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ORIGINAL RESEARCH

Comorbidity Burden and Treatment Patterns of Psoriasis in Vietnam: Real-World Data from the EXPAND Study

Hao Trong Nguyen · Anh Tuan Vu · Nhi Thi Uyen Pham · Tu Nguyen Anh Tran · Nguyen Nhat Pham · Huong Thi Thanh Bui · Thuyen Thi Pham · Vi Thi Thuy Dinh · Yen Thi Bui · Thao Thi Phuong Vu

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ABSTRACT

Introduction: Psoriasis is a multi-faceted, immune-mediated inflammatory disease associated with a wide range of comorbidities. Real-world data on treatment patterns, comorbidities, and economic burden in patients with psoriasis are needed for comprehensive patient care in Vietnam.

Methods: A retrospective chart review study was conducted using secondary data extracted from patients' medical records of two hospitals in Vietnam, with the aim of identifying adult patients with a confirmed diagnosis of psoriasis. The index date was defined as the date of first diagnosis between 1 January 2020 and 31 October 2021. Sociodemographic factors, disease characteristics, comorbidities, medication usage, drug survival, and medication costs were analyzed.

Results: A total of 661 patients were identified (mean ± standard deviation [SD] age 43.5 ± 14.8 years). The most prevalent comorbidity was dyslipidemia (49.6% of patients), followed by hypertension (23.4%), and psoriatic arthritis (10.4%). In total, 44% of patients received biologic therapies. Overall, 66.7% and

H. T. Nguyen (✉) · N. T. U. Pham · T. N. A. Tran · N. N. Pham · T. T. P. Vu
Ho Chi Minh City Hospital of Dermato-Venereology, 2 Nguyen Thong, Ward Vo Thi Sau, District 3, Ho Chi Minh City, Vietnam
e-mail: nthao@ump.edu.vn

N. T. U. Pham
e-mail: drphamthiuyennhi@gmail.com

T. N. A. Tran
e-mail: dr.anhtu712@gmail.com

N. N. Pham
e-mail: drnhatnguyenpham@gmail.com

T. T. P. Vu
e-mail: thaodermato@gmail.com

A. T. Vu · H. T. T. Bui · T. T. Pham · V. T. T. Dinh
Quy Hoa National Leprosy Dermatology Hospital, Quy Nhon City, Binh Dinh Province, Vietnam

A. T. Vu
e-mail: drvtavn@gmail.com

H. T. T. Bui
e-mail: huongdalieu1973@gmail.com

T. T. Pham
e-mail: thuyenpt.qn@gmail.com

V. T. T. Dinh
e-mail: veodto@gmail.com

Y. T. Bui
Novartis Vietnam Company Limited, Ho Chi Minh City, Vietnam
e-mail: yenbt810@gmail.com

54.3% of patients receiving biologic and non-biologic therapies, respectively, had ≥ 1 comorbidity. Only 23.2% of patients with psoriasis-related comorbidities stopped therapy with biologics. Biologics had a longer retention time (17.0 months) than non-biologics (6.0 months) in patients with comorbidities. Patients with comorbidities had significantly higher total annual healthcare costs than those without comorbidities (in US dollars: USD901 vs. USD304; $p < 0.001$), mainly due to the relatively higher costs associated with the use of biologics.

Conclusion: Patients with psoriasis in Vietnam experience a high disease and economic burden due to comorbidities. Evidence from this real-world study supports the need for routine monitoring of and an appropriate treatment course for psoriasis-related comorbidities.

Keywords: Comorbidities; Economic burden; Psoriasis; Retrospective study

Key Summary Points

Why carry out this study?
Psoriasis is an immune-mediated inflammatory disease associated with multiple comorbidities.
These comorbidities are often associated with greater disease burden as well as greater economic and social burdens.
Currently, there is a lack of data on the prevalence of comorbidities in patients with psoriasis in Vietnam, and there are no national guidelines in Vietnam for the treatment of psoriasis-associated comorbidities.
EXPAND was a non-interventional, retrospective chart review study conducted to understand the extent of the burden of psoriasis-associated comorbidities affecting the overall health and economic status of these patients.

What was learned from the study?
The findings of the EXPAND study suggest that psoriasis in Vietnam is associated with multiple comorbidities that influence the treatment pattern and the overall economic burden.
These findings also highlight the prevalence of and the burden associated with comorbidities and may help healthcare providers in the comprehensive management of patients with psoriasis.

