

Healthcare Utilization and Medication Use in Patients with Psoriasis: A Population-Based Study

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ABSTRACT **Background:** Healthcare utilization in patients with psoriasis has been described from the perspective of psoriasis healthcare centers. Psoriasis healthcare utilization at the population level, including appointments with family physicians, impacts the overall financial expenditure.

Objectives: To describe the utilization of healthcare services in patients with psoriasis compared to the general non-psoriasis population.

Methods: We conducted a cross-sectional, population-based analysis of data from Clalit Health Services, the largest public health service provider in Israel, comparing the annual healthcare utilization and medication consumption of all Clalit members with psoriasis in 2023 with an age- and sex-matched group at a primary care clinic. We compared up to five non-psoriasis items.

Results: The study included 835,422 people (140,927 individuals with psoriasis and 694,671 without). Patients with psoriasis had more annual physician appointments than controls, and the meetings were longer. Patients with psoriasis took more sick leave and required more hospital admission compared to the control group. Tumor necrosis factor (TNF) inhibitors were prescribed much more often to patients with psoriasis than to the control group (3147 patients vs. 1857 in the matched control). More IL-17 blockers and IL-23 blockers were also prescribed more in the psoriasis group, although at a much lower level than the TNF inhibitors.

Conclusions: Patients with psoriasis used more healthcare services than the control group. Healthcare providers should allocate more resources to psoriasis care, both for primary care and at specialized psoriasis centers.

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KEY WORDS: annual health, healthcare utilization, psoriasis

is associated with increased healthcare utilization and is a greater burden on healthcare systems [4]. Treatment of psoriasis is determined based on the severity of the disease. Topical therapy is sufficient for mild disease. Moderate to severe disease may require phototherapy, traditional systemic medications (e.g., methotrexate), and/or biologic medications such as tumor necrosis factor (TNF) inhibitors, interleukin (IL)-17 and IL-23 inhibitors, which are associated with increased costs to the healthcare system.

A previous study demonstrated that patients with psoriasis required more annual dermatology clinic visits and emergency room visits, compared to matched controls [5]. In our study, we appraised the healthcare utilization of patients with psoriasis. We evaluated primary care visits, dermatologist community visits, and hospital visits. We also studied the burden of psoriasis patients and those with psoriatic arthritis on the healthcare system.

PATIENTS AND METHODS

DATA SOURCE

Clalit Health Services (CHS) is the largest healthcare service provider in Israel and provides hospital- and community-based medical services. In 2023, CHS provided medical care to 4.8 million members, more than half of the Israeli population (55%). CHS has collected data on a unified electronic medical file since 1998. These records have been continuously updated with administrative and clinical data. Diagnoses are based on the World Health Organization (WHO) International Classification of Disease, version 9 (ICD-9) and augmented by selected International Classification of Primary Care 2nd Edition (ICPC-2) codes. Data are integrated using a unique civil identification number, which is assigned to all Israeli citizens at birth or at immigration. General practitioners or specialists in family medicine or pediatrics provide

Psoriasis is a common skin disease with approximately 125 million people affected worldwide. Psoriasis is associated with co-morbidities such as metabolic syndrome and has a negative impact on health-related quality of life [1-3]. Patients with psoriasis seek more treatment and frontal encounters with physicians. Hence, psoriasis

primary care visits without a co-payment. Specialist consultations are available for most specialties in community-based regional clinics, but those visits require a referral. Specialists provide community-based dermatology consultations as a primary care service (i.e., without the need for a referral). All patient encounters are recorded electronically, including information on visit-type and length [6]. All claims of prescription medications are captured routinely.

