ORIGINAL RESEARCH

The Epidemiology of Palmoplantar Pustulosis: An Analysis of Multiple Health Insurance Claims and Electronic Health Records Databases

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ABSTRACT

Background: Palmoplantar pustulosis (PPP) is a chronic inflammatory condition characterized by sterile pustules on the palms and soles. This study evaluated the epidemiology of PPP using claims and electronic health record (EHR) databases.

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Methods: Patients coded for PPP in the United States (US) and Japan from 2016 to 2020 were identified. Several PPP definitions were evaluated; the specific definition ($\geq$ 2 visits coded for PPP, the second 31–730 days after diagnosis) was chosen for characterizing PPP epidemiology. Baseline characteristics and pre- and post-diagnosis treatments were summarized. Prevalence and incidence rates were analyzed by calendar year, sex, age, and database.
Results: Prevalence and incidence of PPP were higher in Japan than the US. PPP prevalence increased over time. PPP occurred predomi-

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nantly in adulthood and was more common among women. Features of metabolic syndromes, anxiety, and depression were more common among US PPP patients. Consistently high baseline use of anti-bacterial, anti-inflammatory/anti-rheumatic, and obstructive airway disease treatments was observed among PPP patients. Potential miscoding or misclassification of PPP limited this analysis. Prevalence estimates from databases may differ from field- and population-based approaches.

Conclusions: The burden of PPP was greater in Japan than in the US. Additional studies are needed to further elucidate PPP epidemiology worldwide.

Keywords: Epidemiology; Incidence; Japan; Palmoplantar pustulosis; Prevalence; United States

Key Summary Points

Palmoplantar pustulosis (PPP) prevalence and incidence of PPP were an order of magnitude higher in Japan than the United States (US); prevalence of disease increased over time in both countries.

PPP occurred predominantly in adulthood and was more common among women.

This analysis provides insight into characteristics associated with PPP and highlights the greater burden of disease in Japan versus the US.

INTRODUCTION

Palmoplantar pustulosis (PPP) is a rare, chronic, and debilitating inflammatory skin condition characterized by recurrent crops of sterile pustules on the palms and soles [1, 2]. The categorization of PPP is evolving; whether it represents a subtype of palmoplantar psoriasis, a localized type of pustular psoriasis, or a separate

condition is unclear [3]. PPP may present as a primary condition, in association with plaque psoriasis or paradoxical psoriasis (tumor necrosis factor [TNF]-induced psoriasis/psoriasiform dermatitis), or as a feature of auto-inflammatory syndromes, such as synovitis, acne, pustulosis, hyperostosis, and osteitis (SAPHO) syndrome [3, 4]. Although insights into the potential roles of the interleukin (IL)-17, IL-36, and TNF pathways have been gained, the pathogenesis of PPP remains unknown [3, 5, 6].

Because PPP is designated by a single International Classification of Disease version 10 (ICD-10) diagnostic code, health insurance claims and electronic health record (EHR) databases may be used to study the epidemiology of PPP. Using national claims data, Kubota et al. reported a prevalence for PPP of 0.12% in Japan [7]; however, the reported prevalence of PPP was lower (0.001–0.08%) using data from the United States (US) and Europe (Denmark, Germany, and Sweden) [8, 9]. Nonetheless, all these studies found PPP to be more prevalent among women than men and, in studies that included age-specific estimates, PPP was very rare among patients < 18 years of age [7, 9].

Our study sought to further characterize the epidemiology of PPP using claims and EHR databases, specifically in the US and Japan. The study evaluated PPP prevalence and incidence, baseline patient characteristics, and treatments initiated after PPP diagnosis. In addition, we propose novel definitions of PPP to explore approaches for optimizing criteria for identifying PPP patients in claims and EHR databases.

METHODS

Study Population

The ICD-10 code for PPP (L40.3), adopted in Japan in 1994 and the US in 2015, was used to identify patients. Consequently, this analysis was restricted to patients diagnosed with PPP from 2016 to 2020. Three PPP definitions were chosen for consideration: a sensitive definition based on one visit with a PPP diagnostic code; a

specific definition requiring ≥ 2 visits with a PPP code (the second 31–730 days after the first); and a hybrid definition consisting of the specific definition or a single PPP code from a dermatology setting. During evaluation of these definitions, search queries identified infants with post-scabetic acral pustules who were misdiagnosed/misclassified as having PPP. Therefore, patients of any age who were diagnosed with scabies (infestation by *Sarcoptes scabiei* var. *hominis*) or the related condition, acropustulosis of infancy, and/or those prescribed scabies treatments were excluded from the sensitive definition. The specific and hybrid definitions inherently excluded cases of misdiagnosed PPP in infants.

