



















## ORIGINAL ARTICLE

# Google search trends for itch in Europe: a retrospective longitudinal study

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## Abstract

**Background** Itch is a common symptom in the general population. Affected individuals often do not seek medical consultation and rely on Internet searches to obtain information regarding their itch.

**Objectives** The aim of this study was to attain insights into common concerns of the general population regarding itch can by analysing itch-related Internet search behaviour.

**Methods** Google AdWords Keyword Planner was used to assess search volumes for itch-related terms in 15 European countries between September 2014 and August 2018. All identified keywords were qualitatively categorized. Itch-related terms were descriptively analysed and are shown as number of searches/100 000 inhabitants.

**Results** The search volume for the keyword 'itch' per 100 000 inhabitants was highest in Northern Europe, followed by Eastern, Central and Southern Europe. In 4/15 countries, itch was searched for more often in the autumn/winter months compared to in the spring/summer months. Most itch-related terms were related to dermatological conditions such as inflammatory skin diseases (e.g. psoriasis, atopic dermatitis), allergic or immunologic conditions (e.g. urticaria), and infectious diseases or infestations (e.g. scabies). In terms of body location, genitoanal itch dominated the searches. Symptoms and signs related to itch, possible non-dermatological aetiologies, and treatment options were also among the most searched terms.

**Conclusions** These analyses provided for the first time insights into the search behaviour patterns related to itch across Europe. People from Northern and Eastern Europe are more likely to seek online information regarding itch. Causes for the itch, especially dermatological conditions, and genitoanal itch are the most important concerns for Internet users. This unconventional and inexpensive method identifies medical needs of people beyond the medical setting, including people who do not seek medical consultation. Accordingly, the data could be used to guide public health interventions and manage respective inhabitants' medical needs.

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### Conflicts of interest

MP Pereira is an investigator for Trevi Therapeutics; is a consultant for Galderma; and has received speaker honoraria/travel fees from Galderma, Menlo Therapeutics, Novartis, and Trevi Therapeutics. S Ziehfrennd has received speaker honoraria and travel fees from Novartis. FJ Legat is an investigator for DS Biopharma, Eli Lilly, Galderma, Pfizer, Menlo Therapeutics, Trevi Therapeutics. He is a consultant for Galderma, a member of the advisory boards, and/or has received speaker honoraria/travel fees from AbbVie, Ammirall, Celgene, Eli Lilly, Janssen, Leo Pharma, Menlo Therapeutics, Novartis, Pfizer, Trevi Therapeutics and Vifor Fresenius Medical Care Renal Pharma. J Lambert is investigator for Pfizer, Leo Pharma, Sanofi, Galderma, and he received consultancy/speaker honoraria from AbbVie, Leo Pharma, Galderma, Eli-Lilly, Janssen-Cilag, Roche-Posay, Pierre-Fabre, Novartis, UCB Pharma, Meda Pharma, Mylan, Celgene and Bioderma. L Misery is a consultant for Galderma, Menlo, Trevi and Sanofi and was investigator for Galderma, Trevi and Sanofi. E Brenaut is an investigator for Biogen and Galderma, and is a consultant and/or member of the advisory board for Janssen, Lilly, Celgene, Novartis and Pfizer, and received financial support from Sanofi, AbbVie. S Garcovich has received consulting support from companies including Menlo Therapeutics. JC Szepietowski is an investigator for AbbVie, Amgen, Boehringer Ingelheim, Galapagos, InflaRX, Pfizer, UCB, Incyte, Janssen, Helm, Merck, Menlo Therapeutics, Novartis, Regeneron, Trevi, advisor for AbbVie, Leo Pharma, Novartis, Pierre-Fabre, Menlo Therapeutics, Sanofi Genzyme, Sienna Biopharmaceuticals, Trevi, and speaker for AbbVie, Berlin-Chemie Menarini, Eli Lilly, Janssen, Leo Pharma, Novartis, Sanofi-Genzyme and SunFarm. A Reich is a consultant or speaker for AbbVie, Bioderma, Celgene, Chema Elektromet, Eli Lilly, Galderma, Janssen, Leo Pharma, Medac, Menlo Therapeutics, Novartis, Pierre-Fabre, Sandoz and Trevi; Principal Investigator or Subinvestigator in clinical trials sponsored by AbbVie, Drug Delivery Solutions Ltd, Galderma, Genentech, Janssen, Kymab Limited, Leo Pharma, Menlo Therapeutics, MetrioPharm, MSD, Novartis, Pfizer and Trevi. M Gonçalo has been a consultant and received speaker honoraria for Novartis, and Sanofi. A Lvov is a consultant for Galderma, and Novartis and has received speaker honoraria/travel fees from Galderma, Bayer, LEO and Pierre Fabre. S Bobko has received speaker honoraria/travel fees from LEO. E Serra-Baldrich is an investigator, a consultant or gave presentations for Regeneron, Sanofi, Stiefel/GSK, Pierre Fabre, La Roche Posay, Leo Pharma, Novartis, Ammirall, Pfizer, Galderma, Lilly and AbbVie. TA Leslie has been a consultant for Menlo and Novartis. S Ständer is an investigator for Dermasence, Kiniksa, Galderma, Menlo Therapeutics, Novartis and Trevi Therapeutics, and is a consultant and/or member of the advisory board for Ammirall, Beiersdorf, Bellus Health, Cara Therapeutics, Celgene, Clexio Biosciences, Galderma Laboratorium, Galderma S.A., LEO, Menlo Therapeutics, Novartis, Sienna Biopharmaceuticals, Trevi Therapeutics and Vanda Pharmaceuticals. A Zink has been an advisor and/or received speaker's honoraria and/or received grants and/or participated in clinical trials of the following companies: AbbVie, Amgen, Imirall, Beiersdorf Dermo Medical, Bencard Allergie, BMS, Celgene, Eli Lilly, GSK, Janssen Cilag, Miltenyi Biotec, Pfizer, Novartis, Sanofi-Aventis, Takeda Pharma. T Ewering, J Elberling, E. Papadavid, AWM Evers, JA Halvorsen, J Wallengren, E Savk and M Rueth declare no conflicts of interest.

