Research Square

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Assessment of university students' knowledge and behavior levels regarding sun protection

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Research Article

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Abstract

Background/purpose:

Ultraviolet radiation is the primary environmental risk factor for skin cancer, yet adherence to sun-protective behaviors remains insufficient among young adults. This study aimed to evaluate university students' knowledge of skin cancer and sun protection, their sun-protective behaviors, and associated sociodemographic, academic and clinical characteristics.

Methods

Data were collected face-to-face using an 83-item questionnaire incorporating the Turkish versions of the Skin Cancer and Sun Knowledge Scale (SCSKS) and the Sun Protection Behavior Scale (SPBS) from 717 undergraduate students of various faculties.

Results

Medical students demonstrated significantly higher SCSKS scores than non-medical students, whereas no significant difference in SPBS scores was detected between groups. Female participants achieved significantly higher knowledge and behavior scores than males. Participants who reported practicing sun protection during childhood also had significantly higher SCSKS and SPBS scores. Knowledge scores differed significantly according to Fitzpatrick skin type and number of melanocytic nevi; behavior scores also differed by skin type. A weak but significant positive correlation was observed between knowledge and sun-protective behaviors ($r = 0.211$, $p < 0.001$). Knowledge scores correlated positively with age and academic year, whereas behavior scores showed no significant linear associations with these variables.

Conclusion

Medical students had greater knowledge regarding sun protection, without significantly higher protective behavior scores. Female sex and reported childhood sun protection were associated with better photoprotective practices. These findings support evaluating behavioral interventions that address everyday protection alongside knowledge among university students.

1. Introduction

Ultraviolet (UV) radiation is a major environmental risk factor for skin cancer. UVB and UVA contribute to carcinogenesis through mechanisms including direct DNA damage and oxidative stress. Susceptibility varies with individual characteristics and patterns of exposure, and sunburn and excessive exposure during childhood are relevant to later skin cancer risk. Prevention therefore requires attention to UV exposure across the life course. [1]

Skin cancer represents a substantial public health burden. GLOBOCAN 2022 identified non-melanoma skin cancer among the most frequently diagnosed cancers worldwide; its incidence estimates exclude basal cell carcinoma and therefore do not represent the entire burden of keratinocyte cancers. [2] Photoprotection includes sunscreen, protective clothing, hats, sunglasses, shade and avoidance of intense midday exposure. [1] These measures require consistent application in everyday activities.

University students are an important population for sun-safety research because preventive practices and attitudes toward sun exposure are relevant during young adulthood. A review of medical students documented gaps in sun-protection knowledge and practices despite generally moderate to high skin cancer knowledge. [3] Research among Turkish nursing students also identified deficiencies in knowledge and protective behaviors. [4] Such findings support examining both knowledge and behavior rather than treating knowledge as a substitute for preventive practice.

A systematic review found that skin cancer knowledge was positively associated with sun-protective behavior in most studies, although heterogeneous measures limited comparisons. [5] A separate review of campus interventions identified considerable variation in methods, outcomes and study quality, indicating that the most effective approaches for this population remain uncertain. [6] Evaluating knowledge, reported practices and associated characteristics together may help identify priorities for university-based prevention.

This study aimed to evaluate knowledge about skin cancer and sun protection and sun-protective behaviors among university students in Türkiye, compare medical and non-medical students, and examine associations with sociodemographic and dermatological characteristics. The relationship between knowledge and behavior scores was also assessed.

2. Materials and methods

This descriptive, analytical, cross-sectional study used a questionnaire to evaluate university students' knowledge and behaviors regarding sun protection. The study was conducted between January and July 2025 among undergraduate students aged 18–27 years enrolled at Istanbul University. Participants were recruited using non-probability convenience sampling, and participation was voluntary. Data were collected through face-to-face administration of the questionnaire. Before participation, all students were verbally informed about the study objectives and procedures. Students who agreed to participate and provided written informed consent were included in the study. This study was conducted in accordance with the ethical standards of the institutional ethics committee and the Declaration of Helsinki (Approval number: E-29624016-050.99-3121700).