The study population included patients of all ages. For the purposes of epidemiology characterization, the primary analysis was based on the specific PPP definition.

Databases

This study included four claims databases from the US [IBM®MarketScan® Commercial Database (CCAE), Optum's de-identified Clinformatics® DataMart Database (Optum SES), IBM®MarketScan® Multi-State Medicaid Database (MDCD), and IBM®MarketScan® Medicare Supplemental Database (MDCR)], one claims database from Japan [Japan Medical Data Center (JMDC©)], and one US EHR database [Optum® de-identified Electronic Health Record Dataset (Optum EHR)]. CCAE, Optum SES, and Optum EHR represent privately insured patients across the US. MDCR represents patients with private insurance and supplemental Medicare insurance, whereas MDCD represents patients with public insurance (Medicaid). MDCR is generally limited to patients ≥ 65 years of age. JMDC included claims for employed patients and their dependents, and is limited to enrollees < 65 years of age. Data from all the databases were converted to the Observational Medical Outcome Partnership Common Data Model, Version 5.3.1 [10, 11].

Statistical Analysis

For all definitions, the index date was defined by the first diagnosis code. Index dates could be adjusted to account for potential misclassification if PPP-associated signs and symptoms occurred within 30 days of the initial PPP diagnosis. Baseline characteristics were summarized using data from the year before the index date. Pre- and post-index assessments examined PPP treatments prescribed in the years prior to and after the index date.

Consistent with the period prevalence methodology outlined by the Centers for Disease Control [12], annual prevalence estimates were calculated using the number of patients diagnosed with PPP during or prior to a given calendar year divided by the number of patients in the database on July 1 (mid-interval population). Incidence rate estimates were calculated as patients/1000 person-years, excluding patients with PPP prior to the index date. Prevalence and incidence rates were analyzed by calendar year, sex, age, and database. Analyses were performed using a web-based, interactive, Observational Health Data Sciences and Informatics (OHDSI)-developed Cohort Diagnostics application (Version 2.2.4; https://ohdsi.github.io/CohortDiagnostics/).

RESULTS

Identified PPP Patients

Fewer patients with PPP were identified using the specific versus the sensitive PPP definition (Table 1). The primary analysis, reported here, focused on patients identified using the specific definition.

Using the specific definition, more PPP patients were identified in JMDC ($n = 6376$) than in the US databases; the fewest PPP cases were identified in MDCD ($n = 578$) and MDCR ($n = 195$; Table 1). Most patients in the specific PPP cohort were ≥ 18 years of age. Index dates were adjusted for misclassification in 10–20% of patients across the databases. Counts and characteristics may be viewed interactively at https://data.ohdsi.org/PPPCohortDiagnostics.

Table 1 Numbers of PPP patients by database and PPP definition

	Japan	US				
	JMDC	Optum EHR	Optum SES	CCAE	MDCD	MDCR[e]
All patients						
Sensitive PPP definition[a]	11,026	7404	5293	5408	1555	661
Hybrid PPP definition[b]	NR	2555	2707	3420	685	350
Specific PPP definition[c]	6376	1848	1563	1838	578	195
PPP patients (per specific definition)[c] by age group, *n*	6376	1848	1563	1838	578	195
≤ 11 years of age, *n* (%)	202 (3.17)	25 (1.35)	9 (0.58)	25 (1.36)	31 (5.36)	NA[e]
12–17 years of age, *n* (%)	144 (2.26)	37 (2.00)	13 (0.83)	25 (1.36)	18 (3.11)	NA[e]
≥ 18 years of age, *n* (%)	6031 (94.59)	1786 (96.65)	1541 (98.59)	1788 (97.28)	529 (91.52)	NA[e]