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### Introduction

Itch is the most frequent symptom in dermatology, occurring in more than 50% of patients.<sup>1</sup> Furthermore, the general population frequently suffers from itch, predominantly from chronic itch (i.e. lasting >6 weeks), with a prevalence ranging from 13.5% to 31.2%.<sup>2–4</sup> The impact of itch on quality of life is substantial and there is a higher prevalence of depression and suicidal ideation among people with severe itch.<sup>5,6</sup> Patients with acute severe itch (e.g. in urticaria or scabies) or those with chronic pruritus (e.g. atopic eczema or psoriasis) are frequently examined by physicians. However, we speculate that a large

fraction of people affected by itch do not seek medical consultation, especially individuals with only occasionally itching or those with less severe pruritus. For these people and their relatives, who often suffer with them, no reliable data exist regarding their condition and their medical needs.

Since the Internet is often consulted for health information, analysing Internet search behaviour in relation to itch can provide outside of the medical setting insights into the concerns of people experiencing itch.<sup>7</sup> Previous studies analysing itch-related Internet searches in Germany revealed that more searches occurred during the colder months of the year, suggesting an influence of climate conditions on the incidence of itch.<sup>8</sup> Most searches were associated with skin conditions such as eczema

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**Table 1** Searched keywords in original language

Country	Searched keyword in original language
Austria	Juckreiz
Belgium	démangeaison, jeuk, prurit
Denmark	kløe
France	démangeaison, prurit
Greece	Fagoura, knismos
Italy	prurito
The Netherlands	jeuk
Norway	kløe
Poland	świąd
Portugal	comichão
Russia	Зуд, Чесотка
Spain	escozor, picazon, picor
Sweden	klåda
Turkey	kaşıntı
United Kingdom	itch

Two terms meaning itch were chosen in France, Greece, and Russia, and three terms in Belgium and Spain. In the remaining countries, only one term was used for the analysis.

and psoriasis. High search volumes for itch related to particular body parts, especially the genitoanal region and legs, were also recorded.<sup>9</sup>

We analysed search volumes for itch and associated terms in 15 different European countries, as studies analysing itch-related search volume (i.e. number of queries for a term on an Internet search engine over a defined period of time) are missing for many other European countries. We used the Google search engine for our investigation since it is used by the vast majority of the European population.<sup>10</sup> The aim of this study was to gain insight into search behaviour patterns in relation to itch across Europe to detect possible variations across European regions and to determine common concerns of the general population regarding itch. Although this study is mostly of explorative nature, based on previous studies performed in Germany,<sup>8,9</sup> we hypothesize that (i) search volumes for itch are higher in the colder months than in the summer, (ii) there is a correlation between country search volume and supply of dermatologists, and (iii) mostly skin conditions and genitoanal disorders are searched for in connection with itch.

