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Characterization of Hidradenitis Suppurativa Phenotypes: A Multidimensional Latent Class Analysis of the National Italian Registry IRHIS

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In spite of the large heterogeneity, limited data exist on hidradenitis suppurativa (HS) phenotypes. To identify the HS phenotypes that best explain the disease heterogeneity, a cross-sectional study using latent class (LC) analysis was conducted on a cohort of patients examined at 17 dermatological centers participating in the Italian Registry of Hidradenitis Suppurativa and being enrolled between January 2015 and January 2020. Overall, 965 patients aged 32.0 ± 12.4 years (mean ± SD) were evaluated. A three-class model in LC analysis best fitted the data. Patients in LC1 (20.1%) were females, mostly obese, with a high probability of axillary–groin (0.85) and mammary (0.59) lesions and the highest HS severity. Patients in LC2 (29.6%) were nonobese males, with moderate disease severity; with a high probability of gluteal (0.50) and genital (0.17) lesions, besides axillary–groin involvement; and with acne and pilonidal cysts. Patients in LC3 (50%) were nonobese females with a milder disease mostly limited to axillary (0.52) and groin (0.66) areas. The stratification of patients with HS into a severe axillary–mammary–groin phenotype with predominantly anterior body involvement in females, an axillary–gluteal–groin phenotype of intermediate severity mainly affecting males in the posterior body areas, and an axillary–groin phenotype with mildest clinical symptoms and limited skin involvement may help in optimizing HS management.

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INTRODUCTION

Hidradenitis suppurativa (HS) is a chronic inflammatory skin disease characterized by suppurating painful lesions such as nodules and abscesses, sinus tracts, and scars in the intertriginous areas, which significantly impact patient's QOL (Jemec, 2012; Kontis et al., 2017). The condition occurs more frequently in women, with a disease onset in young and middle-aged adults (Garg et al., 2017a). The prevalence of HS has been estimated as less than 1% in the general population (Bettoli et al., 2016). There is a broad spectrum of clinical presentation and the severity of HS (Jemec, 2012). The lack of knowledge on the heterogeneity of lesion appearance and sites of involvement may delay the diagnosis and the proper management of the condition (Sartorius et al., 2010).

Latent class analysis (LCA) is a statistical way of grouping together individuals of a population of interest into sets of clusters. These clusters are subgroups of individuals sharing similar characteristics with a specific probability of occurrence (Goodman, 1974). Compared with other methods of data segmentation used when dealing with categorical variables, LCA has the advantage of helping to create a probabilistic multivariate model to estimate parameters. In other words, taking a number of preselected multifactorial variables, such as demographics, medical history, or other characteristics of the disease of interest, LCA considers the optimal number of clusters as the one that minimizes the degree of relationship among cases belonging to the different clusters. To decide on the optimal number of clusters, two methods dealing with the goodness of fit of a statistical model are usually adopted, the Bayesian Information Criterion and the Akaike Information Criterion.

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Abbreviations: BMI, body mass index; HS, hidradenitis suppurativa; LC, latent class; LCA, latent class analysis

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So far, the use of LCA in dermatology has been limited compared with the use in other areas of application (Canoui-Poitrine et al., 2013; Silverberg et al., 2015).

Insights into the phenotypes of HS may provide novel data on its etiology, class changes over time, prognosis, and effective treatments.

The aim of this study was to identify, by using LCA, the underlying HS phenotypes that best explain the observed heterogeneity within the National Italian Registry of Hidradenitis Suppurativa.

RESULTS

Study population

Overall, we enrolled 1,064 consecutive newly diagnosed patients with HS. A total of 99 patients (9.3%) with missing data in any of the variables considered for LCA were excluded from the final analysis, which comprised 965 patients.

The main characteristics of the patients included in the analysis are reported in Table 1. Almost two-third of the patients (62.3%) were females, the mean age was 32.0 ± 12.4, and the mean body mass index (BMI) was 27.0 ± 6.0; 60.8% were current smokers, and 7% were past smokers. The mean age at HS onset was 21.8 ± 10.4 years, and the mean HS duration was 10.2 ± 9.2 years; 20.8% of patients reported a history of HS in first-degree relatives. The mean Sartorius score was 52.8 ± 40.8. About 48.0% of patients were on Hurley stage II, and 17.8% were on Hurley stage III. The mean Dermatology Life Quality Index was 13.1 ± 7.8, with 58.5% of patients reporting a large impact of HS on their QOL. The most frequent HS-associated lesions were pilonidal cyst (11.4%), acne conglobata (10.1%), and other types of acne (3.1%), whereas the most frequent HS-related comorbidities included psoriasis (1.8%) and thyroid diseases (1.6%).

