Prevalence of patients with self-reported hidradenitis suppurativa in a cohort of Danish blood donors

a cross-sectional study

Theut Riis, P; Pedersen, O B; Sigsgaard, V; Erikstrup, C; Paarup, H M; Nielsen, K R; Burgdorf, K S; Hjalgrim, H; Rostgaard, K; Banasik, K; Ullum, H; Jemec, G B

Published in:
British Journal of Dermatology

DOI (link to publication from Publisher):
10.1111/bjd.16998

Publication date:
2019

Document Version
Accepted author manuscript, peer reviewed version

MR PETER THEUT RIIS (Orcid ID : 0000-0001-7723-8779)

DR GREGOR JEMEC (Orcid ID : 0000-0002-0712-2540)

Article type : Original Article

Prevalence of self-reported hidradenitis suppurativa patients in a cohort of Danish blood donors – a cross-sectional study

P. Theut Riis[1], O.B. Pedersen[2], V. Sigsgaard[1], C. Erikstrup[3], H.M. Paarup[4], K.R. Nielsen[5], K.S. Burgdorf[6], H. Hjalgrim[7,8], K. Rostgaard[7], K. Banasik[9], H. Ullum[6], G.B. Jemec[1]

[1] Department of Dermatology, University Hospital Zealand, Roskilde; Health Sciences Faculty, University of Copenhagen, Denmark

[2] Dept. of Clinical Immunology, Naestved Hospital, Denmark

[3]Dept. of Clinical Immunology, Aarhus University Hospital, Denmark

[4]Dept. of Clinical Immunology, Odense University Hospital, Denmark

[5]Dept. of Clinical Immunology, Aalborg University Hospital, Denmark

[6]Dept. of Clinical Immunology, Copenhagen University Hospital, Denmark

[7]Dept. of Epidemiology Research, Statens Serum Institut, Denmark

[8]Dept. of Hematology, Rigshospitalet, Denmark

[9]Novo Nordisk Foundation Center for Protein Research, Faculty of Health and Medical Sciences, University of Copenhagen, Copenhagen, Denmark.

Conflicts of interest:

GB Jemec has received honoraria from AbbVie, Coloplast, Pfizer, Pierre Fabre, Inflarx, MSD, Novartis and UCB for participation on advisory boards, and grants from Abbvie, Leo Pharma, Novartis, Janssen-Cilag, Regeneron, UCB and Sanofi for participation as an investigator, and received speaker honoraria from AbbVie, Galderma and Leo Pharma.

Funding: PTR received support from the Region Zealand Research Found.

KB was supported by the Novo Nordisk Foundation (grant NNF14CC0001)

Corresponding Author:

Peter Theut Riis

University Hospital Zealand, Roskilde, Department of Dermatology.

Sygehusvej 5, 4000 Roskilde.

pmik@regionsjaelland.dk

Abstract

Background

Hidradenitis suppurativa (HS) is a chronic inflammatory skin disease characterized by recurrent inflamed nodules. No pathognomonic test is available for HS, hence the diagnosis is based on three clinical criteria. We used a questionnaire previously developed for diagnosis of HS to estimate the cross-sectional prevalence and characterize HS patients in the Danish Blood Donor Study cohort.

Method

A questionnaire containing the HS screening questions, the Major Depression Inventory, the Short Form-12, as well as questions about height, weight and drinking habits was answered by 27,725 blood donors.

Results

The prevalence of HS was 1.8% (confidence interval 95%: 1.6% – 2.0%) in the cohort of Danish blood donors. Donors with HS were on average 4.7 years younger (P<0.001), had 2.7 kg/m² higher mean BMI (P<0.001) and were significantly more likely to smoke (OR 1.44, 17.9 % vs 12.1 %, P=0.002) compared with donors without HS. Furthermore, significantly more donors with HS were classified as having a moderate depression (3.2 % vs 0.7 %, P<0.001). Also significantly more with HS were apprenticeship educated, received educational support and sickness or cash benefits.

Conclusion

The prevalence of HS in the cohort of blood donors was estimated to 1.8% (Confidence interval 95%: 1.6% - 2.0%). Donors with HS reported characteristics similar to those reported for hospital-based HS patients such as higher BMI, smoking rates and lower socioeconomic status than donors without HS.

