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REVIEW

Skin signs in eating disorders: a literature review

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Abstract

Purpose To summarize and describe the available knowledge on dermatological manifestation of eating disorders: anorexia nervosa, bulimia nervosa, binge eating disorder and eating disorder not otherwise specified, diagnosed according to Diagnostic and Statistical Manual of Mental Disorders IV-TR and 5th edition.

Methods We searched in PubMed, Scopus and Web of Science databases from January 1, 1980 through May 1, 2020 for papers in English language on the skin manifestation of eating disorders. Results were screened using the PRISMA tool.

Results The study yielded 207 results. According with PRISMA guidelines, 26 papers were included in the review. More than 73% of screened papers (19/26) were case reports. Cross-sectional studies represented the 19.2% of screened papers (5/26). Each eligible study has been screened and analyzed.

Conclusion Huge heterogeneity of skin signs of eating disorders were identified. The number of controlled studies available is very limited, and most papers of interest are case reports or narrative review articles. Larger, more methodologically rigorous studies to evaluate the presence of dermatological issue in eating disorder patients are needed.

Level of evidence Level IV. Evidence obtained from multiple time series analysis such as case studies.

Keywords Dermatology · Eating disorders · Skin signs · Literature review

Introduction

According to the most recent edition of the Diagnostic and Statistical Manual of Mental Disorder (DSM-5) eating disorders (EDs) are characterized by a serious imbalance of eating-related behaviour and body weight [1]. They are associated to both physical and mental problems. It is known that EDs have an extremely negative impact in terms of quality of life and even mortality in people who suffer from them [2, 3]. Indeed, individuals who are affected by anorexia nervosa (AN) and bulimia nervosa (BN) have significantly elevated mortality rates, as well as people with other EDs (Binge Eating Disorder (BED) [4–7]. Patients with AN have the highest mortality rate of any psychiatric disorder [6]. In a long-term follow-up study on more than 5000 inpatients, standardized mortality ratios were found to be of 5.35 for AN, 1.49 for BN, and 1.50 for BED [4]. Furthermore, it is important to remark that EDs can threaten individual general health in term of metabolic, autoimmune, autoinflammatory and dermatologic disease due to the consequences of malnutrition and/or overeating [7, 8].

Dermatologic implication of EDs have been mainly studied since the 1980s [9]; however, few studies exist on their incidence and prevalence worldwide. In particular, Hoek [10] reported that, in high-income countries, AN and BN combined ranked as the 12th leading cause of disability adjusted life years (DALYs) in females aged 15–19 years. In a recent systematic review of studies from 2000 to 2018 [11] it was reported that the weighted mean of lifetime prevalence for AN was 1.4% for women and 0.2% for men. The lifetime prevalence of BN was 1.9% for women and 0.6% for men. Finally, regarding BED, the weighted mean of lifetime prevalence was 2.8% for women and 1.0% for men. The highest prevalence data are reported in adult population. Moreover, EDs seem not to be limited to developed Western countries, since also in Asia and in the developing Middle-Eastern countries a high prevalence has been observed [11].

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Different editions of DSM over the years have described several different diagnostic criteria to identify various manifestation of EDs. Specifically, the DSM-5 [1] classified eating disorders into a new cluster of diseases, named "feeding and eating disorders". This cluster includes: anorexia nervosa (ICD10 F50.8), bulimia nervosa (ICD10 F50.2), binge eating disorder (ICD10F50.4), pica (ICD 10 F50.8 -F98.3), rumination disorder (ICD10 F98.2), avoidant/restrictive food intake disorder, other specified feeding or eating disorder (ICD 10 F50.8) and unspecified feeding or eating disorder (ICD 10 F50.9) [12].

In patients with EDs, cutaneous manifestations may be observed, due to the consequences of overeating or starvation, vomiting, and abuse of drugs (such as laxatives and diuretics) [13]. Indeed, dermatologic symptoms may help in the early diagnosis of hidden EDs, since patients may lack insight into their EDs or they are embarrassed to reveal their dysregulated eating pattern or cannot face their symptoms [9]. In fact, it seems to be more frequent for ED's patients to contact a health specialist for treatment of their skin problems rather than for their eating behaviour problems [14]. This seemingly happens, because patients lean towards avoiding ED's treatment and, at the same time, they tend to have an overemphasized distorted self-perception of skin appearance [9].

Although dermatological correlates of EDs are known in clinical practice, few studies on this association are available in the scientific literature. The primary aim of this study was to perform a review of studies on dermatological diseases which may appear as comorbidities with AN, BN, BED and eating disorder not otherwise specified (EDNOS) or other specified/unspecified feeding or eating disorder.

Methods

Identification and selection of studies

Three search strategies have been used to systematically collect studies of dermatology correlates of ED on three different databases, i.e., PubMed, Scopus and Web of Science. The search was conducted in May 2020, using the following key terms in title, abstract and keyword (or "topic" for Word of Science database) of the paper: (1) (eating disorder) AND (dermatology); (2) (binge eating disorder) AND (dermatology); (3) ("anorexia nervosa"; "bulimia nervosa") AND (dermatology). Inclusion criteria for our analysis were as follows: (1) peer-reviewed and published article in English language from 1980 to 2020. This lower limit was set, because the correlation between EDs and dermopathies have been mainly studied since the 1980s [9]. The upper limit was set in May 2020; (2) human adolescent and adult population sample (age 14 or older); (3) case reports, observational studies, unrandomized and randomized controlled trials; (4) presence of dermatological assessment by a specialist; (5) diagnosis of ED done by a psychiatrist; and (6) presence of dermatological outcome (specified if symptoms or syndromes) related to EDs. Reasons for exclusion were: (1) review articles. These criteria have been selected to capture as many studies as possible. Studies were considered eligible if published in English, human sample, and if they had been peer-reviewed for publishing. A hand-search has been performed to find additional relevant studies from articles reference lists. Additional studies were selected according to inclusion and exclusion criteria used in this work. Finally, duplicate papers from different databases have been removed. Each eligible research has been classified using a standardized coding procedure (see coding section) and is summarized in Table 1. The detailed information about study selection process is provided in the PRISMA flow diagram (Fig. 1).