A total of 802 students were initially recruited. Eighty-five participants were excluded because of incomplete questionnaires, inconsistent responses to repeated items, or withdrawal from the study. Consequently, data from 717 participants were included in the final analysis. An a priori power analysis for a chi-square test, assuming an effect size of w = 0.20, a significance level of 0.05, statistical power of

95%, and 5 degrees of freedom, indicated a minimum required sample size of 495 participants. The final sample exceeded the prespecified minimum sample size.

Data were collected using an 83-item questionnaire that consisted of four sections: (1) sociodemographic characteristics (6 items), (2) skin health and individual risk factors (15 items), (3) knowledge regarding skin cancer and sun protection (36 items), and (4) sun-protection behaviors (26 items). The outcomes were assessed using the Turkish version of the Skin Cancer and Sun Knowledge Scale (SCSKS), which was previously validated by Öztürk Haney et al. [7] The scale consists of 25 items and yields a total score ranging from 0 to 25, with higher scores indicating greater knowledge regarding skin cancer and sun protection. To comprehensively evaluate participants' knowledge, this section included an additional 11 researcher-developed questions based on the literature. Sun-protection behaviors were evaluated using the Turkish version of the Sun Protection Behavior Scale (SPBS), which was adapted and validated by Aygün and Ergün. [8] The SPBS is an 8-item, five-point Likert-type scale with total scores ranging from 8 to 40, where higher scores indicate better sun-protection behaviors. To obtain more detailed information regarding routine photoprotective practices, this section also included 18 additional researcher-developed questions.

2.1 Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 23.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) for normally distributed data and as median with interquartile range (IQR) for non-normally distributed data. Categorical variables were presented as frequencies and percentages. The normality of continuous variables was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. Comparisons of categorical variables were performed using the chi-square test or Fisher's exact test, as appropriate. Comparisons between two independent groups were conducted using the independent-samples t test for normally distributed variables and the Mann–Whitney U test for non-normally distributed variables. Comparisons among three or more groups were performed using one-way analysis of variance (ANOVA) or the Kruskal–Wallis test, as appropriate. Tukey’s post hoc test was used for pairwise comparisons following ANOVA. Correlations between scale scores, age and academic year were assessed using Pearson’s correlation coefficient. For analyses involving academic year, the preparatory year was coded as 0, and subsequent undergraduate years were coded as 1–6. Correlation strength was interpreted as negligible ($r < 0.20$), weak (0.20–0.39), moderate (0.40–0.59), strong (0.60–0.79), or very strong (≥ 0.80). All statistical tests were two-sided, and p-values < 0.05 were considered statistically significant.

2.2 AI assistance

ChatGPT (OpenAI; accessed October 2026; model version not recorded) assisted with language editing, manuscript drafting and organization, reference formatting, preliminary data consistency checks, and graphical abstract preparation. The authors reviewed the outputs against the study materials and sources and take full responsibility for the final content. No identifiable participant information was shared.

3. Results

A total of 717 university students were included in the final analysis, of whom 330 (46.0%) were medical students and 387 (54.0%) were students from other faculties. Females constituted 72.4% of the study population, and the largest age group was 22 years (22.0%). Among medical students, fifth-year students represented the largest subgroup (29.1%), whereas fourth-year students constituted the largest subgroup among students from other faculties (25.6%) (Table 1).

Table 1
Sociodemographic characteristics of the participants

Variables		**n**	**%**
Group	Medical faculty student	330	46.0
	Other faculty student	387	54.0
Gender	Male	198	27.6
	Female	519	72.4
Age (years)	18	67	9.3
	19	65	9.1
	20	82	11.4
	21	122	17.0
	22	158	22.0
	23	128	17.9
	24	66	9.2
	25	17	2.4
	26	7	1.0
	27	5	0.7
Academic years (Faculty of Medicine)	Year 1	47	14.24
	Year 2	35	10.61
	Year 3	33	10.00
	Year 4	63	19.09
	Year 5	96	29.09
	Year 6	56	16.97
Academic years (Other Faculties)	Foreign Language Preparatory	23	5.94
	Year 1	73	18.86
	Year 2	94	24.29
	Year 3	83	21.45
	Year 4	99	25.58
	Year 5	15	3.88

Regarding dermatological characteristics, Fitzpatrick skin type III was the most common (30.5%), followed by skin types II and IV (26.6% each). Nearly half of the participants (47.7%) reported having 11–50 melanocytic nevi, whereas 43.2% had 1–10 nevi. A family history of skin cancer was reported by only 2.4% of participants, and none had a personal history of skin cancer. More than half of the participants (54.5%) reported tanning during the previous 12 months, while only 47.6% reported practicing sun-protective measures during childhood (Table 2).

