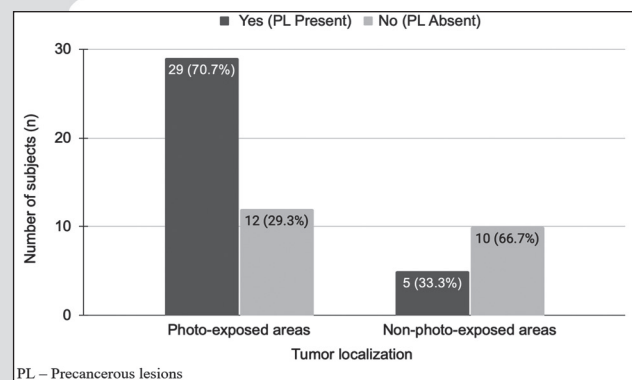


Figure 2. Association between precancerous lesions and tumor localization

Table 3. Association between clinical and demographic characteristics and tumor localization

Characteristics	Category	Localization		p-value
		PE n (%)	NPE n (%)	
Sex	Female	29 (70.7)	13 (86.7)	0.223
	Male	12 (29.3)	2 (13.3)	
Age group (years)	<60	6 (14.6)	2 (13.3)	0.745
	60–69	12 (29.3)	6 (40.0)	
	≥70	23 (56.1)	7 (46.7)	
Living environment	Urban	26 (63.4)	11 (73.3)	0.488
	Rural	15 (36.6)	4 (26.7)	
Working environment	Indoor	22 (53.7)	8 (53.3)	0.983
	Outdoor	19 (46.3)	7 (46.7)	
Skin type	Lighter	27 (65.9)	11 (73.3)	0.596
	Darker	14 (34.1)	4 (26.7)	
Sun exposure	Yes	34 (82.9)	12 (80.0)	0.800
	No	7 (17.1)	3 (20.0)	
Clinical type	Superficial	20 (48.8)	11 (73.4)	0.256
	Nodular	9 (22.0)	2 (13.3)	
	Other types	12 (29.2)	2 (13.3)	
Precancerous lesions	Yes	29 (70.7)	5 (33.3)	<b>0.011</b>
	No	12 (29.3)	10 (66.7)	

PE – photo-exposed areas; NPE – non-photo-exposed areas

## Logistic regression

Binary logistic regression analysis showed that the presence of precancerous lesions was significantly associated with tumor localization in photo-exposed areas ( $p = 0.013$ ). Subjects with precancerous lesions were approximately six times higher odds of developing tumors in photo-exposed regions compared to subjects without precancerous lesions (OR = 5.98; 95% CI: 1.45–24.67).

Sex and age group were not significantly associated with tumor localization.

## Discussion

This study evaluated the association between demographic and clinical characteristics of subjects with basal cell carcinoma and tumor localization, with particular emphasis on photo-exposed and non-photo-exposed anatomical areas. Basal cell carcinoma is strongly associated with cumulative UV exposure and chronic photo-damage, which explains its predominance in sun-exposed skin areas [2,4].

A predominance of female subjects was observed in the study population. This result is in contrast to numerous epidemiological studies reporting a higher incidence of BCC among men, which is commonly attributed to higher occupational and recreational UV exposure among men [2,3]. The observed predominance of women in this cohort may reflect regional population characteristics, health care-seeking behavior, or variability associated with the relatively small study sample. Nevertheless, sex was not significantly associated with tumor localization, suggesting that gender distribution within the study population did not influence whether tumors occurred in photo-exposed or non-photo-exposed anatomical areas.

The majority of subjects were older, supporting the well-established view that cumulative UV exposure significantly contributes to the development of BCC over time [3,5]. Previous studies have shown an increase in the incidence of BCC with age due to prolonged exposure to environmental factors and progressive impairment of cellular DNA repair mechanisms [5,9]. However, in this study, no statistically significant association was found between age group and tumor localization, suggesting that age may contribute to overall susceptibility to BCC without necessarily determining the anatomical distribution of tumors.

Similarly, living environment and work environment were not significantly associated with tumor localization. Although subjects from rural areas and those with predominantly outdoor occupations showed a slightly higher proportion of tumors in photo-exposed areas, these differences did not reach statistical significance. Occupational exposure to UV radiation remains a recognized risk factor for keratinocyte carcinomas, especially among individuals with chronic exposure to outdoor environments [7]. However, the lack of statistical significance in this study may be explained by the relatively homogeneous exposure profile of subjects already diagnosed with BCC, together with the limited sample size.