Background

Hidradenitis suppurativa (HS) is a chronic inflammatory disease of the skin. Patients suffer from recurrent inflamed nodules that can progress to abscesses causing scaring and the formation of intracutaneous tunnels. [1] Patients with hidradenitis generally have high BMI [2-5] and report smoking more often than the general population. [6, 7, 2] The male to female ratio is approximately 1 to 3. [1] HS is an impactful skin disease associated with psychological comorbidities, [8, 9] such as depression, anxiety [10, 11], low quality of life [12-16], decreased utility [17], fatigue [18] and suicide [19]. In addition, HS patients have been shown to have a lower socioeconomic status [20] and a higher rate of unemployment than the background population. [21]

In spite of its clinical presentation and its clear definition HS can be difficult to diagnose. Globally, patients experience an average diagnostic delay of 7.2 years. [22] This can partly be attributed to a lack of recognition of the disease, but also to the relatively mild symptoms experienced by a part of the HS population. While most research is focused on the patients suffering from moderate to severe HS, the silent majority of mildly afflicted patients should not be neglected, as mild disease may progress to more severe forms over time in approximately 30% of cases. [23]

In Denmark, blood donation is unremunerated and mainly motivated by altruism. Since 2010, Danish blood donors are approached to participate in the nationwide Danish Blood Donor Study (DBDS). Participants are presented with a questionnaire and agree to have their data collected in the various Danish registers made available to researchers; allowing for subsequent cross-platform linkage of questionnaire and register data. Since 2015 the DBDS questionnaire contains diagnostic questions for HS, along with the Major Depression Inventory (MDI) and the Short Form-12 (SF-12) life quality questionnaires.

The aim of this study was to estimate the prevalence of HS in a cohort of blood donors and to characterise donors classified as HS patients according to the screening questionnaire compared with blood donors who do not suffer from HS. Additionally, we compared the MDI scores, SF-12 scores and socioeconomic status of the two groups.

Method

A total of 27,765 blood donors completed the DBDS questionnaire, including HS screening questions and items on height, weight, drinking habits, the MDI and SF-12 along with questions of other phenotypes such as attention deficit hyper active disorder, migraine and restless legs syndrome. Questionnaire data were combined with registry data on salary, total income and socioeconomic status based on employment available from Statistics Denmark.

No pathognomonic test is available for HS. The diagnosis of the disease is based on three criteria decided on the Hidradenitis Suppurativa Foundation's meeting in San Francisco 2009: (i) typical lesions, i.e. deep-seated painful nodules – 'blind boils' in early lesions, and abscesses, draining sinus, bridged scars and 'tombstone' double-ended pseudo-comedones in secondary lesions; (ii) typical topography, i.e. axillae, groins, perineal region, buttocks, and infra- and intermammary folds; (iii) chronicity and recurrences. [24]

Based on these criteria a questionnaire has been developed for diagnosis of HS, using two simple questions. E.g. "Have you had outbreak of boils during the last 6 months?" and "Where and how many boils have you had?" listing the locations axilla, groin, genitals, under the breast and other location. We defined HS as an affirmative answer to question 1,

combined with more than two boils in total for question 2,s suggested by Vinding et al. [24] A sensitivity of 90% (95% Confidence interval (CI): 73–98%), a specificity of 97% (95% CI: 85–100%), a positive predictive value of 96% and an negative predictive value of 92% were achieved. [24]

The screening questionnaire was included in the Danish Blood Donor Study and used to identify cases of HS. Donors fulfilling the definition are referred to as "blood donors with HS" and other donors are referred to as "blood donors without HS".

The MDI is a validated Danish questionnaire that covers the depressive symptoms of both ICD-10 and DSM-IV defined depression. [25] The questionnaire covers 10 items across 12 questions. The donors were asked how often during the past two weeks they have experienced depressive symptoms, e.g. "Have you felt low in spirits or sad?" For each item answers were given on a numeric rating scale ranging from 0 to 5 points, with more points indicating more depressive symptoms. Two of the items were divided into two questions where the highest score was used. The MDI's ability to categorize patients as having "No depression" (0-20 points), "Mild depression" (21-25 points), "Moderate depression" (26-30 points) and "Severe Depression" (31-50 points) has been validated. [26, 25]

Short Form - 12 is a shorter version of the Short Form – 36 (SF-36), and is designed to provide a single-page health related quality of life survey. [27] The SF-12 provides a physical component summery (PCS) and a mental component summary (MCS). These scores explain more than 80 % of the variance in the original eight SF-36 scores. [28] To calculate the SF-12 score, questionnaire items are weighted with different endorsements and added to a constant (57.65693 for PCS and 60.58847 for MCS) [29], higher scores indicating better health related quality of life.

Data on income were acquired from Statistics Denmark. These data included information on yearly salary and yearly total income comprising salary and other income, interests and investments included. Furthermore, each adult in Denmark are assigned a nominal social economic status based on employment. The seven most common categories can be rank ordered. This information was also provided by Statistics Denmark.

The National Patient register was searched to see how many of the DBDS participants had the ICD-10 HS diagnosis (L73.2) in the time period 1995-2015.

Categorical data are reported as frequency distribution and percentages. Comparisons are made with Chi-squared tests or Fishers' Exact test as appropriate.