LCA classification

The model selection procedure with 1−5 classes LCA is represented in Supplementary Table S1. A three-class model best fitted the data in our LCA, showing the lowest Bayesian Information Criterion. The estimated class-conditional probabilities of the 11 preselected indicators of these three latent classes (LCs), including sex, age, BMI, smoking habits, educational attainment, age at HS onset, HS duration, diagnostic delay, Sartorius score, Hurley stage, associated lesion types, and related comorbidities, are presented in Supplementary Table S2. The three corresponding phenotypes of LCs are shown in Figure 1. On the basis of LCA model estimates, 20.1% of patients belonged to LC1, 29.6% of patients to LC2, and 50.3% of patients to LC3. Compared with other classes, patients in LC1 had higher probabilities for axillary and groin (0.85) and mammary (0.59) involvement, a positive family history (0.30), and excessive sweating (0.64). Patients in LC2 had high probabilities for gluteal (0.50) and genital (0.17) lesions, besides the involvement of axillary (0.63) and groin (0.69) areas, and also the involvement of neck, ears, chest, back, and legs. These patients had especially high probabilities for follicular lesions, such as pilonidal cysts (0.18), and a history of acne conglobata (0.21). In patients in LC3, there was an almost exclusive localization on axillae (0.52) and groin (0.66) areas with an overall milder disease. We named the three phenotypes of HS as follows: LC1, axillary–mammary–groin phenotype; LC2, axillary–gluteal–groin phenotype; and LC3, regular axillary–groin phenotype.

Patients' and disease characteristics across the LCs

We found significant differences with regard to sex, BMI, smoking status, age at disease onset, HS duration, diagnostic delay, and severity scores when comparing patients and HS characteristics between the three LCs classified on the basis of posterior predicted probabilities (Table 1).

We used the regular axillary–groin phenotype (LC3) as the reference category. Compared with LC3, the axillary–mammary–groin phenotype (LC1) was characterized by a higher proportion of females and smokers, a more severe disease (according to both Sartorius and Hurley), a larger proportion of patients with obesity, earlier disease onset, and longer disease duration. Patients in the axillary–gluteal–groin phenotype (LC2) were more often males and smokers, were more often normal or overweight, and had a moderate-to-high disease severity, with quite an early disease onset and long disease duration. The regular axillary–groin phenotype (LC3) had a higher proportion of females, patients who were normal or overweight, and those with the lowest severity scores compared with the other two phenotypes, with a later disease onset and a shorter disease duration.

DISCUSSION

By relying on LCA, we identified three clinical subtypes of HS at the first clinical presentation. One subtype (LC1) was prevalent among women with obesity and was characterized by a high prevalence of axillary–mammary and groin involvement in a severe form; a second subtype (LC3) was also more prevalent in women and was characterized by an involvement mostly limited to the axillary–groin areas in a milder form. These subtypes correspond to the typical varieties of HS. The remaining clinical subtype (LC2) was characterized by gluteal and genital involvement, besides axillary–groin involvement, and accounted for approximately 30% of patients, corresponding to the atypical variety of HS (Jemec, 2012).

A limited number of studies have tried to define the clinical–pathological subtypes of HS. To the best of our knowledge, only one cross-sectional French study used LCA to identify these subtypes (Canoui-Poitrine et al., 2013). In a sample of 618 patients, the authors found three LCs subtypes: the axillary–mammary, the follicular, and the gluteal LCs. The axillary–mammary LC accounted for about half of the study population and was consistent with the typical HS. The other half of the study population was divided into two atypical phenotypes: the follicular LC, associated with greater disease severity, and the gluteal LC, associated with decreased disease severity. Similar to these results, we identified three LCs but with a larger proportion of the typical HS varieties (corresponding to the axillary–mammary–groin and regular axillary–groin subtypes) and a lower proportion of the atypical varieties (corresponding to the axillary–gluteal–groin subtype). Compared with the patients enrolled in the study mentioned earlier, our patients had more severe disease, with