INTRODUCTION

Plaque psoriasis is a chronic, systemic, immune-mediated disease that is characterized by erythematous scaly patches or plaques of the skin and extra-cutaneous involvement of the nails and joints [1, 2]. Psoriasis is also frequently associated with multiple systemic comorbidities, resulting in an increased disease burden [1, 2]. Up to one-third of patients with psoriasis develop psoriatic arthritis (PsA), which is the most recognized comorbidity of psoriasis [3] and found in about 14% of Asian patients with psoriasis [4]. In addition to PsA, psoriasis is commonly associated with several other comorbidities, such as dyslipidemia (53.9% of cases), hypertension (16.4–27.5%), diabetes mellitus (DM; 7–17.2%), and obesity (8.4%) [5–8]. Moreover, patients with severe psoriasis have a higher risk of developing these comorbidities, which have a substantial impact on patients' quality of life [9]. Life-long management is often required due to the chronic nature of psoriasis, which can lead to substantial medical expenses; comorbid conditions can further complicate the management of psoriasis and increase the economic burden of the patient. Evidence-based international treatment guidelines for psoriasis aim to alleviate psoriasis symptoms and improve patient well-being [10, 11]. These guidelines also recommend that disease management should be optimized by

considering the comorbidities associated with psoriasis [10, 11]. However, despite advances in the treatment of psoriasis, a major treatment gap remains due to delayed diagnosis, undertreatment, inadequate access to biologic therapies, and lack of early detection of comorbid diseases. An understanding of the comorbidity burden associated with psoriasis is important for providing comprehensive medical care to patients with psoriasis. Little is known about the disease burden and the treatment approach for psoriasis-associated comorbidities in lower middle-income countries, such as Vietnam; also, national treatment guidelines in Vietnam in particular are yet to be established. In view of this gap, this retrospective study was conducted to describe the disease characteristics, comorbidities, and treatment patterns in patients with psoriasis in Vietnam, as well as to gain an understanding of the extent of psoriasis-associated comorbidities affecting overall health and economic status in the real-world context.

MATERIALS AND METHODS

Study Design and Patients

EXPAND was a non-interventional, retrospective chart review study based on secondary data extracted from medical records of patients with psoriasis treated at two hospitals in Vietnam: Ho Chi Minh City Hospital of Dermato-Venereology and Quy Hoa National Leprosy Dermatology Hospital. Adult patients (aged $\geq$ 18 years) with a confirmed psoriasis diagnosis (with or without comorbidities) during the identification period (1 January 2020, to 31 October 2021) eligible for inclusion. Data were collected from 4 December 2021 to 11 March 2022. The severity of psoriasis for each patient was assessed by the treating dermatologists and defined using the Psoriasis Area and Severity Index (PASI) score as mild (PASI $<$ 10), moderate (PASI 10–20), and severe (PASI $>$ 20) [10]. The index date (baseline) was defined as the date of the patient's first visit to the dermatology department during the identification period.

The study was reviewed and approved by the Institutional Review Board/Independent Ethics Committee of Ho Chi Minh City Hospital of Dermato-Venereology and Quy Hoa National Leprosy Dermatology Hospital. Informed consent was waived due to the retrospective nature of the study.

Data Collection and Outcome Measures

Data on sociodemographic factors, disease characteristics, comorbidities, medication usage, drug survival, and medication costs were extracted from patient medical records. Patients with $\geq$ 1 comorbidity and patients with new onset of comorbidities within the identification period were identified based on physical examination, laboratory test results, or prescriptions received. The selected comorbidities identified were PsA, DM, hypertension, dyslipidemia, obesity, and 'other comorbidities' (which included anxiety, depression, axial disease, rheumatoid arthritis, cardiovascular disease, chronic joint inflammation, and chronic gastrointestinal disease). The drug survival time of non-biologic, combination, and biologic therapies was calculated as the time from treatment initiation to discontinuation of treatment. Biologic therapies were prescribed for patients with moderate to severe psoriasis, and were also used to treat patients with mild psoriasis who had lesions on special sites (such as the face, scalp, palm, plantar genital) that affected their overall quality of life. Treatment patterns for psoriasis-related comorbidities were assessed based on the non-biologics and biologics received. Medication costs per year for each psoriasis-related treatment type (i.e., topical therapy, conventional treatment, phototherapy, biologics, and combination therapies) were assessed based on the quantity of drug(s) received by each patient, number of days supplied, and the cost of medication. In addition, treatment costs incurred for psoriasis-related comorbidities and the average healthcare cost for management of psoriasis-related comorbidities, including miscellaneous costs for the treatment of disease and associated comorbidities, were also assessed.

Statistical Analysis

No hypothesis testing was planned for this study, and the sample size calculation was based on the confidence interval (CI) approach. Summary statistics for continuous variables included the total number of patients (*N*), number of patient data variables imputed (*n*), mean, median, standard deviation (SD), minimum and maximum. For categorical or binary variables, the number and percentage of patients in each category were presented; all 95% CIs presented were two-sided unless otherwise specified. Statistical analyses were performed on "all patients enrolled data set." All study variables and their respective 95% CIs were evaluated using the Clopper-Pearson/Exact method.

RESULTS

Patient Demographics and Baseline Characteristics

A total of 661 patients from the two study sites were eligible for entry to the study. The majority of the patients (63.7%) were men; mean (± SD) age of patients was 43.5 ± 14.8 years, and the age at onset of psoriasis was 32.2 ± 14.3 years. At the time of diagnosis, 76.4% of the patients had moderate to severe psoriasis. The mean (± SD) PASI score at baseline was 18.6 ± 10.9. Overall, 78.4% of patients had received at least one psoriasis treatment previously, with topical treatment being the most common (75.5%). The baseline demographics and disease characteristics are summarized in Table 1.

