

# Epidemiology of fragile skin: Internet-based surveys in Mexico and Russia

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**Background:** Fragile skin is a poorly understood skin condition, particularly in the general adult population. There are currently limited epidemiological data on the prevalence of fragile skin in adults. The objectives of this study were to assess the prevalence of perceived fragile skin across different skin types in representative samples of the general adult populations in Mexico and Russia, and to identify skin characteristics associated with perceived fragile skin.

**Methods:** Two identical cross-sectional surveys, using a short online self-administered questionnaire, were conducted on samples of recruited individuals that were representative of the general Mexican and Russian populations. Participants responded to questions about fragile skin, with the main question being "In your opinion, do you have fragile skin (ie, skin less resistant and reacting quickly to external aggressions)?" The survey also covered questions relating to skin appearance, skin symptoms, skin disease, dermatological procedures, and living environment and climate.

**Results:** Overall, 1,210 individuals in Mexico (N=606) and Russia (N=604) completed the online survey. Fragile skin was perceived in 50.0% and 45.9% of participants in Mexico and Russia, respectively. The principal skin appearance characteristics reported by individuals with perceived fragile skin were thin, easily wrinkled, and transparent; the main skin symptoms were dryness, redness, and/or itching ( $\geq 50\%$  of individuals in Mexico), and dryness, tightness, and/or redness ( $>60\%$  of individuals in Russia). Individuals with perceived fragile skin had experienced skin disease and/or undergone a dermatological procedure in the past 12 months, and they reported being exposed to stress ( $>80\%$  of individuals in both surveys).

**Conclusion:** A substantial proportion of the general adult population of Mexico and Russia perceived that they had fragile skin, regardless of their skin type; fragile skin was perceived more frequently in women. These findings should assist dermatologists to extend their understanding and management of individuals with perceived fragile skin.

**Keywords:** epidemiology, fragile skin, prevalence, skin type, survey

## Introduction

The skin, the largest human organ, represents an interface between the body and the environment. The most important function of skin is the formation of an effective barrier, providing protection from pathogen invasion and repelling environmental assaults, as well as preventing the unregulated loss of water and solutes.<sup>1,2</sup>

Physical disruption of the skin may be inborn or acquired, and the structural and regulatory factors involved can be present from the dermis to the stratum corneum, frequently resulting from defective structural proteins or a faulty mechanism leading to abnormal protein expression and/or function.<sup>3</sup>

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The concept of fragile skin covers a wide spectrum of skin conditions, including subjectively perceived states of skin reactivity resulting from environmental insults. On the basis of constitutional factors relating to the structure and function of the epidermal barrier, the concept of fragile skin can be a subjective (experienced) and/or objective (clinically evaluated) perception of the skin's condition.<sup>4</sup>

Fragile skin can be classified into four categories: constitutional (physiological), circumstantial (environmental), pathological (related to dermatoses), and iatrogenic (related to dermatological acts and topical dermatological treatments).<sup>3</sup>

For constitutional (physiological age, localization) fragile skin, it is well documented that the epidermis is fragile in specific populations, including newborns, children, adolescents, and the elderly.<sup>4,5</sup> For example, compared with adult skin, newborn skin is structurally and functionally immature and, throughout at least the first year after the birth of a newborn, the skin undergoes physiological maturation.<sup>6</sup>

With regard to circumstantial (environmental) fragile skin, it is important not to overlook the potential influence of environmental aggression (eg, rapid temperature changes, ambient humidity, and sun exposure), psychological stress, and aspects of everyday life (eg, adolescence, unemployment, and family problems).<sup>3</sup> There is a growing body of evidence regarding the underlying pathophysiological mechanisms by which psychosocial stress influences skin homeostasis.<sup>7</sup> All these factors may overlap with the objective signs of skin "fragility," impacting self-perception in individuals and affecting the perception of fragile skin.<sup>3</sup>

The third category of fragile skin, pathological fragile skin, is associated with a wide range of skin diseases, including atopic dermatitis, psoriasis, acne, rosacea, and contact dermatitis.<sup>3,8</sup>

Iatrogenic fragile skin is related to iatrogenic origin – dermatological procedures (eg, laser, peelings, and dermabrasion) and topical treatments, such as irritating local anti-acne treatments (eg, retinoids).<sup>3</sup>

Currently, with the exception of a telephone-based survey in almost 5,000 individuals from France, Japan, Spain, Sweden, and the USA,<sup>9</sup> there are limited epidemiologic data on the prevalence of perceived fragile skin and skin characteristics associated with perceived fragile skin in different general adult populations.