Table 1. Univariate and Multivariate Comparisons of Patients and Disease Characteristics among the Three HS Subtypes Identified by LCA

		Predicted Class Membership[1]				Multivariate Analysis (LC3)[3]			
		LC1 (Axillary–Mammary–Groin Phenotype)	LC2 (Axillary–Gluteal–Groin Phenotype)	LC3 (Regular Axillary– Groin Phenotype)		LC1		LC2	
Characteristics	**N[4] = 965 (%)**	**n[4] = 176 (%)**	**n[4] = 246 (%)**	**n[4] = 543 (%)**	***P*[2]**	**OR (95% CI)**	***P*-value**	**OR (95% CI)**	***P*-value**
Sex					<0.001				
Male	364 (37.7)	6 (3.4)	235 (95.5)	123 (22.7)		1	—	1	—
Female	601 (62.3)	170 (96.6)	11 (4.5)	420 (77.3)		8.93 (2.26– 35.26)	0.002	0.001 (0–0.003)	<0.001
Age (y), mean (SD)	32.0 (12.4)	33.9 (12.7)	33.4 (11.9)	30.8 (12.4)	0.001	—	—	—	—
<25	343 (35.5)	53 (30.1)	66 (26.8)	224 (41.3)		1	—	1	—
25–39	363 (37.6)	68 (38.6)	109 (44.3)	186 (34.3)		1.33 (0.45– 3.92)	0.61	1.56 (0.55–4.37)	0.40
40 or more	259 (26.8)	55 (31.3)	71 (28.9)	133 (24.5)		1.09 (0.14–8.72)	0.93	1.59 (0.21– 11.98)	0.65
BMI (kg/m^2), mean (SD)	27.0 (6.0)	31.3 (6.7)	26.0 (4.4)	26.1 (5.8)	<0.001	—	—	—	—
<25.0	411 (42.6)	28 (15.9)	113 (45.9)	270 (49.7)		1	—	1	—
25.0–29.9	301 (31.2)	51 (29.0)	99 (40.2)	151 (27.8)		2.55 (1.17–5.52)	0.02	0.62 (0.32–1.20)	0.15
≥30.0	253 (26.2)	97 (55.1)	34 (13.8)	122 (22.5)		13.62 (6.12–30.31)	<0.001	0.08 (0.03–0.20)	<0.001
Smoking habits					<0.001				
Never smoked	318 (33.0)	54 (30.7)	49 (19.9)	215 (39.6)		1	—	1	—
Smoker	582 (60.3)	111 (63.1)	174 (70.7)	297 (54.7)		2.06 (1.04– 4.08)	0.04	1.02 (0.50– 2.08)	0.96
Past smoker	65 (6.7)	11 (6.3)	23 (9.3)	31 (5.7)		2.45 (0.52– 11.49)	0.25	1.86 (0.53– 6.56)	0.33
Educational attainment (school)					0.78				
Primary/lower secondary	270 (28)	49 (27.8)	72 (29.3)	149 (27.4)		1	—	1	—
Attainment (school)	515 (53.4)	93 (52.8)	135 (54.9)	287 (52.9)		1.42 (0.65– 3.09)	0.37	0.80 (0.40– 1.58)	0.52
Higher secondary university	180 (18.7)	34 (19.3)	39 (15.9)	107 (19.7)		1.41 (0.54– 3.63)	0.48	1.29 (0.52– 3.17)	0.58
Age at HS onset (y), mean (SD)	21.8 (10.4)	18.7 (9.2)	21.8 (9.4)	22.8 (11.0)	<0.001	—	—	—	—
<15.0	110 (11.4)	71 (40.3)	43 (17.5)	108 (19.9)		1	—	1	—
15.0–24.0	574 (59.4)	71 (40.3)	128 (52.0)	263 (48.4)		0.44 (0.22– 0.88)	0.02	0.52 (0.22– 1.21)	0.13
≥25.0	281 (29.1)	34 (19.3)	75 (30.5)	172 (31.7)		0.06 (0.02– 0.16)	<0.001	0.44 (0.18– 1.08)	0.07
HS duration since					<0.001				
onset (y), mean (SD)	10.2 (9.2)	15.2 (10.3)	11.6 (9.1)	8.0 (8.1)		—	—	—	—
<5	316 (32.7)	14 (8.0)	56 (22.8)	246 (45.3)		1	—	1	—
5–9	257 (26.6)	52 (29.5)	73 (29.7)	132 (24.3)		1.98 (0.78– 5.05)	0.15	1.58 (0.73–3.41)	0.24
≥10	342 (40.6)	110 (62.5)	117 (47.6)	165 (30.4)		4.15 (1.76–9.79)	0.001	3.88 (1.87– 8.05)	<0.001
Diagnostic delay (y), mean (SD)	6.7 (7.7)	9.1 (9.1)	7.5 (7.7)	5.6 (7.0)	<0.001	—	—	—	—
<2	257 (26.6)	29 (16.5)	57 (23.2)	171 (31.5)		1	—	1	—
2–4	246 (25.5)	28 (15.9)	55 (22.4)	163 (30.0)		0.60 (0.23–1.56)	0.30	0.58 (0.26– 1.30)	0.18
5+	462 (47.9)	119 (67.6)	134 (54.5)	209 (38.5)		0.61 (0.25– 1.45)	0.26	0.69 (0.29– 1.63)	0.40
Sartorius score, mean (SD)	52.8 (40.8)	93.0 (38.6)	77.0 (43.4)	28.9 (16.1)	<0.001	—	—	—	—
<30.0	325 (33.7)	2 (1.1)	11 (4.5)	312 (57.5)		1	—	1	—
30.0–59.0	331 (34.3)	29 (16.5)	99 (40.2)	203 (37.4)		26.63 (12.42–57.09)	<0.001	9.81 (3.39–28.37)	<0.001
≥60.0	309 (32.0)	145 (82.4)	136 (55.3)	28 (5.2)		818.9 (253.3–2,647.7)	<0.001	545.7 (168.4–1,767.9)	<0.001