Table 2
Skin health characteristics of the participants.

Variables		n (%)
Fitzpatrick skin type	Type I	41 (5.7)
	Type II	191 (26.6)
	Type III	219 (30.5)
	Type IV	191 (26.6)
	Type V	75 (10.5)
Use of medications that cause sun sensitivity	None	650 (90.7)
	Yes	67 (9.3)
Facial freckles	None	623 (86.9)
	Yes	94 (13.1)
Number of body moles	1–10	310 (43.2)
	11–50	342 (47.7)
	51–100	49 (6.8)
	> 100	16 (2.2)
Eye color	Blue	35 (4.9)
	Hazel	89 (12.4)
	Green	54 (7.5)
	Brown	539 (75.2)
History of skin cancer	None	717 (100)
Family history of any skin cancer	None	700 (97.6)
	Yes	17 (2.4)
Total sunburns in lifetime	None	180 (25.1)
	1–10	448 (62.5)
	11–20	52 (7.3)
	> 20	37 (5.2)
Number of severe sunburns	None	497 (69.3)
	1–2	167 (23.3)
	3–5	33 (4.6)

Variables		n (%)
	> 5	20 (2.8)
Tanning in the last 12 months	No	326 (45.5)
	Yes	391 (54.5)
Number of tanning sessions	None	703 (98)
	1–2	10 (1.4)
	3–5	2 (0.3)
	> 5	2 (0.3)
Did you take precautions against sun exposure during childhood?	No	376 (52.4)
	Yes	341 (47.6)

Medical students achieved significantly higher scores on the SCSKS than students from non-medical faculties (18.10 ± 3.20 vs. 15.96 ± 3.00, $p < 0.001$). Female participants also demonstrated significantly higher knowledge scores than males (17.27 ± 3.13 vs. 16.09 ± 3.48, $p < 0.001$). Participants who reported practicing sun protection during childhood had significantly higher SCSKS scores than those who did not (17.32 ± 3.29 vs. 16.60 ± 3.23, $p = 0.003$) (Table 3). In addition, significant differences in knowledge scores were observed by Fitzpatrick skin type ($p < 0.001$) and by the number of melanocytic nevi ($p = 0.006$) (Table 4).

Table 3
Comparison of Skin Cancer and Sun Knowledge Scale (SCSKS) and Sun Protection Behavior Scale (SPBS) scores between student groups and according to demographic characteristics.

Group	SCSKS n (mean ± SD)	P-value	SPBS n (mean ± SD)	P-value
Medical student	330 (18.1 ± 3.2)	**< 0.001**	330 (24.38 ± 6.37)	0.647
Non-medical student	387 (15.96 ± 3)		387 (24.61 ± 6.56)	
Medical student	330 (18.10 ± 3.2)	**< 0.001**	330 (24.38 ± 6.37)	0.622
Students in non-medical health departments	170 (16.28 ± 3.02)		170 (24.68 ± 6.45)	
Medical student	330 (18.10 ± 3.2)	**< 0.001**	330 (24.38 ± 6.37)	0.152
Nursing student	48 (15.63 ± 2.58)		48 (25.79 ± 6.25)	
Medical student	330 (18.10 ± 3.2)	**0.006**	330 (24.38 ± 6.37)	0.226
Pharmacy student	12 (15.5 ± 3.9)		12 (22.10 ± 7.19)	
Medical student	330 (18.1 ± 3.2)	**0.002**	330 (24.38 ± 6.37)	0.173
Dentistry student	69 (16.78 ± 3.15)		69 (23.25 ± 6.02)	
Medical student	330 (18.1 ± 3.2)	**0.001**	330 (24.38 ± 6.37)	0.057
Health sciences student	41 (16.41 ± 3.05)		41 (26.41 ± 6.85)	
Male	198 (16.09 ± 3.48)	**< 0.001**	198 (20.67 ± 5.87)	**< 0.001**
Female	519 (17.27 ± 3.13)		519 (25.97 ± 6.08)	
No reported childhood sun protection	376 (16.6 ± 3.23)	**0.003**	376 (23.91 ± 6.54)	**0.010**