STUDY DESIGN AND STUDY POPULATION

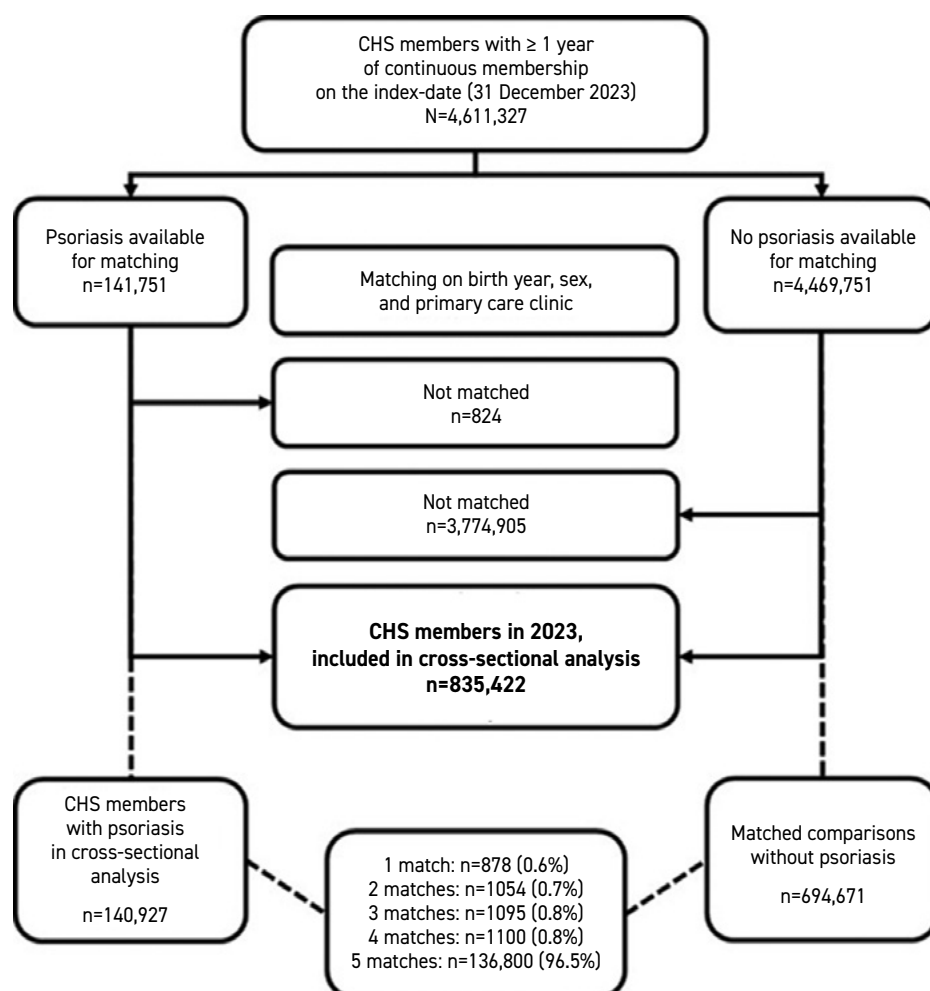
We conducted a cross-sectional, population-based analysis of all CHS members who had been enrolled for at least one year by 31 December 2023. We identified CHS members with psoriasis based on a psoriasis diagnosis entered by

a community-based dermatology specialist. We matched each member with psoriasis with up to five comparisons with the same age, sex, and primary care practice. A summary of the matching process and recruitments of cases and their matches for this study is shown in Figure 1.

Psoriasis was identified only if a dermatology specialist had ever entered a relevant diagnosis (ICD-9 696, 696.1; ICPC-2 S91). To ascertain disease severity and co-diagnosis of psoriatic arthritis, we scanned participant records for relevant diagnoses or medication claims. People with psoriasis and documented claims of systemic anti-psoriatic treatments, climatotherapy, or phototherapy (any time before the end of 2023) were considered as having severe psoriasis. We deemed calcineurin inhibitors, folic acid analogues, interleukin Inhibitors, immunosuppressants, reti-

Figure 1. Participant-flow and matching process

CHS = Clalit Health Services



noic acid for treatment of psoriasis, or TNF inhibitors as relevant systemic treatments. A dermatologist determined the severity of the disease at the medical consultation, using international guidelines and commonly applied tools such as psoriasis area and severity index and body surface area to determine the extent of psoriasis. Psoriatic arthritis was determined if a person with psoriasis had ever been diagnosed with psoriatic arthritis/arthropathy (ICD9-696.0) by a community-based dermatology or rheumatology specialist or had received such a diagnosis.

