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Two Indicators, a Common Trend: Scabicide Dispensing and Search Volume as Indirect Proxies for Scabies in Spain (2021–2025)

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Abstract

Background

Scabies incidence has increased in several European countries, including Spain. However, because it is not a notifiable disease, monitoring relies on indirect indicators.

Objectives

To assess temporal trends in scabies in Spain between 2021 and 2025 using two indirect indicators, scabicide dispensing and Google search activity, and to evaluate changes in the relative use of ivermectin and permethrin.

Methods

We conducted an observational time-series study using monthly Spanish National Health System pharmacy dispensing data for permethrin and ivermectin from January 2021 to August 2025, together with Google Trends relative search volume for scabies-related terms. We analyzed monthly total scabicide dispensing, relative search volume, seasonality, the ivermectin-to-permethrin dispensing ratio, and correlations between dispensing and search activity, including lagged cross-correlation analyses.

Results

Total scabicide dispensing increased from 2021 to 2024, followed by lower dispensing in January–August 2025 compared with the corresponding months of 2024. Scabies-related search activity increased from 2021 to 2023 and declined thereafter. Both indicators showed marked winter seasonality and were positively correlated. Cross-correlation analysis suggested that changes in search activity may precede changes in dispensing. The ivermectin-to-permethrin ratio increased over the study period.

Conclusions

Scabicide dispensing and scabies-related search activity increased in Spain from 2021 to 2023–2024, followed by stabilization and a possible early decline in 2025. Pharmacy dispensing and search activity may provide complementary proxy indicators for monitoring temporal trends in scabies burden. Increasing relative ivermectin use may reflect evolving treatment practices. Search activity may have potential anticipatory value as an early signal of subsequent dispensing trends.

Introduction

Scabies is caused by the mite *Sarcoptes scabiei var. hominis* and is classified by the World Health Organization as a neglected tropical disease [1]. Its incidence has increased over the past decade in several European countries, including Spain [2–7].

Scabies is not a notifiable disease, so estimating its incidence and tracking temporal trends can be challenging. To address this limitation, we used scabicide dispensing (topical permethrin and oral ivermectin are the agents marketed in Spain) and Internet search volume as indirect indicators. In a previous study [7], we observed parallel increases in dispensing and search interest, suggesting a growing incidence of scabies. A more recent study (2011–2023) using other data sources confirmed a sustained increase [5]. Temporal trends over the last two years have not yet been evaluated.

Our aim was to assess temporal trends in scabies in Spain indirectly between 2021 and 2025 using scabicide consumption and Google search volume, their association and changes in the ivermectin-to-permethrin ratio.

Materials and Methods

We conducted an observational time-series study of scabicide consumption and Google relative search volume (RSV) in Spain from January 2021 to August 2025. Monthly pharmacy dispensing data for permethrin (PERM) and ivermectin (IVM) were obtained from the Spanish Ministry of Health (ATC codes p03ac and p02cf respectively) [8], and expressed as thousands of packs. Total consumption (PERM + IVM) and the IVM/PERM ratio were calculated.

We used Google Trends to retrieve scabies related terms in Spain's official languages from January 2021 to December 2025. Weekly RSV values were aggregated monthly to align them with monthly dispensing data.

Mean and standard error of the mean (SEM) were used as descriptive statistics. The association between RSV and scabicide dispensing was assessed using Pearson's and Spearman'scorrelations. Temporal trends were assessed using linear regression, while seasonality was evaluated by decomposing each time series into trend and seasonal components. To remove the winter-related seasonal component, each series was deseasonalized seasonal-trend decomposition (STL) using LOESS. Decomposition was performed with a monthly seasonal period of 12, an odd seasonal window of 13.

Results

Total scabicide consumption increased between 2021 and 2024 (Fig. 1). Permethrin increased between 2021 and 2023, then declined in 2024. Ivermectin showed a sustained increase between 2021 and 2024, declining in 2025 (January–August) compared with the same period in 2024. Mean annual RSV increased between 2021 and 2023 and declined in 2024–2025, remaining above 2021–2022 levels. RSV

was significantly higher ($p < 0.001$) in winter (mean 46.15; SEM 1.82) than in summer (mean 32.78; SEM 0.91).