SCSKS: Skin Cancer and Sun Knowledge Scale; SPBS: Sun Protection Behavior Scale; SD: standard deviation. Values are n (mean ± SD), with sample sizes shown separately for each scale. Each P-value compares the two adjacent groups. Group comparisons were performed using the independent-samples t test. A p-value < 0.05 was considered statistically significant.

Group	SCSKS	P-value	SPBS	P-value
	n (mean ± SD)		n (mean ± SD)	
Reported childhood sun protection	341 (17.32 ± 3.29)		341 (25.16 ± 6.33)	

SCSKS: Skin Cancer and Sun Knowledge Scale; SPBS: Sun Protection Behavior Scale; SD: standard deviation. Values are n (mean ± SD), with sample sizes shown separately for each scale. Each P-value compares the two adjacent groups. Group comparisons were performed using the independent-samples t test. A p-value < 0.05 was considered statistically significant.

Table 4
Comparison of Skin Cancer and Sun Knowledge Scale (SCSKS) and Sun Protection Behavior Scale (SPBS) scores according to students' demographic characteristics.

Group	Category	SCSKS n (mean ± SD)	P-value	SPBS n (mean ± SD)	P-value
Monthly income	0–10.000 TL	423 (16.74 ± 3.21)	**0.007**	423 (24.57 ± 6.32)	**0.048**
	10.000–20.000 TL	173 (17.01 ± 3.24)		173 (25.29 ± 6.45)	
	20.000–30.000 TL	95 (17.95 ± 3.45)		95 (23.18 ± 6.83)	
	> 30.000 TL	26 (16.15 ± 3.26)		26 (23.08 ± 6.96)	
Skin type	Type I	41 (17.93 ± 3.00)	**< 0.001**	41 (25.56 ± 7.55)	**0.007**
	Type II	191 (17.49 ± 3.32)		191 (25.35 ± 6.15)	
	Type III	219 (17.08 ± 3.22)		219 (24.97 ± 6.48)	
	Type IV	191 (16.32 ± 3.14)		191 (23.31 ± 6.42)	
	Type V	75 (16.21 ± 3.39)		75 (23.44 ± 6.24)	
Number of moles	1–10	310 (16.51 ± 3.26)	**0.006**	310 (23.95 ± 6.30)	0.227
	11–50	342 (17.16 ± 3.25)		342 (24.87 ± 6.56)	
	51–100	49 (17.90 ± 3.11)		49 (24.59 ± 6.44)	
	> 100	16 (17.88 ± 3.61)		16 (26.06 ± 6.48)	
Eye color	Blue	35 (17.23 ± 3.21)	0.713	35 (23.43 ± 6.41)	0.539
	Hazel	89 (16.65 ± 3.49)		89 (24.92 ± 6.32)	

SCSKS: Skin Cancer and Sun Knowledge Scale; SPBS: Sun Protection Behavior Scale; SD: standard deviation. Values are n (mean ± SD). Between-group comparisons were performed using one-way ANOVA, followed by Tukey's post hoc test for pairwise comparisons. Displayed P-values are for the overall group comparisons. A p-value < 0.05 was considered statistically significant.

Group	Category	SCSKS n (mean ± SD)	P-value	SPBS n (mean ± SD)	P-value
	Green	54 (16.72 ± 3.24)		54 (23.74 ± 6.56)	
	Brown	539 (17.00 ± 3.25)		539 (24.58 ± 6.49)	

SCSKS: Skin Cancer and Sun Knowledge Scale; SPBS: Sun Protection Behavior Scale; SD: standard deviation. Values are n (mean ± SD). Between-group comparisons were performed using one-way ANOVA, followed by Tukey's post hoc test for pairwise comparisons. Displayed P-values are for the overall group comparisons. A p-value < 0.05 was considered statistically significant.