COVARIATES

We ascertained participant sociodemographic characteristics based on their registered home address. Peripherality status was based on the Israeli Bureau of Statistics Peripherality Index of Localities and Local Authorities, which considers population size, proximity to other local authorities in the country, and the proximity to the Tel Aviv District [7]. The ethnicity (e.g., Arab/ultra-orthodox Jews) of CHS members is not directly recorded in the administrative data; however, a proxy measure was assumed based on the majority ethnic group residing in the catchment area of each primary care clinic. Socioeconomic status designation was grouped into four categories according to the POINTS Location Intelligence Company (Ltd.) data, which uses commercial propriety information to continuously augment neighborhood-level socioeconomic information gathered during a 2008 Israel Central Bureau of Statistics census. The Johns Hopkins Adjusted Clinical Groups Comorbidity score (ACG) was used as an indicator of overall illness burden, reflecting the entire health status of a person based on the duration, severity, diagnostic certainty, etiology, and need for specialist care for individual diagnoses and diagnostic clusters in the past year [8].

STATISTICAL ANALYSIS

We reported participant sociodemographic characteristics and measures of healthcare consumption. We compared patients with and without psoriasis. All *P*-values were calculated using Pearson's chi-square for categorical variables and two-sample *t*-tests for continuous variables.

Statistical analysis was performed using STATA v. 16 IC (StataCorp LLC, College Station, TX, USA). The procedures were conducted in accordance with the ethical standards on human experimentation (institutional or regional) and the Helsinki Declaration of 1975, as revised in 1983. The institutional review board of CHS approved the study. Informed consent was waived, as strictly non-identifiable data were used.

RESULTS

The age and sex distributions were similar among those with psoriasis and their matched comparisons, as were their levels of peripherality and the distribution of socioeconomic status (matching variables). A total of 26,933 (19.20%) were diagnosed with severe psoriasis; 3.80% (5310) of the study group was diagnosed with psoriatic arthritis. Sociodemographic and clinical characteristics study participants are shown in Table 1.

Patients with psoriasis had longer physician visits, took more sick days, and experienced more hospital admissions (11.25% vs. 10.08%, *P*-values < 0.01) compared to the control group [Table 2]. These findings were reproducible and more accentuated in patients with severe psoriasis [Supplemental Table 1, available in the online version only]. Overall annual healthcare utilization in all indicated parameters was increased in patients with psoriasis or psoriatic arthritis compared to the control group [Supplemental Table 2, available in the online version only]. The ACG co-morbidity score of patients with psoriasis was higher.

Topical steroids were used in 32.10% of patients compared to 14.98% in the control group [Table 3]. The combination of betamethasone-calcipotriol was increased in patients with psoriasis compared to the control group (15.98% vs. 0.34%, *P*-values < 0.01). Phototherapy and Dead Sea climatotherapy was completed almost exclusively in patients with psoriasis. Traditional systemic medications such as methotrexate, cyclosporine, and acitretin were used more in the psoriasis group than the control group, even though those systemic medications are not strictly provided to psoriasis (except acitretin). TNF inhibitors were used in 3147 patients (4.01%) vs. 1857 (0.84%) in the control group. Ustekinumab, IL 12/23 inhibitor was used by 423 (0.54%) patients vs. 245 (0.11%) in the control group (*P*-values < 0.01).

IL-17 blockers were used by 1356 patients (1.73%) vs. 91 (0.04%) in the control group (*P*-values < 0.01). IL-23 blockers were used by 1290 patients (1.64%) vs. 83 (0.04%) in the control group (*P*-values < 0.01).

DISCUSSION

Patients with psoriasis had more annual visits to family physicians, longer visit times, and more specialist consultations than the control group. Psoriasis patients also had increased use of topical and systemic medications and required more hospitalizations. They also used more systemic medications and more biologics.

