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## Positive correlation of hidradenitis suppurativa and ultra-processed foods consumption

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### Abstract

Hidradenitis suppurativa (HS) is a chronic inflammatory skin condition whose pathogenesis is not well established. An association between HS and obesity is suggested but few studies explore specific dietary drivers. Non-Hispanic Blacks have the highest HS prevalence and obesity rates as well as the highest UPFs consumption rates, as opposed to Hispanics who have the lowest prevalence of HS despite having the second highest obesity rates in the US. Instead, Hispanics have the lowest UPFs consumption and highest minimally processed foods consumption rates in the US. Since HS appears to correlate more with processed food intake than obesity, we explored this connection more carefully. To identify correlations, we cross referenced 3 sources: (1) relative search volume (RSV) on Google Searches for HS. (2) Published data on prevalence of HS and UPFs consumption by nation, state, race, and age. (3) NHANES data on variation of diet patterns in the US. We identified a strong correlation of RSV and UPFs and HS by country ( $r = 0.83$ ,  $p < 0.0001$ ) and state in the US ( $r = 0.82$ ,  $p < 0.0001$ ) compared to a negative control (melanoma with UPFs;  $r = 0.35$ ,  $p = 0.14$  by country and  $r = 0.22$ ,  $p = 0.23$  by state). The variation in searches for HS from 2004 till 2018 ( $p < 0.0001$ ) was strongly correlated with the increase in UPFs consumption ( $r = 0.79$ ,  $p = 0.019$ ) and inversely correlated with the decrease in minimally-processed foods consumption in the US ( $r = -0.941$ ,  $p = 0.0005$ ). These results suggest an association between UPFs consumption and HS, and the need for future studies to address whether limiting UPFs might ameliorate HS.

### Keywords

Hidradenitis suppurativa; Ultra-processed foods; Processed foods; Minimally-processed foods; Inflammatory diseases; Geographic heterogeneity

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Hidradenitis suppurativa (HS) is a chronic inflammatory skin condition whose pathogenesis is not fully understood, presenting with nodules, abscesses, fistulas, and scar tissue in

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intertriginous skin areas. Several elements have been associated with HS, including genetics, hormonal factors, obesity, and diet, especially dairy and spicy foods.

Non-Hispanic Blacks have the highest HS prevalence, obesity rates and ultra-processed foods (UPFs) consumption rates [1–4]. This is notably opposed to Hispanics, who have the lowest prevalence of HS despite having the second highest obesity rates in the US. Interestingly, Hispanics have the lowest UPFs consumption and highest minimally-processed foods (MPFs) consumption rates in the US [1]. This prompts consideration of a potential correlation between HS and UPFs intake rather than obesity. Specifically, this suggests an association between UPFs consumption with HS and a potential benefit of MPFs to mitigate the development of HS. To identify correlations, we cross referenced several sources: relative search volume (RSV) data for Google Searches using the keyword “Hidradenitis Suppurativa” was obtained using the following parameters: *Worldwide, United States, January 1, 2004–August 23, 2023, all categories and web search*. The heterogeneity of state-level RSV for “Hidradenitis Suppurativa” was compared to that of “Melanoma”, which is expected to have a more uniform distribution. Levene test was used to assess variance heterogeneity. Published data on prevalence of HS and UPFs consumption by nation, state, race and age was obtained [2, 5–7]. The variation of diet patterns was obtained from US NHANES-based papers [1].

A correlation analysis was performed to assess the relationship between processed and UPFs consumption with Google searches for HS by country, state, racial and age groups in the US. A linear regression analysis was conducted to assess trends in Google searches for HS over the years in the US then a correlation analysis was performed to assess the relationship between these trends and the consumption of UPFs and MPFs. R software (4.3.1) and GraphPad Prism (9.5.0) were used for data analysis.  $p < 0.05$  was considered significant.

There was a significant heterogeneity in the variance of HS searches compared with Melanoma ( $p = 0.04$ ), with SDs of 13.07 and 9.82 respectively. We identified a strong correlation of RSV and UPFs and HS by country ( $r = 0.83$ ,  $p < 0.0001$ ) (Fig. 1a) and state in the US ( $r = 0.82$ ,  $p < 0.0001$ ) (Fig. 1b) compared to a negative control (melanoma with UPFs;  $r = 0.35$ ,  $p = 0.14$  by country and  $r = 0.22$ ,  $p = 0.23$  by state). UPFs consumption was strongly correlated with HS prevalence among Non-Hispanic Blacks and among all races between 20 and 39 years of age ( $r = 0.91$  and  $r = 0.90$  respectively). The significant increase in Google searches for HS from 2004 till 2018 ( $p < 0.0001$ ) strongly correlates with the increase in UPFs consumption ( $r = 0.79$ ,  $p = 0.019$ ) (Fig. 1c) and inversely correlates with the decrease in MPFs consumption in the US over the years ( $r = -0.941$ ,  $p = 0.0005$ ) (Fig. 1d).

Our results suggest an association between UPFs consumption and HS. Studies are needed to address whether limiting UPFs consumption might ameliorate HS, incorporating BMI data to better isolate the effects of dietary patterns from those of obesity.