Coding

A standardized data coding form was developed to extract the following information from each study: (a) authors and publication year; (b) study design; (c) characteristics of the study sample (age, size); (d) ED diagnosis; (e) dermatological outcomes of interest.

Results

A total of 207 results have been retrieved. Of them, 118 have been excluded, because not relevant or not in English, 42 were duplicates, thus 47 studies have been selected for further evaluation. For four of them the full paper was not available, and 17 review papers were excluded. The current review is thus based on 26 studies. Each research article was read and analyzed by at least two members of the research team to be included or not in the review. The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRSIMA) [15] flow diagram is provided for this study, to improve transparency in the selection process of papers and describe in summary the process of selection (Figure A). Psychiatric diagnosis of EDs has been assessed contextually with the dermatological examination in few studies, thus, we also considered studies in which the ED had been previously evaluated. The 26 studies are summarized in Table 1.

In our review, more than 73% of screened papers (19/26) were case reports, with a total of 35 patients. These relate almost entirely to AN (restrictive type or purging type). As far as we know, dermatological correlates of BN, BED and EDNOS have never been studied separately. Cross-sectional studies represented the 19.2% of screened papers (5/26), with a total of 368 participants. We found only two cross sectional studies with control group with a total of

Table 1 Detailed information about selected studies

N	Authors, title, publishing date and DOI or PMID (Chronologically) (a)	(b) Type ofstudy (c) Size (N), Mean Age	ED Diagnosis (d)	Dermatological outcomes of interest (e)
1	Marshman, G. M., Hanna, M. J., Ben-Tovim, DI., & Walker, M.K. (1990). Cutaneous abnormalities in anorexia nervosa. The Australasian Journal of Dermatology, 31(l), 9–12. https://doi.org/10.1111/j.14400960.1990.tb00642.x	Cross sectional Clinical study $N=14$ Mean Age = 25 ys	AN	Acne; alopecia; dermatitis; skin hyperpigmentation; hypertrichosis; xeroderma
2	Rustin, M. H., Foreman, J. C., & Dowd, P. M (1990). Anorexia nervosa associated with acromegaloid features, onset of acrocyanosis and Raynaud's phenomenon and worseningof chilblains. Journal of the Royal Society of Medicine, 83(8), 495W96 PMID: 2231576	Case Report $N=2$ Mean age = 30.5 ys	AN	Chilblains; dystrophic nails; finger discolouration; enlargement of hands and toes; periungual erythema and chronic paronychia; Raynaud's phenomenon; swelling of fingers worsened by cold and pain
3	Judd, L. E., & Poskitt, B. L. (1991). Pellagra in a patient with an eating disorder. The British Journal of Dermatology, 125(1), 71–72. https://doi.org/10.1111/j.13652133.1991.tb06044.x	Case Report $N=1$ Mean age = 19 ys	AN (prev. OB)	Pellagra
4	White, K. P., Rothe, M. J., Milanese, A., & Grant-Kels, J. M. (1994). Perniosis in association with anorexia nervosa. pediatric dermatology, 7 7(1), 1–5. https://doi.org/https://doi.org/10.1111/j.1525-1470.1994.tb00063.x	Case Report $N=3$ Mean Age = 21.6	AN	Brittle hair and nails; calloused, scarred knuckles; carotenodermia; cyanotic, hands and feet; diffuse alopecia; asteatotic skin; erythematous macules of the skin; foot pruritus and pain; hyperkeratosis; lanugo-like body hair; perniosis; suppurative lesions of the distal soles and digits
5	Taniguchi, S., Yamamoto, N., Kono, T., & Hamada, T. (1996). Generalized pruritus in anorexia nervosa. The British Journal of Dermatology, 134(3), 510–511	Case Report $N=1$ Age = 19	AN	Hypertricosis; lanugo hair; severe pruritus

Table 1 (continued)

N	Authors, title, publishing date and DOI or PMID (Chronologically) (a)	(b) Type ofstudy (c) Size (N), Mean Age	ED Diagnosis (d)	Dermatological outcomes of interest (e)
6	Schulze, U. M. E., Pettke-Rank, C. V., Kreienkamp, M., Hamm, H., Bröcker, E. B., Wewetzer, C., Trott, G. E., & Warnke, A. (1999). Dermatologic findings in anorexia and bulimia nervosa of childhood and adolescence. Pediatric Dermatology, 16(2), 90–94. https://doi.org/10.1046/j.15251470.1999.00022.x	Non-controlled, cross-sectional clinical study (AN = 27 BN = 3) Mean Age = 15.1	AN, BN	Acrocyanosis; dermatitis artefacta; atopic diathesis; atopic eczema; brittlenails; callusesscars(hands); carotenoderma; decayed teeth; diffuse effluvium; diffuse hypertrichosis on the back; distinct hypertrichosis on the abdomen and arms; excoriated acne; hand erosions; onychophagia; parotid swelling; peripheral edema; perniosis; petechiae; pigmented scars; self-induced scars; split dry hair; trichotillomania; white dermographism; skin xerosis
7	Glorio, R., Allevato, M., De Pablo, A., Abbruzzese, M., Carmona, L., Savarin, M., Ibarra, M., Busso, C., Mordoh, A., Llopis, C., Haas, R., Bello, M., & Woscoff, A. (2000). Prevalence of cutaneous manifestations in 200 patients with eating disorders. International Journal of Dermatology, 39(5), 348–353. https://doi.org/10.1046/j.1365-4362.2000.00924.x	Observational, transverse and prospective study *N* = 200 AN group mean age = 18.35 BN group mean age = 18.76 EDNOS group mean age = 17.50	BN, AN, EDNOS	AN: alopecia; angular cheilitis; depapillated tongue aphthae; factitial dermatitis; hand dermatitis; hypertrichosis lanuginose; interdigital intertrigo; onychophagia; onychoschizia; Russell's sign; seborrheic dermatitis;ungua1 fragility; acne BN: acne; alopecia; angular cheilitis; aphthae; carotenoderma; dental enamel erosion; depapillated tongue; factitial and hand seborrheic dermatitis; hypertrichosis; interdigital intertrigo; onychophagia; opaque hair; Russell's sign; EDNOS: acne; alopecia; carotenodermia; diffuse xerosis; interdigital intertrigo; seborrheic dermatitis
8	Gupta, M. A., & Gupta, A. K. (2001). Dissatisfaction with skin appearance among patients with eating disorders and non-clinica1 controls. British Journal of Dermatology, 145(1), 110–113. https://doi.org/10.1046/j.13652133.2001.04292.x	Randomized Controlled Trial patients group *N* = 32) (control group *N* = 34) Mean age of patients group = 23.4	ED	Skinxerosis; frecklesfinewrinkles; largeporesroughness; patchy hyperpigmentation; sagging skin; superficial tiny vessels; carotenoderma