Table 1. Sociodemographic and clinical characteristics of 41 97 CHS members with psoriasis and 40,771 matched comparisons without psoriasis (31 December 2023)

	Psoriasis, N=140,927	No psoriasis, N=694,671	P-value
Severe psoriasis, n (%)	26,993 (19.2%)	0	
Psoriasis with psoriatic arthritis, n (%)	5310 (3.8%)	0	
Age, years, median (IQR)	40.57 (26.71–56.47)	40.31 (26.56–56.22)	< 0.01
0–24, n (%)	30,961 (21.97%)	154,050 (22.18%)	< 0.01
25–34, n (%)	26,366 (18.71%)	131,040 (18.86%)	
35–44, n (%)	22,312 (15.83%)	110,385 (15.89%)	
45–54, n (%)	22,570 (16.02%)	111,219 (16.01%)	
55–64, n (%)	21,492 (15.25%)	105,483 (15.18%)	
65–74, n (%)	12,747 (9.05%)	61,761 (8.89%)	
75–84, n (%)	3955 (2.81%)	18,537 (2.67%)	
≥ 85, n (%)	524 (0.37%)	2196 (0.32%)	
Sex, female, n (%)	73,001 (51.80%)	360,725 (51.93%)	0.38
Peripherality index, n (%)			
Distant periphery (1–4)	23,730 (16.84%)	115,677 (16.65%)	0.22
Proximate periphery (5–7)	61,402 (43.57%)	302,724 (43.58%)	
Central (8–10)	55,136 (39.12%)	272,787 (39.27%)	
Missing	659 (0.47%)	3483 (0.50%)	
Ethnicity, Arab, n (%)	27,953 (19.84%)	138,677 (19.96%)	0.28
Ultraorthodox Jews, n (%)	7230 (5.13%)	35,610 (5.13%)	0.95
Socioeconomic status, POINTS, mean ± SD	5.88 ± 2.15	5.82 ± 2.15	< 0.01
Lowest (1–3), n (%)	22,929 (16.27%)	117,720 (16.95%)	< 0.01
Medium–low (4–5), n (%)	35,611 (25.27%)	181,084 (26.07%)	
Medium–high (6–7), n (%)	41,012 (29.10%)	197,916 (28.49%)	
Highest (8–10), n (%)	35,428 (25.14%)	168,759 (24.29%)	
Missing, n (%)	5947 (4.22%)	29,192 (4.20%)	
Lives in a nursing home, n (%)	1007 (0.71%)	4926 (0.71%)	0.82
Former Soviet Union and Eastern Europe (immigrant or second generation), n (%)	4017 (2.85%)	23,762 (3.42%)	< 0.01
North Africa (immigrant or second generation), n (%)	16,807 (11.93%)	91,640 (13.19%)	< 0.01
Ethiopia (immigrated or second generation), n (%)	1408 (1.00%)	17,218 (2.48%)	< 0.01
Central and Western Europe (immigrated or second generation), n (%)	6077 (4.31%)	26,828 (3.86%)	< 0.01
North America (immigrated or second generation), n (%)	1661 (1.18%)	8161 (1.17%)	0.90
John Hopkins Adjusted Clinical Groups Comorbidity score (ACG), mean ± SD	3.44 ± 1.14	3.22 ± 1.13	< 0.01
1–2, n (%)	32,180 (22.83%)	198,504 (28.58%)	< 0.01
3, n (%)	38,233 (27.13%)	207,876 (29.92%)	
4, n (%)	39,641 (28.13%)	165,585 (23.84%)	
5–6, n (%)	24,527 (17.40%)	90,309 (13.00%)	
Missing, n (%)	6346 (4.50%)	32,397 (4.66%)	

CHS = Clalit Health Services, IQR = interquartile range, SD = standard deviation

Table 2. Annual healthcare utilization of CHS members with psoriasis and their matched comparisons, 2023