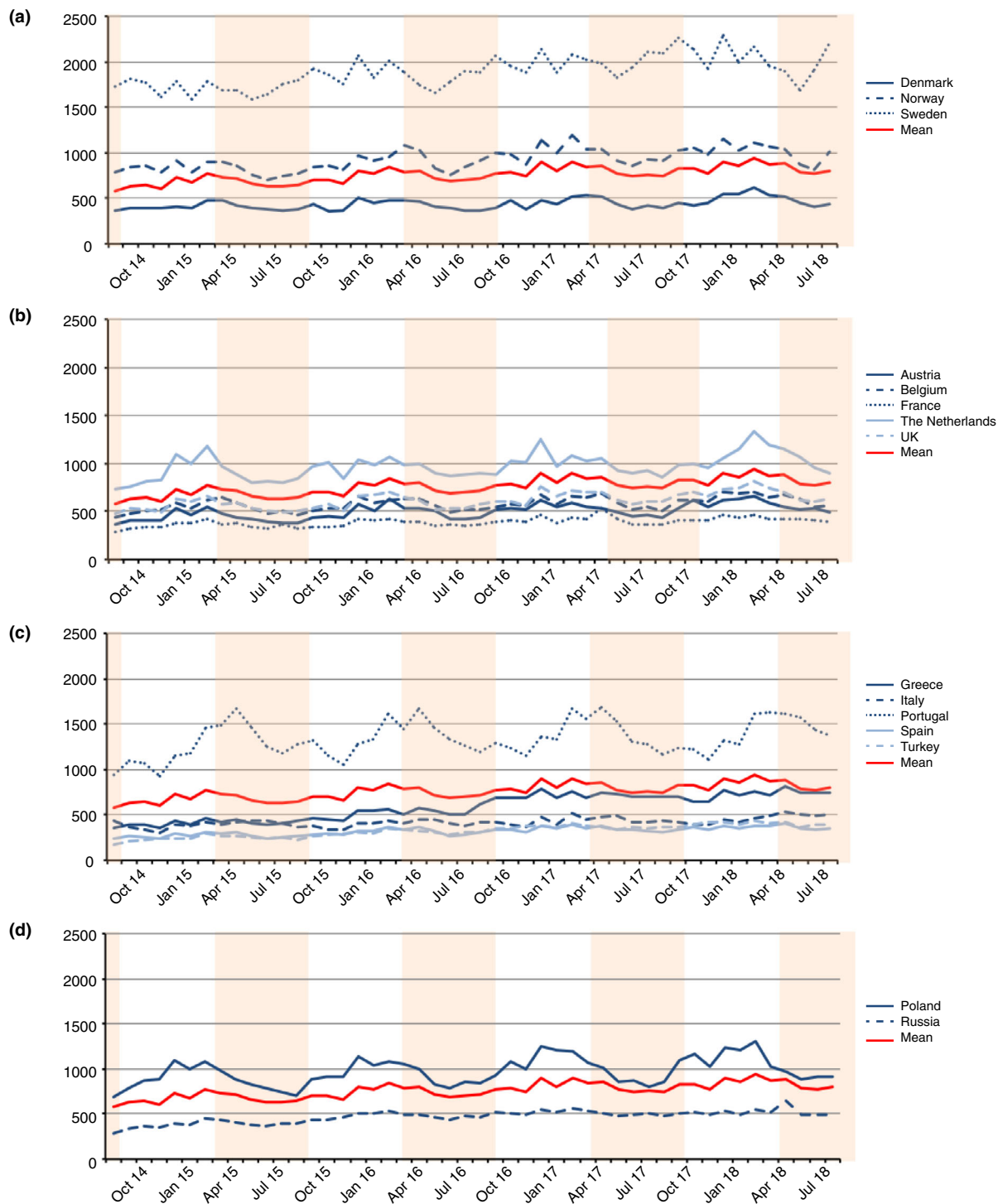
## Methods

Google AdWords Keyword Planner was used to determine the Google search volume for itch. This tool was developed for optimizing advertisement but has been used previously for research purposes. Google AdWords Keyword Planner delivers an estimate of the monthly search volume for selected keywords.<sup>8,9,11,12</sup> In this retrospective longitudinal study, we analysed the search volume for the keyword *itch* in 15 different European countries (Austria, Belgium, Denmark, France, Greece, Italy, the Netherlands, Norway, Poland, Portugal, Russia, Spain, Sweden, Turkey

and the United Kingdom) between September 2014 and August 2018. For each country, the translated layman term of the keyword *itch* in the corresponding local languages was used for analysis. Two terms translating itch were chosen in France, Greece and Russia, and three terms in Belgium and Spain. In the remaining countries, only one term was used for the analysis (Table 1). For the analyses, the identified keywords for countries with two and three terms for itch were summarized, and duplicates were removed. We set the region and language settings to limit the search volume data using Google solely to users in the abovementioned countries, which included limiting the language settings to the main spoken languages of each respective country. The translation of the layman term and the back translation of the 20 keywords most often searched was performed by investigators specialized in the field of itch in their own respective countries (dermatologist FJL, JL, JE, LM, EB, EP, SG, JAH, JCS, AR, MG, AL, SB, ES-B, JW, ES, TL; health psychology: AWME); data collection and statistical analysis by the German research team consisting of specialists in the field of itch and Internet search analysis (MPP, SZ, MR, TE, SS, AZ). Even if up to 1036 keywords could be identified for a single country (range 637–1036), the 20–50 most frequently searched show an above average search volume. Thus, for a good data management the 20 keywords most often searched for in combination with itch were determined for each country and analysed descriptively. Institutional review board approval and informed consent were not applicable for this study.