Table 1 (continued)

N	Authors, title, publishing date and DOI or PMID (Chronologically) (a)	(b) Type ofstudy (c) Size (N), Mean Age	ED Diagnosis (d)	Dermatological outcomes of interest (e)
9	Strumia, R., Varotti, E., Manzato, E., & Gualandi, M. (2001). Skin signs in anorexia nervosa. Dermatology (Basel, Switzerland), 203(4), 314–317 https://doi.org/10.1159/000051779	Noncontrolled clinical study $N=24$ Mean Age = 23.6	AN (restrictiv e and purging types)	Acne; acrocyanosis; carotenoderma; diffuse hypertrichosis; factitial dermatitis; generalized pruritus; gingivitis; hair effluvium; skin hyperpigmentation; melasma; nail changes; poor wound healing; Russell's sign; striae distensae
10	Quirk, C. M., Seykora, J., Wingate, B. J., & Cotsarelis, G. (2002). Acrodermatitis enteropathica associated with anorexia nervosa. JAMA, 288(21), 2655–2656 https://doi.org/10.1001/jama.288.21.2655	Case Report $N=1$ Age = 27	AN (purging type)	Hypopigmented, psoriasiform hyperplasia; erosions on fingers, palms, soles, perioral area and oral mucous membranes; multiple dusky vesicles with maceration in the vulvar area; perifollicular haemorrhage in the axillary and pretibial regions
11	Prousky, J. E. (2003). Pellagra may be a rare secondary complication of anorexia nervosa: a systematic review of the literature. Alternative Medicine Review: A Journal of Clinical Therapeutic, 8(2), 180–185 PMID: 12777163	Review of case report $N=4$	AN	Erythema; glossitis; pellagra; photosensitivity; pruritic eruptions; slight hyperpigmentation and desquamation; stomatitis
12	Strumia, R., Manzato, E., & Gualandi, M (2003). Cutaneous manifestations in male anorexia nervosa: four cases. Acta dermato-venereologica, 83(6), 464W65 https://doi.org/10.1080/00015550310012683	Clinical Case Report, follow-up $N=4$ Mean Age = 25	AN (all male)	Hyperpigmentation; striae distensae; purpura; lip xerosis; mild alopecia
13	MacDonald, A., & Forsyth, A. (2005) Nutritional deficiencies and the skin. Clin Exp Dermatol, 30(4), 388–390 https://doi.org/10.111l/j.1365–2230.2005.01787.x	Case Report $N=2$ Age = 42	AN	Dermatosis, desquamation, marked depigmentation and crusting on hands; painful blistering on hands and feet; pustules over the metacarpophalangeal joints
14	Strumia, R., Borghi, A., Colombo, E., Manzato, E., & Gualandi, M. (2005). Low prevalence of twisted hair in anorexia nervosa. Clin Exp Dermatol, 30(4), 349–350. https://doi.org/10.1111/j.1365-2230.2005.01745.x	Case report $N=2$ Mean Age = 24	AN	Acrocyanosis; cystic acne; hypertrichosis; perimylolysis; scars due to cigarette burns on forearms; severe effluvium; severe skin and lip xerosis

Table 1 (continued)

N	Authors, title, publishing date and DOI or PMID (Chronologically) (a)	(b) Type ofstudy (c) Size (N), Mean Age	ED Diagnosis (d)	Dermatological outcomes of interest (e)
15	Roberts, C. M. L., Martin-Clavijo, A., Winston, A. P., Dharmagunawardena, B., & Gach, J.E. (2007). Malnutrition and a rash: think zinc. Clinical and Experimental Dermatology, 32(6), 654–657. https://doi.org/10.111l/j.1365-2230.2007.02475.x	Case Report $N=1$ Age = 27	AN purging type	Eczematous; scaly rash; macular eruption of the skin
16	Kim, S. T., Kang, J. S., Baek, J. W., Kim, T. K., Lee, J. W., Jeon, Y. S., & Suh, K.S. (2010) Acrodermatitis enteropathica with anorexia nervosa. The Journal of Dermatology, 37(8), 726–729 https://doi.org/10.1111/j.1346-8138.2010.00835.x	Case Report $N=1$ Age = 37	AN	Acrodermatitis enteropathica
17	Altunay, I., Demirci, G. T., Ates, B., Kucukunal, A., Aydin, C., Karamustafalioglu, 0., & Altuntas, Y. (2011). Do eating disorders accompany metabolic syndrome in psoriasis patients? Results of a preliminary study. Clinical, Cosmetic and Investigational Dermatology, 4, 139–143. https://doi.org/10.2147/CCID.S24165	Cross-sectional, randomized, controlled trial $N=100$ Mean age = 37.71	BED, EDNOS	Psoriasis
18	Garrido, Colmenero, C.,&Aneiros Fernández, J (2015). Diffuse reticulate purpura in a boywith anorexia nervosa. Cmaj, 187(18), E514. https://doi.org/10.1503/cmaj.141543	Case Report $N=1$ Age = 14	AN	Purpura
19	Levavasseur, M., Becquart, C., Pape, E., Pigeyre, M., Rousseaux, J., Staumont-Salle, D., & Delaporte, E. (2015). Severe scurvy: an underestimated disease. *European Journal of Clinical Nutrition, 69(9),* 1076 1077. https://doi.org/10.1038/ejcn.2015.99	Case Report $N=3$ Mean age = 43.33	AN	Hair dystrophy; perifollicular hyperkeratosis; purpura
20	Dessinioti, C., Katsambas, A., Tzavela, E., Karountzos, V., & Tsitsika, A.K. (2016). Erythema ab igne in three girls with anorexia nervosa. Pediatr Dermatol, 33(2), e149-150. https://doi.org/10.1111/pde.12770	Case Report $N=3$ Mean age = 16	AN	Erythema ab igne,1esions on the dorsal aspect of hands