Correlation and Temporal Trend Analysis Between Monthly Dispensing and RSV

There was a strong, positive, and significant association between monthly dispensing and RSV in both the parametric ($r = 0.92$; $p < 0.001$) and the non-parametric analysis ($\rho = 0.90$; $p < 0.001$). Both series showed marked, coincident, and recurrent winter seasonality, with peaks between December and March and minima during the summer months. Temporal trends fit the regression model $Y_t = \beta_0 + \beta_1 \cdot t + \varepsilon_t$, where Y_t represents monthly dispensing, t represents time in months, and ε_t represents the error term, with a significant upward trend in dispensing ($\beta = +0.28$ units/month; $R^2 = 0.18$; $p < 0.001$) and in RSV ($\beta = +0.12$ units/month; $R^2 = 0.07$; $p = 0.02$).

Key STL decomposition parameters for the RSV series were: average value of the trend component = 37.998; seasonal component amplitude = 50.1738; and residual standard deviation = 8.594. For total dispensing, the corresponding values were: average value of the trend component = 87.220; seasonal component amplitude = 73.261; and residual standard deviation = 10.457. Both series showed a marked seasonal component (amplitude > 50 points in RSV and > 73 in dispensing). Deseasonalization slightly reduced variability and removed the repeating 12-month pattern, leaving clean series for the analysis of non-seasonal relationships. Table 1 shows the descriptive statistics of the original and deseasonalized series.

Table 1
Original vs. Deseasonalized Descriptive Statistics

Variable	n	mean	SD	min	25%	50%	75%	max
RSV original	56	40.306	13.259	19.750	31.875	40.900	47.812	73.500
RSV deseasonalized	56	40.160	13.064	-20.456	37.270	39.977	46.429	66.242
Dispensing original	56	90.839	39.638	24.080	63.295	91.465	125.658	158.460
Dispensing deseasonalized	56	91.618	34.499	7.853	76.651	106.830	114.140	135.760

RSV: relative search volume; SD, standard deviation.

Cross-correlation of deseasonalized RSV and total dispensing was assessed at lags from − 24 to + 24 months. The original simple linear correlation value (without deseasonalization, lag = 0) was 0.806 (strong positive relationship), and the lag-0 correlation after deseasonalization was 0.7424 (still strong, but somewhat lower). The maximum correlation was 0.840 (very strong) at lag + 10 months. The

approximate significance threshold (95% confidence, $2/\sqrt{n}$ rule) was ± 0.267, with almost all lags between − 24 and + 19 (except a few intermediate values very close to zero) exceeding this threshold.

Monthly dispensing of both drugs between 2021 and 2025 was positively and significantly correlated ($r = 0.95$; $p < 0.001$), with nearly parallel covariation (r range 0.94–0.96). Similarly, Spearman's coefficient showed significantly high values ($\rho = 0.93$; $p < 0.001$), with a ρ range of 0.92–0.95. There was no systematic lag between the two series.

Temporal Trend Analysis

Linear regression showed a significant upward trend for ivermectin ($\beta = +0.42$ units/month; $R^2 = 0.27$; $p < 0.001$), whereas no significant trend was observed for permethrin ($\beta = +0.05$ units/month; $R^2 = 0.03$; $p = 0.18$). Total scabicide dispensing was significantly higher in winter than in summer (mean 107.79, SEM 10.35 vs. mean 66.01, SEM 4.89; $p = 0.0012$).

Permethrin dispensing showed a stable trend with marked annual seasonality, with recurrent peaks in December–February and minima in June–August. By contrast, ivermectin showed a slightly upward trend with a positive slope in linear regression. Although it retained the same winter seasonality as permethrin, annual peak values for ivermectin increased progressively over time. The annual ivermectin-to-permethrin ratio showed a sustained linear increase ($\beta = +0.17$/year; $R^2 = 0.92$; $p = 0.002$), increasing from 0.38 in 2021 to 1.1 in 2025.