The objectives of the current study were to assess the prevalence of perceived fragile skin in the general adult populations of two countries with very different populations, climates, and lifestyles (Mexico and Russia), and to identify skin characteristics associated with perceived fragile skin.

## Methods

### Study design and setting

Two identical cross-sectional surveys, using a short online self-administered questionnaire, were conducted in Mexico and Russia (between October 16 and 28, 2015). Consumer Science & Analytics (CSA, Puteaux, France) conducted each survey on samples of ~600 recruited individuals who were representative of the general Mexican and Russian populations.

### Study participants

Participants were selected from an Internet access panel established by CSA, composed of 89,000 and 190,000 individuals from Mexico and Russia, respectively. All recruited individuals were aged  $\geq 18$  years. Since the study consisted of two identical surveys and did not include manipulation of the subject or the subject's environment, institutional review board approval was not necessary.

Participants were invited by email to participate in the surveys and selected according to the national quota method (gender, age, and geographical region). At their recruitment, each participant agreed to the country-specific Terms and Conditions and Privacy Policy in order to utilize their data.

### Data collection

Responses from each participant were collected online and captured directly in the database for analysis. Data were de-identified and have been transferred to Pierre Fabre. Participants responded to questions about "fragile skin," with the main question being "In your opinion, do you have fragile skin (ie, skin less resistant and reacting quickly to external aggressions)?" In addition, the survey covered a series of other questions, relating to skin appearance (eg, transparent, thin, easily wrinkled, and velvety in appearance), skin symptoms (tingling, warming up sensation, tightness, itching, burning, pain, redness, and dryness), skin disease (eg, acne, eczema, psoriasis, and pigment spots), dermatological procedures (eg, peeling, lasers, dermabrasion, dermatological surgery, and wrinkle filling), and living environment and climate (eg, sun, wind, cold, pollution, humidity, air conditioning, and stress). Medical history and socioeconomic data were also recorded.

### Statistical analysis

Quantitative variables are described by the mean, median, standard deviation, minimum, and maximum, and were compared using the Student's *t*-test or Wilcoxon rank sum test. Qualitative variables are described by the frequency and percentage, and were compared using the  $\chi^2$  test, or Fisher's

exact test if conditions for application were not met. Descriptive analyses were performed on the overall populations and by gender, age category (18–34, 35–44, and ≥45 years), and perceived fragile skin. The level of significance was set at 0.05. There were no missing values because only participants with a complete questionnaire were analyzed. Statistical analyses were performed using SAS software (version 9.4; SAS Institute, Cary, NC, USA).

## Results

A total of 1,210 individuals in Mexico (N=606) and Russia (N=604) completed the online survey. Table 1 presents demographic data for all participants by country of origin.

### Mexico

Among the 606 participants in Mexico, 51.5% were female and the overall mean age was 37.9±12.1 years, with 44.6% of individuals aged between 18 and 34 years, 21.8% between 35 and 44 years, and 33.7% aged ≥45 years (Table 1). Most participants had Mestizo (67.8%) or Caucasian skin (23.6%) (Table 1). In this population, 54.6% of individuals reported having thin skin, 66.2% reported dryness, 48.0% experienced acne, and 44.1% pigment spots in the past 12 months. Regarding living environment and climate, 85.5% of individuals were exposed frequently to the sun, 71.1% to pollution, and 75.9% to stress (Table 1). Almost all individuals (600 out of 606) reported having at least one extrinsic or intrinsic factor as the origin of fragile skin (sun, wind, cold, pollution, humidity, air conditioning, and stress).