Comorbidities in Patients with Psoriasis

More than half of the patients (59.8%) had at least one psoriasis-related comorbidity, with dyslipidemia (49.6%) being the most common, followed in decreasing prevalence by hypertension (23.4%), PsA (10.4%), DM (6.1%), and obesity (4.5%). Among the 'other comorbidities' present in the population, anxiety-depression (2.9%) was the most commonly reported. All patients received appropriate treatment for PsA, but less than half received treatment for dyslipidemia and none received treatment for obesity. The proportion of patients with hypertension, DM, and other comorbidities receiving appropriate treatment ranged from 84.6% to 97.4% (Table 2).

The mean (± SD) duration from the onset of psoriasis to onset of comorbidities ranged from 7.9 ± 10.4 years (PsA) to 10.6 ± 8.8 years (dyslipidemia) (Table 2).

Psoriasis Treatments in Patients with Specific Comorbidities

In total, 55.7% (152/273) of patients assessed with severe psoriasis, 50.4% (117/232) with moderate psoriasis, and 14.1% (22/156) with mild psoriasis received treatment with biologics (Table 3). In terms of the treatment received by patients with a specific comorbidity, a high proportion of patients with PsA (42/69, 60.9%) or obesity (18/30, 60.0%) received biologic therapy. In contrast, patients with diabetes (30/40, 75.0%) or hypertension (117/155, 75.5%) received topical therapy more often than other treatments (Table 3).

In terms of treatment groups, in the biologic therapy group, the proportion of patients with comorbidities was higher than the proportion of patients without any comorbidity (66.7% vs. 33.3%), whereas in the non-biologic group, these two proportions were more similar (54.3% vs. 45.7%). There was a high prevalence of dyslipidemia in those treated with biologic (57.0%) or conventional disease-modifying antirheumatic drugs (cDMARDs; 51.1%) (Table 3).

Psoriasis Treatment Models and Their Relationship to the Specific Comorbidities

Overall, in comparison to patients with psoriasis receiving topical therapy exclusively, those receiving biologic agents were associated with higher prevalence of comorbidities (prevalence ratio [PR] = 1.17, 95% CI [1.01; 1.38]; $p = 0.036$). In comparison, the prevalence of

Table 1 Patient demographics and baseline characteristics

Characteristic	Study population (*N* = 661)
Age (years), mean ± SD	43.5 ± 14.8
Male, *n* (%)	421 (63.7)
BMI (kg/m^2), mean ± SD	23.3 ± 3.6
Age of onset (years), mean ± SD	32.2 ± 14.3
Duration of psoriasis (years), mean ± SD	11.3 ± 8.9
Baseline PASI score, mean ± SD	18.6 ± 10.9
Had a history of inappropriate treatment regarding psoriasis severity, *n* (%)	427 (64.6)
Had current inappropriate treatment regarding psoriasis severity, *n* (%)	95 (14.4)
Psoriasis severity, n (%)	
Mild	156 (23.6)
Moderate	232 (35.1)
Severe	273 (41.3)
With at least one psoriasis treatment previously, n (%)	518 (78.4)
Topical treatment	499 (75.5)
Oral treatment	47 (7.1)
Phototherapy	25 (3.8)
Biologic agents	43 (6.5)
Had a history of inappropriate treatment regarding psoriasis severity, *n* (%)	427 (64.6)
Had current inappropriate treatment regarding psoriasis severity, *n* (%)	95 (14.4)

BMI Body mass index, *N* total number of patients, *n* number of patients, *PASI* Psoriasis Area and Severity Index, *SD* standard deviation

comorbidities was lower in patients who were given cDMARDS in combination with phototherapy than in those receiving topical treatment exclusively (PR = 0.49 [95% CI 0.26; 0.94]; $p = 0.008$). In terms of individual comorbidities, the prevalence of dyslipidemia was higher in patients treated with biologics than in those treated with topical treatment alone (PR = 1.32 [95% CI 1.07; 1.62]; $p = 0.006$). On the contrary, the prevalence of hypertension was lower in patients treated with biologics than in those treated with topical treatment (PR = 0.69 [95% CI 0.48; 0.98]; $p = 0.044$); similarly, the prevalence of PsA in the cDMARDs group was less than that in the topical treatment group (PR = 0.31 [95% CI 0.13; 0.76]; $p = 0.006$) (Table 4).

Treatment Patterns and Drug Survival in Patients with Psoriasis-Related Comorbidities

Nearly one-fourth of patients had undergone non-biologic treatment prior to the current biologic therapies, 25.1% of patients had a history of receiving topical treatment, and 7.9% of patients had a history of other treatment modalities taken together, such as conventional oral medication, phototherapy, and biologic therapy. Overall, 45.0% of patients received concomitant treatment with biologic therapy.

Overall, 23.2% of the patients with comorbidities undergoing biologic therapies discontinued the treatment, of whom 37.8% discontinued due to financial issues and 6.7% discontinued for not achieving the expected efficacy (Table 5). Drug survival in the comorbid population was higher in the biologic treatment group (17.0 months, interquartile range [IQR] 9.3–22.0 months) than in the non-biologic treatment group (6.0 months, IQR 2.0–14.0 months). In the non-biologic group, patients receiving topical treatment had the highest retention time (7.0 months, IQR 3.0–14.0 months) compared to those receiving other treatments.

