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PATIENT PAGE

Sun protection and sun exposure habits among tattooed individuals

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Abstract

Background: Little is known about sun-exposure and sun-protection behaviors among tattooed individuals.

Objectives: This study sought to investigate the sun-exposure and sun-protective habits among tattooed individuals.

Methods: Population-based study using a representative sample of the general population aged ≥18 years from four countries (Brazil, China, Russia and United-States). All participants were asked to fill in a digital structured questionnaire. We inquired about socio-demographics, self-evaluation of their skin phototype (from I to VI), tattoo(s) and sun-exposure and sun-protection habits.

Results: A total of 9031 adult participants responded to the questionnaire of whom 1682 (18.6%) had ≥ 1 tattoo(s). The prevalence of tattoos was significantly higher among individuals with lighter skin tone (phototype I to III, 20.2%) compared to those with darker one (phototype IV to VI, 13.9%, $p<0.001$). Almost 20% percent of the tattooed individuals acknowledged heavy lifestyle sun-exposure compared to 11% of those without tattoos ($p<0.001$). Multinomial analyses showed that Brazilians and those having ≥ 1 tattoo were more likely to have intermediate and intense lifestyle sun-exposure. Tattooed individuals were more likely to report that they used regular or occasional sun-protection methods than non-tattooed individuals ($p < 0.001$ and 0.016 respectively). Multinomial analyses for regular sun-protection methods showed significant association with respondents from Brazil and those having one tattoo, but not more than one tattoo. Limitations include mainly that this is a questionnaire-based study and and we lack of questions about sunburns and skin cancers.

Conclusions: This large population-based study shows that tattooed individuals do have a heavily sun-exposed lifestyle but, at the same time, display sun-protection habits.

KEYWORDS
outdoor, sun, sun protection, sunscreen, tattoo

INTRODUCTION

Almost one out of five individuals (18%) of the general population aged ≥18 years has ≥1 tattoo.[1] Association between skin cancer and tattoos is considered thus far as fortuitous.[2–5] Skin cancers are mostly associated with history of excessive or chronic sun exposure. There is a lack of data about sun exposure habits among tattooed individuals. We evaluated in a representative sample of the general population from four countries (Brazil, China, Russia and the United States) sun-exposure and sun-protection habits of tattooed individuals.

MATERIAL AND METHODS

Population sample

The methodology is identical to several previous national based studies about body-art.[1,6,7] The study population was selected from the mega database used for market research and opinion surveys, which includes more than 200 million e-mail addresses worldwide (Megabase, Kantar Health) as described elsewhere.[8] For each country, a representative sample aged ≥18 years from the general population was constituted using a stratified proportional sampling method with replacement design. Fixed quotas of subjects fulfilling predefined socio-demographic criteria were selected (gender, age, socio-professional status and regional distribution) to ensure the study population is representative of each country. Each selected participant was contacted by e-mail. If the contact was not achieved, another potential participant with the same characteristics was randomly selected. Each participant accepted to fill in a digital questionnaire. A total of 9031 individuals filled in an online questionnaire between January and March 2019. Of note, respondents are different from our prior studies.[1,6,7]

We inquired about socio-demographics, self-evaluation of their skin phototypes, tattoo(s) and sun-exposure and sun-protection habits. Questionnaire regarding sun-exposure and sun-protection have not been pretested or formally validated (Supplementary material).

Since the survey did not include manipulation of the subject or the subject's environment, submission to the institutional review board was waived.

Statistical analysis

Quantitative variables were expressed as the mean and standard deviation. Qualitative variables were expressed as the frequencies and percentages. We first compared all sun-exposure and sun-protection related variables using univariate logistic regression. All variables were compared between nontattooed and tattooed individuals and between individuals with one and more than one tattoo. We performed two multiple multinomial regression using as outcomes level of sun exposure expressed in four levels (none, weak, intermediate and intense) and regularity of sun protection expressed in three levels (never, rarely and occasionally). We expressed tattoos in three categories (none, one and more than one) and adjusted on known sun-exposure and protection confounders (phototype, country, gender and age). Statistical analyses were performed using R software version 3.5.1 (The R Project for Statistical Computing; The R Foundation). Multinomial regression was done using the package nnet.