Overall, 50.0% (95% confidence interval [CI] 45.9%, 54.1%) of participants reported having fragile skin. The rate of fragile skin was not significantly different between skin types ( $P=0.4167$ ), although 47.5% of participants (95% CI 42.5%, 52.4%) with Mestizo skin reported fragile skin versus 57.3% of participants (95% CI 48.8%, 65.6%) with Caucasian skin. The rate of fragile skin was not significantly different between regions ( $P=0.1720$ ).

Overall, 136 patients experienced no skin disease and/or dermatological procedure during the previous 12 months. Of these patients, 29.4% declared that they had fragile skin. However, among the 470 patients with at least one skin disease and/or who experienced at least one dermatological procedure during the past 12 months, 56.0% of patients declared that they had fragile skin ( $P<0.0001$ ).

### Analysis according to gender

There were no differences in sociodemographic characteristics or skin type according to gender. Overall, the perception of fragile skin was significantly higher in female (58.7%)

**Table 1** Characteristics of study participants

Characteristics	Mexico (N=606)	Russia (N=604)
Gender, n (%)		
Male	294 (48.5)	272 (45.0)
Female	312 (51.5)	332 (55.0)
Age (years)		
Mean±SD	37.9±12.1	42.4±12.6
Range (years), n (%)	18–73	18–80
18–34	270 (44.6)	190 (31.5)
35–44	132 (21.8)	111 (18.4)
≥45	204 (33.7)	303 (50.2)
Region		
Mexico, n (%)		
Center	235 (38.8)	
North	142 (23.4)	
Gulf	92 (15.2)	
Pacific	77 (12.7)	
South	60 (9.90)	
Russia, n (%)		
Central Federal District		169 (28.0)
Southern Federal District		92 (15.2)
Northwestern Federal District		65 (10.8)
Far Eastern Federal District		21 (3.5)
Siberian Federal District		77 (12.8)
Ural Federal District		62 (10.3)
Volga Federal District		118 (19.5)
Skin type, n (%)		
Mestizo	411 (67.8)	7 (1.2)
Caucasian	143 (23.6)	567 (93.9)
Black	4 (0.7)	1 (0.2)
Arabic	8 (1.3)	1 (0.2)
Asian	7 (1.2)	8 (1.3)
Indian	3 (0.5)	NA
Turkish	1 (0.2)	5 (0.8)
Mongolian	NA	5 (0.8)
"I do not want to answer"	29 (4.8)	10 (1.7)
Living environment and climate, n (%)		
Sun	518 (85.5)	421 (69.7)
Wind	387 (63.9)	484 (80.1)
Cold	293 (48.4)	455 (75.3)
Pollution	431 (71.1)	365 (60.4)
Humidity	334 (55.1)	247 (40.9)
Air conditioning	290 (47.9)	282 (46.7)
Stress	460 (75.9)	430 (71.2)

**Abbreviation:** NA, not applicable.

than in male (40.8%) participants ( $P<0.0001$ ). Female participants also reported the following skin characteristics more frequently than males: velvety skin in appearance (45.8% vs 33.7%;  $P=0.0023$ ), dryness (72.1% vs 59.9%;  $P=0.0014$ ), and tightness (28.9% vs 14.3%;  $P<0.0001$ ). In the previous 12 months, females experienced pigment spots (55.5% vs 32.0%;  $P<0.0001$ ) and eczema (24.0% vs 16.0%;  $P=0.0135$ ) more frequently than males and had dermatological procedures, including peeling (14.4% vs 7.5%;  $P=0.0065$ ) and lasers (17.0% vs 3.4%;  $P<0.0001$ ),

more frequently. Females were also more frequently exposed to pollution (74.7% vs 67.4%;  $P=0.0465$ ) and stress (81.1% vs 70.4%;  $P=0.0021$ ).

### Analysis according to age category

There were no differences in sociodemographic characteristics or skin type according to age. There were also no differences in skin characteristics by age, with the exception of other skin characteristics which increased with age (8.9% [18–34 years] vs 16.7% [35–44 years] vs 17.7% [ $\geq 45$  years];  $P=0.0109$ ). All skin symptoms decreased with age. With regard to skin diseases, acne decreased with age (66.3% [18–34 years] vs 47.0% [35–44 years] vs 24.5% [ $\geq 45$  years];  $P<0.0001$ ). Dermabrasion was the only dermatological procedure which differed according to age (11.9% [18–34 years] vs 8.3% [35–44 years] vs 3.4% [ $\geq 45$  years];  $P=0.0043$ ). Participants in the oldest age category ( $\geq 45$  years) were less exposed to cold ( $P=0.0005$ ), humidity ( $P=0.0067$ ), and stress ( $P=0.015$ ).