For continuous data means and standard deviation or medians and interquartile range were used depending on normality assessed by histograms. Differences between groups were calculated with t-tests or Mann-Whitney U tests, likewise, depending on normality.

To isolate the association of HS on outcomes, a multiple linear regression analyses were performed for continuous outcomes for the study base of blood donors adjusting for age, sex, BMI, smoking and HS-status. Linearity were tested with scatterplots, multivariate normality was tested with histograms and QQ-plots, multicollinearity was tested with correlation matrix with correlation coefficients less than 0.80 considered acceptable. Homoscedasticity was tested with residuals against predicted values.

A multinomial logistic regression analysis was performed to assess the association between HS-status and socioeconomic rank adjusting for age, sex, BMI and smoking. For continuous variables outliers were assessed by converting to z-scores, removing values below -3.29 and over 3.29 (n=1). Multicolinearity was assessed by correlation matrix.

Statistics was performed in SPSS 24.0 (IBM, USA, New York), a p-value less than 0.05 was considered statistically significant. Benjamini-Hochberg procedure for multiple testing was used with a false discovery rate set to 0.05.

Results

Prevalence

A total of 27,765 blood donors completed the questionnaire, and 500 of these fulfilled the definition of HS, suggesting a point prevalence of 1.80% (95% CI: 1.64% – 1.96%).

Gender and lifestyle characteristics

We found no difference in gender distribution between the groups. In the HS group 49.8% were female compared with 45.7% in the non-HS group ($P = 0.066$). The blood donors with HS were younger than blood donors without HS with a mean age of 36.6 compared with 41.3 years ($P < 0.001$) and they also reported a higher mean BMI of 27.0 compared with 25.7 of the control group ($P < 0.001$). Blood donors with HS were more likely to be smokers than the blood donors without HS group, odds ratio (OR) 1.44 (95% CI: 1.14 – 1.82). Stratified analysis showed that this was due to an excess of female smokers with an OR of 1.83 (95% CI: 1.36 – 2.48) compared with an OR of 1.05 (CI 95%: 0.73 – 1.52) for the males. There was no difference in self-reported frequency of beer consumption (P = 0.99), but blood donors

with HS drank wine significantly less frequent than blood donors without HS (P = 0.02) but spirits/liqueur significantly more frequent (P<0.001) (Table 1)

Only 11 (2.2 %) of the blood donors with HS were registered with the diagnosis of HS in the national patient register, while 42 (0.15 %) of the blood donors without HS were registered with HS (P <0.001).

Psychological co-morbidities and quality of life

According to the MDI questions, the odds ratio of having no depression was 0.467 (95% CI: 0.315–0.694), the odds of mild depression 1.317 (95%CI: 0.676–2.568), the odds of moderate depression 4.774 (95 % CI: 2.842–8.012), and the odds of severe depression 0.741 (95%CI: 0.183–2.998) when comparing blood donors with HS to blood donors without HS. Both groups reported a median of 4 MDI (P = 0.615). Blood donors with HS reported more often a feeling of guilt or bad conscience, being subdued or slowed down and having reduced appetite based on ranked data (P = 0.044, P = 0.040, and P = 0.010, respectively, however, these were not significant after Benjamini Hochberg correction for multiple testing). No difference was seen for the other items. The distribution of answers to the MDI are given in supplementary table 1. Multivariable linear regression analysis adjusted for sex, age, BMI and smoking showed that concomitant HS increased MDI by an average of 1.427 (P < 0.001) Table 2.

There was no significant difference between the groups in the number reporting being diagnosed with depression by a doctor, 51 (10.2 %) blood donors with HS, compared with 2,094 (7.8 %) of the control group (P = 0.140). However, of those diagnosed with depression, blood donors with HS were significantly more often medically treated (32/51, 62.7 %) compared with blood donors without HS (1033/2094, 49.5 %) (P = 0.014) (Table 2).

In the SF-12 questionnaire, blood donors with HS reported a similar median physical component summary of 56.5612 compared with a median of 56.5808 for the blood donors without HS (P = 0.619).. However, blood donors with HS reported a lower mental component summary with a median of 54.96 compared with 55.51 of the blood donors without HS (P = 0.041). See table 2. In the unadjusted analysis, blood donors with HS rated their general health as worse (P = 0.025), indicated that they were more limited in moderate activities (P = 0.019) as well as in climbing several flights of stairs (P = 0.0313). Blood donors with HS felt less calm and peaceful (P = 0.049), and had less energy (P = 0.008) than blood donors without HS. However none of these differences were significant after correction for multiple testing. There was no difference for the other items. The full record and distribution of answers to the SF-12 as well as the endorsements for each item are

provided in supplementary table 2. Multivariable linear regression revealed that, after adjusting for sex, age, BMI and smoking, HS affected neither PCS nor MCS significantly (P = 0.262 and P = 0.067, respectively) (Table 2 and supplementary table 3).