Table 2 Comorbidity and treatment patterns in patients with psoriasis

Comorbidities	Prevalence of specific comorbidity, *n* (%)	Prevalence of comorbidity with appropriate treatment, *n* (%)	Age at onset (years), mean ± SD	Duration from the onset of psoriasis to diagnosis of comorbidity/comorbidities (years), mean ± SD	Age at initiation of treatment (years), mean ± SD	Duration from the onset of comorbidity/comorbidities to appropriate treatment (years), mean ± SD
With at least one comorbidity	395/661 (59.8)	193/395 (48.9)	–	–	–	–
Dyslipidemia	328/661 (49.6)	139/328 (42.4)	48.5 ± 12.9	10.6 ± 8.8	56.4 ± 10.3	0.0 ± 0.2
Hypertension	155/661 (23.4)	151/155 (97.4)	53.1 ± 8.7	8.9 ± 11.8	53.4 ± 8.7	0.2 ± 0.7
PsA	69/661 (10.4)	69/69 (100.0)	40.6 ± 14.7	7.9 ± 10.4	41.4 ± 14.2	0.8 ± 3.4
DM	40/661 (6.1)	38/40 (95.0)	53.2 ± 9.0	9.2 ± 12.8	54.4 ± 7.9	0.1 ± 0.5
Obesity	30/661 (4.5)	0/30 (0.0)	39.9 ± 13.9	9.2 ± 7.7		
'Other comorbidities'	39/661 (5.9)	33/39 (84.6)	–	–	–	–
Anxiety-Depression	19/661 (2.9)	–	–	–	–	–
IBD	10/661 (1.5)	–	–	–	–	–
CVD	9/661 (1.4)	–	–	–	–	–
AS	5/661 (0.8)	–	–	–	–	–
Other minor comorbidities[a]	4/661 (0.6)	–	–	–	–	–
Other chronic arthritis	3/661 (0.5)	–	–	–	–	–

Table 2 continued

Comorbidities	Prevalence of specific comorbidity, *n* (%)	Prevalence of comorbidity with appropriate treatment, *n* (%)	Age at onset (years), mean ± SD	Duration from the onset of psoriasis to diagnosis of comorbidity/comorbidities (years), mean ± SD	Age at initiation of treatment (years), mean ± SD	Duration from the onset of comorbidity/comorbidities to appropriate treatment (years), mean ± SD
RA	2/661 (0.3)	–	–	–	–	–

AS Ankylosing spondylitis, *CVD* cardiovascular diseases, *DM* diabetes mellitus, *IBD* inflammatory bowel disease, *n* number of patients, *PsA* psoriatic arthritis, *RA* rheumatoid arthritis

[a]Other minor comorbidities include: femoral head avascular necrosis, lymph node tuberculosis, hepatitis B, elevated liver transaminase with unknown cause

Economic Burden Associated with Psoriasis-Related Comorbidities

The annual mean costs of psoriasis and comorbidity treatment were higher (US dollars [USD] 637) than those of psoriasis treatment alone (USD591). Patients with comorbidities had to bear the annual cost that was almost threefold higher than those without comorbidities (USD901 vs. USD304; $p < 0.001$). Within the group of specific comorbidities, patients with obesity had the highest expenditure for psoriasis treatment (USD 5536), followed by those with PsA (USD3468) and dyslipidemia (USD1026). The respective sub-groups of patients without comorbidities such as obesity, PsA, and dyslipidemia had expenditures ranging from USD392 to USD579. Contrary to these findings, patients with DM or hypertension as a comorbidity had a lower expenditure for psoriasis treatment when compared to their non-comorbid counterparts (Fig. 1).

DISCUSSION

To the best of our knowledge, this is the first study that provides real-world insight into the prevalence of comorbidities, associated treatment patterns, and economic burden among patients with psoriasis in Vietnam. Consistent with previous analyses, in the present study more men were identified with psoriasis and the average age of patients was 43.5 years [7, 12, 13]. We observed a high prevalence of moderate to severe psoriasis in these patients, which may possibly be explained by both study sites being top-tier dermatology hospitals in Vietnam, which tend to admit patients with more severe forms of psoriasis. Patients in the current study had a mean (SD) body mass index (BMI) of 23.3 (3.6) kg/m^2, which is slightly different from another study conducted in Vietnam in which patients with psoriasis had a mean BMI of 21.9 (3.1) kg/m^2 [6]. Additionally, the BADBIR cohort study conducted in the UK found that the BMI was 30.8 (7.2) kg/m^2 in 13,422 patients with psoriasis, which is higher than that observed in the current study [14].