The rate of fragile skin tended to be higher in the youngest age categories (53.0% in the 18–34 years category and 52.3% in the 35–44 years category) compared with the oldest participants (44.6%), but the difference did not reach statistical significance ( $P=0.1658$ ).

### Analysis according to fragile skin

Among the participants with perceived fragile skin, there were no differences in age or skin type according to fragile skin; however, significantly more females than males perceived their skin to be fragile (60.4% vs 39.6%;  $P<0.0001$ ;

Table 2). Participants with perceived fragile skin reported the following characteristics more frequently than individuals who did not perceive that they had fragile skin:

- Skin appearance: thin (60.7% vs 48.5%;  $P=0.0025$ ), easily wrinkled (45.2% vs 22.1%;  $P<0.0001$ ), and transparent (18.5% vs 9.2%;  $P<0.005$ ) (Table 3).
- Skin symptoms: principally dryness (74.6% vs 57.8%;  $P<0.0001$ ), redness (55.1% vs 23.8%;  $P<0.0001$ ), and itching (49.5% vs 33.3%;  $P<0.0001$ ) (Table 3).
- Skin disease in the past 12 months: principally acne (53.1% vs 42.9%;  $P<0.0117$ ) and pigment spots (52.2% vs 36.0%;  $P<0.0001$ ) (Table 4).
- Dermatological procedures in the past 12 months: principally peeling (14.5% vs 7.6%;  $P=0.0065$ ) (Table 4).
- Exposure to stress (81.2% vs 70.6%;  $P=0.0024$ ), pollution (77.2% vs 65.0%;  $P=0.0009$ ), and cold (56.8% vs 39.9%;  $P<0.0001$ ) (Table 2).
- Among the 600 patients having at least one extrinsic or intrinsic factor as the origin of fragile skin (sun, wind, cold, pollution, humidity, air conditioning, and stress), 50.2% of patients declared that they had fragile skin.

### Russia

Among the 604 participants in Russia, 55.0% were female and the overall mean age was  $42.4 \pm 12.6$  years, with 31.5% of individuals aged between 18 and 34 years, 18.4% between 35 and 44 years, and 50.2% aged  $\geq 45$  years (Table 1). Almost all participants (93.9%) had Caucasian skin (Table 1). Moreover, 46.2% of individuals reported having thin skin, 70.0% reported skin dryness, 53.6% tightness, and

**Table 2** Characteristics of the study population according to fragile skin

Characteristics	Mexico (N=606)		P-value ( $\chi^2$ )	Russia (N=604)		P-value ( $\chi^2$ )
	Fragile skin (N=303)	No fragile skin (N=303)		Fragile skin (N=277)	No fragile skin (N=327)	
Age (years)						
18–34, n (%)	143 (47.2)	127 (41.9)	0.1658	96 (34.7)	94 (28.8)	0.1051
35–44, n (%)	69 (22.8)	63 (20.8)		55 (19.9)	56 (17.1)	
$\geq 45$ , n (%)	91 (30.0)	113 (37.3)		126 (45.5)	177 (54.1)	
Gender, n (%)						
Male	120 (39.6)	174 (57.4)	<b>&lt;0.0001</b>	82 (29.6)	190 (58.1)	<b>&lt;0.0001</b>
Female	183 (60.4)	129 (42.6)		195 (70.4)	137 (41.9)	
Living environment and climate, n (%)						
Sun	261 (86.1)	257 (84.8)	0.6447	197 (71.1)	224 (68.5)	0.4855
Wind	204 (67.3)	183 (60.4)	0.0758	233 (84.1)	251 (76.8)	<b>0.0239</b>
Cold	172 (56.8)	121 (39.9)	<b>&lt;0.0001</b>	217 (78.3)	238 (72.8)	0.1145
Pollution	234 (77.2)	197 (65.0)	<b>0.0009</b>	181 (65.3)	184 (56.3)	<b>0.0231</b>
Humidity	169 (55.8)	165 (54.5)	0.7439	113 (40.8)	134 (41.0)	0.9634
Air conditioning	148 (48.8)	142 (46.9)	0.6256	152 (54.9)	130 (39.8)	<b>0.0002</b>
Stress	246 (81.2)	214 (70.6)	<b>0.0024</b>	226 (81.6)	204 (62.4)	<b>&lt;0.0001</b>