RESULTS

General population

Out of the 9031 respondents, 18.6% ($n = 1682$) had ≥1 tattoo(s). The prevalence of tattoos according to countries was as follows: 31.5% (United-States), 22.3% (Brazil), 11.8% (China) and 11.7% (Russia). Tattooed individuals were younger (mean age 35.7 ± 11.6 years) than non-tattooed ones (40.7 ± 14.4 years; Student t-test, $p < 0.001$). Over 80% (80.9%, $n = 1361$) of the tattooed individuals had a skin phototype I–III. The prevalence of tattoos was significantly higher among individuals with lighter skin tone (phototype I–III, 20.2%) than those with darker one (phototype IV–VI, 13.9%, $p < 0.001$). The prevalence of tattoos was the highest among individuals with phototype I (26.2%) and the lowest among those with phototype IV (13.5%). There was no significant difference regarding skin phototypes whether tattoo bearers had one tattoo or more (Table 1).

Sun exposure habits

Almost 20% percent of the tattooed individuals acknowledged heavy lifestyle sun-exposure (whether on vacations, for hobbies, at work or daily life), compared to 11% of those without tattoos ($p < 0.001$). Tattooed individuals reported significantly more often moderate to heavy lifestyle sun-exposure (67.5% $n = 1135$) compared to nontattooed (61.3%, $n = 4504$; $p < 0.00001$).

Multinomial analysis including gender, age, country, phototype and tattoo(s) showed that individuals from Brazil and having ≥1 tattoo were associated significantly with intermediate and intense lifestyle sun-exposure

TABLE 1 Characteristics of the respondents according to tattoos ($n = 1$ or > 1) or no tattoos.

	Tattooed *n* (%)	Nontattooed *n* (%)	$p < 0.05$ Univariate logistic regression	Tattoo $n = 1$ *n* (%)	Tattoos $n > 1$ *n* (%)	$p < 0.05$ Univariate logistic regression
Total	1682 (18.6)	7349 (81.4)	—	978 (58.1)	704 (41.6)	—
Gender						
M ($n = 4486$)	803 (17.9)	3683 (83.1)	0.079	497 (61.9)	306 (38.1)	0.003
W ($n = 4545$)	879 (19.3)	3666 (80.7)		481 (54.7)	398 (45.2)	
Mean age (y, SD)	35.7 (11.6)	40.7 (14.4)	<0.001	35.6 (11.9)	35.9 (11.3)	0.52
Skin phototype						
1	309 (18.4)	869 (11.8)	Reference	178 (18.2)	131 (18.6)	Reference
2	436 (25.9)	1802 (24.5)	<0.001	240 (24.5)	196 (27.8)	0.488
3	616 (36.6)	2683 (36.5)	<0.001	370 (37.8)	246 (34.9)	0.473
4	213 (12.7)	1370 (18.6)	<0.001	120 (12.3)	93 (13.2)	0.774
5	57 (3.4)	326 (4.4)	<0.001	35 (3.6)	22 (3.1)	0.593
6	51 (3.0)	299 (4.1)	<0.001	35 (3.6)	16 (2.3)	0.14
Has your lifestyle (vacations, hobbies, daily life or work) led you to be exposed to the sun in one of the following ways?						
Heavily	329 (19.6)	811 (11.0)	<0.001	232 (23.7)	97 (13.8)	<0.001
Moderately	806 (47.9)	3694 (50.3)	0.399	447 (45.7)	359 (51.0)	0.195
Slightly	405 (24.1)	2136 (29.1)	0.599	228 (23.3)	177 (25.1)	0.229
None	142 (8.4)	708 (9.6)	Reference	71 (7.3)	71 (10.1)	Reference
When you are exposed to the sun (e.g., during your vacation, your hobbies, your daily life or at work), do you use methods to protect yourself from the sun?						
Yes, regularly	681 (40.5)	2566 (34.9)	<0.001	428 (43.8)	253 (35.9)	<0.001
Yes, occasionally	738 (43.9)	3343 (45.5)	0.016	429 (43.9)	309 (43.9)	<0.001
No	263 (15.6)	1440 (19.6)	Reference	121 (12.4)	142 (20.2)	Reference
What methods do you use to protect yourself against the sun?						
Umbrella	363 (25.6)	1895 (32.1)	<0.001	237 (24.2)	126 (17.9)	0.027
Long sleeves	374 (26.4)	1950 (33.0)	<0.001	262 (26.8)	112 (15.9)	<0.001
Sunscreen	982 (69.2)	4590 (77.7)	<0.001	549 (56.1)	433 (61.5)	<0.001
Shade	420 (29.6)	2050 (34.7)	<0.001	235 (24.0)	185 (26.3)	0.027
Glasses	824 (58.1)	3522 (59.6)	0.291	480 (49.1)	344 (48.9)	0.052
Hat	541 (38.1)	2790 (47.2)	<0.001	321 (32.8)	220 (31.3)	0.522
Food supplements	127 (8.9)	339 (5.7)	<0.001	91 (9.3)	36 (5.1)	0.007
What are the reasons you do not use something to protect yourself against the sun?						
I don't think about it	162 (61.6)	1002 (69.6)	0.011	72 (52.9)	90 (58.1)	0.52
I don't know what to choose	47 (17.9)	204 (14.2)	0.127	26 (19.1)	21 (13.5)	0.16
It's too expensive	47 (27.9)	181 (12.6)	0.021	22 (16.2)	25 (16.1)	0.903
I don't have enough information	35 (13.3)	171 (11.9)	NS	16 (11.8)	19 (12.3)	0.97
When do you apply the sun protection product?						
Intense exposure (beach, skiing)	835 (85.0)	3681 (80.2)	<0.001	464 (47.4)	371 (52.7)	0.612