## Statistics

IBM SPSS Statistics v. 26 (IBM Corporation, Armonk, NY, USA) was used for statistical analyses. Search volume data were analysed descriptively and are shown as the number of searches per 100 000 inhabitants to allow comparisons between countries. We used Eurostat and the International Monetary Fund as sources for the number of inhabitants per country (Table S1). For each country, the number of dermatologists per capita was calculated by dividing the total number of dermatologists reported by Eurostat for 2015 by the number of inhabitants. The number of dermatologists per capita could not be calculated for Russia. Cross-country and regional comparisons of the overall itch-related search volume were performed with one-way analyses of variance (ANOVA). Tukey's range test was used for multiple comparisons as post hoc tests. An unpaired *t*-test was used for comparisons of search volume across regions and between spring/summer (April–September) and autumn/winter months (October–March). We used the non-parametric Spearman's rho to correlate search volume with the number of inhabitants and dermatologists per capita. The 20 associated terms most searched for in combination with itch were analysed qualitatively for each country and classified according to whether they referred to skin conditions, non-dermatological causes of itch, localization, symptoms or treatment. A term could be attributed to multiple categories if



**Figure 1** Search volume of itch-related keywords over time. Search volume for itch-related keywords over time in Northern (Panel a), Central (Panel b), Southern (Panel c) and Eastern (Panel d) European countries. Spring/summer months (April–September) are highlighted in red. Average number of searches for all 15 countries is shown by the red line. For each country, the translated layman term of the keyword itch in the corresponding local languages was used for analysis. Two terms meaning itch were chosen in France, Greece and Russia, and three terms in Belgium and Spain. In the remaining countries, only one term was used for analysis.

**Table 2** Search terms associated with itch – skin conditions

Term	Number of searches per 100 000	Country
Psoriasis	3409.38	AT, BL, FR, IT, NL, PL, PT, RU, TR, UK
Eczema	1795.21	AT, BL, DK, ES, FR, GR, NL, NO, PL, RU, SE, TR, UK
Urticaria	981.61	BL, FR, IT, PL, RU
Dermatitis	748.70	BL, ES, GR, IT, NL, PT, RU, UK
Atopic dermatitis/eczema	594.77	AT, BL, DK, NL, NO, PL, PT, SE
Scabies	663.49	PL, RU, SE
Mycosis/candidiasis	538.11	NO, PL, SE, TR
Papilloma	352.86	RU
Skin rash/redness	343.13	AT, BL, DK, GR, NL, NO, PL, SE, UK
Acne	316.25	BL, IT, NL, RU
Furuncle	209.27	RU
Seborrhoeic eczema	185.03	BL, NL, NO, PL, SE
Couperose/Rosacea	178.08	BL, FR, RU
Warts	118.61	RU
Demodicosis	101.37	RU
Dry skin/Xeroderma	60.47	BL, GR, NL, NO
Lice	55.34	PT
Prurigo	44.07	BL, FR
Nummular Eczema	37.74	DK, UK
Mole	36.94	UK
Quincke oedema	18.45	PL
Hand Eczema	17.93	DK, NL
Dyshidrotic eczema	14.64	BL, NL
Insect Bite	4.56	GR
Contact Eczema	2.12	DK

Number of searches per 100 000 inhabitants is shown as well as the countries in which the search term was among the top 20 most searched terms associated with itch. AT, Austria; BL, Belgium; DK, Denmark; ES, Spain; FR, France; GR, Greece; IT, Italy; NL, The Netherlands; NO, Norway; PL, Poland; PT, Portugal; RU, Russia; SE, Sweden; TR, Turkey; UK, United Kingdom.

appropriate. Terms not related to itch were excluded from the analyses as per the investigators' assessment.

Data are shown as mean  $\pm$  standard deviation. The level of significance was set at  $\alpha = 0.05$  for all analyses.

## Results

### Search volume of the itch-related keywords over time

In total we recorded 145 755 050 searches for itch-related keywords between September 2014 and August 2018. The average number of searches per 100 000 inhabitants per month was 717. Sweden ( $1894 \pm 179$ ), Portugal ( $1338 \pm 198$ ) and the Netherlands ( $973 \pm 128$ ) had the highest average number of queries per month per 100 000 inhabitants, while Spain ( $321 \pm 45$ ), Turkey ( $325 \pm 66$ ) and France ( $389 \pm 46$ ) had the lowest (Fig. 1). One-way

**Table 3** Search terms associated with itch – non-dermatological causes

Term	Number of searches per 100 000	Country
Haemorrhoids	534.36	PL
Allergy	493.94	BL, DK, ES, NL, NO, PL, PT, RU, TR
Varicocele	183.73	RU
Pregnancy	55.59	UK
Food intake	18.31	PT
Roundworms (anal itch)	17.65	ES
Urinating	16.94	ES

Number of searches per 100 000 inhabitants is shown as well as the countries in which the search term was among the top 20 most searched terms associated with itch. AT, Austria; BL, Belgium; DK, Denmark; ES, Spain; FR, France; GR, Greece; IT, Italy; NL, The Netherlands; NO, Norway; PL, Poland; PT, Portugal; RU, Russia; SE, Sweden; TR, Turkey; UK, United Kingdom.

