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ORIGINAL ARTICLE

Tracking Public Interest in Psychoactive Substances: Insights from Google Trends Data

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Main Points

- Cannabis had the highest relative search volume in Türkiye.
- Search interest in psychoactive substances peaked in spring and summer.
- Cocaine and amphetamine searches increased significantly between 2011 and 2025.
- Google Trends detected rising public interest in drug testing and detox.
- Google Trends may serve as an early warning tool for emerging drug trends in Türkiye.

Abstract

This study explores public interest in psychoactive substances in Türkiye using Google Trends, a digital epidemiology tool that tracks search behaviors. Search trends were analyzed for five commonly used substances—cannabis, heroin, cocaine, amphetamine, and ecstasy—across different provinces, time periods, and seasonal variations. Results indicate that cannabis had the highest relative search volume nationwide, with regional variations showing Hakkari leading for heroin, Antalya for cannabis, Istanbul for cocaine and ecstasy, and Samsun for amphetamine. Search interest peaked during spring and summer, possibly linked to tourism and festival seasons. Cannabis-related searches increased by approximately 30% over the study period. Frequently searched topics included drug detection, health risks, and substance use among celebrities. Google Trends is a valuable tool for monitoring real-time public interest; however, it has some limitations. These include the lack of absolute search numbers, potential algorithmic biases, and the inability to determine user intent. Despite these challenges, Google Trends offers a cost-effective tool for tracking emerging drug trends and informing public health policies. Future studies should integrate Google Trends data with epidemiological records to improve surveillance and prevention strategies for substance use in Türkiye.

Keywords: Infodemiology, internet, medical Informatics, psychoactive drugs

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Introduction

The use of psychoactive substances is a global public health problem. In 2018, the global prevalence of substance use disorders was reported by the United Nations to be 5.4%, and it is projected to increase to 11% by 2030 (United Nations, 2021). According to the Türkiye 2024 Drug Report, the five most common substances leading to treatment admissions are amphetamines, opioids, cannabis, cocaine, and ecstasy (Emniyet Genel Müdürlüğü Narkotik Suçlarla Mücadele Başkanlığı, 2024). The most recent data for Türkiye in the United Nations Office on Drugs and Crime (UNODC) country data pool is from 2018, and the most frequently used five substances are cannabis, ecstasy, cocaine, opioids, and amphetamines, respectively (United Nations Office on Drugs and Crime, 2024).

The internet is a digital network facilitating communication, interaction, and unlimited information transmission on any topic at any time. The internet plays a significant role in shaping substance use behaviors, not only as an information source but also as a platform for discussing and promoting drug-related content. Websites provide information on psychedelics, including their use, risks, and purchasing options; however, many lack scientific references, potentially contributing to misinformation (Al-Imam et al., 2022); (Parker et al., 2017). Online

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forums, social media, and websites may facilitate the introduction of new psychoactive substances, share methods to evade detection in drug tests, and even serve as illicit marketplaces (Jena & Goldman, 2011; Qeadan et al., 2022). Experienced users, called "e-Psychonauts," actively share both positive and negative experiential knowledge about substances on drug forums under the anonymity the internet provides (Soussan & Kjellgren, 2014). Given these influences, public health strategies should consider internet-based interventions to counter misinformation and promote evidence-based harm reduction.

On the other hand, internet search behavior may also reflect individuals' efforts to obtain information, avoid harm, or seek assistance. One study examining internet searches for medical symptoms prior to seeking information about 12-step addiction treatment programs found that ten medical symptoms were predictive of searches related to Alcoholics Anonymous, while nine symptoms predicted interest in Narcotics Anonymous (Nitzburg et al., 2019). In another study investigating the impact of awareness days on online health information – seeking behavior related to substance use disorders, significant increases in search activity were observed on the International Day Against Drug Abuse and Illicit Trafficking over the past 5 years (Singh & Balhara, 2024). These findings suggest that common medical symptoms and public awareness events can prompt help-seeking behavior and highlight the internet's role as a resource for accessing support and information related to substance use.

Infodemiology is defined as the science of studying information distribution and determinants via electronic media (like the internet), which aims to inform public health and policy (Mavragani & Ochoa, 2019; Rovetta, 2024). It utilizes non-clinical data, such as web searches, to assess users' interest in health issues, providing insights into behaviors and lifestyles that are difficult to measure through traditional surveys (Mavragani & Ochoa, 2019; Nuti et al., 2014). Internet-based tools, such as Google Trends (GT), offer a more efficient alternative by analyzing temporal and geographical trends in search behavior (Demir & Bandawe, 2024; Schuurman & Bont, 2022).