	Psoriasis, N=140,927	No psoriasis, N=694,671	P-value
Primary care			
Annual number of visits per person, median (IQR)	16 (19)	14 (17)	< 0.01
One visit or more, n (%)	134,535 (95.464%)	641,252 (92.310%)	< 0.01
Accumulated annual contact time per person, minutes			
Median (IQR)	95 (38–198)	73 (25–163)	< 0.01
Over one hour, n (%)	89,832 (63.744%)	385,407 (55.481%)	< 0.01
Community-based specialist consultations			
Annual number of visits per person, median (IQR)	4 (1–10)	3 (0–8)	< 0.01
One visit or more, n (%)	114,781 (81.447%)	495,876 (71.383%)	< 0.01
Accumulated annual contact time per person, minutes			
Median (IQR)	40 (7–120)	23 (0–87)	< 0.01
Over one hour, n (%)	57,133 (40.541%)	223,887 (32.229%)	< 0.01
Dermatology (community-based)			
Annual number of visits per person, median (IQR)	0 (0–1)	0 (0–0)	< 0.01
One visit or more, n (%)	55,744 (39.555%)	150,367 (21.646%)	< 0.01
Accumulated annual contact time per person, minutes			
Median (IQR)	0 (0–9)	0 (0–0)	< 0.01
Over one hour, N (%)	4394 (3.118%)	8487 (1.222%)	< 0.01
Administrative (physician encounters)			
Annual number of visits per person, median (IQR)	2 (0–5)	2 (0–4)	< 0.01
One visit or more, n (%)	5669 (4.023%)	23,346 (3.361%)	< 0.01
Accumulated annual contact time per person, minutes			
Median (IQR)	5 (0–15)	3 (0–12)	< 0.01
Over one hour, N (%)	5669 (4.023%)	23,346 (3.361%)	< 0.01
Sick leave			
Annual days per person, median (IQR)	0 (0–4)	0 (0–4)	< 0.01
Over one week, annually, n (%)	47,121 (33.436%)	221,735 (31.919%)	< 0.01
Hospital admissions (any ward)			
Any admission, n (%)	15,856 (11.251%)	70,012 (10.078%)	< 0.01
1–7 accumulated inpatient days, annually, n (%)	11,195 (7.944%)	49,840 (7.175%)	< 0.01
> 7 accumulated inpatient days, annually, n (%)	4661 (3.307%)	20,172 (2.904%)	
Dermatology ward admissions			
Any admission, n (%)	310 (0.220%)	448 (0.064%)	< 0.01
1–7 accumulated inpatient days, annually, n (%)	104 (0.074%)	150 (0.022%)	< 0.01
> 7 accumulated inpatient days, annually, n (%)	206 (0.146%)	298 (0.043%)	
Disability status			
Bedbound, n (%)	91 (0.065%)	583 (0.084%)	0.02
Homebound, n (%)	214 (0.152%)	1214 (0.175%)	0.06
Requires assistance with ambulation, n (%)	621 (0.441%)	2703 (0.389%)	< 0.01

CHS = Clalit Health Services, IQR = interquartile range

Traditional systemic medications such as methotrexate and cyclosporine were utilized more in the psoriasis group than the control group. TNF inhibitors were used more often in patients with psoriasis. CHS mandates the initial use of TNF inhibitors prior to the approval of either IL-17 blockers or IL-23 blockers.

Our findings demonstrated that patients with psoriasis used more healthcare services, which is similar to results other countries including the United States, Europe, and Japan [9-14]. In the United States, Merola and colleagues [9] investigated the healthcare costs of patients with psoriasis and psoriatic arthritis over an 11-year period. They observed that all-cause healthcare costs increased over time, especially among patients with psoriatic arthritis. Shin et al. [10] conducted a questionnaire-based study of 682 patients with psoriasis and found that they were significantly more likely to have more healthcare visits than controls. Unfortunately, the authors of the study did

not investigate the severity of the disease or other essential elements related to healthcare usage. Blauvelt and co-authors [11] investigated different costs for patients with psoriasis treated with two biologics and found that 407 patients were treated with ixekizumab and 2702 were treated with adalimumab for 48 months. All-cause healthcare resource utilization was higher in ixekizumab than adalimumab users. The investigators have noticed that the cost differences were largely driven by higher treatment adherence associated with ixekizumab rather than with adalimumab. At the time of this study, ixekizumab was a newer and more costly drug. Newer classes of biologics are often initially more expensive, which may increase overall costs. Armstrong et al. [12] conducted a population-based study using electronic health records of dermatology practices in the United States. Over a 1-year period, they found increased use of healthcare resources due to more medical appointments and more complex