PPP palmoplantar pustulosis, *JMDC* Japan Medical Data Center, *EHR* Optum® de-identified Electronic Health Record Database, *SES* Optum's Clinformatics® de-identified Data Mart Database, *CCAE* IBM®MarketScan® Commercial Database, *MDCD* IBM®MarketScan® Multi-State Medicaid Database, *MDCR* IBM®MarketScan® Medicare Supplemental Database, *NR* not reported, *NA* not applicable

[a]PPP code (ICD-10 code = L40.3) at a single visit

[b]At least 2 visits with a PPP code, with the second occurring between 31 and 730 days after the initial diagnosis, *or* diagnosis of PPP in a dermatology setting

[c]At least 2 visits with a PPP code, with the second occurring between 31 and 730 days after the initial diagnosis

[d]For all definitions, the index date (initial PPP diagnosis) could be adjusted to an earlier time if PPP-associated signs and symptoms (i.e., eruption, inflammatory dermatosis, psoriasis, and psoriasis vulgaris) occurred within 30 days prior to the date of PPP diagnosis

[e]Medicare eligibility is restricted to adults ≥ 65 years of age

Prevalence and Incidence of PPP

PPP was rare across all the databases, although the prevalence of PPP was an order of magnitude higher in JMDC (Supplementary Information Fig. 1) versus US databases (Fig. 1). For example, in 2020, the prevalence/100,000 people was 89.35 in Japan versus 8.68, 7.43, and 6.41 for Optum EHR, Optum SES, and CCAE, respectively (Supplementary Information Table 1). Higher prevalence of PPP among women versus men was observed across databases (Supplementary Information Tables 1, 2, 3, 4, 5). With each year, the prevalence of PPP increased across all databases, except for a slight

decline in 2020 in MDCR (Supplementary Information Table 1), which may reflect disruption in non-urgent services associated with the COVID-19 pandemic. This increase in PPP prevalence was primarily driven by patients ≥ 18 years of age; PPP prevalence was limited among pediatric patients (Supplementary Information Tables 2, 3, 4). Based on US data, the estimated PPP prevalence/100,000 population in 2020 was ≤ 1.28 and ≤ 2.37 among patients ≤ 11 years of age and 12–17 years of age, respectively. In contrast, the estimated PPP prevalence for 2020 using data from Japan was 14.51 for patients ≤ 11 years of age and 27.25 for those 12–17 years of age. PPP incidence rates were generally consistent with
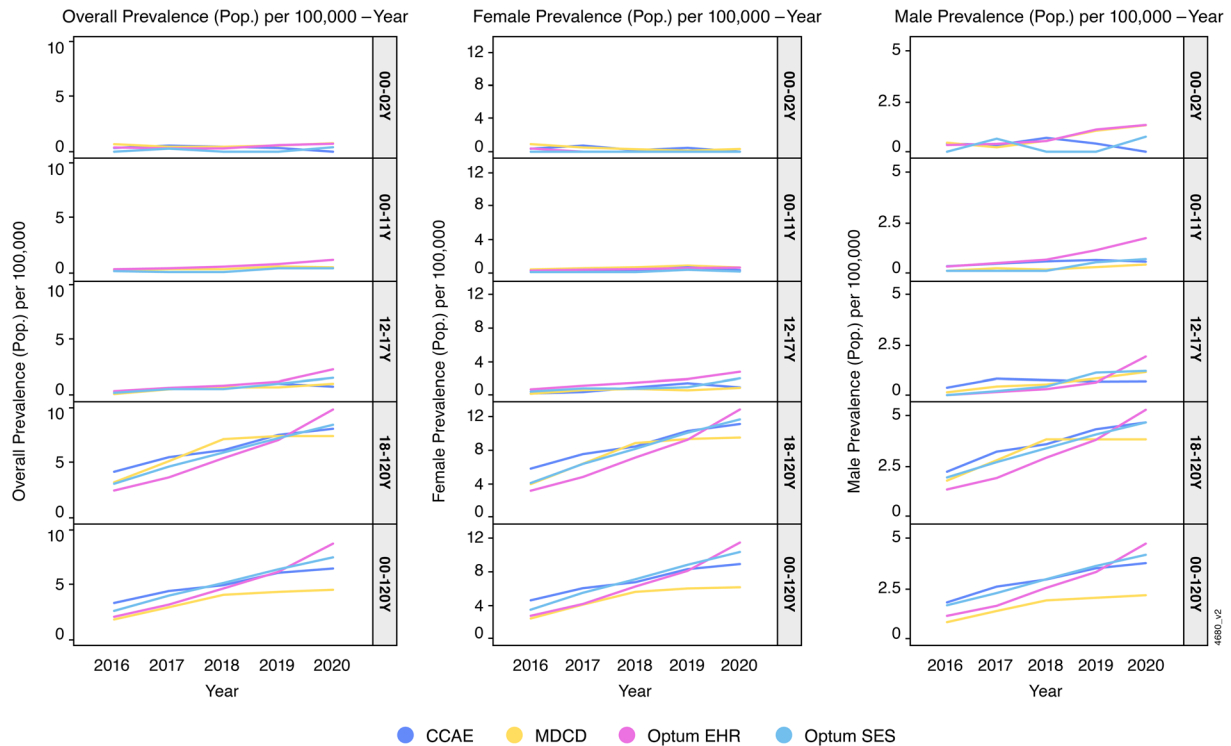
Fig. 1 Prevalence using the specific PPP definition by database, [a]age, and sex. [a]Only US databases are shown; see Fig. 2 for prevalence based on the specific PPP definition in JMDC. MDCR includes only adults ≥ 65 years of age; thus, data from MDCR were excluded from the figure to facilitate interpretability of the graphs. *PPP* palmoplantar pustulosis, *EHR* Optum® de-identified Electronic Health Record Database, *SES* Optum's Clinformatics® de-identified Data Mart Database, *CCAE* IBM® MarketScan® Commercial Database, *MDCD* IBM® MarketScan® Multi-State Medicaid Database, *MDCR* IBM® MarketScan® Medicare Supplemental Database, *US* United States