Table 1 (continued)

N	Authors, title, publishing date and DOI or PMID (Chronologically) (a)	(b) Type ofstudy (c) Size (N), Mean Age	ED Diagnosis (d)	Dermatological outcomes of interest (e)
21	Drucker, A. M., Li, W.-Q., Cho, E., Li, T., Flint, A. J., Camargo Jr., C. A., & Qureshi, A.A. (2016). Atopic conditions are associated with food addiction in US women. The Journal of Allergy and Clinical Immunology: In Practice, 4(6), 1246–1247.e1. https://doi.org/10.1016/j.jaip.2016.06.007	Observational Longitudinal Study $N=6339$ Mean age = 54.5	OB (Food Addiction)	Atopic dermatitis
22	Latzer, I. T., Agmon-Levin, N., Somech, R., & Stein, D. (2016). Eruption of urticaria and angioedema induced by binging and purging in an anorexia nervosa patient. In The International journal of eating disorders (Vol. 49, Issue 8, pp. 822–825) https://doi.org/10.1002/eat.22514	Case Report $N=1$ Age = 16	AN (binge/pur ge type)	Angioedema; eyelids and lips swollen; rash (central swelling surrounded by mildly pruritic erythema); urticaria
23	Capucilli, P., Wan, J., Corry, J., Chuang, J. H., Linn, R. L., & Perman, M.J. (2018). Prurigo Pigmentosa: An Itchy, Urticarial Eruption Confused for Food Allergy. The Journal of Allergy and Clinical Immunology. In Practice, 6(4), 1381–1382 https://doi.org/10.1016/j.jaip.2018.02.033	Case Report $N=1$ Age = 17	AN	Prurigo pigmentosa
24	Charlton, 0. A., Dickison, P., Smith, S. D., & Roger, S.D. (2019). Nail clubbing in laxative abuse: case report and review of the literature. In Journal of eating disorders (Vol. 7, p. 6). https://doi.org/10.1186/s40337-019-0236-4	Case report + review $N=1$ Age = 36	ED (underwhe ight and symptoms of laxative abuse)	Bilateral clubbing of all finger nails

Table 1 (continued)

N	Authors, title, publishing date and DOI or PMID (Chronologically) (a)	(b) Type ofstudy (c) Size (N), Mean Age	ED Diagnosis (d)	Dermatological outcomes of interest (e)
25	Paszynska, E., Dutkiewicz, A., Osinska, A., Mozol-Jursza, M., Smalc, N., Tyszkiewicz- Nwafor, M., Dmitrzak-Weglarz, M., Slopien, A., & Jenerowicz, D. (2020). Anorexia nervosa with vomiting episodes: dermatological and oral complications. European Journal of Dentistry, 14(1), 180–185. https://doi.org/10.1055/s-0040-1705073	Clinical Case Report $N=3$ Mean age = 14.66	AN purging type	Acral coldness; alopecia; atopic dermatitis; atrophic—erythematous lesions; bordered erythema and oedema localized within the skin of distal interphalangeal joints and periungual area as well as both hands; cheilitis; exfoliative dermatitis; facial erythema and minor skin peeling; removable plaque and white sediment on the dorsal surface of the tongue; Russell's sign; severe skin pruritus; small erosions and scaling due to self-induced trauma caused by picking at the skin; xerosis of the whole body
26	Roy-Lavallee, J., Bahrani, B., Weinstein, M., & Katzman, D. K. (2020). Scurvy: an unexpected nutritional complication in an adolescent female with anorexia nervosa. Journal of Adolescent Health, 67(4), 618–620. https://doi.org/10.1016/j.jadohealth.2020.02.022	Case Report $N=1$ Age = 16	AN	Corkscrew hairs on the abdomen; multiple hyperpigmented perifollicular petechial papules

AN anorexia nervosa; *BN* bulimia nervosa; *OB* obesity; *BED* binge eating disorder; *EDNOS* Eating Disorder Not Otherwise Specified

63 participants assigned to the experimental group and 103 participants assigned to the control group. The study by Gupta and Gupta [16] investigated dermatological condition and dissatisfaction with the appearance of the skin in 32 ED's patients compared with 34 non-clinical controls. The 32 EDs participants had AN and/or BN, according to the diagnostic criteria of DSM-III, the 34 participants of the control group, where randomly selected with random digit dialing technique. Authors found that the women with EDs had significantly higher scores on the scales measuring weight-related body image psychopathology and higher levels of dissatisfaction about their skin appearance than non-clinical controls. Therefore, authors suggests that ED's patient with greater dissatisfaction and skin appearance who seek a dermatological consultation may have a higher level of psychopathology and more medical complications, which also increase *pari passu* with disordered eating behaviours [16]. The second study by Altunay et a1. [17] investigated the presence of EDs in 100 psoriasis patients with and without metabolic syndrome. ED's assessment was conducted using the Eating Attitude Test (EAT-26) [18] and through a psychiatric interview. EAT scores were suggestive of clinical ED in 7% of patients. Authors also reported that four of 31(12.9%) patients with metabolic syndrome and psoriasis and three of 69 (4.3%) psoriatic patients without metabolic syndrome had ED. One observational study only on obese people by Drucker et a1. [19] was screened. Authors studied the association between atopic conditions like atopic dermatitis, food allergy, hay fever and asthma and food addiction (FA) in a sample of obese people. The construct of FA was conceptualized as a chronic relapsing eating problem caused by several factors that increase craving for hyperpalatable food or food-related substances, leading to a state of high pleasure, energy or excitement [19–21]. The link between food addiction and BED is controversial: in fact, despite multiple similarities, the construct of FA does not entirely overlap BED clinical features [22] FA is not currently recognized within the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [1]. However, increasing data in literature seem to confirm the existence of this pathological eating pattern [23, 24]. Drucker et al. [19] found that in a sample of 76,325 participants included, 6339 (8.3%) met criteria for FA. In addition, 11.9% of subjects who met FA criteria had atopic dermatitis and 10.7% had food allergy. In the group without FA, 10% also had atopic dermatitis and 8.3% had food allergy. The authors concluded that the psychological burden of atopic conditions probably led to food addiction.