ANOVA showed significant differences in the search volume between countries ( $P < 0.001$ ). We recorded more queries per 100 000 inhabitants in Northern European countries (Denmark, Norway, Sweden:  $1087 \pm 620$ ) compared to in Eastern (Poland, Russia:  $720 \pm 278$ ;  $P < 0.001$ ), in Central (Austria, Belgium, France, the Netherlands, United Kingdom:  $612 \pm 214$ ;  $P < 0.001$ ) and in Southern European countries (Greece, Italy, Portugal, Spain, Turkey:  $599 \pm 400$ ;  $P < 0.001$ ). Eastern European countries also had more queries than Southern European countries ( $P = 0.05$ ).

The search volume per 100 000 inhabitants was higher in the autumn/winter months compared to in the spring/summer months in Austria ( $532 \pm 80$  vs.  $472 \pm 63$ ;  $P = 0.006$ ), the Netherlands ( $1013 \pm 133$  vs.  $933 \pm 112$ ;  $p = 0.028$ ), Poland ( $1058 \pm 140$  vs.  $881 \pm 107$ ;  $P < 0.001$ ) and the United Kingdom ( $639 \pm 88$  vs.  $592 \pm 72$ ;  $P = 0.048$ ). In contrast, in Italy ( $403 \pm 49$  vs.  $442 \pm 43$ ;  $P = 0.005$ ) and in Portugal ( $1268 \pm 183$  vs.  $1408 \pm 192$ ;  $P = 0.013$ ) more searches were performed in the spring/summer months. In the remaining countries, we recorded no differences in search volume between the autumn/winter and spring/summer months ( $P > 0.05$ ).

### Classification of itch-related keywords

Table S2 shows the 20 most often searched terms associated with itch translated to English for each country, while the terms in the local languages can be consulted in Table S3. Excluded keywords not related to itch are given in Table S4.

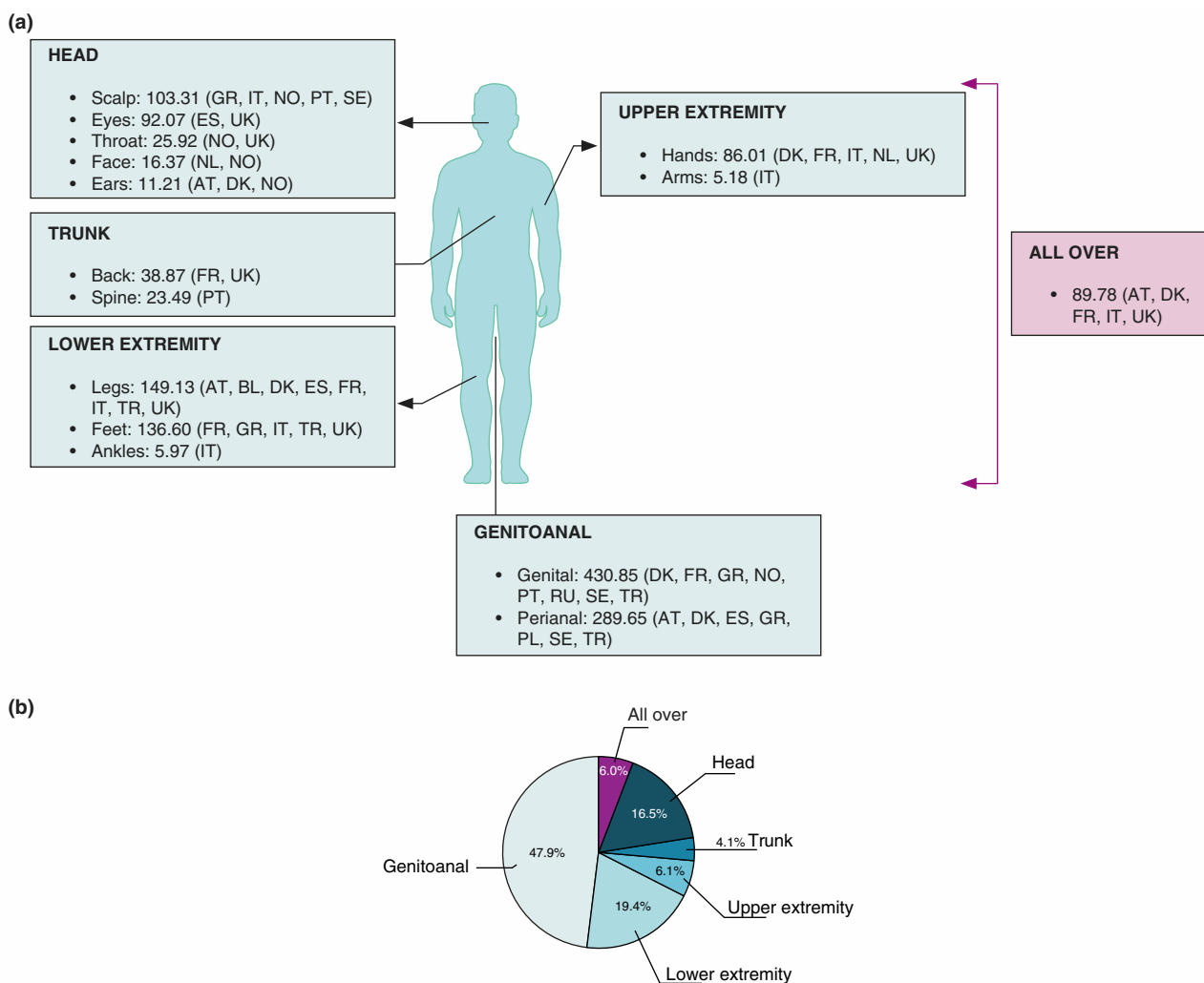
**Skin conditions** Most search terms associated with itch were related to skin diseases. Among these, chronic inflammatory conditions were the most searched for including psoriasis (3409.38/100 000), eczema (1795.21/100 000) and atopic dermatitis/eczema (594.77/100 000). The term 'eczema' and 'atopic eczema' is considered separately for this analysis, since the broad

