Melasma: Trends in worldwide Internet searches (2000–2019)

Sir,

The wide use of research tools on the Internet allows the exploration of patterns of interest in specific topics, and the behaviour related to searches for terms linked to diseases may reflect characteristics of local epidemiology.[1] Google Trends is a free tool that allows the quantification of the search interest of a specific population for specific terms. This has been used to analyse the population's interest in other medical conditions, however, there is no research on the infodemiology of melasma. The incidence of melasma is thought to be increasing, but the reasons associated with this phenomenon are not understood.

We aimed to investigate the characteristics of worldwide Internet search behaviour related to melasma in the past 10 years. An ecological study was performed based on the global interest in searching melasma on the Internet. Data was collected through the Google Trends tool from January 2010 to December 2019. The selected research terms were "melasma," "cloasma" and "chloasma." The outcome is the relative search volume, which scales, from 0 to 100, the search for the term relative to the total volume of searches in the period in a country.

Countries with more than 10% of missing values in the time series were excluded, as well as countries whose languages do not refer to the disease by the selected terms. The monthly relative search volume through the period and its seasonality for each country were registered, and the temporal variation was assessed by the seasonal Mann-Kendall trend test. The seasonality of interest was calculated as the standard deviation of the mean monthly seasonality coefficients, defined as the ratio of a given data point and the average interest for that year. The growth of interest through the period is represented as the slope of the relative search volume regression line from each country.

Factors explored as potential determinants to these outcomes were country data related to sun exposure, oral contraceptive use, female gender proportion, fertility rate, socioeconomic data and CO_2 emissions. The LASSO (least absolute shrinkage and selection operator) method was used to identify the relevant measures in variable selection. Multiple regression was used to determine the significance and intensity of each independent variable on the outcomes. Significance was set as a P-value <0.05.

Google Trends identified interest in melasma in 29 countries. The increase in relative search volume from the countries analysed is presented in Table 1, revealing a mean 54.4% increase in global interest in melasma in the last decade. The group of countries with more expressive growth includes those that have a high rate of miscegenation, either due to their previous population formation or more recent migratory movements.[2] Melasma has a higher prevalence among more pigmented phenotypes and among the admixed population (which includes Hispanic-Americans and Brazilian population, in Americas).[2]

Searches for melasma on the Internet exhibit significant seasonality, especially among countries with high latitudes. The growth in interest in melasma through the period is independently associated with three variables [Table 2]: solar exposure (average theoretical photovoltaic potential in kWh/m²/day; World Bank), oral contraceptive use (percentage of female population usage; World Contraceptive Use, United Nations Development Programme) and average CO_2 emissions by country (amount of emissions in Gt of CO_2 equivalent per km²; Emissions Database for Global Atmospheric Research of the European Commission Joint Research Centre).

Ultraviolet A, B and visible light (blue-violet) are the main types of radiation that induce melanogenesis. They act directly on melanocytes and induce the production of dermal mediators, which indirectly stimulate melanogenesis.[3] Sunlight radiation exposure generates 6-Formylindolo[3,2-b]carbazole, a tryptophan derivate which is an endogenous activator of the transcription factor aryl hydrocarbon receptor. The aryl hydrocarbon

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Table 1: Rate of RSV increase and seasonality for the search of melasma among the 29 main countries, through the period (2010–2019). The Seasonal Mann-Kendall test is a nonparametric test for trends applicable to data sets with seasonality. The seasonality of interest is annual, in a monthly fashion (12 seasons per cycle)

Country	Increase of RSV (2010–2019)	Kendall τ	*P*-value
Brazil	69.3%	0.950	<0.001
Philippines	45.7%	0.672	<0.001
Australia	41.0%	0.585	<0.001
France	37.9%	0.461	<0.001
Portugal	36.7%	0.472	<0.001
United Kingdom	34.3%	0.587	<0.001
Canada	34.1%	0.672	<0.001
Spain	33.4%	0.556	<0.001
India	32.5%	0.631	<0.001
United States	27.6%	0.791	<0.001
Singapore	22.4%	0.241	0.001
Mexico	20.7%	0.369	<0.001
Peru	18.4%	0.233	0.001
United Arab Emirates	14.5%	0.257	<0.001
Colombia	14.3%	0.322	<0.001
Italy	13.0%	0.346	<0.001
Ireland	9.6%	0.137	0.059
Venezuela	9.3%	0.091	0.213
Netherlands	6.4%	0.104	0.154
Germany	2.6%	0.067	0.366
Argentina	2.5%	0.196	0.006
Switzerland	1.9%	0.065	0.379
New Zealand	1.3%	0.015	0.856
Poland	-0.7%	0.028	0.716
Chile	-1.7%	0.022	0.776
South Africa	-4.7%	0.011	0.897
Romania	-5.5%	0.020	0.795
Turkey	-6.5%	-0.102	0.161
Ecuador	-15.3%	-0.096	0.185
World	54.4%	0.954	0.000

RSV: Relatives Search Volumes

Table 2: Multivariate analysis on the RSV for the search according to the main variables related to the 29 countries, through the period (2010–2019)

	Standardized β Coefficient	*P*-value
Solar exposure	0.651	0.004
Use of oral contraceptive (2019)	0.630	0.002
Average CO_2 emissions per area (2010–2019)	0.390	0.022
Gross Domestic Product (2019)	0.483	0.059
Average female proportion on population (2010–2019)	11.125	0.081
Female proportion on population (2017)	-10.944	0.086
Fertility rate (2018)	-0.129	0.542

P (model) = 0.006; R^2 = 0.611; RSV: Relatives Search Volumes

receptor is a cytoplasmic receptor present in many cell types (including melanocytes, keratinocytes, mast cells and fibroblasts) that sheds its chaperoning proteins when activated and starts a nuclear translocation signal (including the pathway of upregulation of tyrosinase in melanocytes).[4]

The aryl hydrocarbon receptor is also a well-known pleiotropic sensor of xenobiotics, such as particulate matter and other Polycyclic Aromatic Hydrocarbons.[5] There is accumulating evidence that air pollution plays an important role in extrinsic ageing and pigmentation. Pollution may be a risk factor for melasma due to airborne particulate matter and polycyclic aromatic hydrocarbons exposure, which can enter the skin via nanoparticles and activate the aryl hydrocarbon receptor.[4]

The study has limitations related to the limited access to the Internet by the global population. Furthermore, China is a large country in which access to Google is restricted.

In conclusion, the interest in searching melasma on the Internet is increasing globally. In the last decade, a greater increase in melasma searches was found in countries with greater solar exposure, air pollution and oral contraceptive use.

Declaration of patient consent

Patient's consent is not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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