Income

Blood donors with HS had a lower annual salary of 292,959 DKK compared with 331,850 DKK of the blood donors without HS (P < 0.001). The mean total income was 337,286 DKK for blood donors with HS compared with 383,320.24 DKK of the group without HS (P > 0.001). The mean difference of 38,890 DKK equals approximately 5,200 Euro (Table 2). After adjusting for age, sex, HS did not affect salary or total income in a linear regression model (P = 0.968 and 0.596, respectively) (table 2 and supplementary table 3).

Socioeconomic ranking

Significantly more blood donors with HS were apprenticeship educated (P <0.001), or received cash benefits (P <0.001).Socioeconomic status was rank ordered where applicable. The order of the ranking was: (1) Chief executive, (2) high skill level employee, (3) moderate skill level employee, (4) basic skill level employee, (5) apprenticeship educated, (6) unemployed for at least 6 months in a year and (7) publicly supported (cash benefits, sickness benefits). This accounted for 84.3% of the persons included (85.8% of HS donors and 84.3% of non-HS donors). The categories “others”, “other employees”, “co-working spouse”, “retired” and “self-employed” were all excluded as these were a minority of cases and did not fit into a rank system. As a group, blood donors with HS (n = 429) had a lower socioeconomic rank than blood donors without HS (n = 22,587) (P < 0.001), see table 3. Multinomial regression showed that after adjusting for sex, BMI and age, HS negatively affected socioeconomic rank. Calculating odds of belonging to various socioeconomic strata (1-7) relative to stratum (4) the odds ratios between donors with HS and donors without HS were: (1) Received sickness benefit or educational support 2.441 (95% CI: 1.107 – 5.380), (2) Unemployed 1.771 (95% CI -0.886 – 3.543), (3) apprenticeship educated 1.484 (95% CI: 1.043 – 2.113), (5) employee moderate skill level 1.136 (95% CI: 0.862 – 1.497), (6) employee high skill level 1.097 (95 % CI: 0.816–1.474), (7) chief executive 1.464 (95 % CI: 0.859–2.496)(Supplementary table 4).

Discussion

A prevalence of HS of 1.8% (95% CI: 1.6% - 2.0%) was found in the cohort of blood donors. Population based self-reported estimates of HS prevalence range between 0.97 and 2.1. [30, 24, 31, 32] A previous study also performed as a cross-sectional study of a Danish population

with the same validated diagnostic questionnaire found 344 cases of HS among 16,404 participants (prevalence 2.10%, 95% CI: 1.88 – 2.32) in the age group 30-89 years. [24]

Blood donors in Denmark must be between 17 and 60 years old, generally healthy and weigh at least 50 kg. The "generally healthy" criterion will presumably preclude a certain part of the HS afflicted in the general population, especially those that are moderately to severely affected, from volunteering and being accepted as a blood donor. It has previously been suggested that blood donors as a group are healthier than non-donors (even before considering any potentially beneficial effect of blood donation). [33] Due to this selection bias the true prevalence in the general population may be even higher.

The gender and lifestyle characteristics of HS patients were similar to the findings of the previously performed background population study (21). Blood donors with HS had higher BMIs and a higher rate of female smokers than blood donors without HS despite being younger. The significance of this is evident when considering that studies have shown that BMI increases with age. [34]

In the previous Danish population study using the same diagnostic questions the mean BMI of HS patients was 28.6 [24] compared with 27.0 in this study. Similarly, the prevalence of smoking for HS patients in the general Danish population was found to be 41.2 % [24], with 40.3%-89% [30, 35] found in French and German studies, respectively, while we found a smoking prevalence of 17.9 %. The fact that smoking prevalence and BMI for donors with HS are higher than for the donors without HS, but lower than for HS patients in the general population suggest that blood donors with HS are healthier than HS cases from the general population, which is consistent with the known selection criteria for individuals eligible for donation [33].

Several studies have shown that HS patients are prone to depressive symptoms and depression. [8, 11, 10, 19] In this study significantly fewer donors with HS were classified in the "No depression group" and more in the "Moderate depression group" according to the MDI scores, suggesting that HS blood donors are more depressed than non-HS donors. Furthermore, of blood donors reporting a clinical diagnosis of depression, significantly more donors with HS reported having received medical treatment for their depression, which suggests a propensity for more severe depression in donors with HS. Finally, the regression analysis of the role of HS as a predictor of MDI scores found blood donors with HS scored an average of 1.427 higher on the MDI ($P < 0.001$) after adjusting for BMI, sex, age and smoking. [36]

Socioeconomic status for blood donors with HS was significantly lower than donors without HS based on job description. Multinomial regression models also showed that HS negatively affected socioeconomic rank after adjusting for age, sex and BMI. A Dutch study found that hospital-recruited HS patients had a lower mean household income [20] based on ranked data of neighbourhood averages, compared with age and sex matched controls. However, the present study found no evidence that blood donors with HS had a lower personal income than blood donors without HS, after adjusting for age and sex. Blood donors with HS do not seem to have a lower socioeconomic status than their peers which may reflect the mild disease of the population studied.