Table 3 Models of psoriasis treatment in terms of the specific comorbidity according to the 95% confidence interval evaluated using the Clopper-Pearson/Exact method

Overall and specific comorbidity	Topical treatment		Oral treatment		Phototherapy		Biologic agents	
	With (*n* = 429)	Without (*n* = 232)	With (*n* = 227)	Without (*n* = 434)	With (*n* = 95)	Without (*n* = 566)	With (*n* = 291)	Without (*n* = 370)
Overall rate (*n* = 661)	429 (64.9) [61.1; 68.5]	232 [35.1) (31.5; 38.9]	34.3 [30.7; 38.1]	65.7 [61.9; 69.3]	14.4 [11.8; 17.3]	85.6 [82.7; 88.2]	44.0 [40.2; 47.9]	56.0 [52.1; 59.8]
Psoriasis severity								
Mild (*n* = 156)	113 (26.3) [22.2; 30.8]	43 (18.5) [13.8; 24.1]	61 (26.9) [21.2; 33.1]	95 (21.9) [18.1; 26.1]	24 (25.3) [16.9; 35.2]	132 (23.3) [19.9; 27.0]	22 (7.6) [4.8; 11.2]	134 (36.2) [31.3; 41.3]
Moderate (*n* = 232)	139 (32.4) [28.0; 37.1]	93 (40.1) [33.7; 46.7]	69 (30.4) [24.5; 36.8]	163 (37.6) [33.0; 42.3]	27 (28.4) [19.6; 38.6]	205 (36.2) [32.3; 40.3]	117 (40.2) [34.5; 46.1]	115 (31.1) [26.4; 36.1]
Severe (*n* = 273)	177 (41.3) [36.6; 46.1]	96 (41.4) [35.0; 48.0]	97 (42.7) [36.2; 49.4]	176 (40.6) [35.9; 45.3]	44 (46.3) [36.0; 56.8]	229 (40.5) [36.4; 44.6]	152 (52.2) [46.3; 58.1]	121 (32.7) [27.9; 37.7]
Comorbidity								
With (*n* = 395)	251 (58.5) [53.7; 63.2]	144 (62.1) [55.5; 68.3]	139 (61.2) [54.6; 67.6]	256 (59.0) [54.2; 63.7]	41 (43.2) [33.0; 53.7]	354 (62.5) [58.4; 66.5]	194 (66.7) [60.9; 72.1]	201 (54.3) [49.1; 59.5]
Without (*n* = 266)	178 (41.5) [36.8, 46.3]	88 (37.9) [31.7; 44.5]	88 (38.8) [32.4; 45.4]	178 (41.0) [36.3; 45.8]	54 (56.8) [46.3; 67.0]	212 (37.5) [33.5; 41.6]	97 (33.3) [27.9; 39.1]	169 (45.7) [40.5; 50.9]
PsA								
With (*n* = 69)	47 (11.0) [8.2; 14.3]	22 (9.5) [6.0; 14.0]	21 (9.3) [5.8; 13.8]	48 (11.1) [8.3; 13.4]	4 (4.2) [1.2; 10.4]	65 (11.5) [9.0; 14.4]	42 (14.4) [10.6; 19.0]	27 (7.3) [4.9; 10.4]
Without (*n* = 592)	382 (89.0) [85.7; 91.8]	210 (90.5) [86.0; 94.0]	206 (90.7) [86.2; 94.2]	386 (88.9) [85.6; 91.7]	91 (95.8) [90.0; 98.8]	501 (88.5) [85.6; 91.0]	249 (85.6) [81.0; 89.4]	343 (92.7) [89.6; 95.1]
DM								
With (*n* = 40)	30 (7.0) [4.8; 9.8]	10 (4.3) [2.1; 7.8]	18 (7.9) [4.8; 12.2]	22 (5.1) [3.2; 7.6]	5 (5.3) [1.7; 11.9]	35 (6.2) [4.3; 8.5]	18 (6.2) [3.7; 9.6]	22 (5.9) [3.8; 8.9]
Without (*n* = 621)	399 (93.0) [90.2; 95.2]	222 (95.7) [92.2; 97.9]	209 (92.1) [87.8; 95.2]	412 (94.9) [92.4; 96.8]	90 (94.7) [88.1; 98.3]	531 (93.8) [91.5; 95.7]	273 (93.8) [90.4; 96.3]	348 (94.1) [91.1; 96.2]