Hurley stage				<0.001				
I	330 (34.2)	19 (10.8)	45 (18.3)	266 (49.0)	1[5]	—	1[5]	—
II	463 (48)	103 (58.5)	113 (45.9)	247 (45.5)	5.39 (3.06–9.49)	<0.001	3.07 (1.87–5.06)	<0.001
III	172 (17.8)	54 (30.7)	88 (35.8)	30 (5.5)	23.33 (11.27–48.30)	<0.001	22.02 (10.26–47.25)	<0.001
DLQI, mean (SD)	13.1 (7.8)	15.2 (7.2)	13.4 (7.8)	12.4 (7.8)	0.001	—	—	—
<6 (no/small)	133 (19.7)	12 (9.8)	28 (17.6)	93 (23.7)	1[5]	—	1[5]	—
6–10 (moderate)	147 (21.8)	24 (19.7)	36 (22.6)	87 (22.1)	2.98 (1.22–7.27)	0.02	1.95 (0.94– 4.06)	0.07
>10 (large)	394 (58.5)	86 (70.5)	95 (59.7)	213 (54.2)	3.78 (1.73–8.25)	0.001	2.38 (1.28– 4.41)	0.006

Abbreviations: BMI, body mass index; CI, confidence interval; DLQI, Dermatology Life Quality Index; HS, hidradenitis suppurativa; LC, latent class; LCA, latent class analysis.
[1]Based on modal posterior probabilities.
[2]Pearson chi-square test and Kruskal–Wallis test were used for categorical and continuous variables, respectively.
[3]Multinomial logistic regression including the following variables: sex, BMI, Sartorius score, age at HS onset, and HS duration.
[4]Numbers may not add up to the total owing to missing data.
[5]Sartorius score was not included in the model owing to collinearity issue.