Behavioral aspects of EDs associated with dermatologic signs

According to the articles included in our review, behavioral consequences of EDs may be associated with the following dermatologic signs:

- Dermatitis artefacta (DA) is reported even as "small erosions and scaling due to self- induced trauma caused by picking at the skin" [25]. DA is a not a common pathology of the skin. This disorder is associated with unrecognized psychopathology and patients often deny any role in causation [26, 27].
- Erythema *ab igne* [28] is an asymptomatic, reticulated and pigmented dermatosis. It is associated to repetitive and prolonged moderate heat exposure, not intense enough to cause a burn [29]. Patients with AN, mostly adolescents, could use heat exposure to obtain a general feel of hot and to alleviate the subjective and aversive feeling of fullness after food intake. Due to the prolonged and increasing level of heat the skin changes may persist over time or even become permanent [30].
- Russell's sign [31], also variously denominated by other authors as "scarred knuckles" [32], "hand erosions" [27], "pustules over the metacarpophalangeal joints" [33], "erosions on fingers, palms, soles, perioral area and oral mucous membranes" [34], "depigmentation and crusting over dorsa of hands and finger" [33], or "lesions on the dorsal aspect of hands" [28]. This is a pathognomonic sign of repeated self-induced vomiting due to the contact of the incisors to the skin of the hand. A symptom like the excessive weight loss is not useful to differential diagnosis between AN and BN. For this reason, Russell's sign may have a huge implication for a good assessment of EDs [35].
- Scars, self-induced lesion by burning [27]. People with EDs are at higher risk of suicide, suicide attempts or self-injurious behaviour than general population [36]. Impulsivity and self-wounding in EDs population are linked to obsessionality and depression [37]. For this reason, psychological assessment of depression, impulsivity and suicide risk is strongly recommended in presence of those dermatologic signs [9].
- Scratching (pruritus) [27]. According to Strumia [38] the presence of pruritus in EDs has several possible explanations. Pruritus may be an expression of psychopathology. Indeed, psychopathologic features could modulate patient's sensory perception, or can become a compulsive ritual [39]. However, the simplest explanation of co-occurrence of pruritus in EDs is the presence of eczema due to compulsive behaviours, such as repeated washings, that could worsen pruritus [39]

- Self-phlebotomy [13]. This behaviour is rare but present more in AN than in BN and is used by patients as a purging method [40]. Self-bloodletting should be taken into account in case of severe, unexplained or rapidly occurring anemia. Even unexplained needle tracks on the skin and a history of self-harming behaviours are suggestive of self-phlebotomy. Occupational history of health- care professional could also be considered as a risk factor. We should be alert for these methods of purging, because patients often do not disclose this behaviour to clinicians [41], but dermatologists could correctly identify those signs during clinical screening.
- Trichotillomania (TTM) [13, 27] is a disorder of repetitive hair pulling, characterized by hair loss and inability to stop pulling. TTM shares many phenomenological similarities with EDs, including ritualized compulsive behaviours. Moreover, TTM comorbidity with EDs is quite often reported, particularly in BN and EDNOS [42].

Discussion, limitations and conclusions

In accordance with what has emerged regarding the quantity and quality of work on this subject, it does not appear possible to carry out properly a systematic review of these papers due to the heterogeneity of available data and due to the design of most available studies [43]. Nevertheless, it has been possible to report analytically the results of our analysis.

To the best of our knowledge, the first documented description of dermatologic assessment in a case of AN is reported in Evans [44] and cited in Prousky [45]. Evans described a 38-year-old woman with dermatologic and neuropsychologic symptoms suggestive of pellagra. The patient was not cooperative during physical examination, refused all food and drink, and required 500 mg of niacin a day with meals [45].

This work highlights difficulties in finding controlled studies about dermatological conditions associated with eating disorders, even if clinicians seem to be aware that cutaneous manifestation in patients with EDs are quite common [46]. The number of controlled studies available is in fact very limited, as most papers of interest are case reports or review articles. To our knowledge, in the last years, some narrative reviews and cross-sectional studies [26] of dermatologic signs of EDs have been published, but not a systematic review according to PRISMA model was published. All EDs display a variety of dermatologic symptoms. According to Gupta et al. [47] dermatologic signs of EDs can be classified in: signs directly due to maladaptive eating behavior patterns (malnutrition/starvation, laxative or diuretic drug abuse, vomiting) and signs not strictly related to ED, but associated to psychiatric morbidity (dermatitis artefacta, acne excoriée, scars). Glorio et a1. [48] identified some "guiding signs" (hypertrichosis, Russell's sign, self-induced dermatitis, perimylolysis) that can be useful in differential diagnosis between EDs and the huge variety of medical problems that are possibly confused with EDs (hyperthyroidism, inflammatory bowel disease, immunodeficiency, malabsorption, chronic infections, Addison's disease, malignancy and diabetes) [9]. For the first time, Tyler et al. [13] identified and classified forty dermatologic signs referred to AN, BN, EDNOS and obesity. Furthermore, authors classified symptomatology according to their frequency in clinical contexts (common, occasional, rare, very rare) for each ED. In Table 1 are reported all dermatologic signs in EDs traced in this work.