Table 3 continued

Overall and specific comorbidity	Topical treatment		Oral treatment		Phototherapy		Biologic agents	
	With (n = 429)	Without (n = 232)	With (n = 227)	Without (n = 434)	With (n = 95)	Without (n = 566)	With (n = 291)	Without (n = 370)
Hypertension								
With (n = 155)	117 (27.3) [23.1; 31.8]	38 (16.4) [11.9; 21.8]	60 (26.4) [20.8; 32.7]	95 (21.9) [18.1; 26.1]	18 (18.9) [11.6; 28.3]	137 (24.2) [20.7; 28.0]	54 (18.6) [14.3; 23.5]	101 (27.3) [22.8; 32.1]
Without (n = 506)	312 (72.7) [68.2; 76.9]	194 (83.6) [78.2; 88.1]	167 (73.6) [67.3; 79.2]	339 (78.1) [73.9; 81.9]	77 (81.1) [71.7; 88.4]	429 (75.8) [72.0; 79.3]	237 (81.4) [76.5; 85.7]	269 (72.4) [67.9; 77.2]
Dyslipidemia								
With (n = 328)	204 (47.6) [42.7; 52.4]	124 (53.4) [46.8; 40.0]	116 (51.1) [44.4; 57.8]	212 (48.8) [44.1; 53.7]	29 (30.5) [21.5; 40.8]	299 (52.8) [48.6; 57.0]	166 (57.0) [51.1; 62.8]	162 (43.8) [38.7; 49.0]
Without (n = 333)	225 (52.4) [47.6; 57.3]	108 (46.6) [40.0; 53.2]	111 (48.9) [44.2; 55.6]	222 (51.2) [46.3; 55.9]	66 (69.5) [59.2; 78.5]	267 (47.2) [43.0; 51.4]	125 (43.0) [37.2; 48.9]	208 (56.2) [51.0; 61.3]
Obesity								
With (n = 30)	15 (3.5) [2.0; 5.7]	15 (6.5) [3.7; 10.4]	10 (4.4) [2.1; 8.0]	20 (4.6) [2.8; 7.0]	2 (2.1) [0.3; 7.4]	28 (4.9) [3.3; 7.1]	18 (6.2) [3.7; 9.6]	12 (3.2) [1.7; 5.6]
Without (n = 631)	414 (96.5) [94.3; 98.0]	217 (93.5) [89.6; 96.3]	217 (95.6) [92.0; 97.9]	414 (95.4) [93.0; 97.2]	93 (97.9) [92.6; 99.7]	538 (95.1) [92.9; 96.7]	273 (93.8) [90.4; 96.3]	358 (96.8) [94.4; 98.3]

Values in table are presented as the number (of patients) with the percentage in parentheses and the 95% confidence interval in square brackets
n Number of patients

Table 4 The relationship of models of psoriasis treatment and the specific comorbidities

Overall comorbidities and specific comorbidities	Topical treatment exclusively	cDMARD(s) treatment exclusively [95% CI]	Phototherapy exclusively	cDMARDs and phototherapy [95% CI]	Biologic therapy [95% CI]
Comorbidity/comorbidities		$p = 0.73$[a]	$p = 0.149$	$p = 0.008$ PR = 0.49 [(0.26; 0.94]	$p = 0.036$ PR = 1.17 [1.01; 1.38]
With	89	88	17	7	194
Without	68	62	21	18	97
PsA		$p = 0.006$[a] PR = 0.31 [0.13; 0.76]	$p = 0.071$[b]	$p = 0.059$[b]	$p = 0.620$[a]
With	20	6	1	0	42
Without	137	144	37	25	249
DM		$p = 0.431$[a]	$p = 0.437$[b]	$p = 0.220$[b]	$p = 0.848$[a]
With	9	12	1	0	18
Without	148	138	37	25	273
Hypertension		$p = 0.528$[a]	$p = 0.957$[a]	$p = 0.251$[a]	$p = 0.044$[a] PR = 0.69 [0.48; 0.98]
With	42	45	10	4	54
Without	115	105	28	21	237
Dyslipidemia		$p = 0.959$[a]	$p = 0.469$[a]	$p = 0.068$[a]	$p = 0.006$[a] PR = 1.32 [1.07; 1.62]
With	68	74	14	6	166
Without	89	76	24	19	125

Table 4 continued

Overall comorbidities and specific comorbidities	Topical treatment exclusively	cDMARD(s) treatment exclusively [95% CI]	Phototherapy exclusively	cDMARDs and phototherapy [95% CI]	Biologic therapy [95% CI]
Obesity		$p = 0.701$[a]	$p = 0.859$[b]	$p = 0.366$[b]	$p = 0.170$[a]
With	5	6	1	0	18
Without	152	144	37	25	273

CI Confidence interval, *cDMARDs* conventional disease-modifying antirheumatic drugs, *PR* probability ratio

[a] *p* values were calculated with the Chi-squared test for exclusive topical treatment

[b] *p* values were calculated with the Fisher exact test for exclusive topical treatment

This study confirmed the high comorbidity burden in patients with psoriasis, as reported in previous studies [15, 16]. The proportion of patients in the present study with at least one comorbidity was 59.8%, mostly due to the high proportion of patients with dyslipidemia. This finding is similar to that of another study conducted in Vietnam in which 53.9% of patients with psoriasis had dyslipidemia as a comorbidity [6]. However, this finding differs from a study conducted in China in which only 13.7% of patients had dyslipidemia [7]. This result may suggest a higher prevalence of dyslipidemia in patients with psoriasis in Vietnam compared to other Asian countries. In this study, hypertension was the second-most common comorbidity in patients with psoriasis. This result is similar to observations from previous studies in which the proportion of patients with psoriasis having hypertension ranged from 16.4% to 27.5% [5, 7]. In studies carried out in other areas, the prevalence of PsA was lower, especially in the northern population of Spain (9.8%) and in the UK (13.8%) [17, 18].

A systematic review of 27 studies found that the prevalence of DM among patients with psoriasis ranged from 4.4% to 54.0% [19]. According to research conducted in China, 7.8% of 12,000 patients with psoriasis had DM, which is similar to our findings (6.1%) [7]. The prevalence of obesity reported in the current study (4.5%) was also close to that observed in China (5.2%) [7]. Compared to the present study population, a higher proportion of patients were diagnosed with obesity (8.4%) in patients with psoriasis in Israel [5]. Among all 'other comorbidities,' anxiety-depression was the most prevalent in the present study; this finding was expected as anxiety-depression is a common comorbidity in these patients [20].