TABLE 1 (Continued)

	Tattooed *n* (%)	Nontattooed *n* (%)	$p < 0.05$ Univariate logistic regression	Tattoo $n = 1$ *n* (%)	Tattoos $n > 1$ *n* (%)	$p < 0.05$ Univariate logistic regression
Working outside	468 (47.7)	2244 (48.9)	0.127	250 (25.6)	218 (31.0)	0.134
Recreational activity outside	437 (44.5)	2286 (49.8)	0.003	236 (24.1)	201 (28.6)	0.283
During intense sun exposure, how many times per day do you apply a sun protection product?[a]						
One time	200 (24.0)	1190 (32.3)	Reference	118 (25.4)	82 (22.1)	Reference
Two times	392 (46.9)	1610 (43.7)	<0.001	218 (47.0)	174 (46.9)	0.431
Three times	141 (16.9)	537 (14.6)	<0.001	77 (16.6)	64 (17.3)	0.42
Every 2 h	102 (12.2)	344 (9.3)	<0.001	51 (11.0)	51 (13.7)	0.137
When you are working in the open air, how many times per day do you apply a sun protection product?[b]						
One time	107 (22.9)	744 (33.2)	Reference	54 (21.6)	53 (20.4)	Reference
Two times	191 (40.8)	882 (39.3)	0.002	104 (41.6)	87 (34.8)	0.509
Three times	84 (17.9)	362 (16.1)	0.003	44 (17.6)	40 (16.4)	0.793
Every 2 h	86 (18.4)	256 (11.4)	<0.001	48 (19.2)	38 (28.4)	0.46
When you are doing a recreational activity outdoors, how many times per day do you apply a sun protection product?[c]						
One time	105 (24.0)	795 (34.8)	Reference	64 (27.1)	41 (20.4)	Reference
Two times	158 (36.2)	860 (37.6)	<0.015	88 (37.3)	70 (34.8)	0.398
Three times	73 (16.7)	328 (14.3)	<0.002	40 (19.6)	33 (16.4)	0.413
Every 2 h	101 (23.1)	303 (13.3)	<0.001	44 (18.6)	57 (28.4)	0.013
What sun protection factor (SPF) do you usually use?[d]						
6–10	71 (7.2)	247 (5.4)	Reference	41 (7.5)	30 (6.9)	Reference
10–25	220 (22.4)	1262 (27.5)	0.001	138 (25.1)	82 (18.9)	0.454
30–50	492 (50.1)	2333 (50.8)	0.031	270 (49.2)	222 (51.3)	0.65
50+	199 (20.3)	748 (16.3)	0.621	100 (18.2)	99 (22.9)	0.278

Abbreviations: M, men; SD, standard deviation; W, women; y, years.

[a]Difference remained significant when pooling once/twice versus thrice/every 2 h, tattooed versus nontattooed, $p = 0.0022$.

[b]Difference remained significant when pooling once/twice versus thrice/every 2 h, tattooed versus nontattooed, $p = 0.0002$.

[c]Difference remained significant when pooling once/twice versus thrice/every 2 h, tattooed versus nontattooed, $p < 0.00001$.

[d]Difference was not significant when pooling 6–25 versus 30–50+, tattooed versus nontattooed, $p = 0.05$.

(Figure 1). The odds ratio (OR) for intense lifestyle exposure was higher for people with only one tattoo 3.14 [2.33–4.23] than for those having more than one tattoo.