## Funding

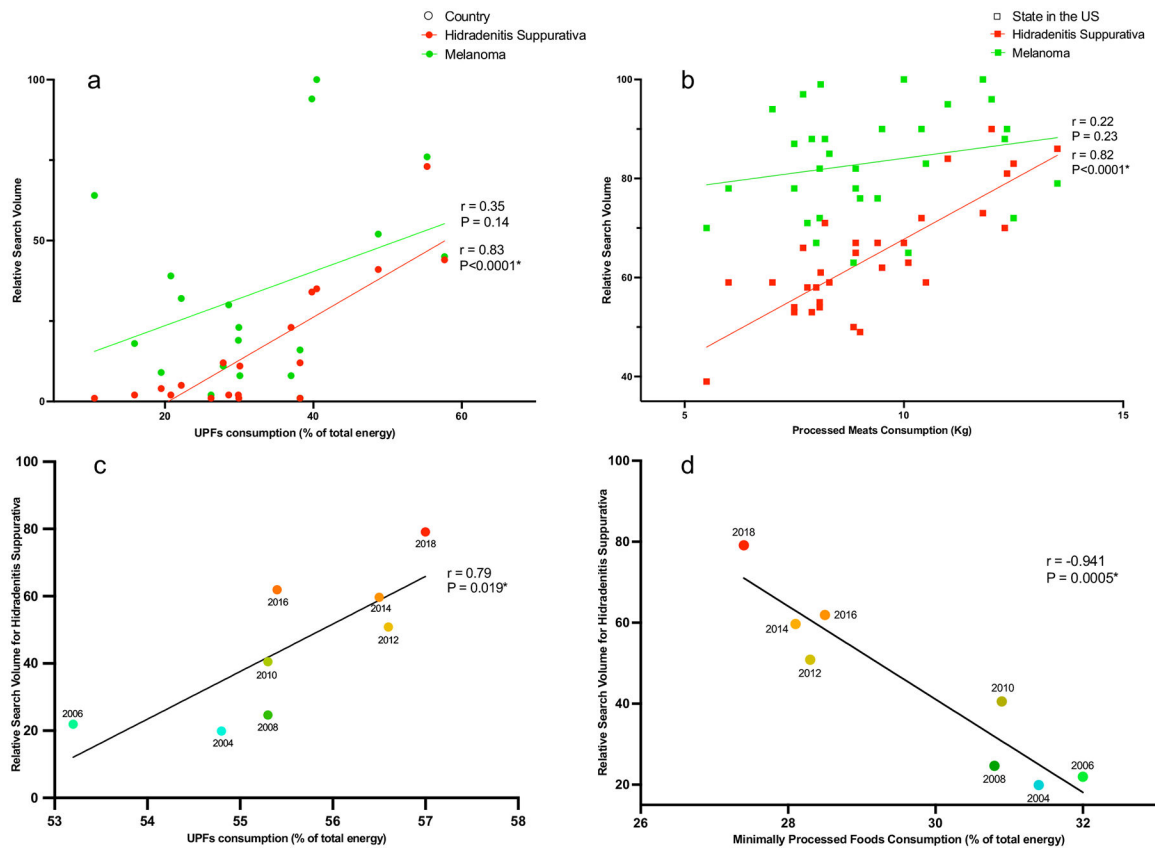
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## Data availability

The analysis presented in this paper relies entirely on previously published data. All datasets analyzed are available in the public domain or through the respective published articles. Detailed references to the original sources of the data are provided in the bibliography.

## References

1. Juul F, Parekh N, Martinez-Steele E, Monteiro CA, Chang VW (2022) Ultra-processed food consumption among US adults from 2001 to 2018. *Am J Clin Nutr* 115(1):211–221. 10.1093/ajcn/nqab305 [PubMed: 34647997]
2. Sachdeva M, Shah M, Alavi A (2021) Race-specific prevalence of hidradenitis suppurativa. *J Cutan Med Surg* 25(2):177–187. 10.1177/1203475420972348 [PubMed: 33174482]
3. Garg A, Kirby JS, Lavian J, Lin G, Strunk A (2017) Sex- and age-adjusted population analysis of prevalence estimates for hidradenitis suppurativa in the United States. *JAMA Dermatol* 153(8):760–764. 10.1001/jamadermatol.2017.0201 [PubMed: 28492923]
4. Vaidya T, Vangipuram R, Alikhan A (2017) Examining the race-specific prevalence of hidradenitis suppurativa at a large academic center; results from a retrospective chart review. *Dermatol Online J* 23(6):13030/qt9xc0n0z1
5. Steele EM, Khandpur N, Sun Q, Monteiro CA (2020) The impact of acculturation to the US environment on the dietary share of ultra-processed foods among US adults. *Prev Med* 141:106261. 10.1016/j.ypmed.2020.106261 [PubMed: 33022323]
6. Semba RD, Ramsing R, Thorne-Lyman AL et al. (2023) Retail purchases of red and processed meat by State in the United States. *Nutr Cancer* 75(1):247–255. 10.1080/01635581.2022.2108072 [PubMed: 35942589]
7. Marino M, Puppo F, Del Bo' C et al. (2021) A systematic review of worldwide consumption of ultra-processed foods: findings and criticisms. *Nutrients* 13(8):2778. 10.3390/nu13082778 [PubMed: 34444936]



**Fig. 1.**

Correlation between HS relative search volume or prevalence and ultra-processed foods consumption. **a** HS and UPFs positive correlation by country: the countries who consume UPFs the most have the highest HS RSV ( $r = 0.83$ ,  $p < 0.0001$ ) as opposed to melanoma where no correlation was found ( $r = 0.35$ ,  $p = 0.14$ ); **b** HS and processed foods positive correlation by state in the US: the states who consume processed foods the most have the highest HS RSV ( $r = 0.82$ ,  $p < 0.0001$ ) as opposed to melanoma where no correlation was found ( $r = 0.22$ ,  $p = 0.23$ ); **c** HS and UPFs consumption changes and correlation over the years in the US: both UPFs consumption and HS have increased with a strong positive correlation ( $r = 0.79$ ,  $p = 0.019$ ); **d** HS and MPFs consumption changes and correlation over the years in the US. A strong negative correlation was found between MPFs and HS: while MPFs consumption has decreased, HS RSV has increased ( $r = -0.941$ ,  $p = 0.0005$ )