a higher Sartorius score and more advanced Hurley stage, and had an impaired QOL owing to HS. These patients were more frequently current smokers and overweight or obese, and a greater proportion of them presented a family history of HS. Notably, compared with the French paper, we collected a larger number of variables in our study, including, for example, educational attainment, delay of diagnosis, and Dermatology Life Quality Index. We also considered as a location the genital areas, which were not mentioned in the French study. It is of interest that the proportion of involvement of the axillary–mammary areas in our study was similar to the one observed in the French study, where the probability of such involvement was 0.74 in their so-called axillary–mammary and 0.96 in their follicular subtypes. Additional HS-related characteristics, which might influence phenotype classification, such as the presence of hypertrophic scars not considered as a component of the active inflammatory process or folliculitis, which are a rather unspecific feature, were not collected in our registry. It is of interest that follicular lesions such as acne conglobata and pilonidal cysts were associated with the axillary–gluteal–groin subtype in our study population and that papules and folliculitis were observed with a similar probability (0.71) in the atypical HS varieties identified in the Canoui-Poitrine's study, namely the follicular and gluteal subtypes. Multiple clinically distinct HS phenotypes have been proposed on the basis of less stringent criteria. Usually, five subtypes are recognized (Goldburg et al., 2020; Heid and Chartier, 2001; Micheletti, 2014; Shalom, 2017). The most common is the regular subtype, which includes patients who fully comply with the diagnostic criteria for HS and lack any specific feature (van der Zee and Jemec, 2015). Accordingly, in half of our patients, we identified the regular axillary–groin subtype, which was characterized by an unspecific localization of lesions, and a more benign course (late onset, shorter duration, mild symptoms). Less frequent are the frictional furuncle subtype, which features lesions in flexural sites, especially in patients who were overweight, and the conglobata subtype, which consists of cysts and acne conglobata mostly on the face and trunk in normal-weight men (van der Zee and Jemec, 2015). In our study, these two subtypes are likely to coexist in a single axillary–gluteal–groin subtype with patients who are more often males and smokers and normal or overweight and present acne conglobata and pilonidal cysts in frictional sites as well in other areas, such as the face or trunk.

The results of our study are consistent with other previously reported findings. Females, who are usually affected more than twice as often as males (Garg et al., 2017a, 2017b), manifest lesions in the anterior part of the body, including breast and axillae (Canoui-Poitrine et al., 2013; Jansen et al., 2001; Jemec, 1988). By contrast, the back of the body (Canoui-Poitrine et al., 2009) and the gluteal area (Canoui-Poitrine et al., 2013; Jemec, 2012; Poli et al., 2010) are more frequently involved in males, who may also present pilonidal cyst (Canoui-Poitrine et al., 2009). In our study, we were able to separate these two distinct subsets represented by our LC1 or LC3 and LC2, respectively. In agreement with other studies (Saunte et al., 2015), we found a significant delay in the diagnosis of HS (mean of >5 years), especially in the severe axillary–mammary–groin subtype. In such a

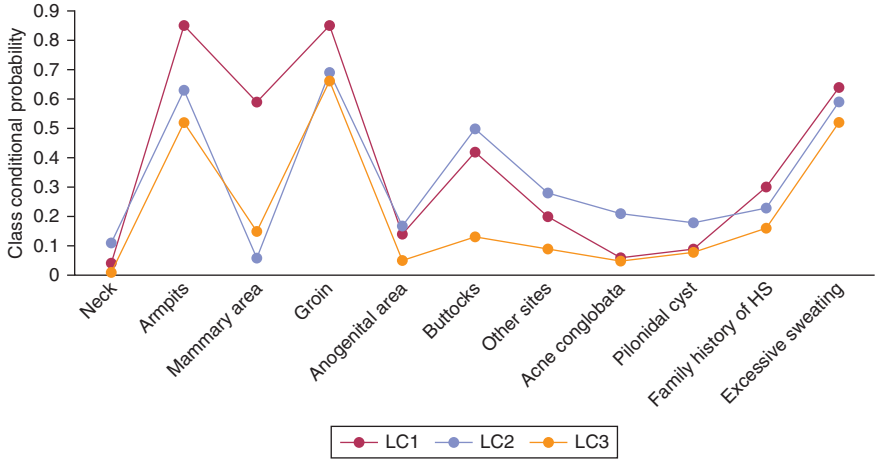

Figure 1. Estimated class-conditional probability of HS subtype features identified by LCA. HS, hidradenitis suppurativa; LC, latent class; LCA, LC analysis.

subtype, with a dramatically decreased QOL, obesity appears to increase the proinflammatory response (Delany et al., 2018; Kjaersgaard Andersen et al., 2018) so that people with the highest BMI had the worse disease severity (confirmed by the highest Sartorius score) (Theut Riis et al., 2018).