Sun protection habits

Tattooed individuals were more likely to report that they used sun-protection methods (umbrella, clothes, sunscreen, shade and/or food supplements) than nontattooed individuals: 40.5% ($n = 681$) versus 34.9% ($n = 2566$), OR 1.45 [1.24–1.7], $p < 0.001$, using regularly sun-protection and 43.9% ($n = 738$) versus 45.5% ($n = 3343$), OR 1.21 [1.04–1.41], $p = 0.016$, using occasionally sun-protection. Eighty-five percent of the tattooed individuals ($n = 835$) used sun-protection methods in case of planned intense sun-exposure versus 80.2% of the nontattooed ($n = 3681$, OR = 1.4 [1.16–1.7], $p = < 0.001$). The proportion of respondents that used sun-protection in case of outdoor work or reactional activity dropped in both groups.

When asked how often they would apply sunscreen according to situation (intense sun-exposure; outdoor work, outdoor leisure activity), tattooed individuals were significantly more likely to apply sunscreen more often (Table 1).

The main reason for not using sun-protection was forgetting about it. Tattooed individuals seemed to forget less (61.6% vs. 69.6%, OR 0.7 [0.53–0.92], $p < 0.001$). Costs

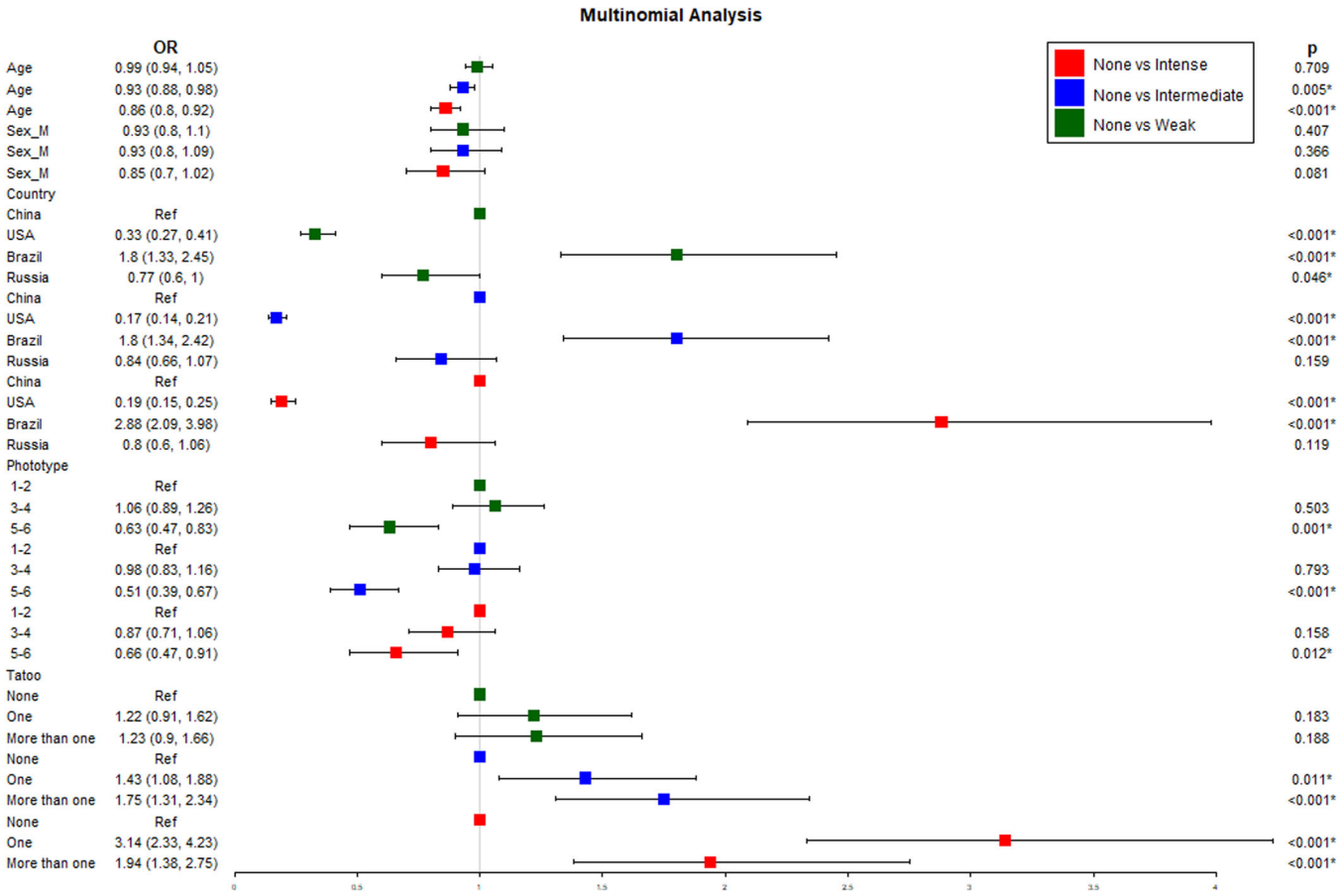

FIGURE 1 Multiple analysis of intensity of sun exposure due to lifestyle considering age, gender, country, skin phototype and tattoos (no, 1 or >1). OR, odds ratio.