Table 3. Absolute numbers and proportions of CHS members with psoriasis, severe psoriasis, and psoriasis with psoriatic arthritis: medications for selected groups, 2023

	Psoriasis, N=140,927	Severe psoriasis, N=26,993	Psoriasis with psoriatic arthritis, N=5,310
Topical steroids (D07)	45,238 (32.100%)	10,575 (39.177%)	2141 (40.320%)
Topical calcineurin inhibitors (D11AH01, D11AH02)	741 (0.526%)	311 (1.152%)	35 (0.659%)
Crisaborole (D11AH06)	194 (0.138%)	78 (0.289%)	7 (0.132%)
Systemic steroids (H02)	16,011 (11.361%)	4549 (16.853%)	1178 (22.185%)
Phototherapy (UVA/UVB)	1900 (1.348%)	1900 (7.039%)	105 (1.977%)
Climatotherapy	2347 (1.665%)	2347 (8.695%)	548 (10.320%)
Systemic immunosuppressants (L04A)	9308 (6.605%)	8746 (32.401%)	2802 (52.768%)
Other antidepressants (N06AX)	8703 (6.176%)	2251 (8.339%)	631 (11.883%)
Gabapentinoid (N02BF)	4961 (3.520%)	1406 (5.209%)	423 (7.966%)
Nonselective monoamine reuptake inhibitors (N06AA)	2744 (1.947%)	745 (2.760%)	220 (4.143%)
Selective serotonin reuptake inhibitors (N06AB)	13,569 (9.628%)	3202 (11.862%)	757 (14.256%)
Betamethasone–Calcipotriol (D05AX52)	22,524 (15.983%)	8029 (29.745%)	1587 (29.887%)
Calcipotriol (D05AX02)	122 (0.087%)	65 (0.241%)	10 (0.188%)
Acitretin (D05BB02)	2036 (1.445%)	2,036 (7.543%)	151 (2.844%)
Immunosuppressive drugs	2963 (2.103%)	2963 (10.977%)	925 (17.420%)
Ciclosporin (L04AD01)	239 (0.170%)	239 (0.885%)	16 (0.301%)
Methotrexate (L01ba01; L04ax03)	2749 (1.951%)	2749 (10.184%)	909 (17.119%)
Apremilast (L04AA32)	430 (0.305%)	430 (1.593%)	112 (2.109%)
Anti-TNF	3147 (2.233%)	3141 (11.636%)	1075 (20.245%)
Ustekinumab (L04AC17)	423 (0.300%)	423 (1.567%)	91 (1.714%)
IL-17 blockers	1356 (0.962%)	1355 (5.020%)	652 (12.279%)
IL-23 blockers	1290 (0.915%)	1290 (4.779%)	342 (6.441%)

CHS = Clalit Health Services, IQR = interquartile range

diagnoses in patients with psoriasis. Interestingly, higher healthcare resource utilization was observed for phototherapy. This latter finding, however, was not seen in our study. One possible explanation may be that phototherapy is less accessible in the United States than in Israel. They also found that annual medication costs were higher for biologics than for oral systemic medications.

Puig and colleagues [13] investigated the issue of treatment costs in study conducted in Spain. They found that patients with psoriasis required more primary care visits, outpatient visits, and hospital visits. In a study from Finland, Vesikansa et al. [14] indirectly investigated the healthcare utilization in patients with psoriasis using either biologics or conventional immunosuppressant medications. They concluded that patients taking conventional medications required more care than those prescribed biologics; hence, the overall expenditure was lowered with newer medication.

Esposti et al. [15] compared healthcare consumption in Italy of 351 patients with psoriasis and psoriatic arthritis who had been treated with biologics to evaluate the financial costs. Their results showed that the healthcare costs were primarily related to hospitalization and the initiation biologics treatment [16], although hospitalization is rarely required for patients with psoriasis or psoriatic arthritis.