Except for obesity and dyslipidemia, the present study demonstrated that a high proportion of patients received the appropriate treatment for comorbidities, ranging from 84.6 to 100% of all patients. The age at onset of comorbidities and the age at the initiation of appropriate treatments for the specific disease were almost the same, indicating that these comorbidities are usually treated early after diagnosis.

Table 5 History of various treatment modalities, discontinuations, and drug survival

Characteristics	Values
History of biologic treatment prior to current biologic therapy, *n* (%)	11/291 (3.8)
Concomitant treatment with biologic therapy, *n* (%)	131/291 (45.0)
Stop current psoriasis biologic therapy within comorbidity group, *n* (%)	45/194 (23.2)
History of non-biologic treatment prior to current biologic therapy, n (%)	74/291 (25.4)
Topical treatment	73/291 (25.1)
Oral treatment	9/291 (3.1)
Phototherapy	3/291 (1.0)
Reasons for stopping biologic therapy in those with comorbidity, n (%)	
Planning for a pregnancy	1/45 (2.2)
Switching to other agents or continued in another facility	4/45 (8.9)
Financial issues	17/45 (37.8)
Adverse events	1/45 (2.2)
Do not achieve the as-expected efficacy	3/45 (6.7)
Unknown causes/loss of follow-up	19/45 (42.2)
Duration with treatment in those with comorbidity, months, (IQR)	
Biologic therapy (n = 194)	17.0 (9.3, 22.0)
Non-biologic therapy (n = 266)	6.0 (2.0, 14.0)
Topical treatment (n = 252)	7.0 (3.0, 14.0)
Oral treatment (n = 139)	3.0 (1.0, 6.5)
Phototherapy (n = 34)	1.0 (1.0, 1.0)
Combined therapy (n = 208)	4.0 (2.0, 7.3)

IQR Inter-quartile range, *n* number of patients

The study demonstrated that the more severe the disease, the higher the likelihood of patients receiving effective therapy, such as cDMARDs and biologic agents. In corroboration with this finding, Takeshita et al. [20] demonstrated that patients with severe forms of psoriasis were more likely to receive biologic treatments. The finding that patients with PsA were more likely to receive biologic agents than other medications could be due to the more severe disease in these patients. A high proportion of patients with obesity receiving biologics may suggest that the disease tends to be more severe in these patients.

The high proportion of patients with dyslipidemia in those treated with biologics and cDMARDs can be explained by the fact that serum lipid tests were done more routinely in patients treated with these modalities.

Patients with psoriasis receiving biologic therapy had a higher prevalence of comorbidities than those receiving only topical treatment. This high prevalence could be attributed to the diagnosis of comorbidities based on routine screening and laboratory investigations performed on patients treated with biologic agents. hypertension among patients receiving biologic therapy was less prevalent that hypertension

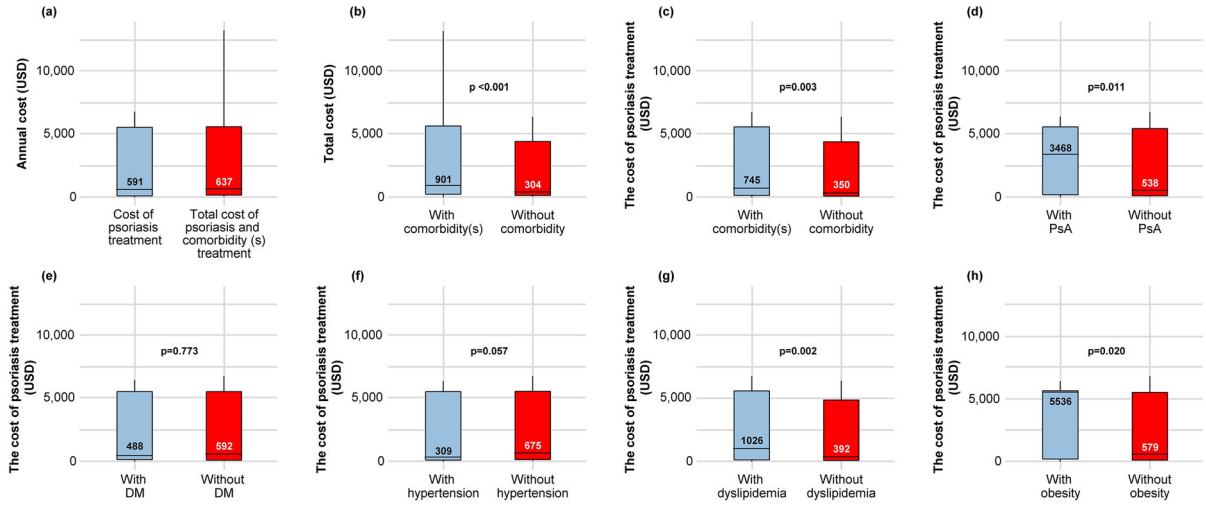

Fig. 1 Boxplots of expenditure in patient groups according to comorbidities relating to psoriasis. **a** Cost of psoriasis treatments and the total expenditure, **b** total expenditure regarding comorbidities, **c–h** cost of psoriasis treatment in patients with comorbidities (**c**), PsA (**d**), DM (**e**), hypertension (**f**), dyslipidemia (**g**), and obesity (**h**). *p* values were obtained using the Mann–Whitney–Wilcoxon test. Values in boxes above the horizontal line are means. *DM* Diabetes mellitus, *PsA* psoriatic arthritis, *USD* US dollar