Discussion

Our results show an increase in scabicide dispensing up to 2024. In the months available for 2025, consumption declined from the previous year but remained high compared with earlier years, (Fig. 1) [7]. A strong positive relationship between RSV and total dispensing persisted after removal of the seasonal component, with a maximum correlation of 0.84 compared with 0.81 in the original series. RSV acted as the leading variable, with changes in RSV preceding changes in total dispensing. This suggests that RSV may serve as a leading indicator of dispensing. The dominant seasonal component indicates that both series follow a clear annual cycle of large amplitude. STL decomposition removed this component, leaving residuals with lower variability and deseasonalized series better suited to forecasting or regression modelling. The temporal and seasonal concordance between both indicators supports their potential combined usefulness for monitoring trends in scabies.

The rise in scabies incidence up to 2023–2024 has previously been attributed to inadequate contact treatment, changes in social contact patterns, and increased shared housing [5–6, 9]. Reduced sensitivity to conventional treatments is another possible factor [10, 11], although confirmatory studies in Spain are still lacking.

The stabilization in 2024 and possible decline in 2025 should be interpreted cautiously and confirmed through sustained follow-up using complementary indicators. A decline in dispensing may reflect a reduction in incidence, but other explanations are possible, including changes in prescribing patterns in Spain, potentially related to a perceived reduction in treatment effectiveness. A survey published in 2021 showed that alternative treatments, like sulfur ointment or benzyl benzoate were commonly used after permethrin failure [12]. Likewise, the decline in RSV may reflect not only lower incidence, but also changes in information-seeking behaviour, including the partial replacement of traditional search engines by artificial intelligence language models such as ChatGPT [13].

The close temporal association with coincident seasonality of permethrin and ivermectin suggests common underlying factors, such as disease seasonality or similar prescribing patterns, rather than a direct causal relationship between them. (Fig. 1). However, the divergence in overall trends, with a progressive increase in relative ivermectin use, suggests a change in therapeutic patterns rather than a parallel variation in disease burden. This shift in clinical practice may be influenced by the perception of reduced permethrin efficacy [10–12]. This is the first Spanish study to use both ivermectin and permethrin dispensing as indirect indicators of scabies trends.

Consistent with previous studies [4], we observed significant winter increases in both indicators (Fig. 1). This seasonal pattern may partly reflect greater mite survival under cold, humid conditions, although behavioural and household-related factors may also contribute.

Limitations

This study is based on indirect indicators. Dispensing does not equate to the number of cases, as it may be influenced by dosing variability, treatment of contacts, use for other indications, and changes in therapeutic regimens. Dispensing data were restricted to National Health System prescriptions dispensed in community pharmacies, excluding in-hospital use and private prescribing. RSV may also be affected by population bias, including lower Internet use among older adults, media coverage and changing search habits.

Conclusions

During 2021–2024, scabicide consumption and RSV increased. Data from 2025 suggest an incipient decline in both indicators, although the interpretation of this finding is limited by the absence of a complete annual cycle. Future studies should confirm whether this decline at the end of the series persists over time and reflects a true reduction in cases.

The strong correlation between both indicators, maintained after deseasonalization, supports their usefulness as an indirect approach for monitoring temporal trends in scabies. Cross-correlation analysis suggests a possible anticipatory value of RSV with respect to dispensing.

Declarations

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Conflict of Interest: The authors declare that they have no conflicts of interest.

Author contribution statement: Conception and design of the study: INF, AFC, PAG; acquisition of data: INF; analysis and interpretation of data: INF, PAG; critical revision of the manuscript. AFC, PAG

All authors approved the final version to be submitted and agree to be accountable for all aspects of the work.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Use of Artificial Intelligence

During preparation of this manuscript, Grammarly was used for grammar checking. ChatGPT 5.5 was used to assist with language editing and vocabulary refinement. The authors reviewed and edited all tool-assisted output as necessary and take full responsibility for the content of the manuscript.