**Notes:** P-values shown in bold are those which reached the 5% significance level.

**Table 3** Skin appearance and symptoms according to fragile skin

Skin characteristics	Mexico (N=606)		P-value ( $\chi^2$ )	Russia (N=604)		P-value ( $\chi^2$ )
	Fragile skin (N=303)	No fragile skin (N=303)		Fragile skin (N=277)	No fragile skin (N=327)	
Skin appearance, n (%)						
Transparent	56 (18.5)	28 (9.2)	<b>0.0010</b>	88 (31.8)	28 (8.6)	<b>&lt;0.0001</b>
Thin	184 (60.7)	147 (48.5)	<b>0.0025</b>	184 (66.4)	95 (29.1)	<b>&lt;0.0001</b>
Easily wrinkled	137 (45.2)	67 (22.1)	<b>&lt;0.0001</b>	133 (48.0)	88 (26.9)	<b>&lt;0.0001</b>
Velvety in appearance	124 (40.9)	118 (38.9)	0.6187	119 (43.0)	149 (45.6)	0.5207
Other skin characteristics	48 (15.8)	34 (11.2)	0.0964	44 (15.9)	57 (17.4)	0.6118
Skin symptoms, n (%)						
Tingling	117 (38.6)	66 (21.8)	<b>&lt;0.0001</b>	102 (36.8)	75 (22.9)	<b>0.0002</b>
Warming up sensation	143 (47.2)	116 (38.3)	<b>0.0266</b>	129 (46.6)	118 (36.1)	<b>0.0090</b>
Tightness	94 (31.0)	38 (12.5)	<b>&lt;0.0001</b>	202 (72.9)	122 (37.3)	<b>&lt;0.0001</b>
Itching	150 (49.5)	101 (33.3)	<b>&lt;0.0001</b>	126 (45.5)	86 (26.3)	<b>&lt;0.0001</b>
Burning	77 (25.4)	30 (9.9)	<b>&lt;0.0001</b>	76 (27.4)	44 (13.5)	<b>&lt;0.0001</b>
Pain	50 (16.5)	26 (8.6)	<b>0.0032</b>	56 (20.2)	51 (15.6)	0.1384
Redness	167 (55.1)	72 (23.8)	<b>&lt;0.0001</b>	175 (63.2)	119 (36.4)	<b>&lt;0.0001</b>
Dryness	226 (74.6)	175 (57.8)	<b>&lt;0.0001</b>	239 (86.3)	184 (56.3)	<b>&lt;0.0001</b>