The SPBS scores did not differ significantly between medical and non-medical students (24.38 ± 6.37 vs. 24.61 ± 6.56, p = 0.647). Similarly, no significant differences were observed between medical students and students from other health-related faculties. However, female participants demonstrated significantly better sun-protective behaviors than males (25.97 ± 6.08 vs. 20.67 ± 5.87, p < 0.001). Participants who reported practicing sun protection during childhood also had significantly higher SPBS scores than those who did not (25.16 ± 6.33 vs. 23.91 ± 6.54, p = 0.010) (Table 3). SPBS scores differed significantly according to Fitzpatrick skin type (p = 0.007), whereas no significant associations were observed with the number of melanocytic nevi (p = 0.227) or eye color (p = 0.539) (Table 4).

Pearson correlation analysis showed a weak positive association between SCSKS and SPBS scores (r = 0.211, p < 0.001). SCSKS scores were also positively associated with age (r = 0.180, p < 0.001) and academic year (r = 0.306, p < 0.001). No statistically significant linear associations were detected between SPBS scores and either age (r = 0.055, p = 0.140) or academic year (r = 0.046, p = 0.223) (Table 5).

Table 5
Correlation between Skin Cancer and Sun Knowledge Scale (SCSKS), Sun Protection Behavior Scale (SPBS), age, and academic year

Variable	Statistic	SCSKS Total score	SPBS Total score	Age	Academic year
SPBS total score	r	0.211	1		
	p	**< 0.001**			
	n	717	717		
Age	r	0.180	0.055	1	
	p	**< 0.001**	0.140		
	n	717	717	717	
Academic year	r	0.306	0.046	0.699	1
	p	**< 0.001**	0.223	**< 0.001**	
	n	717	717	717	717

SCSKS: Skin Cancer and Sun Knowledge Scale; SPBS: Sun Protection Behavior Scale; r: Pearson's correlation coefficient. All tests were two-sided, and p-values < 0.05 were considered statistically significant.

4. Discussion

This study found that medical students had greater knowledge of skin cancer and sun protection than non-medical students, without significantly higher sun-protective behavior scores. Knowledge and behavior were weakly positively correlated, indicating that greater awareness was accompanied by only modest differences in reported protection. Together, these findings highlight the importance of assessing knowledge and everyday preventive practices as distinct but related outcomes in university populations.

The difference between medical students' knowledge and reported practices is consistent with previous research. Nahar et al.'s review identified deficiencies in preventive practices among medical students despite generally moderate to high skin cancer knowledge. [3] Baghani et al. similarly reported higher knowledge among medical students/general practitioners than among dermatology patients, whereas patients reported better practices. [9] Among Emirati undergraduates, Anshasi et al. found no significant correlation between knowledge and sun avoidance. [10] Although differences in populations and behavioral measures preclude direct quantitative comparisons, these studies provide a consistent context for our findings. Our weak positive correlation also agrees with Day et al.'s systematic review, which found positive knowledge–protection associations in most studies while emphasizing

heterogeneity in measurement. [5] Knowledge therefore remains relevant to prevention, but knowledge scores alone provide an incomplete picture of protective behavior.

Beliefs, motivations and practical barriers are relevant considerations when examining this relationship. Julian et al. investigated beliefs about UV exposure in relation to sunscreen and tanning behaviors, [11] while Auerbach et al. examined reasons for protection and non-protection among young women. [12] Miller et al. evaluated sun-safety behaviors and barriers in relation to sunburn history among college students. [13] These studies support examining the circumstances in which knowledge is translated into action. Although our questionnaire included additional questions about motivations and barriers, the present analyses did not examine whether these factors accounted for the observed knowledge–behavior relationship.

Knowledge scores were positively associated with age and academic year, whereas neither variable showed a statistically significant linear association with behavior scores. This pattern suggests that differences in knowledge across stages of university education may not be accompanied by corresponding differences in daily protection. It also reinforces the value of including practical behavioral outcomes when evaluating university sun-safety education.

Female participants had higher knowledge and behavior scores than males. Tamer et al. likewise reported more frequent sun-protective practices among female fifth-year medical students in Türkiye. [14] The lower scores among men in our sample identify a group warranting particular attention in prevention activities. Understanding which messages and practical approaches are most relevant to male students could help inform the design of future interventions.

