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PERCEIVED CLIMATE-RELATED SKIN CHANGES AND SUN-PROTECTION BEHAVIORS AMONG ADULTS IN TBILISI, GEORGIA: A CROSS-SECTIONAL SURVEY-BASED STUDY

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მარინა გიორგობიანი, მზექალა კონდრატიევა, ნინო შიუკაშვილი

კლიმატთან დაკავშირებული კანის ცვლილებების აღქმა და მზისგან დამცავი ქცევის ჩვევები ზრდასრულებში თბილისში, საქართველოში: ჯვარედინი კვლევა

თბილისის სახელმწიფო სამედიცინო უნივერსიტეტი, კენ უოლკერის საერთაშორისო უნივერსიტეტი, თბილისი, საქართველო

რეზიუმე

ქალაქის მოსახლეობაში კლიმატთან დაკავშირებული კანის ცვლილებები შეიძლება განვითარდეს და შესაბამისად, მათ შეუძლიათ კანის დასაცავად შეცვალონ მიდგომები. ეს ონლაინ, ჯვარედინი კვლევა, რომელიც ჩატარდა თბილისში (საქართველო) მცხოვრებ მოზრდილებში (n = 296), შეისწავლიდა მზისგან დაცვის რუტინებს, კლიმატთან დაკავშირებულ კანის ცვლილებებს და დერმატოლოგიური სერვისების გამოყენებას.

კითხვარი აფასებდა სოციოდემოგრაფიულ მახასიათებლებს, დერმატოლოგთან ვიზიტებსა და ჩივილებს, მზისგან დასაცავად მიღებულ სტრატეგიებსა და ცვლილებებს ბოლო 5 წლის განმავლობაში, კლიმატთან დაკავშირებულ კანის ცვლილებებსა და კლიმატისა და კანის შესახებ ინფორმაციის მიღების ინტერესს. მონაწილეთა უმეტესობა საშუალო ასაკის ქალი იყო; თითქმის ნახევარს არასოდეს უნახავს დერმატოლოგი. დაახლოებით ორმა მესამედმა განაცხადა, რომ გაზარდა მზისგან დამცავი რუტინა, ძირითადად SPF კრემების გამოყენებით, და 60%-მა აღიქვა კლიმატთან დაკავშირებული კანის ცვლილებები, უმეტესად სიმშრალე, მგრძნობელობა, აკნეს გამწვავება და პიგმენტური ცვლილებები.

ეს დასკვნები მიუთითებს, რომ კლიმატთან დაკავშირებული კანის პრობლემები ხშირია და რისკის აღქმა და დერმატოლოგთან კონტაქტი შეიძლება იყოს მნიშვნელოვანი ბერკეტი, გლობალური დათბობის რისკქვეშ მყოფ ქალაქურ გარემოში, კანის პრევენციული ჯანმრთელობის ქცევების გასაძლიერებლად.

Introduction. Climate change is widely recognized as one of the major health challenges of this century, with effects projected across the life course and health systems worldwide. Rising temperatures, altered precipitation patterns, more frequent heatwaves and extreme weather events are already affecting patterns of disease and straining health services [1]. Within this broader climate–health landscape, the skin is a primary interface between the body and the external environment, and is therefore particularly vulnerable to climatic and environmental stressors.

Recent dermatologic reviews have highlighted multiple pathways by which climate change may influence skin health. Climate-related factors such as stratospheric ozone depletion, increased ultraviolet (UV) radiation, rising temperatures, humidity changes and deteriorating air quality can affect the skin's capacity to maintain homeostasis and may contribute to a wide spectrum of dermatoses, including skin cancers, photoaging, atopic dermatitis, psoriasis, acne vulgaris, melasma and pigmentary disorders [2,3].

A recent review on atopic dermatitis and climate highlights that climate-related stressors, including heat waves, humidity extremes, air pollution and other extreme weather events, can exacerbate disease activity and underscores the need for tailored management strategies adapted to local climatic conditions [4]. Given that skin diseases rank among the leading causes of non-fatal global disease burden, even modest climate-related shifts in incidence or severity of common conditions such as eczema, acne and pigmentary disorders may translate into substantial population-level impacts [5]. In this context,

preventive strategies, especially sun protection, barrier care and trigger avoidance, are likely to become increasingly important, and dermatologists have been urged to integrate climate considerations into clinical counselling and advocacy [6].

Despite this emerging evidence, relatively little is known about how people themselves perceive climate-related changes in their own skin, how these perceptions relate to preventive behaviors such as sun protection. These questions are particularly under-studied in Eastern Europe and the South Caucasus, including Georgia, where climatic conditions, pollution burdens and health-system characteristics may differ from those in better-studied settings.