Our study has various strengths. By using LCA, we recognized phenotypes without a priori hypotheses. Indeed, compared with other methods of data segmentation, LCA represents a robust method for stratifying patients sharing similar characteristics, using posterior membership probabilities (Magidson and Vermunt, 2002). It also has the advantage of helping to create a probabilistic multivariate model to estimate multiple parameters, including demographics and nonclinical variables (Magidson and Vermunt, 2002). Moreover, our study sample was collected prospectively, and only a few patients had missing data. Given the large sample size we used, we were able to include multiple indicators and covariates in the analysis. Together with the high number of centers participating in the Italian Registry of Hidradenitis Suppurativa registry, this may make our results more representative of the HS population.

There are some limitations to consider. The cross-sectional study design did not allow to make a validation of our classification scheme on the basis of outcomes. Additional HS-related characteristics and comorbidities such as the presence of hypertrophic scars and folliculitis, comedones, papules, and epidermal cysts and/or macrocysts, which might influence phenotypes classification, were not collected in the registry. Moreover, we did not perform a formal validation on an independent dataset, and we did not have enough statistical power to perform split validation to test clusters stability; therefore, our results should be interpreted with caution. Finally, our registry is limited to tertiary-care outpatient HS cases seen in the Italian population, so our results may not be generalizable to other populations.

By using LCA, we found three distinct phenotypes of HS. The axillary–mammary–groin phenotype has an anterior body area involvement, mainly in women who are obese, and carry the most severe course. The axillary–gluteal–groin phenotype has a posterior body area involvement. It mainly affects men, current smokers, and patients who are not obese and may present the involvement of other sites, such as the genitalia, face, and trunk, with acne and pilonidal cysts. A third phenotype, the regular axillary–groin phenotype has the mildest clinical course and an almost exclusive involvement of the axillae and groin. Although these three phenotypes do not currently guide therapeutic decisions, consideration of them may help optimize disease management (Vekic et al., 2018). Future studies should investigate the validity of our findings and the significance of our phenotypes in terms of disease characteristics, genetic background, and prospective outcome of treatments.

MATERIALS AND METHODS

This was a cross-sectional analysis of baseline data from a cohort of consecutive patients with a first clinical diagnosis of HS at a network of 17 Italian dermatological outpatient clinics, participating in the Italian Registry of Hidradenitis Suppurativa (Bettoli et al., 2019). All consecutive patients with a first ever diagnosis of HS at the participating centers were included in the study. Patients who were not able to comply with the registry procedures and follow-up requirements were excluded. All patients gave written informed consent before inclusion in the registry. The study was approved by the ethics committee of each participating center.

Data collection

Data were collected in the registry between January 2015 and January 2020 using a centralized electronic data collection form and included demographics (age, sex, occupation, educational attainment); anthropometric measures (weight and height); smoking habits; clinical history of the disease, including age at onset and at first HS diagnosis; family history of HS in first-degree relatives; localizations at onset; clinical characteristics at entry into the registry and at regular follow-up intervals, including severity, QOL measure, localizations, presence of worsening factors, presence of comorbidities, previous and current therapies for HS prescribed for at least 1 month. The severity of HS was mainly assessed using the Sartorius score (Sartorius et al., 2003). Harmonization exercises of clinical assessment were conducted among assessors, and an online calculator was adopted to standardize Sartorius score reporting. Hurley severity stage (Hurley, 1996) and patient's pain assessment based on visual analog scale were also collected. Patients' QOL was

evaluated using the Dermatology Life Quality Index. Dermatology Life Quality Index values <6, between 6 and 10, and ≥11 were considered as no and/or limited, moderate, and large impact on QOL, respectively (Hongbo et al., 2005).

Statistical analysis

For descriptive purposes, continuous data were presented as means with SDs, whereas categorical data were presented as numbers with percentages. Continuous variables were also categorized using clinically relevant cut-offs or tertiles of their distribution. LCA was conducted to find latent phenotypes in HS presentation. For LCA, the following clinical variables were selected: HS localization and type, main reported HS-related comorbidities (acne conglobata and pilonidal cyst), family history of HS, and presence of excessive sweating. Different LCA models were fitted by varying the number of possible LCs. Log-likelihood, Akaike Information Criterion, and Bayesian Information Criterion were estimated for each model. The model with the lowest Bayesian Information Criterion was considered as the most reliable statistically. In addition, the following covariates were included in the best-selected model: sex, BMI, Sartorius score, age at HS onset, and HS duration since onset. Patients with missing data in any of the included variables were excluded from LCA. Outliers were also removed for better model fitting.