term ‘eczema’ may refer to an origin other than atopic, such as, e.g., allergic or seborrhoeic. Urticaria and Quincke oedema were also among the most searched terms with 981.61 and 18.45 queries per 100 000 inhabitants, respectively, as well as infectious diseases (scabies, 663.49/100 000; fungal infections, 538.11/100 000; papilloma/warts, 471.47/100 000; lice, 55.34/100 000). A complete list of the search terms related to skin diseases is provided in Table 2.

**Non-dermatological causes for itch** The cause for the itch is a common concern in people affected by itch. There were 58.01/100 000 queries for *causes* and 34.65/100 000 for *Why does itch happen?*. The searched keywords related to dermatological causes

for itch are provided in the section above. Searched terms associated with non-dermatological causes are provided in Table 3 and include genitoanal diseases (haemorrhoids, 534.36/100 000; varicocele, 183.73/100 000; anal roundworms, 17.65/100 000), allergic conditions (allergy, 493.94/100 000; food intake, 18.31/100 000) and physiological processes (pregnancy, 55.59/100 000; urinating 16.94/100 000).

**Body location** Figure 2 provides an overview of the body locations searched for in association with itch. Genitoanal itch dominated the searches with 47.9% (720.5/100 000) of the searches related to body location. Genital itch was searched more often (430.85/100 000) than perianal itch (289.65/100 000). In only



**Figure 2** Search terms associated with itch – body location. (a) Cumulative number of searches per 100 000 inhabitants is shown for each body location as well as the countries in which the search term was among the top 20 most searched terms associated with itch. (b) Percentage of number of searches per body location. AT, Austria; BL, Belgium; DK, Denmark; ES, Spain; FR, France; GR, Greece; IT, Italy; NL, The Netherlands; NO, Norway; PL, Poland; PT, Portugal; RU, Russia; SE, Sweden; TR, Turkey; UK, United Kingdom.

**Table 4** Search terms associated with itch – symptoms

Term	Number of searches per 100 000	Country
Discharge	123.54	ES, NO, SE
Erythema	66.80	IT
Tooth pain	49.51	PL
Dandruff	34.97	ES
Burning	22.00	NO, SE
Eye pain	11.75	ES
Bumps	10.28	NL
Stinging	4.89	DK
Bleeding (anal)	4.18	GR

Number of searches per 100 000 inhabitants is shown as well as the countries in which the search term was among the top 20 most searched terms associated with itch. AT, Austria; BL, Belgium; DK, Denmark; ES, Spain; FR, France; GR, Greece; IT, Italy; NL, The Netherlands; NO, Norway; PL, Poland; PT, Portugal; RU, Russia; SE, Sweden; TR, Turkey; UK, United Kingdom.

four countries was genitoanal itch not among the top 20 itch-related keywords (BL: rang 24, IT: rang 26, UK: rang 31, and NL: rang 35). The second most often searched body region was the lower extremity (19.4%; 291.70/100 000), especially the legs (149.13/100 000) and feet (136.60/100 000), while the head (16.5%; 248.88/100 000), particularly the scalp (103.31/100 000) and eyes (92.07/100 000), was the third most searched for region. Upper extremity (6.1%; 91.19/100 000) and trunk (4.1%; 62.36/100 000) were the least searched for body regions. In 6.0% of the cases, generalized itch was searched using different terms (e.g. all over, diffuse).