patterns of PPP prevalence. Incidence of PPP was greater in Japan than the US, and higher among women than men. However, unlike prevalence, PPP incidence rates were generally stable over time (Fig. 2; Supplementary Information Fig. 2).

Characteristics of PPP Patients

Among patients identified using the specific PPP definition, PPP occurred predominantly in adulthood and was more common among women across databases (Table 2). A higher proportion of women with PPP was seen in the US databases (67–79%) versus JMDC (57%; Table 2). In MDCD, 3% of patients with PPP were Hispanic/Latino, 32% were Black/African American, and 52% were White. Compared with MDCD, Optum EHR and Optum SES had

fewer PPP patients who were Black/African American (9–11%) and more patients who were White (75–84%); a similar proportion was Hispanic/Latino (4–7%).

Comorbidities associated with metabolic syndrome (e.g., diabetes) were consistently more common among US versus Japanese PPP patients, as were anxiety and depression (Table 3). Most autoimmune or inflammatory conditions (e.g., atopic dermatitis) occurred in PPP patients with varying frequency across databases, with some exceptions; hidradenitis suppurativa, idiopathic arthritis, and psoriatic arthritis were less common in JMDC than US databases, and atopic dermatitis was more common in JMDC. Across databases, acute respiratory disease and visual system disorders were commonly associated with PPP (≥ 40% in JMDC; ≥ 30% in ≥ 1 US database).
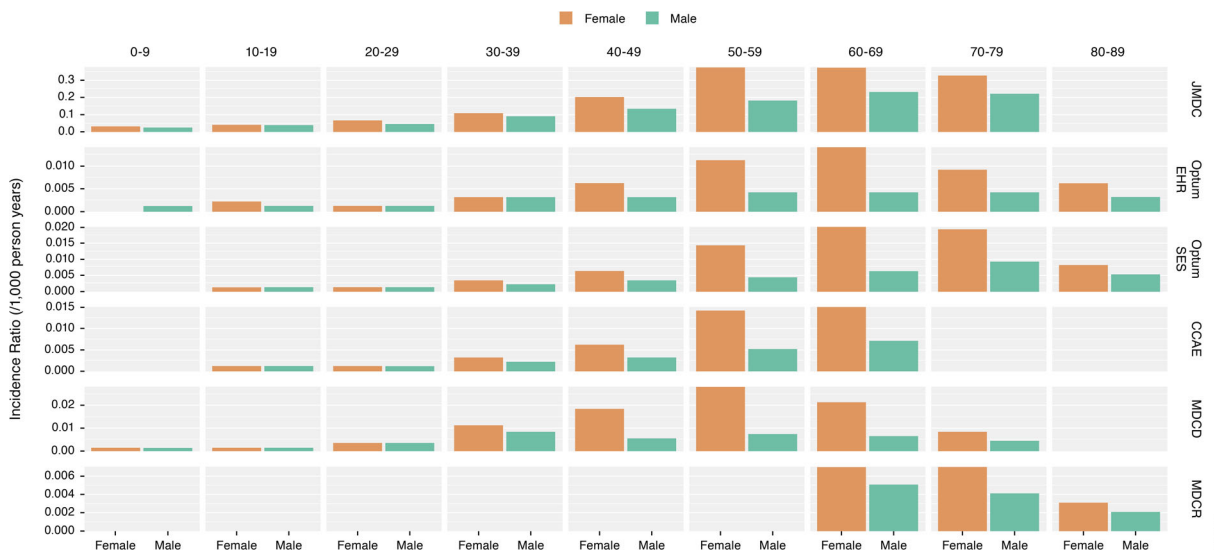
Fig. 2 Incidence rates using the specific PPP definition by database, age, and sex. *PPP* palmoplantar pustulosis, *JMDC* Japan Medical Data Center, *EHR* Optum® de-identified Electronic Health Record Database, *SES* Optum's Clinformatics® de-identified Data Mart Database, *CCAE* IBM® MarketScan® Commercial Database, *MDCD* IBM® MarketScan® Multi-State Medicaid Database, *MDCR* IBM® MarketScan® Medicare Supplemental Database, *US* United States