**Notes:** P-values shown in bold are those which reached the 5% significance level.

**Table 4** Skin diseases and dermatologic procedures according to fragile skin

Skin disease/ dermatologic procedure	Mexico (N=606)		P-value ( $\chi^2$ )	Russia (N=604)		P-value
	Fragile skin (N=303)	No fragile skin (N=303)		Fragile skin (N=277)	No fragile skin (N=327)	
Skin disease, n (%)						
Acne	161 (53.1)	130 (42.9)	<b>0.0117</b>	68 (24.6)	39 (11.9)	<b>&lt;0.0001 (C)</b>
Eczema	85 (28.1)	37 (12.2)	<b>&lt;0.0001</b>	28 (10.1)	8 (2.5)	<b>&lt;0.0001 (C)</b>
Psoriasis	17 (5.6)	8 (2.6)	0.0660	22 (7.9)	13 (4.0)	<b>0.0376 (C)</b>
Pigment spots (pale spots, brown spots)	158 (52.2)	109 (36.0)	<b>&lt;0.0001</b>	118 (42.6)	68 (20.8)	<b>&lt;0.0001 (C)</b>
Other skin diseases	23 (7.6)	15 (5.0)	0.1801	42 (15.2)	30 (9.2)	<b>0.0236 (C)</b>
Dermatologic procedures, n (%)						
Peeling	44 (14.5)	23 (7.6)	<b>0.0065</b>	83 (30.0)	33 (10.1)	<b>&lt;0.0001 (C)</b>
Lasers	40 (13.2)	23 (7.6)	<b>0.0237</b>	26 (9.4)	15 (4.6)	<b>0.0195 (C)</b>
Dermabrasion	32 (10.6)	18 (5.9)	<b>0.0387</b>	18 (6.5)	2 (0.6)	<b>&lt;0.0001 (F)</b>
Dermatological surgery (resection, curettage)	17 (5.6)	7 (2.3)	<b>0.0373</b>	6 (2.2)	6 (1.8)	0.7713 (C)
Wrinkle filling injections	10 (3.3)	8 (2.6)	0.6322	17 (6.1)	7 (2.1)	<b>0.0122 (C)</b>
Other dermatological procedure	18 (5.9)	19 (6.3)	0.8653	29 (10.5)	12 (3.7)	<b>0.0009 (C)</b>

**Notes:** P-values shown in bold are those which reached the 5% significance level.

**Abbreviations:** C,  $\chi^2$ ; F, Fisher's test.

48.7% redness. In addition, 30.8% of individuals experienced pigment spots and 19.2% underwent peeling in the past 12 months. With regard to living environment and climate, 80.1% of individuals were exposed frequently to wind, 75.3% to cold, 71.2% to stress, and 69.7% to sun (Table 1). Almost all individuals (576 out of 604) reported having at least one extrinsic or intrinsic factor as the origin of fragile skin (sun, wind, cold, pollution, humidity, air conditioning, and stress).

In this population, 45.9% (95% CI 41.8%, 49.9%) of individuals reported having fragile skin. There was no relevant difference in the rate of fragile skin between regions ( $P=0.4386$ ).

Overall, 251 patients experienced no skin disease and/or dermatological procedure during the previous 12 months. Of these patients, 27.1% declared that they had fragile skin. However, among the 353 patients with at least one skin disease and/or who experienced at least one dermatological

procedure during the past 12 months, 59.2% of patients declared that they had fragile skin ( $P<0.0001$ ).

### Analysis according to gender

There were no differences in sociodemographic characteristics or skin type according to gender. Overall, the perception of fragile skin was significantly higher in females than in males (58.7% vs 30.2%;  $P<0.0001$ ). A higher proportion of female participants also reported having thin skin (57.5% vs 32.4%;  $P<0.0001$ ) or velvety skin (54.2% vs 32.4%;  $P<0.0001$ ), and skin symptoms, including dryness (83.7% vs 53.3%;  $P<0.0001$ ) and tightness (69.3% vs 34.6%;  $P<0.0001$ ). Females also experienced pigment spots (42.8% vs 16.2%;  $P<0.0001$ ) and acne (23.5% vs 10.7%;  $P<0.0001$ ) more frequently than males and more frequently underwent dermatological procedures during the previous 12 months, including peeling (30.1% vs 5.9%;  $P<0.0001$ ). Females were also exposed to pollution (65.4% vs 54.4%;  $P=0.0062$ ) and stress (79.8% vs 60.7%;  $P<0.0001$ ) more frequently than male participants.

### Analysis according to age category

There were no differences in sociodemographic characteristics, skin type, skin characteristics, or living environment and climate, according to age. With regard to skin symptoms, warming up sensation decreased with age (46.8% [18–34 years] vs 44.1% [35–44 years] vs 36.0% [ $\geq 45$  years];  $P=0.0428$ ). With regard to skin diseases, acne decreased with age (32.1% [18–34 years] vs 22.5% [35–44 years] vs 6.9% [ $\geq 45$  years];  $P<0.0001$ ), whereas pigment spots increased with age (20.5% [18–34 years] vs 36.0% [35–44 years] vs 35.3% [ $\geq 45$  years];  $P=0.001$ ). Peeling was the only dermatological procedure that differed significantly according to age (22.6% [18–34 years] vs 27.9% [35–44 years] vs 13.9% [ $\geq 45$  years];  $P=0.002$ ). The rate of fragile skin tended to be higher in the youngest age categories (50.5% in the 18–34 years category and 49.5% in the 35–44 years category) compared with the oldest participants (41.6%), but the difference did not reach statistical significance ( $P=0.1051$ ).