Estimated class population shares as well as predicted class membership based on modal posterior probabilities were also reported. Univariate differences among predicted LCA classes were assessed on the basis of Pearson's chi-square test and Kruskal–Wallis test for categorical and continuous variables, respectively. Multivariate assessment was performed by using multinomial logistic regression including covariates. The strength of variables on each class membership was expressed in terms of ORs along with their 95% confidence intervals and *P*-values. All tests were considered statistically significant at *P*-value < 0.05. Analyses were performed with SPSS, version 26 (IBM, Armonk, NY), and for LCA, R software, version3.6.2 (R Foundation for Statistical Computing, Vienna, Austria) with package poLCA, version 1.4.1 was used.

Data availability statement

Datasets related to this article can be found at https://data.mendeley.com/datasets/bv9smj9w99/1 hosted at Mendeley (Cazzaniga et al. [2020], "Characterization of Hidradenitis Suppurativa Phenotypes," Mendeley Data, v1https://doi.org/10.17632/bv9smj9w99.1).

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CONFLICT OF INTEREST

AO has been a principal investigator in clinical trials and has been paid as a consultant by Abbvie, Almirall, Amgen, Celgene, Eli Lilly, Leo Pharma, Novartis, Regeneron, and Sanofi. The remaining authors state no conflict of interest.

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AUTHOR CONTRIBUTIONS

Conceptualization: LN, VB, SC; Data Curation: LN, SC; Formal Analysis: SC, LN; Investigation: SC, LN; Methodology: SC, LN; Project Administration: LN; Resources: LN, VB, DA, AVM, AP, LA, GF, AO, CL, VD, MC, SPC; Software: SC, LN; Supervision: LN; Validation: SC, LN; Visualization: EP, SC, LN, VB, DA, AVM, AP, LA, GF, AO, CL, VD, MC, SPC; Writing - Original Draft Preparation: EP, SC, LN; Writing - Review and Editing: EP, SC, LN

SUPPLEMENTARY MATERIAL

Supplementary material is linked to the online version of the paper at www.jidonline.org, and at https://doi.org/10.1016/j.jid.2020.08.032.

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SUPPLEMENTARY MATERIALS

Supplementary Table S1. Model Selection with 1–5 Classes of HS Based on LCA

N of Classes	Log-Likelihood	AIC	BIC	N of Estimated Parameters
1	−5,415.0	10,852.0	10,906.6	11
2	−5,363.9	10,773.7	10,888.0	23
3	**−5,319.1**	**10,708.1**	**10,882.1**	**35**
4	−5,285.9	10,665.7	10,899.3	47
5	−5,262.0	10,642.1	10,935.3	59

Bold indicates the preferred classification based on the lowest BIC value.
Abbreviations: AIC, Akaike information criterion; BIC, Bayesian information criterion; HS, hidradenitis suppurativa; LCA, latent class analysis; N, number.

Supplementary Table S2. Results of LCA Based on Three Classes of HS

Parameter	Prevalence of Indicators, %	LC1 (Axillary–Mammary–Groin Phenotype)	LC2 (Axillary–Gluteal–Groin Phenotype)	LC3 (Regular Axillary–Groin Phenotype)
Probability of class membership	—	0.20	0.29	0.50
Conditional probabilities of[1]				
Localizations				
Neck	4.7	0.04	0.11	0.01
Axillae	61.8	0.85	0.63	0.52
Mammary area	21.3	0.59	0.06	0.15
Groin	70.7	0.85	0.69	0.66
Genital area	10.5	0.14	0.17	0.05
Buttocks	29.7	0.42	0.50	0.13
Other sites	16.8	0.20	0.28	0.09
Lesion characteristics				
Acne conglobate	10.1	0.06	0.21	0.05
Pilonidal cysts	11.4	0.09	0.18	0.08
Family history of HS	20.8	0.30	0.23	0.16
Excessive sweating	56.8	0.64	0.59	0.52

Abbreviations: BMI, body mass index; HS, hidradenitis suppurativa; LC, latent class; LCA, latent class analysis.
[1]The following covariates were used in the model: Sartorius score, sex, BMI, age at disease onset, and disease duration. LCA was estimated on 965 patients with complete data.