Consistently high baseline use of anti-bacterial (46–71%), obstructive airway disease (56–76%), and anti-inflammatory/anti-rheumatic (28–51%) treatments was observed. Higher rates of anti-malarial treatment use were seen in the US (2–3% pre-diagnosis; 1–2% post-diagnosis, where estimates were available) compared with Japan, where anti-malarial treatment was rare (< 0.1% pre- and post-diagnosis). At baseline, treatments for conditions associated with metabolic syndromes and mental health conditions were more commonly prescribed for PPP patients in the US than Japan, mirroring the frequency of their corresponding comorbidities.

Use of retinoids (5–7%), mostly acitretin, was observed in the post-diagnosis period in the US; however, evidence for their use was rare (≤ 1%) in Japan. Pre-diagnosis treatment with anti-TNFα agents was more frequent in US databases than in JMDC (4–13% and 0.8%, respectively, Supplementary Information Table 6), a pattern that was also seen 31–365 days post-diagnosis (6–16% and 0.8%, respectively; Supplementary Information Table 7). In the US, adalimumab (4–10%), secukinumab (3%), and ustekinumab (2–3%) were the most frequently prescribed post-diagnosis biologics. Post-diagnosis use of biologics was rare (≤ 1%) in Japan; however, post-diagnosis use of phototherapy was more common in Japan than in the US. This observation is consistent with common clinical practice since patients in Japan typically must fail to respond to phototherapy and/or topical corticosteroids before treatment with biologics is considered.

DISCUSSION

Through analysis of several available health insurance claims and EHR databases, this study sought to characterize the epidemiology of PPP in the US and Japan. Our findings identified an order of magnitude greater burden (by prevalence and incidence) of PPP in Japan versus the US. Despite this striking cross-national difference, results from both countries indicated PPP is more common among women and is rarely seen in patients < 25 years of age. In both countries, prevalence of PPP increased over time, which may reflect improvements in

Table 2 Baseline demographics of PPP patients identified using the specific definition