### Analysis according to fragile skin

Among the participants with perceived fragile skin, there were no differences in age or skin type according to fragile skin; however, significantly more females than males perceived their skin to be fragile (70.4% vs 29.6%;  $P<0.0001$ ; Table 2). Individuals with perceived fragile skin reported the

following characteristics more frequently than individuals who did not perceive that they had fragile skin:

- Skin appearance: thin (66.4% vs 29.1%;  $P<0.0001$ ), easily wrinkled (48.0% vs 26.9%;  $P<0.0001$ ), and transparent (31.8% vs 8.6%;  $P<0.0001$ ) (Table 3).
- Skin symptoms: principally dryness (86.3% vs 56.3%;  $P<0.0001$ ), tightness (72.9% vs 37.3%;  $P<0.0001$ ), and redness (63.2% vs 36.4%;  $P<0.0001$ ) (Table 3).
- Skin disease in the past 12 months: principally pigment spots (42.6% vs 20.8%;  $P<0.0001$ ) and acne (24.6% vs 11.9%;  $P<0.0001$ ) (Table 4).
- Dermatological procedures in the past 12 months: principally peeling (30.0% vs 10.1%;  $P<0.0001$ ) (Table 4).
- Exposure to wind (84.1% vs 76.8%;  $P=0.0239$ ), stress (81.6% vs 62.4%;  $P<0.0001$ ), pollution (65.3% vs 56.3%;  $P=0.0231$ ), and air conditioning (54.9% vs 39.8%;  $P=0.0002$ ) (Table 2).
- Among the 576 patients having at least one extrinsic or intrinsic factor as the origin of fragile skin (sun, wind, cold, pollution, humidity, air conditioning, and stress), 46.7% of patients declared that they had fragile skin.

## Discussion

The current study, reporting rich data from two identical Internet-based surveys conducted in Mexico and Russia, provides a valuable insight into the prevalence of perceived fragile skin and skin characteristics associated with perceived fragile skin, in two distinct populations totaling more than 1,200 adults.

Despite the wide geographic separation between the two populations, the majority of findings from the surveys in Mexico and Russia revealed clear similarities with regard to the perception of fragile skin. In Mexico and Russia, the prevalence of perceived fragile skin was significantly higher in females than in males. The principal skin appearance characteristics reported by individuals with perceived fragile skin were thin, easily wrinkled, and transparent; the main skin symptoms were dryness, redness, and/or itching ( $\geq 50\%$  of individuals in Mexico), and dryness, tightness, and/or redness ( $>60\%$  of individuals in Russia). Individuals with perceived fragile skin in both countries had experienced skin disease in the past 12 months, mainly pigment spots and acne, had undergone a dermatological procedure in the past 12 months, principally peeling or laser, and reported being exposed to stress ( $>80\%$  of individuals in both surveys). The latter observation is particularly notable given the growing body

of evidence regarding the significant role that psychosocial stress plays in the exacerbation of skin disease.<sup>7,10</sup>