Reported childhood sun protection was associated with higher knowledge and behavior scores in young adulthood. Littlewood and Greenfield identified parental beliefs and practical barriers relevant to children's protection, [15] while Thoonen et al. examined relationships between parental protection and children's own protective behavior. [16] Our findings extend this discussion to young adults and support further investigation of family influences on sun-safety practices across the life course. Longitudinal studies would help determine whether early protective habits persist into university years.

Knowledge and behavior scores also differed across Fitzpatrick phototypes. Differences in sunburn susceptibility and perceived need for protection may be relevant to this pattern. Yilmaz et al. also reported differences in knowledge and protective behavior according to skin characteristics among nursing students. [4] Prevention messages should acknowledge individual susceptibility while emphasizing that protection remains relevant across phototypes. As discussed by Krutmann et al., people with skin of colour also have photoprotection needs. [17] Fitzpatrick phototype should not be treated as interchangeable with ethnicity or as a basis for assuming that darker skin requires no protection.

Knowledge scores differed across nevus-count categories, whereas behavior scores did not differ significantly. This finding raises the question of whether awareness of personal risk is reflected in

everyday protection. Income-category differences showed no consistent gradient in either knowledge or behavior. These exploratory findings suggest that the relationships between personal characteristics and protection are more complex than a simple increase in protective practices with greater perceived risk or financial resources.

More than half of participants reported tanning during the previous 12 months, underscoring the relevance of exposure-related choices alongside protective practices. For university prevention programs, an important implication is to assess changes in behavior rather than relying solely on knowledge gains. Asai et al.'s review suggested potential benefits of multicomponent interventions, often combining UV photography with education, although the evidence was heterogeneous and generally of poor quality. [6] Practical guidance, personally relevant messages and approaches addressing reported barriers are reasonable candidates for evaluation. Future studies should assess sustained protective behavior and, where feasible, sunburn or UV-exposure outcomes.

Strengths of this study include the sample of 717 students, the inclusion of medical and non-medical faculties, and the use of established Turkish-language instruments. Several limitations should be considered. Recruitment used non-probability convenience sampling at one university, and the female predominance and voluntary participation may limit generalizability. Self-reported practices and retrospective childhood information are susceptible to reporting and recall bias. The cross-sectional design cannot establish causality, persistence of childhood habits or the effects of medical education. Analyses were not adjusted for potential confounding, including interrelationships between age, academic year and faculty. Multiple comparisons increase the possibility of chance findings, particularly for borderline results and small subgroups. Overall group tests do not establish specific pairwise differences, and a non-significant comparison does not demonstrate equivalence. Differences in preparatory-year arrangements may also limit comparisons of academic year. Finally, previous validation of the Turkish SCSKS in nursing students and SPBS in adolescents does not establish their measurement performance in every subgroup of the present sample. [7] [8]

In conclusion, medical students had greater knowledge of skin cancer and sun protection than non-medical students, without significantly higher reported protective behavior scores. The weak knowledge–behavior association supports evaluating university sun-safety programs using both knowledge and sustained behavioral outcomes. Female sex and reported childhood protection were associated with higher behavior scores, providing directions for further research and prevention planning.

Declarations

Funding sources: None

Conflict of interest disclosure: None

Data availability statement: Data available on request from the authors.

Ethics statement: This study was approved by the Clinical Research Ethics Committee of Istanbul University, Istanbul Faculty of Medicine (Approval No: 2024/2222; Meeting No: 01; Date: January 10, 2025).

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Competing interests

The authors declare no competing interests.

Ethics approval

This study was approved by the Clinical Research Ethics Committee of Istanbul University, Istanbul Faculty of Medicine (Approval No: 2024/2222; Meeting No: 01; Date: January 10, 2025).

Consent to participate

Written informed consent was obtained from all participants.

Data availability

The data that support the findings of this study are available from the corresponding author upon request.

Author contributions

Mucahit Ergun contributed to the study design, collected and analyzed the data, and drafted the manuscript. Tugba Atci supervised the study and contributed to the study design, interpretation of the findings, and critical revision of the manuscript. Both authors reviewed and approved the final manuscript.

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