	Japan	US				
	JMDC (*n* = 6376)	Optum EHR (*n* = 1848)	Optum SES (*n* = 1563)	CCAE (*n* = 1838)	MDCD (*n* = 578)	MDCR (*n* = 195)
Age group						
0–4	0.7%	0.8%	< 0.3%	0.4%	3.1%	–
5–9	1.6%	0.4%	< 0.3%	0.4%	1.7%	–
10–14	2.1%	0.8%	0.6%	1.2%	2.3%	–
15–19	1.7%	2.3%	0.7%	1.5%	2.3%	–
20–24	2.1%	1.5%	1.0%	1.4%	1.7%	–
25–29	3.5%	2.4%	1.3%	2.0%	4.7%	–
30–34	4.8%	3.2%	1.9%	3.8%	7.6%	–
35–39	7.4%	5.1%	3.7%	5.3%	11.4%	–
40–44	10.1%	5.3%	4.3%	7.6%	9.5%	–
45–49	15.3%	8.3%	7.3%	11.5%	8.1%	–
50–54	16.9%	11.8%	9.7%	17.0%	13.0%	–
55–59	15.8%	14.9%	12.9%	24.7%	13.3%	< 2.6%
60–64	11.1%	15.5%	11.5%	22.3%	12.3%	< 2.6%
65–69	4.7%	11.0%	15.1%	0.8%	4.2%	31.8%
70–74	2.1%	8.1%	14.0%	–	2.8%	33.9%
75–79	< 0.1%	4.8%	9.5%	–	1.7%	16.9%
80–84	–	2.6%	4.1%	–	–	7.7%
85–89	–	1.2%	1.9%	–	< 0.9%	6.2%
90–94	–	–	< 0.3%	–	–	< 2.6%
Female	56.8%	75.8%	72.7%	71.3%	79.2%	67.2%
Race[a]						
Asian	–	1.5%	2.9%	–	–	–
Black or African American	–	9.2%	10.9%	–	31.5%	–
White	–	83.7%	75.0%	–	52.4%	–
Ethnicity						
Hispanic or Latino	–	3.6%	7.2%	–	2.9%	–

Table 2 continued

	Japan	US				
	JMDC (*n* = 6376)	Optum EHR (*n* = 1848)	Optum SES (*n* = 1563)	CCAE (*n* = 1838)	MDCD (*n* = 578)	MDCR (*n* = 195)
Not Hispanic or Latino	–	91.1%	88.9%	–	–	–

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[a] Data on race and ethnicity were not reported in the JMDC, CCAE, and MDCR databases. Databases may also include "other/unknown", so percentages may not add to 100%

recognizing and reporting the condition. In all evaluated US databases, the prevalence and incidence of PPP were low and would meet the US Food and Drug Administration's criteria for rare disease [13].

Multiple factors may contribute to the differences in prevalence and incidence of PPP observed between Japan and the US in this study. Recognition of PPP as a disorder distinct from other psoriatic conditions may be inconsistent across different medical communities. Familiarity with PPP diagnostic coding may be another factor, particularly since ICD-10 (which introduced the code for PPP) was implemented earlier in Japan than the US. Genetic and environmental factors may also contribute to the differences in PPP prevalence and incidence between countries.

Our study estimated the prevalence of PPP/100,000 population in 2020 to be 89.4 in Japan, based on JMDC, and 8.7, 7.4, and 6.4 in the US based on Optum EHR, Optum SES, and CCAE, respectively. Research derived from nationwide claims data in Japan from 2010–2011 reported a PPP prevalence of 120/100,000 [7]. Nationwide data from Sweden reported a prevalence of 20–26/100,000 [9]. Another analysis reported prevalence estimates of 9, 5, and 80/100,000 based on databases from the US, Demark, and Germany, respectively; the authors postulated that the higher PPP prevalence in Germany may be attributed to inter-country differences in healthcare access, diagnosis, or coding [8]. Nonetheless, consistent with our findings, each

of these studies found that PPP was more common among women and, where analyzed, was rare in pediatric patients.

US-based rates in our study were consistent with estimates from Denmark, but not Sweden or Germany. There are several possible reasons for these differences. First, other studies of PPP employed a variety of different approaches to define PPP [7–9, 14, 15]. Our analysis required two visits with PPP diagnostic codes, the second occurring 31–730 days after the first. This more stringent definition is likely to yield lower, but potentially more accurate, prevalence estimates compared to less restrictive definitions. Second, the databases may reflect diversity in healthcare systems and the patient populations they serve in different countries (nationwide single-payer systems in Japan, Sweden, Demark, and Germany; a subset of insurance for employed individuals and their dependents in JMDC; private, commercial insurance [e.g., CCAE] and public insurance [e.g., MDCD] in the US). Lastly, variability in the methods used to estimate prevalence (e.g., specifying the denominator) may have contributed to divergent results.