The prevalence of perceived fragile skin in the current Internet-based study (50.0% [Mexico] and 45.9% [Russia]) was consistent between the two distinct populations but differed slightly from that reported in a previously published telephone-based survey.<sup>9</sup> The previous survey, conducted in 4,913 individuals aged 15–65 years in France, Spain, Sweden, Japan, and the USA, reported perceived fragile skin in 24.4%, 29.7%, 52.7%, and 42.2% of participants with Caucasian South, Caucasian North, Asian, and Black skin, respectively.<sup>9</sup> There may be multiple reasons to explain these differences based upon the four classification categories of fragile skin proposed by Stalder et al.<sup>3</sup> The prevalence rates in the current study, 50% in Mexico (mainly Mestizo skin) and 45.9% in Russia (mainly Caucasian), are at the high end of the range reported in the previous study. These high rates may possibly reflect the fact that nearly all patients surveyed in Mexico (600/606) and Russia (576/604)<sup>11</sup> declared having at least one intrinsic or extrinsic factor (sun, wind, cold, pollution, humidity, air conditioning, or stress) as the origin of fragile skin. Other potential contributing factors include the presence of concomitant skin diseases such as acne or eczema, or the need to undergo dermatological procedures such as peeling, laser therapy, or dermabrasion. However, the relative risks of these various factors remain to be elucidated.

At the molecular level, fragile skin associated with acne, rosacea, and reactive skin has been linked to innate immunity dysfunction via inflammasome pathway activation.<sup>12,13</sup> Therefore, variables originating from individuals, as well as exogenous factors, have an important influence on epidermal barrier parameters.<sup>14</sup> For example, skin type, regardless of race and gender, has previously been shown to influence epidermal permeability barrier function, with darkly pigmented skin displaying a more resistant barrier that recovers more rapidly after perturbation than lighter pigmented skin.<sup>15</sup> However, further studies are required to assess whether differences in the perception of fragile skin in various regions of the world reflect differences in epidermal permeability barrier function in individuals.

Within the wider concept of fragile skin, there is a reactive skin entity (also referred to as sensitive skin), which is a complex dermatological condition defined by the occurrence of unpleasant sensations (eg, stinging, burning, pain, pruritus, and tingling) in response to stimuli that normally should not provoke such sensations and that cannot be explained by lesions attributable to skin disease.<sup>3,16</sup> A recent

study has shown that the pathophysiology of skin sensitivity resembles that of neuropathic pruritus within the context of small fiber neuropathy, and that environmental factors may alter skin innervation.<sup>17</sup> Reactive skin can appear normal or accompanied by erythema, can affect all body locations, particularly the face, and may worsen in the presence of a simultaneous dermatosis.<sup>16</sup>

Although there are currently limited data on the perceived prevalence of fragile skin in general adult populations, previous studies have evaluated the prevalence of reactive (sensitive) skin in individuals from a range of different populations, including the UK,<sup>18</sup> France,<sup>19</sup> Europe,<sup>20</sup> Japan,<sup>21</sup> Brazil and Russia,<sup>22</sup> and the USA.<sup>23</sup> Individuals reported a high prevalence of perceived reactive skin in these studies and, in general, reactive skin appeared to be reported more frequently in females than in males.<sup>24</sup> Although it is important to acknowledge differences between reactive skin and fragile skin, the findings from our study show that a similarly substantial proportion of the general adult populations in Mexico and Russia has perceived fragile skin, and that it occurred in significantly more females than males.

Although Internet-based surveys represent a popular method of survey data collection, self-selection and population coverage potentially limit their representativeness.<sup>25,26</sup> In the current study, individuals from a large panel who were representative of the Mexican and Russian populations were invited by email to participate in the Internet-based surveys. Participants, selected using the quota method according to gender, age, and geographical region, were requested to complete the questionnaire online. Consequently, data are representative of the adult Mexican and Russian populations, but only according to the quota criteria. Overall, 15.8% and 10.4% of invited participants in Mexico and Russia, respectively, had incomplete questionnaires. However, since only participants with a complete questionnaire were analyzed, the study had a relatively low risk of bias regarding representativeness.

Data from the current web-based surveys showed that the difference in the rate of fragile skin was not significantly different between age categories (although there was a tendency for a higher prevalence in the youngest age categories), contrary to the findings from the survey conducted by telephone interview.<sup>9</sup> However, this study confirmed the higher prevalence of perceived fragile skin among females compared with males in Mexico and Russia.

In summary, this study shows that, regardless of skin type, a substantial proportion of the general population of Mexico and Russia perceives fragile skin. Moreover, in both

populations, fragile skin was perceived more frequently in women. These findings add to those reported previously from other geographical locations and should assist dermatologists to extend their understanding and management of individuals with perceived fragile skin.

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