No statistically significant association was found between skin type, reported sun exposure, and tumor localization. This finding should be interpreted with caution given the well-established etiological role of UV radiation in the pathogenesis of basal cell carcinoma [2,4]. Self-reported sun exposure may inadequately reflect cumulative lifetime UV exposure, occasional intense exposure, exposure patterns during childhood, or use of photoprotective measures. Furthermore, sim-

Table 4. Binary logistic regression analysis of factors associated with tumor localization

Variable	Category	B	S.E.	OR (Exp(B))	95% CI	p-value
Precancerous lesions	Present vs absent	1.79	0.72	5.98	1.45–24.67	0.013
Sex	Male vs female	0.51	0.90	1.67	0.29–9.71	0.569
Age group	<60 years vs $\geq 70$ years	0.82	1.02	2.27	0.31–16.65	0.418
Age group	60–69 years vs $\geq 70$ years	-0.49	0.73	0.61	0.15–2.54	0.497

Dependent variable: tumor localization (0 = non-photo-exposed area; 1 = photo-exposed area)

Reference categories: absence of precancerous lesions, female sex, age  $\geq 70$  years

Abbreviations: B – regression coefficient; S.E. – standard error; OR – odds ratio; CI – confidence interval

plified categorical assessments of skin type and UV exposure may not fully capture the biological complexity of individual susceptibility to photo-damage and cutaneous carcinogenesis [10].

The clinical subtype of BCC also did not show a statistically significant association with tumor localization. However, nodular and infiltrative subtypes were more common within photo-exposed anatomical areas. Previous studies have shown that nodular BCC usually develops on chronically sun-exposed skin, especially on the head and neck, although superficial BCC has often been described in less chronically exposed areas such as the trunk [2,11]. The lack of statistical significance in this study most likely reflects the relatively small cohort size and the fragmentation of subgroups after stratification into multiple histopathological categories.

The most important result of this study was a statistically significant association between precancerous lesions and tumor localization. Subjects with precancerous lesions showed a significantly higher probability of developing tumors in photo-exposed areas. Logistic regression analysis confirmed this association independently of sex and age group. Subjects with precancerous lesions were approximately six times more likely to develop basal cell carcinoma in photo-exposed anatomical areas compared to subjects without precancerous lesions (OR = 5.98; 95% CI: 1.45–24.67;  $p = 0.013$ ).

This finding strongly supports the established biological link between chronic UV exposure, actinic skin damage, and cutaneous carcinogenesis [4,8]. The coexistence of precancerous lesions and BCC within photo-exposed anatomical areas likely reflects common pathogenic mechanisms associated with cumulative photodamage and field carcinogenesis [12]. Precancerous lesions, particularly actinic keratoses, are widely recognized as markers of chronic UV-induced skin injury and increased carcinogenic potential [8,12].

Identification of precancerous lesions as significant markers of photo-exposed tumor localization may have practical clinical implications in routine dermatological screening. Patients with actinic skin damage and precancerous lesions may represent a subgroup that requires closer surveillance due to the increased likelihood of UV-related skin cancer.

Several limitations should be considered when interpreting the results of this study. The relatively small sample size may have reduced statistical power and limited the detection of weaker associations. In addition, the prospective observational design without long-term follow-up limited the assessment of patterns of recurrence and disease progression. Certain variables, particularly sun exposure, were based in part on patient-reported data, which introduced the possibility of recall bias. Furthermore, simplified categorical variables may not fully capture the complexity of environmental and behavioral risk factors associated with cumulative UV exposure.

Despite these limitations, this study provides clinically relevant insights into the epidemiological and clinical characteristics of basal cell carcinoma (BCC) and highlights the importance of precancerous lesions as markers of chronic UV-induced skin damage. The results may contribute to better identification of high-risk patients and support preventive dermatological screening strategies targeting photo-exposed anatomical areas.

## Conclusion

This study showed that precancerous lesions were significantly associated with photo-exposed basal cell carcinoma localization, further supporting the important role of chronic ultraviolet radiation exposure in the pathogenesis of basal cell carcinoma. Recognition of precancerous skin changes may therefore contribute to improved identification of patients at increased risk of UV-related cutaneous carcinogenesis.

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Corresponding Author

Nermina Kurtalic,

Cantonal Hospital "Dr. Irfan Ljubijankic",

Bihac,

Bosnia and Herzegovina,

E-mail: sadatku@hotmail.com