We found significant comorbidity, particularly components of metabolic syndrome, among patients with PPP. The presence of such comorbidities was more pronounced in patients from the US than Japan. This may reflect country-specific differences in factors such as lifestyle and/or diet, or differences in approach to treatment of these comorbidities. Mental

Table 3 Baseline medical history of PPP patients identified using the specific definition

	Japan	US				
	JMDC (*n* = 6376)	**Optum EHR** (*n* = 1848)	**Optum SES** (*n* = 1563)	**CCAE** (*n* = 1838)	**MDCD** (*n* = 578)	**MDCR** (*n* = 195)
Acute respiratory disease	47.8%	16.2%	29.5%	31.7%	38.2%	28.7%
Atopic dermatitis	17.0%	3.0%	8.8%	7.6%	7.1%	6.1%
Anxiety	4.1%	16.2%	19.8%	17.4%	38.8%	13.9%
Cellulitis	4.5%	7.7%	11.6%	7.7%	11.6%	10.8%
Chronic obstructive lung disease	0.9%	6.6%	12.4%	4.5%	20.2%	16.4%
Depressive disorder	5.7%	14.3%	18.8%	13.0%	36.2%	12.3%
Diabetes mellitus	10.4%	14.4%	24.9%	14.4%	25.3%	21.5%
Hidradenitis suppurativa	0.1%	1.6%	1.1%	1.4%	6.9%	< 2.6%
Hyperlipidemia	18.8%	32.3%	54.0%	35.0%	34.8%	66.1%
Hypertensive disorder	17.8%	31.8%	53.2%	35.5%	45.3%	66.1%
Idiopathic osteoarthritis	0.0%	1.2%	2.9%	1.8%	1.9%	3.6%
Irritable bowel syndrome	3.0%	2.6%	3.1%	2.2%	3.5%	3.6%
Obesity	0.8%	13.1%	17.9%	14.2%	24.1%	10.3%
Psoriasis vulgaris	8.0%	5.2%	24.3%	27.3%	12.1%	27.7%
Psoriasis with arthropathy	0.2%	5.2%	9.1%	10.2%	7.6%	5.1%
Rheumatoid arthritis	2.6%	4.9%	7.6%	6.1%	8.3%	5.6%
Ulcerative colitis	0.6%	0.6%	1.0%	1.6%	< 0.9%	< 2.6%
Uveitis	0.5%	0.3%	0.5%	0.9%	< 0.9%	< 2.6%
Visual system disorder	40.1%	12.6%	40.5%	22.0%	40.1%	55.9%

PPP palmoplantar pustulosis, *JMDC* Japan Medical Data Center, *EHR* Optum® de-identified Electronic Health Record Database, *SES* Optum's Clinformatics® de-identified Data Mart Database, *CCAE* IBM®MarketScan® Commercial Database, *MDCD* IBM®MarketScan® Multi-State Medicaid Database; MDCR IBM®MarketScan® Medicare Supplemental Database

health conditions such as anxiety and depression, while more common in the US, were notably prevalent among PPP patients in both countries, and may, in part, reflect the debilitating nature of PPP and its impact on quality of life [2].

Although it may seem paradoxical, anti-TNFα treatment may exacerbate or lead to development of de novo psoriasiform palmoplantar skin lesions [6, 16, 17]. Approximately 10% of US-based patients in our study had an anti-TNFα treatment in the year prior to diagnosis, whereas use of TNFα inhibitors was less common (< 1%) among Japanese PPP patients. This disparity in use of anti-TNFα agents may account for the greater incidence of anti-TNFα–induced PPP in the US. Alternatively, anti-TNFα-induced palmoplantar disease may be misclassified as PPP in the US or there may be a higher prevalence of idiopathic PPP in Japan. In our analysis of US data, the occurrence of anti-TNFα–induced PPP was more common

among women, a finding consistent with prior research [6]. Data regarding other risk factors, such as smoking, were not systematically collected and could not be assessed; however, potential proxies, such as prevalence of chronic obstructive lung disease and treatment for obstructive airway diseases were common among PPP patients in both countries.