**Symptoms/signs** Other sensory symptoms in addition to itch were found among the top 20 keywords. Burning (22.00/100 000) and stinging (4.89/100 000) were recorded in three countries (Table 4).

As for signs, discharge was the most searched term (123.54/100 000), especially in connection to genital disorders, followed by erythema (66.80/100 000; Table 4).

**Treatment** Keywords related to treatment were also found among the top 20 itch associated search terms. *What is good for itch?* (55.00/100 000) and *relief* (22.82/100 000) as well as *cream/ointment* (36.94/100 000) and *shampoo* (5.49/100 000) were searched for. Treatment options were specifically searched for urticaria (18.10/100 000) and eczema (15.33/100 000). Furthermore, various terms related to anti-acne agents (antibiotics, retinoids, benzoyl peroxide) and vitamin complexes were search for (Tables S2 and S3).

**Further findings** Additional keywords that could not be attributed to the abovementioned categories were among the 20 most searched terms (Tables S2 and S3). Of interest were the 69.47/100 000 queries for the term *dermatologist*. *Nocturnal itch* (18.66/100 000) and *scratching* (12.16/100 000) as well as the

terms *neonatal* (18.33/100 000) and *baby* (14.36/100 000) were also recorded.

## Discussion

This large multicentre retrospective longitudinal study provides for the first time valuable data regarding Internet search behaviour patterns related to itch across Europe. We gained considerable insight into healthcare relevant concerns and the needs of people who suffer from itch beyond the medical setting.

We recorded an average of 717 searches per 100 000 inhabitants per month. Most Northern (exception: Denmark) European countries showed more searches than average, and Central European (exception: the Netherlands) and Southern European countries (exception: Portugal) showed less searches than average. There was no relationship between the search volume per country and its population size and the number of dermatologists per capita. These observations may point to a variance in knowledge levels regarding Internet use across Europe. Presumably, other aspects such as the degree of urbanization, demographics of the population, accessibility to health care, socioeconomic factors and cultural aspects also influence the search volume across European countries. Interestingly, we recorded the highest search volume in Portugal and one of the lowest in Spain, two neighbouring southern European countries. Possible reasons for these findings include linguistic and socio-cultural differences as well as discrepancies in healthcare system across the two countries. In a previous analysis of search volume data for itch in 16 different German cities, a higher proportion of female inhabitants, lower age and smaller urban areas were associated with higher search volumes.<sup>8</sup>

In only 4/15 countries (Austria, the Netherlands, Poland, the United Kingdom) was the search volume higher in the colder months of the year (autumn/winter) compared to in the warmer months. We expected a more pronounced search volume in the colder months since skin conditions that lead to itch such as xerosis, atopic dermatitis and psoriasis aggravate in the winter, and this increased search volume in colder months was observed for Internet searches in Germany.<sup>8</sup> However, in our study we did not control for temperature, relative humidity, or other weather parameters, which may explain the partial discrepancies between our study and previous analyses. Surprisingly, in two countries (Italy, Portugal) more searches were performed in the spring/summer months. These are two of the warmest countries in Europe,<sup>13</sup> and higher temperatures in the summer may be associated with a greater incidence of itchy conditions such as insect bites, skin infestations and allergic reactions to the sun (e.g. polymorphic light eruption). Additionally, heat is a common trigger for itch, possibly due to activation of TRPV1, which is involved in itch transmission and may aggravate pre-existing conditions (e.g. urticaria, atopic dermatitis).<sup>14</sup> Excessive sweating may also worsen itch and atopic eczema.<sup>14</sup> In agreement, higher search volumes for itch have been linked to higher temperatures in a previous study.<sup>15</sup>

The most often searched for terms associated with itch were related to underlying causes, especially skin diseases. In line with previous analyses of search volumes performed in Germany, most queries dealt with chronic inflammatory diseases (psoriasis, eczema, atopic dermatitis).<sup>9</sup> Conditions leading to severe acute itch such as urticaria or scabies were also frequently searched for. These findings reflect the high prevalence of these conditions in the general population. As in previous reports,<sup>9</sup> we noticed that dermatological causes for the itch were searched far more often than other possible aetiologies, such as allergic conditions and systemic diseases. This suggests a higher prevalence of dermatological causes for itch but possibly also a general lack of knowledge of non-dermatological conditions that may cause itch.