Blood donors with HS reportedly drink less wine but more liquor than Blood donors without HS, which has also been suggested to be indicative of a lower social status. [37] Interestingly, no difference in the consumption of beer was found. Brewer's yeast, a component of most beers, has been suggested to worsen symptoms of HS. [38]

The study was conducted to determine the prevalence of HS in a relatively healthy population and to characterize the HS subpopulation in this cohort. The 7.2 year average diagnostic delay [22] shows that many HS patients fail to be diagnosed, which is especially relevant in this presumably less severely affected population. Only 2.2 % of HS patients had the diagnosis of HS (L73.2) in the National patient register. This demonstrates a large number of undiagnosed HS patients that could benefit from a diagnosis, which provides not only access to guideline-based treatment, but also a certainty that their boils is part of a disease. Early and aggressive treatment of the disease will reduce the risk of scaring, tunnel formation and the need for surgery. [1] However, the low number also raises questions about coding issues and the validity of the screening questionnaire. An in-setting validation of the questionnaire is recommended for blood donors. The questionnaire had an estimated sensitivity of 90% and specificity of 97%, which could explain the lack of difference in gender distribution found in this study, but also indicates that an underestimation of the true HS prevalence is likely.

The large sample size is a noticeable strength of this study. However, extrapolating results from a study of blood donors to the general population should generally be done with great caution due to the selection bias, although as demonstrated the findings corresponds well with current knowledge. Although the within-group analysis reported here is suggested to be a better approach, than comparing to other population studies [39], the selection bias limits the external validity of our results, as it narrows the focus to the healthier part of the HS population. The DBDS questionnaire presented to donors changes every few years and blood

donors are approached again to fill out a new questionnaire. This provides the opportunity for follow-up data in later studies on this unique cohort.

In conclusion, even in a healthy population such as blood donors, HS appears to be a relatively common disease. Blood donors with HS report similar characteristics to hospital based HS patients such as higher BMI, higher smoking rates, and lower socioeconomic status than their blood donor peers. It appears that HS is more prevalent than assumed emphasizing the challenge of diagnosing HS patients in the early relatively mild stages.

Additional information:

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent was obtained from all individual participants included in the study.

Reference list

1. Jemec GB. Clinical practice. Hidradenitis suppurativa. N Engl J Med. 2012;366(2):158-64. doi:10.1056/NEJMcp1014163.
2. Zouboulis CC, Desai N, Emtestam L, Hunger RE, Ioannides D, Juhasz I et al. European S1 guideline for the treatment of hidradenitis suppurativa/acne inversa. J Eur Acad Dermatol Venereol. 2015;29(4):619-44. doi:10.1111/jdv.12966.
3. Edlich RF, Silloway KA, Rodeheaver GT, Cooper PH. Epidemiology, pathology, and treatment of axillary hidradenitis suppurativa. J Emerg Med. 1986;4(5):369-78.
4. Harrison BJ, Read GF, Hughes LE. Endocrine basis for the clinical presentation of hidradenitis suppurativa. Br J Surg. 1988;75(10):972-5.
5. Rompel R, Petres J. Long-term results of wide surgical excision in 106 patients with hidradenitis suppurativa. Dermatol Surg. 2000;26(7):638-43.
6. Revuz J. Hidradenitis suppurativa. J Eur Acad Dermatol Venereol. 2009;23(9):985-98. doi:10.1111/j.1468-3083.2009.03356.x.
7. Kurzen H, Kurokawa I, Jemec GB, Emtestam L, Sellheyer K, Giamarellos-Bourboulis EJ et al. What causes hidradenitis suppurativa? Exp Dermatol. 2008;17(5):455-6; discussion 7-72. doi:10.1111/j.1600-0625.2008.00712_1.x.
8. Shavit E, Dreiher J, Freud T, Halevy S, Vinker S, Cohen AD. Psychiatric comorbidities in 3207 patients with hidradenitis suppurativa. J Eur Acad Dermatol Venereol. 2015;29(2):371-6. doi:10.1111/jdv.12567.
9. Matusiak L, Bieniek A, Szepietowski JC. Psychophysical aspects of hidradenitis suppurativa. Acta Derm Venereol. 2010;90(3):264-8. doi:10.2340/00015555-0866.
10. Onderdijk AJ, van der Zee HH, Esmann S, Lophaven S, Dufour DN, Jemec GB et al. Depression in patients with hidradenitis suppurativa. J Eur Acad Dermatol Venereol. 2013;27(4):473-8. doi:10.1111/j.1468-3083.2012.04468.x.