Finally, Tada et al. [16] examined 1730 patients treated systemically for psoriasis over a 4-year period in Japan. They found that switching treatment was associated with an increase in total costs.

When we examined the annual healthcare utilization of patients with psoriasis, we noticed that patients with psoriasis had more appointments with primary care physicians and dermatologists. They used more sick leave and had more hospital admissions [Supplemental Table 1 and Supplemental Table 2 are available in the online version only]. Having more sick leave may lead to lower productivity and an increased economic burden.

We found that patients with psoriasis required more hospitalization (11.25% vs. 10.08%), although the absolute difference (1.17%) was relatively small. While CHS members with psoriasis were more likely to be hospitalized and for longer, the absolute difference was small, and the clinical significance is uncertain.

We found that more claims and medical resources were required to treat severe disease due to the costs of biological modifying drugs than were required for mild disease that was treated topically. These financial aspects must be considered by policymakers and health service providers.

STRENGTHS

We conducted a large population-based study using routinely collected data from CHS. To the best of our knowledge, our study was the largest to examine healthcare utilization.

LIMITATIONS

Our study was retrospective in nature. We relied on recorded diagnoses and could not confirm validity. Nevertheless, dermatologists performed the diagnosis.

Although dermatologists determined the severity of the disease, the definition of severe psoriasis in this study was determined by whether the patient ever received systemic therapy, climathotherapy, or phototherapy. Hence, it is possible that a patient who used a biologic treatment in the past may have been in remission in 2023 and still be classified as severe. However, the purpose of such therapy is to achieve remission and cessation of such therapy may lead to a decline in the patient's condition.

Last, the cross-sectional design of our study prevented establishing a causal relationship. Medication data did not distinguish between treatments started in 2023 and ongoing treatments.

CONCLUSIONS

Patients with psoriasis have increased utilization of healthcare services. Providing optimal healthcare services to patients with psoriasis may mitigate the overall expenses. Future studies should propose guidelines for early intervention to try to reduce overall expenditure and thus improve healthcare services.

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Capsule

Blood-based circular RNAs for early diagnosis of Alzheimer's disease

Phillips and co-authors investigated whether circular RNAs (circRNAs) detected in peripheral blood could serve as sensitive and specific biomarkers for Alzheimer's disease. Circular RNAs are highly stable, covalently closed RNA molecules that regulate gene expression and are resistant to degradation, making them attractive candidates for diagnostic testing. Using high-throughput transcriptomic profiling and machine-learning algorithms, the investigators identified a panel of circulating circRNAs that distinguished individuals with early Alzheimer's disease from cognitively healthy controls with high diagnostic accuracy. The biomarker

signature also differentiated Alzheimer's disease from other neurodegenerative disorders and correlated with established pathological markers, including amyloid and tau pathology, as well as measures of cognitive decline. Importantly, the diagnostic performance of the circRNA panel remained robust across independent validation cohorts, suggesting good reproducibility and generalizability. Because the assay relies on a simple blood sample, it offers a practical alternative to invasive lumbar puncture and costly neuroimaging.

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Eitan Israeli

Capsule

Malaria immunity by attenuated parasite

After entering the body through a mosquito bite, *Plasmodium* parasites multiply and mature in the liver before exiting the tissue and infecting red blood cells, triggering the symptoms of malaria. In chemovaccination, exposure to live parasites is accompanied by the administration of antimalarial drugs that arrest the parasite life cycle, preventing illness and allowing the immune system to respond to the attenuated parasite. **Steel** and colleagues tested inhibitors of the conserved *Plasmodium* aspartyl proteases plasmepsin IX and

X in a chemovaccination protocol in mice, offering an alternative to strategies that block the parasite life cycle at different stages (see the Perspective by Prudêncio and Mota). This approach arrested the late liver stage of the parasite, resulting in the formation of chemo-attenuated liver merozoites, which induced B and T cell responses that contributed to durable protection against *Plasmodium* infection.

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