Against this backdrop, we conducted a cross-sectional survey of adults living in Tbilisi, Georgia, to explore how climate change is perceived in relation to skin health and how these perceptions relate to sun-protection behavior and dermatology service use. Our objectives were to (1) describe sun-protection routines; (2) estimate the prevalence and self-reported types of perceived climate-related skin changes; and (3) examine associations between perceived climate-related skin changes, increased sun-protection behavior and dermatology service use.

Methods. We conducted a cross-sectional, anonymous online survey to explore sun-protection behaviors and perceived climate-related skin changes among residents of Tbilisi, Georgia. Eligible participants were individuals living in Tbilisi who were able to complete the questionnaire independently. The survey link was disseminated through multiple social media channels. The questionnaire was developed by the investigators based on the study objectives and existing literature on skin health, sun protection and climate-related health perceptions. The final survey included the following domains: sociodemographic variables; Dermatology service use; Sun-protection behavior; Perceived climate-related skin changes.

For statistical analysis SPSS (version 26) was used. Descriptive statistics were used to summaries sample characteristics; for bivariate analyses, Chi-square tests were used. Adjusted odds ratios (aORs) with 95% CIs and p-values were reported. Model fit was evaluated using pseudo-R^2 and likelihood ratio tests. Statistical significance was set at $\alpha = 0.05$.

Results. A total of 412 respondents completed the survey; however, after data cleaning the final sample size was 296; almost all were female and predominantly middle-aged, with the majority in the 36–45-year group. Almost half of respondents reported never having visited a dermatologist or not remembering their last visit, while the remainder reported a range of frequency of visits (Table 1).

Table 1. Sociodemographic and dermatology-related characteristics of respondents (N = 296)

Characteristic	Category	n	%
Age group (years)	14–18	3	1.0
	19–25	19	6.4
	26–35	73	24.7
	36–45	150	50.7
	46–55	42	14.2
	56–65	8	2.7
	66–75	1	0.3
Gender	Female	286	96.6
	Male	10	3.4
Time since last dermatologist visit	1 month before	29	9.8
	2–6 months before	60	20.3
	1 year before	61	20.6
	Never / do not remember	146	49.3

Dermatologist visits in last 5 years	Never	124	41.9
	1–2 times	87	29.4
	3–5 times	56	18.9
	6–10 times	29	9.8

Percentages are calculated with N = 296 as the denominator unless otherwise indicated.

Among those who had consulted a dermatologist, acne and skin-care/cosmetic concerns were the most common reasons, followed by dry skin and allergy. Most participants reported having increased their skin-protection routine over the previous five years, and SPF-based sun protection was the predominant strategy, often used alone or in combination with other methods. Approximately 60% of respondents reported that they had noticed changes in their skin that they attributed to climate change in the last five years. Among those perceiving climate-related changes, dryness was the most frequently mentioned manifestation, followed by allergic reactions/sensitivity, acne exacerbations and pigmentary changes (Table 2).

Table 2. Dermatologic complaints, sun-protection behaviors, perceived climate-related skin changes, and interest in information

Variable	Category / response	n	%
Main complaint at dermatology visit*	Acne	66	22.3
	Skin-care routine / cosmetic advice	41	13.9
	Dry skin	20	6.8
	Allergy	14	4.7
	Moles and pigmentations	7	2.4
	Nail issues	4	1.4
	No visit	144	48.6
Increase in skin-protection routine (last 5 years)	Yes, significantly	141	47.6
	Yes, somehow	104	35.1
	No changes	51	17.2
Current sun-protection method	SPF sun-cream protection	198	66.9
	Combined methods (SPF + other)	37	12.5
	Nothing	35	11.8
	Active avoidance	17	5.7
	Hat / sunglasses/ Clothes	9	3.0
Perceived climate-related skin changes (last 5 years)	Yes	179	60.5
	I don't know	71	24.0
	No	46	15.5
Type of perceived climate-related skin changes† (among those answering "Yes", n = 179)	Dry skin	114	63.7‡
	Allergic reactions / sensitivity	50	27.9‡
	Acne / acne exacerbation	49	27.4‡
	Pigmentation changes	43	24.0‡
	Wrinkles /ageing	2	1.1‡
	Skin infections	1	0.6‡

** Percentages for complaints use N = 296 as denominator and therefore include non-visitors as "no complaint reported".*
† Multiple responses possible; categories are not mutually exclusive.
‡ Percentage of respondents who perceived climate-related skin changes (n = 179)

Bivariate associations. In bivariate analyses, perceived climate-related skin changes did not differ significantly by age group, number of dermatologist visits or main complaint category. In contrast, perceived climate-related changes were positively associated with an increase in sun-protection routine.