Furthermore, review studies that cover such a wide period of time could have several limitations, since diagnostic criteria for EDs changed over time, especially for EDNOS. BED in DSM-5 [1] was considered properly as an eating disorder, whereas in the previous edition, DSM- IV TR [49] it was described in DSM "Appendix B" among the categories of disorders that needed further study to be confirmed and could be only diagnosed using the broad diagnostic category "EDNOS". Therefore, papers published prior to 2013 include in EDNOS even patients who, in DSM-5, could have been diagnosed as BED, and not as EDNOS. This change in diagnostic criteria over time could have produced some inaccuracies in the categorization of cutaneous diseases that are observed in the different EDs, and it could explain why researches on dermatologic issues of BED are so limited, compared to those concerning AN and BN. Second, different dermatological disorders have been categorized according to different criteria (e.g., according to eating disorder to which dermatological disease is associated, or according to pathogenesis—like self-induced vomiting or starvation, abuse of laxatives or psychiatric comorbidity). Therefore, to our knowledge, there is not yet a clear and shared classification of dermatological correlates of EDs.

According to ED's clinical features, the management of ED's patients who request dermatological examination should be undertaken by a multidisciplinary team, or by clinicians whose breadth of experience allows them to work effectively with the range of features found in ED patients. Several authors warn that these patients very often do not know that they have eating related problems or do not want to receive psychiatric attention for their disorder. Most patients with EDs, or generally with psychocutaneous disease, reject psychiatric intervention, trusting the management of their problems completely into the hands of dermatologists [14]. Nevertheless, most dermatological problems which arise in these patients can be solved through the elimination of EDs, hence the need for a timely psychological assessment in case of suspected EDs. A professional,

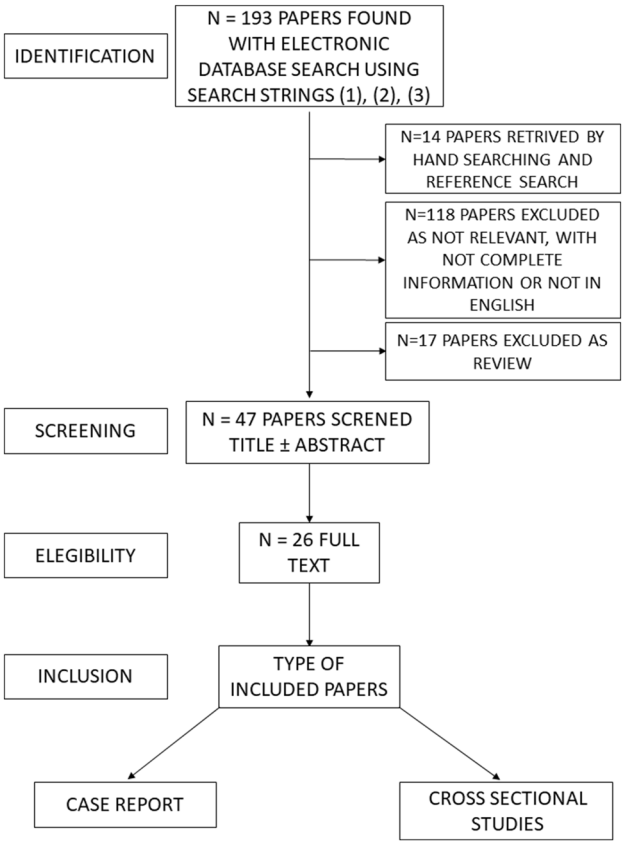

Fig. 1 PRISMA flow diagram describing the search results and the article selection process

direct, and empathic approach helps patients to feel safe with clinicians and could elicit relevant psychiatric information.

Larger, more methodologically rigorous studies to evaluate the presence of dermatological issue in ED's patients are needed, as it is seemly appropriate to assert also that larger and more rigorous studies of prevalence, incidence, features, and types of ED are needed for dermatologic patients. Standardized outcome EDs measures, such as the Eat Attitude Questionnaire (EAT-26) [17, 50] or the Eat Disorder Examination Questionnaire (EDE-Q) [51], and not only the psychiatric examination or merely the BMI measures, the latter performed by dermatologists, should be used both in research and in practice to improve the quality of information about this topic and to provide better patient care.

Truthfully no rigorous review has been conducted on this topic due to the scarcity and the low quality of the available studies. This study actually highlights the limited knowledge about the dermatological features in patients with EDs and aims to precisely collect the currently available knowledge to identify the starting point for future more rigorous studies on this topic. These results indicate that dermatologists should pay particular attention to certain specific signs on the patients' skin, to early identify people at risk of EDs and directing them towards appropriate treatments. Therefore, it would be useful for clinicians (i.e., mental health professionals and dermatologists) to focus their attention on a more interdisciplinary collaboration to better take care of patients' health.

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Declarations

Conflict of interest We wish to confirm that there are no known conflicts of interest associated with this publication.