11. Esmann S, Jemec GB. Psychosocial impact of hidradenitis suppurativa: a qualitative study. Acta Derm Venereol. 2011;91(3):328-32. doi:10.2340/00015555-1082.
12. Matusiak L, Bieniek A, Szepietowski JC. Hidradenitis suppurativa markedly decreases quality of life and professional activity. J Am Acad Dermatol. 2010;62(4):706-8, 8 e1. doi:10.1016/j.jaad.2009.09.021.
13. Alavi A, Anooshirvani N, Kim WB, Coutts P, Sibbald RG. Quality-of-life impairment in patients with hidradenitis suppurativa: a Canadian study. Am J Clin Dermatol. 2015;16(1):61-5. doi:10.1007/s40257-014-0105-5.
14. Deckers IE, Kimball AB. The Handicap of Hidradenitis Suppurativa. Dermatol Clin. 2016;34(1):17-22. doi:10.1016/j.det.2015.07.003.
15. Jemec GB. Quality of life considerations and pain management in hidradenitis suppurativa. Semin Cutan Med Surg. 2017;36(2):75-8. doi:10.12788/j.sder.2017.016.
16. Jobanputra R, Bachmann M. The effect of skin diseases on quality of life in patients from different social and ethnic groups in Cape Town, South Africa. Int J Dermatol. 2000;39(11):826-31.
17. Riis PT, Vinding GR, Ring HC, Jemec GB. Disutility in Patients with Hidradenitis Suppurativa: A Cross-sectional Study Using EuroQoL-5D. Acta Derm Venereol. 2016;96(2):222-6. doi:10.2340/00015555-2129.
18. Riis PT, Sigsgaard V, Boer J, Jemec GBE. A pilot study of fatigue in patients with hidradenitis suppurativa. Br J Dermatol. 2018;178(1):e42-e3. doi:10.1111/bjd.15842.
19. Thorlacius L, Cohen AD, Gislason GH, Jemec GBE, Egeberg A. Increased Suicide Risk in Patients with Hidradenitis Suppurativa. J Invest Dermatol. 2018;138(1):52-7. doi:10.1016/j.jid.2017.09.008.
20. Deckers IE, Janse IC, van der Zee HH, Nijsten T, Boer J, Horvath B et al. Hidradenitis suppurativa (HS) is associated with low socioeconomic status (SES): A cross-sectional reference study. J Am Acad Dermatol. 2016;75(4):755-9 e1. doi:10.1016/j.jaad.2016.04.067.
21. Theut Riis P, Thorlacius L, Knudsen List E, Jemec GBE. A pilot study of unemployment in patients with hidradenitis suppurativa in Denmark. Br J Dermatol. 2017;176(4):1083-5. doi:10.1111/bjd.14922.
22. Saunte DM, Boer J, Stratigos A, Szepietowski JC, Hamzavi I, Kim KH et al. Diagnostic delay in hidradenitis suppurativa is a global problem. Br J Dermatol. 2015;173(6):1546-9. doi:10.1111/bjd.14038.
23. Kromann CB, Deckers IE, Esmann S, Boer J, Prens EP, Jemec GB. Risk factors, clinical course and long-term prognosis in hidradenitis suppurativa: a cross-sectional study. Br J Dermatol. 2014;171(4):819-24. doi:10.1111/bjd.13090.
24. Vinding GR, Miller IM, Zarchi K, Ibler KS, Ellervik C, Jemec GB. The prevalence of inverse recurrent suppuration: a population-based study of possible hidradenitis suppurativa. Br J Dermatol. 2014;170(4):884-9. doi:10.1111/bjd.12787.
25. Bech P, Rasmussen NA, Olsen LR, Noerholm V, Abildgaard W. The sensitivity and specificity of the Major Depression Inventory, using the Present State Examination as the index of diagnostic validity. J Affect Disord. 2001;66(2-3):159-64.
26. Bech P, Timmerby N, Martiny K, Lunde M, Soendergaard S. Psychometric evaluation of the Major Depression Inventory (MDI) as depression severity scale using the LEAD (Longitudinal Expert Assessment of All Data) as index of validity. BMC Psychiatry. 2015;15:190. doi:10.1186/s12888-015-0529-3.
27. Jenkinson C, Layte R, Jenkinson D, Lawrence K, Petersen S, Paice C et al. A shorter form health survey: can the SF-12 replicate results from the SF-36 in longitudinal studies? J Public Health Med. 1997;19(2):179-86.
28. Ware J, Jr., Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Med Care. 1996;34(3):220-33.
29. Andrews G. A brief integer scorer for the SF-12: validity of the brief scorer in Australian community and clinic settings. Aust N Z J Public Health. 2002;26(6):508-10.