For the secondary outcome, increased sun protection was not significantly associated with age, but showed clear associations with dermatology use and symptom burden. Participants with a recent dermatologist visit, a higher number of visits in the previous five years, or any documented dermatologic complaint were more likely to report increasing their skin protection than those without such contacts or complaints (Table 3).

Table 3. Bivariate associations between perceived climate-related skin changes and key predictors
Perceived climate-related skin change was dichotomized as Yes vs No/unsure.

Predictor	Category	Climate-related change "yes" N (%)	p-value*
Age group (years)	18–35	64/95 (67.4)	0.244
	36–45	87/149 (58.4)	
	≥46	28/51 (54.9)	
Dermatology visits in last 5 years	0 (never)	73/123 (59.3)	0.489
	1–2	50/87 (57.5)	
	≥3	56/85 (65.9)	
Complaint category	Acne	45/66 (68.2)	0.277
	None / no visit	81/143 (56.6)	
	Other complaints	53/86 (61.6)	
Increase in skin protection (last 5 years)	No change	21/47 (44.7)	0.020
	Any increase	157/245 (64.1)	

** p-values from Chi-square tests comparing the distribution of perceived climate-related skin changes across categories of each predictor.*

Multivariable logistic regression. In the multivariable model for **perceived climate-related skin changes (Outcome A)**, increased sun protection remained the only independent predictor: participants who had increased their sun-protection routine had more than twice the adjusted odds of reporting climate-related skin changes compared with those who had not changed their routine, after controlling for age, visit frequency and complaint category. Other covariates were not significantly associated with the outcome, and the model explained a modest proportion of variance.

In the model for **increased sun protection (Outcome B)**, both perceived climate-related skin changes and frequent dermatology use were independently associated with behavior change. Respondents who perceived climate-related skin changes had approximately double the odds of having increased their protection, and those with three or more dermatologist visits in the past five years had substantially higher odds compared with those with no visits (Table 4). Age group and complaint category were not independently associated with increased protection.

Table 4. Multivariable logistic regression models for perceived climate-related skin changes (Outcome A) and increased sun protection (Outcome B)

Predictor	Category vs reference	Outcome A: perceived climate-related skin change aOR (95% CI)	p-value	Outcome B: increased protection aOR (95% CI)	p-value
Age group	36–45 vs 18–35	0.71 (0.41–1.25)	0.240	0.74 (0.34–1.61)	0.445
	≥46 vs 18–35	0.76 (0.36–1.60)	0.467	0.44 (0.17–1.16)	0.095
Dermatologist visits (last 5 y)	1–2 vs 0	0.57 (0.27–1.22)	0.150	2.31 (0.87–6.15)	0.094
	≥3 vs 0	0.79 (0.37–1.68)	0.537	4.76 (1.49–15.22)	0.008
Complaint category	None vs acne	0.56 (0.26–1.23)	0.152	0.96 (0.33–2.83)	0.945
	Other vs acne	0.85 (0.42–1.73)	0.650	1.38 (0.45–4.25)	0.576

Protection / climate perception	Any increase vs no increase (Outcome A)	2.15 (1.11–4.15)	0.023	—	
	Climate-related change yes vs no/unsure (Outcome B)	—	—	2.19 (1.13–4.24)	0.020

Reference categories: age 18–35 years; 0 dermatologist visits in last 5 years; acne as main complaint; no increase in protection (for Outcome A); no climate-related skin change (for Outcome B).
Notes: Outcome A model includes increased protection, age group, dermatologist visit frequency, and complaint category (complete-case n = 292; pseudo-$R^2 \approx 0.03$).
Outcome B model includes perceived climate-related skin changes, age group, visit frequency and complaint category (n = 292; pseudo-$R^2 \approx 0.10$).

Discussion. This study we examined sun-protection behaviors and perceived climate-related skin changes among adults in Tbilisi, Georgia. In a largely female, middle-aged urban sample, many respondents reported skin changes they personally attributed to climate change, most commonly dryness, sensitivity, acne flares and pigmentary changes, with intensified sun-protection routines in the previous five years. Increased protection was independently associated with perceiving climate-related skin changes, and frequent dermatologist visits were independently associated with increased protection. These findings are consistent with the growing recognition that climate change and environmental stressors are relevant to dermatologic disease. Reviews describe rising temperatures, altered humidity, changes in UV exposure and shifting distributions of infectious vectors as important drivers of skin morbidity, alongside air pollution and extreme weather [7]. Around 60% of respondents reported skin changes that they themselves linked to climate change. The pattern, dryness, sensitivity, acne exacerbations and pigmentary changes, is consistent with conditions influenced by environmental stressors. Climate-focused dermatology reviews likewise highlight xerosis, eczema flares, pigmentary disorders and other inflammatory dermatoses as likely to be affected by climatic and pollution-related changes [8].