among patients with topical treatment, and patients receiving cDMARDs had a lower prevalence of PsA than patients receiving topical treatment. These differences may be due to the small number of patients treated with such modalities. However, these results are in line with those of BADBIR study in which the authors reported a higher proportion of patients with history of hypertension, DM, dyslipidemia, and PsA among patients receiving biologic therapy than among those receiving cDMARDs [21].

In addition, in the present study 45.0% of the patients received concomitant treatments with biologic medications, whereas Takeshita et al. [20] found that only 38.2% of patients received concomitant treatments. During the entire study period, 23.2% of the patients with comorbidities in the present study discontinued biologic therapies, with 37.8% of patients discontinuing due to financial issues. In contrast, a 12-month follow-up study in the USA found that approximately 46.0% of patients stopped using biologic therapy [22]. Interestingly, in the current study, biologic therapy had the longest retention period, followed by topical treatment; phototherapy had the shortest retention time, possibly because phototherapy requires patients to stay close to the treatment facility and to make multiple visits every week. Because both study sites were two of the few facilities in their respective regions able to treat patients with phototherapy, the number of treatment sessions and patients' adherence to this therapy may have been affected.

In a study conducted in Malaysia, the total cost of psoriasis treatment per capita was 10,634 Malaysian Ringgits (approximately USD2569 in 2019), which is significantly higher than our findings [12]. This difference may be explained by the fact that the Malaysian study not only reported the cost of medication, but also included the costs of laboratory tests, radiography, out-of-pocket expenses, transportation, and loss of productivity in the overall costs. However, in the current study, only the costs of medications for treating the psoriasis and associated comorbidities were considered. In comparison to a study conducted in Germany, the psoriasis medication cost was EUR4978 (equivalent to USD6841), which is higher than our results [23]. A study in the USA reported that the total cost for the treatment of psoriasis and its comorbidities was USD27,123 in 2015,

which is also higher than our results [15]. Of note, the cost of psoriasis medication in the USA increased from USD4555 to USD7829 from 2009 to 2014 [24]. Patients with comorbidities had a higher total annual cost than those without ($p < 0.001$). Patients with obesity had a higher expenditure for psoriasis than those with other comorbidities, as most of the patients with obesity were treated with biologic agents. Similarly, a high proportion of patients with dyslipidemia being treated with biologic and cDMARDs for psoriasis may explain the high cost for psoriasis in the dyslipidemia group.

The current study had a number of limitations, including low patient numbers for the comorbidities not specifically selected and specific limitations inherent to a retrospective chart review study. The findings cannot be generalized to the entire population as the data were extracted from only two sites. Further, these sites were tertiary centers that are more likely to provide care to patients with more severe form of the disease; consequently, patients with milder forms of the disease may have been underrepresented. Moreover, it is difficult to compare and interpret the results of this study in the absence of data from similar studies conducted in Vietnam.

CONCLUSIONS

Psoriasis has a high comorbidity and economic burden. These findings, which are consistent with previous results in the literature, demonstrate that a substantial proportion of patients with psoriasis have comorbid conditions that may confer additional health risks and may influence the choice of treatment. Given the sparsity of data on the prevalence of comorbidities in patients with psoriasis in Vietnam, this real-world study provides dermatologists with practical information on the diagnosis and management of comorbidities often found in patients with psoriasis. In clinical practice, a multidisciplinary approach should be followed where screening for comorbidities associated with psoriasis is performed by dermatologists and general practitioners, especially in severe cases. Further research is needed for a deeper understanding of the dynamics of comorbidity burden in patients with psoriasis in Vietnam.

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Data Availability. All data generated or analyzed during this study are included in this published article.

Declarations

Conflict of interest. Hao Trong Nguyen has served as an advisory board member and speaker for Novartis, Janssen, and Menarini. Nhi Thi Uyen Pham, Tu Nguyen Anh Tran, and Thao Thi Phuong Vu have served as a speaker for Novartis, Janssen, and Menarini. Huong Thi Thanh Bui, Vi Thi Thuy Dinh have served as a speaker for Novartis. Huong Thi Thanh Bui, Vi Thi Thuy Dinh have served as a speaker for Novartis. Yen Thi Bui was an employee of Novartis Vietnam Co., Ltd at the time of manuscript development. Anh Tuan Vu, Nguyen Nhat Pham, and Thuyen Thi Pham have nothing to disclose.

Ethics approval. This study has been reviewed and approved by the Institutional Review Board/Independent Ethics Committee of Ho Chi Minh City Hospital of Dermato-Venereology and Quy Hoa National Leprosy Dermatology Hospital. Informed consent was waived due to the retrospective nature of the study.

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