Most searches regarding body location concerned the genitoanal region. Accordingly, high search volumes for genitoanal itch were also identified in previous studies performed in Germany, with genital and/or anal itch being the second (after 'whole body')<sup>9</sup> and third (after 'whole body' and 'legs')<sup>8</sup> most searched terms related to body location. The large search volume for genitoanal itch points to the high prevalence of genitoanal pruritic conditions. These can be of diverse aetiology, including dermatoses (e.g. eczema, psoriasis, lichen sclerosus, contact dermatitis), infections and infestations (e.g. scabies, infestations with parasite), anorectal conditions (e.g. haemorrhoids, anal marisca), tumours (e.g. anal carcinoma, extramammary Paget disease) and neuropathic disorders (e.g. pudendal nerve entrapment).<sup>16</sup> Previously a study confirmed that shame can trigger seeking online health information.<sup>17</sup> Thus, another aspect to consider is that patients may be ashamed of discussing genitoanal conditions during medical consultation and may prefer to seek advice on the Internet for such issues. Physicians should ask more often about genitoanal itch during regular dermatological visits. Genitoanal itch was also searched for in association with other keywords such as 'discharge', a typical sign of genitoanal disease.

The lower extremity was the second body region searched for the most in our study. Xerosis cutis generally affects body sites with few sebaceous glands, such as the legs and feet,<sup>18</sup> which may explain higher incidence rates of itch in these areas and thus a high search volume for these terms. Moreover, itch on the legs can be related to venous insufficiency and varicose veins, causing xerosis and stasis eczema,<sup>19</sup> while itch on the feet may be associated with dyshidrotic eczema or athlete's foot (*tinea pedis*), two common skin conditions of the feet.<sup>20,21</sup> Another important body region is the scalp, which was often searched for in many countries. Scalp pruritus poses a challenge since it may underlie numerous distinct diseases, and its treatment is often refractory to available treatments.<sup>22</sup>

Surprisingly, compared to previous studies performed in Germany,<sup>8,9</sup> 'itch all over the body' showed low search volumes in our European study. This may be due to different methodologies since we considered for the classification the search volumes of

only the top 20 itch-related keywords of each country, while in previous studies the entire list of search terms that go beyond the 20 most search terms were considered.

Interestingly, additional sensory symptoms were searched for in association with itch, especially 'burning' and 'stinging'. Such sensory qualities are often reported in neuropathic itch<sup>23</sup> and in neuropathic pain conditions.<sup>24</sup> However, these sensory qualities are also found in other pruritic conditions such as atopic dermatitis,<sup>25,26</sup> psoriasis<sup>25</sup> and chronic prurigo,<sup>27,28</sup> suggesting a possible neuropathic component in these diseases. Accordingly, the epidermal neural architecture is altered in chronic inflammatory pruritic conditions, and cutaneous mechano- and heat-sensitive C-fibres, which transmit burning and stinging sensations in addition to itch,<sup>29</sup> are sensitized in chronic itch conditions.<sup>30</sup>

This study has a few limitations. For the classification, only the 20 most searched for keywords were considered for each country. Therefore, the search volume for these keyword categories could be underestimated, while data regarding keywords not entering the top 20 in any country were lost.

Moreover, there are difficulties that exist when translating sensory descriptors from one language to another. An ascending or data-driven approach could have been adopted. Nevertheless, we chose the descending method for its simplicity, and as previously performed,<sup>31</sup> we observed consistent results across countries, suggesting that the main itch-related terms were identified.

We did not control the data for demographic variables. This is important since elderly people probably consult the Internet less than younger ones, while the prevalence of itch increases with age.<sup>32</sup> As a result, our study may not fully take into account the concerns of elderly individuals regarding their itch. We also did not control the data for sex. A possible divergent behaviour between women and men in regard to their Internet search behaviour may thus induce bias in this study.

Only searches in each country's local languages were considered, and thus searches in foreign languages within a country were not taken into account. Therefore, immigrants who resort to their own language for Internet searches are likely to be underrepresented in our analysis.

Another limitation is that only searches performed with Google were considered while other search engines were disregarded. However, Google has a market share of 93.51% in Europe,<sup>10</sup> and thus, it is likely that Google searches reflect overall Internet search behaviour. One exception is in Russia, where Google is used by only 52.91% of the population.<sup>33</sup> Therefore, our data from Russia should be interpreted with caution. Also, the inherent limitations of Google AdWords Keyword Planner should be disclosed since this tool only provides an estimation of monthly search volumes, and Google does not divulge how this estimation is performed.

Despite the limitations of the unconventional methodology adopted in our study, we provided substantial insights into



Internet search patterns related to itch across Europe. This method can be helpful for identifying the burden and medical needs of people with certain diseases or concerns. Under consideration of community and disease-based variables such as age distribution, sociocultural aspects and progression of disease, respectively, this can contribute to the development of new strategies and interventions to address medical needs in person-centred care, for example, by offering reliable information via the Internet through government-funded trustworthy websites about itch tailored to the identified needs of a certain country or region.

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## Supporting information

Additional Supporting Information may be found in the online version of this article:

**Table S1.** Population of participating countries.

**Table S2.** Top 20 most searched terms associated with itch by country.

**Table S3.** Top 20 most searched terms associated with itch in local language.

**Table S4.** Excluded search terms.