30. Revuz JE, Canoui-Poitrine F, Wolkenstein P, Viallette C, Gabison G, Pouget F et al. Prevalence and factors associated with hidradenitis suppurativa: results from two case-control studies. J Am Acad Dermatol. 2008;59(4):596-601. doi:10.1016/j.jaad.2008.06.020.
31. Jemec GB, Heidenheim M, Nielsen NH. [Prevalence of hidradenitis suppurativa in Denmark]. Ugeskrift for laeger. 1998;160(6):847-9.
32. Jemec GB, Kimball AB. Hidradenitis suppurativa: Epidemiology and scope of the problem. J Am Acad Dermatol. 2015;73(5 Suppl 1):S4-7. doi:10.1016/j.jaad.2015.07.052.
33. Ullum H, Rostgaard K, Kamper-Jorgensen M, Reilly M, Melbye M, Nyren O et al. Blood donation and blood donor mortality after adjustment for a healthy donor effect. Transfusion. 2015;55(10):2479-85. doi:10.1111/trf.13205.
34. Nysom K, Molgaard C, Hutchings B, Michaelsen KF. Body mass index of 0 to 45-y-old Danes: reference values and comparison with published European reference values. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity. 2001;25(2):177-84. doi:10.1038/sj.ijo.0801515.
35. Konig A, Lehmann C, Rompel R, Happle R. Cigarette smoking as a triggering factor of hidradenitis suppurativa. Dermatology. 1999;198(3):261-4. doi:10.1159/000018126.
36. Gill SC, Butterworth P, Rodgers B, Mackinnon A. Validity of the mental health component scale of the 12-item Short-Form Health Survey (MCS-12) as measure of common mental disorders in the general population. Psychiatry research. 2007;152(1):63-71. doi:10.1016/j.psychres.2006.11.005.
37. McCann SE, Sempos C, Freudenheim JL, Muti P, Russell M, Nochajski TH et al. Alcoholic beverage preference and characteristics of drinkers and nondrinkers in western New York (United States). Nutrition, metabolism, and cardiovascular diseases : NMCD. 2003;13(1):2-11.
38. Cannistra C, Finocchi V, Trivisonno A, Tambasco D. New perspectives in the treatment of hidradenitis suppurativa: surgery and brewer's yeast-exclusion diet. Surgery. 2013;154(5):1126-30. doi:10.1016/j.surg.2013.04.018.
39. Atsma F, Veldhuizen I, Verbeek A, de Kort W, de Vegt F. Healthy donor effect: its magnitude in health research among blood donors. Transfusion. 2011;51(8):1820-8. doi:10.1111/j.1537-2995.2010.03055.x.

Donor Characteristics	Donor with HS n = 500	Donors without HS n = 27,265	*P* value
Female, n (%)	249 (49.8)	12,238 (45.7)	0.066
Male, n (%)	251 (50.2)	14,558 (54.3)	
Age, mean (S.D)	36.57 (11.32)	41.30 (12.80)	<0.001‡
Female age, mean (S.D)	35.80 (11.04)	40.53 (13.15)	<0.001
Male age, mean (S.D)	37.33 (11.57)	41.94 (12.46)	<0.001
BMI mean (S.D)	27.00 (5.12)	25.70 (4.07)	<0.001‡
Female BMI, mean (S.D)	27.24 (5.61)	25.27 (4.46)	<0.001
Male BMI, mean (S.D)	26.70 (4.60)	26.05 (3.68)	0.015
Smokers, n (%)	89 (17.9)	3,511 (12.1)	0.002‡
Non-smokers, n (%)	409 (82.1)	23,221 (86.7)	
Female:			
Smokers, n (%)	56 (22.5)	1,669 (13.7)	<0.001
Non-smokers, n (%)	193 (77.5)	10,546 (86.3)	
Male:			
Smokers, n (%)	33 (13.3)	1,842 (12.7)	0.791
Non-smokers, n (%)	216 (86.7)	12,675 (87.3)	
Drinks beer:			
Never / almost never, n (%)	155 (31.8)	8,145 (30.4)	0.99
Few times a month, n (%)	230 (46.0)	12,264 (45.8)	
Few times a week, n (%)	102 (20.4)	5,507 (20.6)	
Daily, n (%)	13 (2.6)	641 (2.4)	
Drinks wine:			
Never / almost never, n (%)	159 (31.8)	6,871 (25.6)	0.02‡
Few times a month, n (%)	249 (49.8)	13,485 (50.3)	
Few times a week, n (%)	76 (15.2)	5,547 (20.7)	

Daily, n (%)	15 (3.0)	744 (2.8)	
Drinks spirits:			
Never / almost never, n (%)	278 (55.6)	16,275 (60.7)	<0.001‡
Few times a month, n (%)	198 (39.6)	9,396 (35.1)	
Few times a week, n (%)	19 (3.8)	715 (2.7)	
Daily, n (%)	1 (0.2)	40 (0.1)	
Registered with HS in the national patient register	11 (2.2)	42 (0.15)	<0.001‡

Table 1: Characteristics of a cohort of Danish blood donors. HS = Hidradenitis suppurativa. BMI = Body mass index. N = Number. S.D. =Standard Deviation. IQR= Interquartile range. ‡=Significant after Benjamini-Hochberg correction with false discovery rate set to 0.05. Subanalysis of gender for smokers, BMI and age, were not included in the correction. For sex-stratified alcohol consumption, see supplementary table 1.