References

1. American Psychiatric Association (2013) Feeding and Eating Disorders. Diagnostic and Statistical Manual of Mental Disorders, 5th edn. American Psychiatric Association. https://doi.org/10.1176/appi.books.9780890425596.dsm10
2. Crowell MD, Murphy TB, Levy RL, Langer SL, Kunin-Batson A, Seburg EM, Senso M, Sherwood NE (2015) Eating behaviors and quality of life in preadolescents at risk for obesity with and without abdominal pain. J Pediatr Gastroenterol Nutr 60(2):217–223. https://doi.org/10.1097/MPG.0000000000000585
3. Harrison A, Mountford VA, Tchanturia K (2014) Social anhedonia and work and social functioning in the acute and recovered phases of eating disorders. Psychiatry Res 218(1–2):187–194. https://doi.org/10.1016/j.psychres.2014.04.007
4. Fichter MM, Quadflieg N (2016) Mortality in eating disorders—results of a large prospective clinical longitudinal study. Int J Eat Disord 49(4):391–401. https://doi.org/10.1002/eat.22501
5. Crow SJ, Peterson CB, Swanson SA, Raymond NC, Specker S, Eckert ED, Mitchell JE (2009) Increased mortality in bulimia nervosa and other eating disorders. Am J Psychiatry 166(12):1342–1346. https://doi.org/10.1176/appi.ajp.2009.09020247
6. Micula-Gondek W, Tao Y, Guarda AS (2018) Atypical purging behaviors in a patient with anorexia nervosa: consumption of raw red kidney beans as an emetic. Eat Weight Disord 23(4):537–539. https://doi.org/10.1007/s40519-017-0433-6
7. Rantala MJ, Luoto S, Krama T, Krams I (2019) Eating disorders: an evolutionary psychoneuroimmunological approach. Front Psychol 10:2200. https://doi.org/10.3389/fpsyg.2019.02200
8. Zerwas S, Larsen JT, Petersen L, Thornton LM, Quaranta M, Koch SV, Pisetsky D, Mortensen PB, Bulik CM (2017) Eating disorders, autoimmune, and autoinflammatory disease. Pediatrics 140(6):e20162089. https://doi.org/10.1542/peds.2016-2089
9. Strumia R (2005) Dermatologic signs in patients with eating disorders. Am J Clin Dermatol 6(3):165–173. https://doi.org/10.2165/00128071-200506030-00003
10. Hoek HW (2016) Review of the worldwide epidemiology of eating disorders. Curr Opin Psychiatry 29(6):336–339. https://doi.org/10.1097/YCO.0000000000000282

11. Galmiche M, Déchelotte P, Lambert G, Tavolacci MP (2019) Prevalence of eating disorders over the 2000–2018 period: a systematic literature review. Am J Clin Nutr 109(5):1402–1413. https://doi.org/10.1093/ajcn/nqy342
12. Al-Adawi S, Bax B, Bryant-Waugh R, Claudino AM, Hay P, Monteleone P, Norring C, Pike KM, Pilon DJ, Herscovici CR, Reed GM, Rydelius P-A, Sharan P, Thiels C, Treasure J, Uher R (2013) Revision of ICD—status update on feeding and eating disorders. Adv Eat Disord 1(1):10–20. https://doi.org/10.1080/21662630.2013.742971
13. Tyler I, Wiseman MC, Crawford RI, Birmingham CL (2002) Cutaneous manifestations of eating disorders. J Cutan Med Surg 6(4):345–353. https://doi.org/10.1177/120347540200600407
14. Kuhn H, Mennella C, Magid M, Stamu-O'Brien C, Kroumpouzos G (2017) Psychocutaneous disease: clinical perspectives. J Am Acad Dermatol 76(5):779–791. https://doi.org/10.1016/j.jaad.2016.11.013
15. Moher D, Liberati A, Tetzlaff J, Altman DG, Group T. P. (2009) Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLOS Med 6(7):1–6. https://doi.org/10.1371/journal.pmed.1000097
16. Gupta MA, Gupta AK (2001) Dissatisfaction with skin appearance among patients with eating disorders and non-clinical controls. Br J Dermatol 145(1):110–113. https://doi.org/10.1046/j.1365-2133.2001.04292.x
17. Altunay I, Demirci GT, Ates B, Kucukunal A, Aydın C, Karamustafalıoglu O, Altuntas Y (2011) Do eating disorders accompany metabolic syndrome in psoriasis patients? Results of a preliminary study. Clin Cosmet Investig Dermatol 4:139–143. https://doi.org/10.2147/CCID.S24165
18. Garner DM, Garfinkel PE (1979) The eating attitudes test: an index of the symptoms of anorexia nervosa. Psychol Med 9(2):273–279. https://doi.org/10.1017/S0033291700030762
19. Drucker AM, Li W-Q, Cho E, Li T, Flint AJ, Camargo CA Jr, Qureshi AA (2016) Atopic conditions are associated with food addiction in US women. J Allergy Clin Immunol 4(6):1246-1247.e1. https://doi.org/10.1016/j.jaip.2016.06.007
20. von Deneen KM, Liu Y (2012) Food addiction, obesity and neuroimaging. In: Belin D (ed) Addictions. IntechOpen. https://doi.org/10.5772/33331
21. Gearhardt AN, Corbin WR, Brownell KD (2009) Food addiction: an examination of the diagnostic criteria for dependence. J Addict Med 3(1):1–7. https://doi.org/10.1097/ADM.0b013e318193c993
22. Gearhardt AN, White MA, Potenza MN (2011) Binge eating disorder and food addiction. Curr Drug Abuse Rev 4(3):201–207. https://doi.org/10.2174/1874473711104030201
23. Pursey KM, Stanwell P, Gearhardt AN, Collins CE, Burrows TL (2014) The prevalence of food addiction as assessed by the Yale Food Addiction Scale: a systematic review. Nutrients 6(10):4552–4590. https://doi.org/10.3390/nu6104552
24. Rogers PJ, Smit HJ (2000) Food craving and food "addiction": a critical review of the evidence from a biopsychosocial perspective. Pharmacol Biochem Behav 66(1):3–14. https://doi.org/10.1016/S0091-3057(00)00197-0
25. Paszynska E, Dutkiewicz A, Osinska A, Mozol-Jursza M, Smalc N, Tyszkiewicz-Nwafor M, Dmitrzak-Weglarz M, Slopien A, Jenerowicz D (2020) Anorexia nervosa with vomiting episodes: dermatological and oral complications. Eur J Dent 14(1):180–185. https://doi.org/10.1055/s-0040-1705073
26. Gattu S, Rashid RM, Khachemoune A (2009) Self-induced skin lesions: a review of dermatitis artefacta. Cutis 84(5):247–251 (**PMID: 20099617**)
27. Schulze UME, Pettke-Rank CV, Kreienkamp M, Hamm H, Bröcker E-B, Wewetzer C, Trott G-E, Warnke A (1999) Dermatologic findings in anorexia and bulimia nervosa of childhood and adolescence. Pediatr Dermatol 16:90–94. https://doi.org/10.1046/j.1525-1470.1999.00022.x
28. Dessinioti C, Katsambas A, Tzavela E, Karountzos V, Tsitsika AK (2016) Erythema ab igne in three girls with anorexia nervosa. Pediatr Dermatol 33:e149–e150. https://doi.org/10.1111/pde.12770
29. Fischer J, Rein K, Erfurt-Berge C, de Zwaan M (2010) Three cases of erythma ab igne (EAI) in patients with eating disorders. Neuropsychiatrie: Klinik, Diagnostik, Therapie Und Rehabilitation: Organ Der Gesellschaft Osterreichischer Nervenarzte Und Psychiater 24(2):141–143. https://pubmed.ncbi.nlm.nih.gov/20605010/. Accessed 1 March 2021
30. Beneke J, Koerner M, de Zwaan M (2014) Erythema ab igne bei einer Patientin mit Bulimia nervosa [Erythema ab igne in a patient with bulimia nervosa]. Psychother Psychosom Med Psychol 64(5):197–199. https://doi.org/10.1055/s-0033-1361141
31. Russell G (1979) Bulimia nervosa: an ominous variant of anorexia nervosa. Psychol Med 9(3):429–448. https://doi.org/10.1017/S0033291700031974
32. White KP, Rothe MJ, Milanese A, Grant-Kels JM (1994) Perniosis in association with anorexia nervosa. Pediatr Dermatol 11:1–5. https://doi.org/10.1111/j.1525-1470.1994.tb00063
33. MacDonald A, Forsyth A (2005) Nutritional deficiencies and the skin. Clin Exp Dermatol 30:388–390. https://doi.org/10.1111/j.1365-2230.2005.01787.x
34. Quirk CM, Seykora J, Wingate BJ, Cotsarelis G (2002) Acrodermatitis enteropathica associated with anorexia nervosa. JAMA 288(21):2655–2656. https://doi.org/10.1001/jama.288.21.2655
35. Daluiski A, Rahbar B, Meals RA (1997) Russell's sign. Subtle hand changes in patients with bulimia nervosa. Clin Orthop Relat Res 343:107–109. https://pubmed.ncbi.nlm.nih.gov/9345215/. Accessed 1 March 2021
36. Stein D, Lilenfeld LRR, Wildman PC, Marcus MD (2004) Attempted suicide and self- injury in patients diagnosed with eating disorders. Compr Psychiatry 45(6):447–451. https://doi.org/10.1016/j.comppsych.2004.07.011
37. Favaro A, Santonastaso P (1997) Suicidality in eating disorders: clinical and psychological correlates. Acta Psychiatr Scand 95:508–514. https://doi.org/10.1111/j.1600-0447.1997.tb10139.x
38. Strumia R (2013) Eating disorders and the skin. Clin Dermatol 31(1):80–85. https://doi.org/10.1016/j.clindermatol.2011.11.011
39. Gupta MA, Gupta AK, Haberman HF (1987) The self-inflicted dermatoses: a critical review. Gen Hosp Psychiatry 9(1):45–52. https://doi.org/10.1016/0163-8343(87)90101-0
40. Morgan JF, Lacey JH (2000) Blood-letting in anorexia nervosa: a case study. Int J Eat Disord 27:483–485. https://doi.org/10.1002/(SICI)1098-108X(200005)27:4%3c483::AID-EAT15%3e3.0.CO;2-Y
41. Grewal S, Birmingham CL (2003) Self-phlebotomy in eating disorders. Eat Weight Disord 8(4):336–340. https://doi.org/10.1007/BF03325037
42. Greenberg E, Grant JE, Curley EE, Lochner C, Woods DW, Tung ES, Stein DJ, Redden SA, Scharf JM, Keuthen NJ (2017) Predictors of comorbid eating disorders and association with other obsessive-compulsive spectrum disorders in trichotillomania. Compr Psychiatry 78:1–8. https://doi.org/10.1016/j.comppsych.2017.06.008
43. Shelby LB, Vaske JJ (2008) Understanding meta-analysis: a review of the methodological literature. Leis Sci 30(2):96–110. https://doi.org/10.1080/01490400701881366
44. Evans VL (1939) pellagra with psychosis and minimal physical symptoms. J Am Med Assoc 112(13):1249–1250. https://doi.org/10.1001/jama.1939.62800130005010d