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Figures

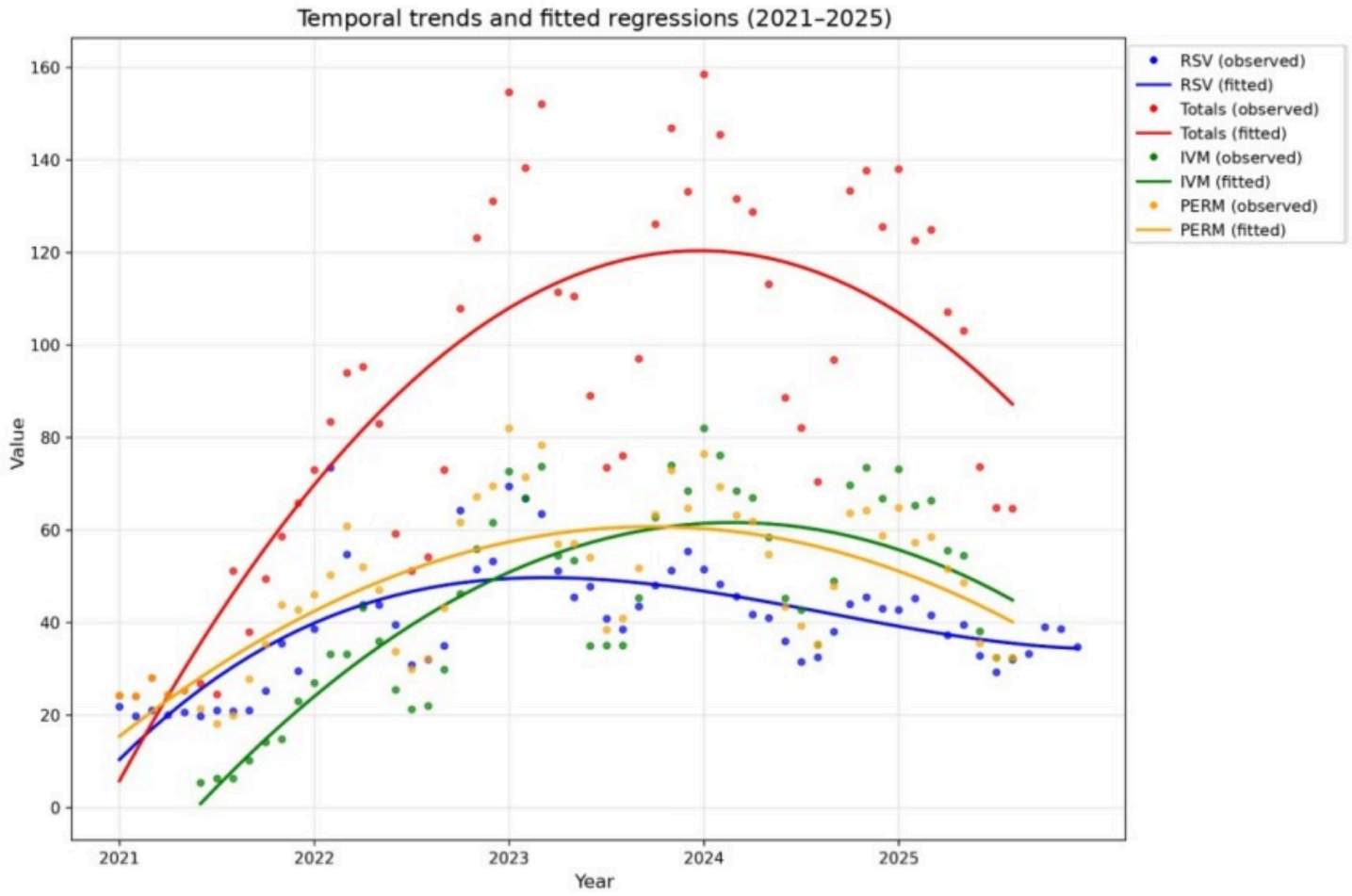

Figure 1

Temporal trends in search interest and scabicide consumption in Spain. Monthly values (points) and fitted curves are shown for relative search volume (RSV) and pharmacy dispensing (thousands of packs) of permethrin (PERM), ivermectin (IVM), and total dispensing (PERM+IVM).