were more often reported by tattooed individuals ($p = 0.021$).

One tattoo versus >1 tattoos

We analysed whether having several tattoos may be associated with different behaviours (Table 1). We considered several tattoos as an indirect surrogate for tattooed skin surface. Individuals with one tattoo were more likely to report regular or occasional sun-protection ($p < 0.001$). Sunscreen use was more frequent among individuals with >1 tattoo (61.5%) compared to those with only one tattoo (56.1%, OR 1.88 [1.48–2.4], $p = < 0.001$) while the latter were more using parasols or long sleeve clothes. Individuals with >1 tattoo used more frequently SPF level>30 than those with only one tattoo (74.1% vs. 67.4%, OR 1.39 [1.05–1.83], $p = 0.022$).

Multinomial analysis for regular sun-protection methods showed significant association with respondents from Brazil and those having one tattoo. Having several tattoos was neither associated with increased occasional or regular sun-protection (Figure 2).

DISCUSSION

We report here the first international study about sun-exposure habits among tattooed individuals. The latter were more likely to have a heavily sun-exposed lifestyle, but also more likely to apply sun protection measures compared to nontattooed individuals. Methods of sun protection were different according to whether they had one tattoo or more. Differences between both groups may be explained by attitudes towards tattoos. Individuals with several tattoos may be more likely to have tattoos on sun-exposed areas (upper arms, legs) and to show them off outside. Conversely, they applied sunscreen with higher SPF to protect them, rather than wear long sleeves for instance. Such results are of interest. The question whether having tattoos is a risk factor for intense sun