45. Prousky JE (2003) Pellagra may be a rare secondary complication of anorexia nervosa: a systematic review of the literature. Altern Med Rev 8(2):180–185 (**PMID: 12777163**)
46. Tohid H, Shenefelt PD, Burney WA, Aqeel N (2019) Psychodermatology: an association of primary psychiatric disorders with skin. Revista Colombiana de Psiquiatria 48(1):50–57. https://doi.org/10.1016/j.rcp.2017.07.002
47. Gupta MA, Gupta AK, Haberman HF (1987) Dermatologic signs in anorexia nervosa and bulimia nervosa. Arch Dermatol 123(10):1386–1390. https://doi.org/10.1001/archderm.1987.01660340159040
48. Glorio R, Allevato M, De Pablo A, Abbruzzese M, Carmona L, Savarin M, Ibarra M, Busso C, Mordoh A, Llopis C, Haas R, Bello M, Woscoff A (2000) Prevalence of cutaneous manifestations in 200 patients with eating disorders. Int J Dermatol 39:348–353. https://doi.org/10.1046/j.1365-4362.2000.00924.x
49. American Psychiatric Association (1994) The Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text revision (DSM-IV-TR). Author, Washington, DC
50. Orbitello B, Ciano R, Corsaro M, Rocco PL, Taboga C, Tonutti L, Armellini M, Balestrieri M (2006) The EAT-26 as screening instrument for clinical nutrition unit attenders. Int J Obes 30(6):977–981. https://doi.org/10.1038/sj.ijo.0803238
51. Luce KH, Crowther JH (1999) The reliability of the eating disorder examination—Self-report questionnaire version (EDE-Q). Int J Eat Disord 25:349–351. https://doi.org/10.1002/(SICI)1098-108X(199904)25:3%3c349::AID-EAT15%3e3.0.CO;2-M