Questionnaire and register data	Donors with HS n = 500	Donors without HS n = 27,265	*P* value	Beta value for HS in regression (CI 95%)	*P* value for HS beta
Major depression Inventory, median (IQR)	4 (6)	4(5)	0.615	1.43 (0.937 – 1.917) †	<0.001
No depression, n (%)	463 (94.5 %)	25,648 (95.7 %)	<0.001		
Mild depression, n (%)	9 (1.8 %)	369 (1.4 %)	0.417		
Moderate depression, n (%)	16 (3.2 %)	185 (0.7 %)	<0.001		
Severe depression, n (%)	2 (0.4 %)	145 (0.5 %)	1		
Depression diagnosed by doctor, n (%)	51 (10.2 %)	2,094 (7.8 %)	0.140		
Depression treated medically, n (%)	32 (62.7 %)	1,033 (49.5 %)	0.014		
SF-12 PCS, median (IQR)	56.5612 (3.19)	56.5808 (3.28)	0.619	-0.23 (-0.635 – 0.173)†	0.262
SF-12 MCS, median (IQR)	54.9672 (6.92)	55.5088 (6.49)	0.041	-0.62 (-1.256 – 0.043) †	0.067
Salary, mean (S.D)	292,959.33 (226,324.75)	331,849.70 (226,983.73)	<0.001	-365 (-179,040 – 17,209)†	0.968
Total Income, mean (S.D)	337,286.35 (233,237.70)	383,320.42 (257,551.59)	<0.001	-5,707 (- 26,799 – 15,384)†	0.596

Table 2. Questionnaire and register data. HS = Hidradenitis suppurativa. n = Number. IQR = Interquartile range. S.D = Standard Deviation. SF-12 = Short form – 12. PCS= Physical component score, MCS = Mental component score. Beta-values for HS are given with confidence interval. † = Adjusted for sex, age, BMI and smoking.

Rank	Socio-economic status	Donors with HS	Donors without HS	*P* value
1	Chief executive, n (%)	16 (3.2 %)	858 (3.2 %)	0.998
2	High skill level employee, n (%)	77 (15.4 %)	4,898 (18.3 %)	0.099
3	Moderate skill level employee, n (%)	97 (19.4 %)	5,500 (20.5 %)	0.537
4	Basic skill level employee, n (%)	115 (23 %)	7,030 (26.2 %)	0.103
5	Apprenticeship educated, n (%)	108 (21.6 %)	3,874 (14.5 %)	<0.001‡
6	Unemployed, at least 6 months a year, n (%)	9 (1.8 %)	282 (1.1 %)	0.118
7	Receiver of sickness benefits, educational support etc., n (%)	7 (1.4 %)	145 (0.5 %)	0.011
Not ranked	Selfemployed, 10 or more employees, n (%)	0 (0 %)	7 (0 %)	-
Not ranked	Selfemployed, 5 - 9 or more employees, n (%)	1 (0.2 %)	31 (0.1 %)	0.447
Not ranked	Selfemployed, 1 - 4 or more employees, n (%)	2 (0.4 %)	123 (0.5 %)	1
Not ranked	Selfemployed, No employees, n (%)	8 (1.6 %)	630 (2.4 %)	0.367
Not ranked	Co-working spouse, n (%)	0 (0 %)	18 (0.1 %)	-
Not ranked	In early retirement, n (%)	2 (0.4 %)	107 (0.4 %)	1
Not ranked	Retiree, n (%)	0 (0 %)	105 (0.4 %)	0.270
Not ranked	Post-employment benefits, n (%)	1 (0.2 %)	399 (1.5 %)	0.012
Not ranked	Cash benefits, n (%)	9 (1.8 %)	140 (0.5 %)	<0.001‡
Not ranked	Other employees, n (%)	40 (8 %)	2,420 (9 %)	0.475
Not ranked	Others, n (%)	8 (1.6 %)	226 (0.8 %)	0.069

Table 3. Socioeconomic status, and *P* values for the difference between the groups. HS = Hidradenitis suppurativa. ‡=Significant after Benjamini-Hochberg correction with false discovery rate set to 0.05.