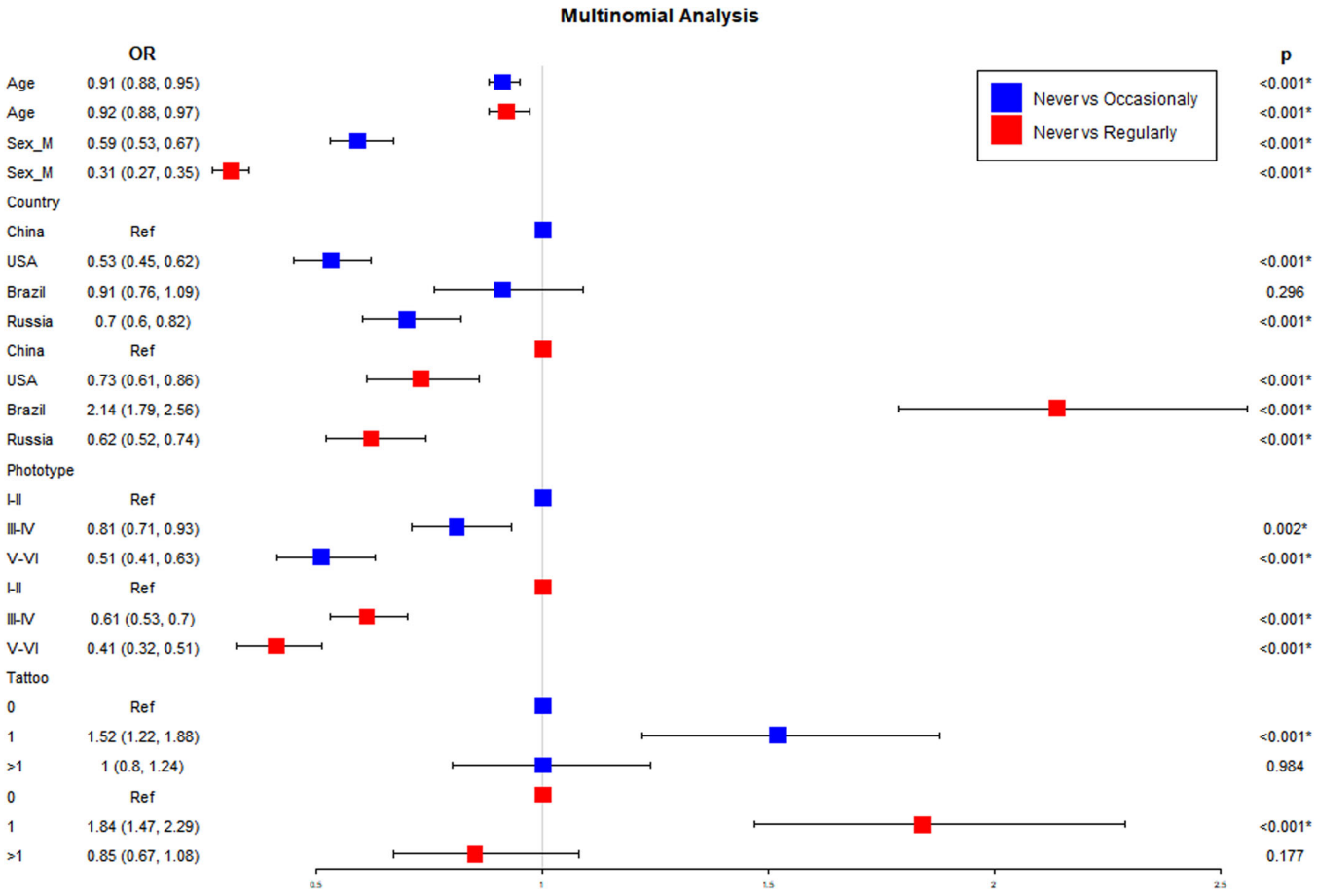

FIGURE 2 Multiple analysis of the use of sun protection methods considering age, gender, country, skin phototype and tattoos (no, 1 or >1). OR, odds ratio.

exposure is legitimate. Tattooed people were more likely to apply sunscreen. Explanation may lie in the fear for tattoo premature photoaging and colour fading.[9] In a study among 144 sea bathers in Denmark during summer, 84% of them reported using sunscreen routinely and 15% applied to prevent tattoo photoaging.[10] However, sunscreen may also paradoxically lead to excess of sun exposure.[11] Our study did not evaluate if the application of high SPF sunscreen is associated with an excessive sun exposure.

UV exposure can be responsible for triggering various patterns of reactions within tattoos. Acute and short-lasting reactions (swelling, itching, redness) can last for days after sun exposure, mainly on black tattoos, in some individuals.[9,10] In a large Danish series of 493 reactions,[12] light-induced reactions represented 11%. Other studies by the same Danish group found that photosensitivity concerned 15% to 21.5% of the tattooed individuals.[9,10] Sunscreen may be used by tattooed individuals to prevent such reaction.[10] Acute UV exposure on a recent tattoo may play a role in the occurrence of eruptive keratoacanthomas.[13] UV exposure can also trigger photoinduced tattoo allergy. Those reactions can occur on recent or old tattoos, mainly on red, yellow, or orange.[14] Photosensitive reactions account for 1,3% of a Dutch cohort.[15] Lastly, history of past chronic UV exposure may be a cofounding factor that can explain occurrence of skin cancers on sun-exposed tattooed areas.[2]

Limitations of our studies includes its self-declarative nature. We did not enquire about past-history of sunburns or skin cancer that would have been additional indicators of past sun-exposure history. We do not know about the number of tattoos nor the extent of the tattooed surface. We considered having one tattoo and several tattoos as an indirect surrogate for tattooed skin surface (the more tattoos, the large area of skin is covered). However, one single tattoo can cover a wide area (an arm sleeve or an entire back), while several tattoos may be small altogether. Lastly, we used a questionnaire that has not undergone any validation process.

Our study shows that tattooed individuals do have heavy sun-exposed lifestyle but have at the same time

sun-protection habits. Further studies are necessary to evaluate whether tattooing is rather a risk factor or protective factor towards sun exposure.

AUTHOR CONTRIBUTIONS

Nicolas Kluger: Drafted and wrote the manuscript; revised the manuscript. **Jason Shourick**: Performed the statistical analyses; revised the manuscript. **Sophie Seité**: Study conception and design; data collection. **Charles Taieb**: Study conception and design; data collection; revised the manuscript

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CONFLICT OF INTEREST STATEMENT

Sophie Seité has been employed by La Roche-Posay. The other authors have no conflicts of interest in relation with this study.

DATA AVAILABILITY STATEMENT

Data available on request from the authors.

ETHICS STATEMENT

Not applicable

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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