This analysis developed and evaluated strategies to identify PPP cases in claims and EHR data, resulting in three candidate definitions for PPP. Consideration of different criteria to identify PPP patients was a strength of our approach. Ultimately, we chose the specific definition for this epidemiological analysis to minimize capturing data from misdiagnosed and/or non-PPP patients. Nonetheless, further studies using chart review approaches and/or manual curation of narrative text from EHRs may help validate the specific definition. Such studies may provide additional insights into the value of the hybrid PPP definition, including whether this definition should be considered for future analyses. Furthermore, future studies may evaluate alternative PPP definitions (e.g., excluding plaque psoriasis and/or dyshidrotic eczema [or pompholyx]) or assess impacts on inter-country prevalence, incidence estimates, and baseline characteristics. Lastly, our study analyzed data from two countries and several different types of databases, capturing PPP data in a variety of patient populations, which we believe is a strength.

Nonetheless, this study has limitations inherent to the observational nature of the data. There may be biases in the validity of claims codes for both PPP and the baseline comorbidities that we assessed, as some codes may be subject to miscoding/misclassification. In addition, as the databases reflect information collected during patient interactions across various healthcare systems, prevalence estimates from these claims and EHR databases may differ from field- and population-based approaches that systematically assess disease occurrence through surveys. Despite these limitations, we believe this analysis contributes to better understand the overall epidemiology of PPP.

CONCLUSION

In this cross-national study based on claims and EHR data, we examined the epidemiology of PPP and confirmed a greater burden of PPP in Japan than the US. Although rare, PPP is a debilitating condition with high unmet medical need and increasing prevalence. Further research is needed to identify factors that contribute to patterns of PPP epidemiology and disease severity, particularly using data from other sources, settings, and geographic locations.

under license for the current study and are not publicly available. Other researchers should contact Optum.

Declarations

Conflict of Interest. At the time the research was conducted, Darmendra Ramcharran was an employee of Janssen Research & Development; he is currently an employee of GSK. Bruce Strober served as a consultant (honoraria) and/or speaker and/or investigator for AbbVie, Almirall, Amgen, Arcutis, Arena, Aristea, Asana, Boehringer Ingelheim, Bristol Myers Squibb, Cara, Connect Biopharma, CorEvitas Psoriasis Registry, Dermavant, Dermira, Eli Lilly, EPI Health, Evelo Biosciences, Immunic Therapeutics, Incyte, Janssen, LEO Pharma, Maruho, Meiji Seika Pharma, Mindera Health, Novartis, Ono, Pfizer, Regeneron, Sanofi-Genzyme, Sun Pharma, UCB Pharma, Union Therapeutics, Ventyxbio, and vTvt Therapeutics; served as co-Scientific Director (consulting fee) of CorEvitas (formerly Corrona) Psoriasis Registry and Editor-in-Chief (honorarium) of *Journal of Psoriasis and Psoriatic Arthritis*. Kenneth Gordon received research/grant support from AbbVie, Amgen, Boehringer Ingelheim, Celgene, Eli Lilly, Janssen, Novartis, and UCB Pharma, and honoraria for consultation from AbbVie, Amgen, Boehringer Ingelheim, Celgene, Dermira, Eli Lilly, Janssen, Novartis, and UCB Pharma. Amy Paller has been an investigator for AbbVie, Dermavant, Eli Lilly, Incyte, Janssen, Krystal, and UCB; a consultant with honorarium for Aegerion Pharma, Azitra, BioCryst, Boehringer Ingelheim, Bristol Myers Squibb, Castle Creek, Eli Lilly, Janssen, Krystal, LEO Pharma, Novartis, Regeneron, Sanofi/Genzyme, Seanergy, TWI Biotechnology, and UCB; and is on data safety monitoring boards for AbbVie, Abeona, Catawba, Galderma, and InMed. Cynthia DeKlotz, Joel Swerdel, and Jill Hardin are employees of Janssen Research & Development and Steven Fakharzadeh and Ya-Wen Yang are employees of Immunology Global Medical Affairs, Janssen Pharmaceutical Companies of Johnson & Johnson; employees may own stock in Johnson & Johnson, of which

Janssen is a subsidiary. Sridhar Dronavalli has no conflicts to disclose.

Ethical Approval. The Optum and IBM MarketScan databases used in this study were reviewed by the New England Institutional Review Board (IRB) and were determined to be exempt from broad IRB approval, as this research project did not involve human subject research. Based on Ethical Guidelines for Epidemiological Research issued by the Japanese Ministry of Health, Labor and Welfare, ethics approval and informed consent for the JMDC database were not applicable for this study.

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