In this survey, however, the outcome is perception rather than confirmed climatic causality. Participants were asked whether *they* considered their skin changes related to climate change; responses therefore reflect symptom experience, attribution and broader climate awareness. Such perceptions are clinically important because they shape help-seeking and openness to counselling. The lack of strong associations with age group, visit frequency or complaint type suggests that climate-related skin concerns are diffuse in this urban population, rather than confined to a narrow high-risk subgroup.

A central finding is the robust association between perceived climate-related skin changes and increased sun protection. In multivariable analyses, perceived climate-related change remained an independent predictor of increased protection.

These patterns fit with broader health-behavior models in which perceived personal relevance of risk can motivate preventive actions. At the same time, this cross-sectional design cannot determine directionality: individuals who are generally more health-conscious may both protect more and attend more closely to skin changes, framing them in climate terms; conversely, recurrent or worsening symptoms may prompt information-seeking and reinterpretation in light of climate narratives. The modest explanatory power of the models suggests that unmeasured factors (e.g. education, socioeconomic status, occupational and recreational sun exposure, and health literacy) also contribute [9-11].

Dermatology contact emerged as an additional correlate of behavior change. Participants with recent dermatologist visits and those with more visits over five years were significantly more likely to report intensified protection, with a clear dose–response pattern. This aligns with the idea that clinical

encounters provide key opportunities to deliver prevention messages and adaptation advice, whether related to UV exposure, barrier care or recognition of environment-triggered flares [12-15]. Yet almost half of respondents had never consulted a dermatologist or could not recall doing so, implying that those most likely to improve protection are already connected to specialist care. To avoid widening disparities, dermatology-based counselling should be complemented by strategies in primary care and community settings.

Limitations and future research opportunities. Although the study involves a relatively large sample for a single-city survey; simultaneous assessment of dermatology use, complaints, protective behavior and perceived climate-related skin changes, the limitations must be acknowledged. The sample was drawn from one urban center and was overwhelmingly female, limiting generalizability to men, rural populations and other regions. The cross-sectional design precludes causal inference. All measures were self-reported and subject to recall and reporting biases. Classification of changes as "climate-related" reflects personal attribution rather than objective causality; media and public discourse may influence these responses. The models explained only a modest proportion of variance, indicating that important determinants such as socioeconomic status, detailed sun-exposure behavior and psychological factors were not captured. Finally, the study did not incorporate meteorological, UV or pollution data; so, reported skin changes cannot be directly linked to specific environmental trends.

Despite these limitations, the findings suggest that climate-related concerns are already salient in dermatologic practice and that perceived climate impact and dermatologist contact are linked to adaptive behavior in the form of increased sun protection. For clinicians, this underscores the value of brief, targeted counselling on sun protection and skin-care routines, particularly for patients with dryness, sensitivity, acne and pigmentary problems. For public-health practitioners, skin health offers a concrete, personally relevant entry point for broader climate-adaptation messaging. Future research should include more diverse and representative samples beyond Tbilisi, use longitudinal and mixed-methods designs to track how perceptions and behaviors evolve, and link self-reported outcomes with clinical assessments and environmental indicators such as temperature, humidity, UV index and air-pollution metrics.

Conclusion. In this cross-sectional survey of adults in Tbilisi, many participants perceived their skin as affected by climate change and had already modified their sun-protection routines, especially those with more frequent dermatology contact. Perceived climate-related skin changes and dermatologist visits were both independently associated with increased protection, while age and main dermatologic complaint were not, suggesting that risk perception and clinical encounters are key levers for preventive behavior. Future research should include more diverse populations, link self-reported changes with objective clinical and environmental data, and test targeted educational interventions to strengthen adaptive, preventive skin-health behaviors in a warming world.

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SUMMARY

Adults in urban settings may experience skin changes related to climate and adjust their protection behaviors accordingly. This cross-sectional online survey of adults living in Tbilisi, Georgia (final sample n = 296), explored sun-protection routines, perceived climate-related skin changes and dermatology service use. The questionnaire assessed sociodemographic characteristics, dermatology visits and complaints, changes in sun-protection behavior over the past 5 years, perceived climate-related skin changes and interest in information on climate and skin. Most participants were middle-aged women;

almost half had never visited a dermatologist. About two-thirds reported increasing their sun-protection routine, mainly using SPF creams, and 60% perceived climate-related skin changes, predominantly dryness, sensitivity, acne flares and pigmentary changes. In multivariable analyses, increased protection independently predicted perceived climate-related changes, while both perceived changes and frequent dermatology visits independently predicted greater protection. These findings suggest that climate-related skin concerns are common and that risk perception and dermatology contact may be important levers for strengthening preventive skin-health behaviors in a warming urban environment.

Keywords: Skin health; climate change; environment; sun protection.