According to Statista's web browser market share in Türkiye as of August 2024, Google has dominated the search engine market with a share of around 76%. This market share is much higher than that of other leading search engines like Safari (12.26 %), Samsung Internet (3.84) and Yandex Browser (2.97 %) (Statista, 2025). This makes GT a particularly valuable tool for estimating public interest in health-related topics, including psychoactive substances.

Google Trends is a well-known digital epidemiology tool that tracks the search terms entered into Google's search engine. It provides real-time and archived data from 2004 onward. Google Trends data is freely accessible, anonymized, and normalized for population size, allowing comparisons across different regions. It measures the search volumes and tracks changes over time for specific terms. Relative search volume is a standardized metric ranging from 0 (no significant searches) to 100 (peak interest), with data standardized by dividing search volumes by total searches in a given area and time frame. This makes GT a cost-effective, valuable, accessible resource for analyzing public interest and behavior (Alibudbud, 2023; Nuti et al., 2014; Rovetta, 2024; Sindhoo et al., 2023).

Previous studies have demonstrated GT can effectively monitor drug-related trends (Jankowski & Hoffmann, 2016; Perdue et al., 2018). For instance, in the United States of America, the smoothed and regressed GT search patterns for "naloxone" closely mirrored the opioid overdose trends reported by the National Center for Health Statistics (Ghosh et al., 2022). Similarly, a comparative study of GT data and forum discussions on 48 novel psychoactive substances found that substances often appeared on GT before being officially reported by UNODC and other sources (Batistic et al., 2021).

While GT has been widely used for substance-related research globally, to the best of the authors' knowledge, no study has examined search trends for psychoactive substances in Türkiye. This study aims to address this gap by analyzing GT data on the five most commonly used illicit psychoactive substances.

Material and Methods

Searching Tool

Google Trends is a free, open-access tool that aggregates and categorizes Google search data, excluding infrequent searches and repeated queries from the same Internet Protocol (IP) address within a short period. It allows users to analyze search patterns across various platforms, including web, image, news, and YouTube searches (Alibudbud, 2023; Mavragani & Ochoa, 2019; Nuti et al., 2014).

Google Trends enables searches for specific terms or broader "topics," which group related keywords, including the exact term, misspellings, and acronyms. It is also language agnostic. A "category" filter can also be applied to refine searches and to avoid terms that are unrelated to researchers' search interests (Alibudbud, 2023; Mavragani & Ochoa, 2019; Nuti et al., 2014; Rovetta, 2024).

Google Trends provides real-time data from the past 7 days and archival data from January 2004 to the past 36 hours. Google Trends normalizes data by scaling search volumes from 0 to 100, where 100 represents the peak search interest for a given term or topic, and all other values are adjusted relative to this peak. This metric, known as relative search volume (RSV), quantifies user interest by comparing keyword-related queries to total web queries within a specified time and location and adjusts data for population size, enabling meaningful comparisons across regions. Researchers can export results in CSV format for further analysis (Alibudbud, 2023; Mavragani & Ochoa, 2019; Nuti et al., 2014; Rovetta, 2024).

Keyword Selection and Data Query

This study examined the five most commonly used illicit psychoactive substances according to Türkiye 2024 Drug Report and UNODC country data. Then, the corresponding RSVs were collected for each keyword.

Data collection was performed on February 19, 2025, using the public web facility GT, available from https://trends. google. com/trends/.

Google Trends was queried for the following keywords: Esrar (cannabis), eroin (heroin), kokain (cocaine), amfetamin (amphetamine) and ekstazi (ecstasy).

To ensure relevant search results, the following filters were applied: "Türkiye" as the search region, "Health" as the category,

and "Web Search" as the search type. The search was limited to the "Health" category to exclude irrelevant information and confounding results, which aligns with Mavragani et al.'s methodological framework (Mavragani & Ochoa, 2019).

The original plan was to examine the GT data from 2004 onwards, but as it was found that the GT had made methodological improvements at later dates, the analysis was refined into three periods:

(a) From 2004, the earliest available data,
(b) From January 1, 2011, when GT improved its geographical accuracy,
(c) From January 1, 2022, when GT implemented its latest data collection improvements.

Evaluations for these three periods are presented in the Results section.

Data Analysis

We have conducted a time trend and a geospatial trend search to monitor the month-wise and state-wise patterns, respectively. The index of measurement used was the RSV, a scale from 0 to 100, with higher values indicating higher popularity (Nuti et al., 2014). The data for this study were exported to Microsoft Excel and downloaded on February 19, 2025. The exact GT query URLs are provided in Supplementary File 1.

In addition to the figures provided by GT, a time series analysis was conducted in Microsoft Excel. Seasonal decomposition was performed using a centered moving average [CMA(4)] method to extract the trend (T_t) and seasonal (S_t) components, enabling the identification of recurring seasonal patterns and long-term changes in RSV.

All data used in this study were publicly accessible and anonymized, containing no personal health information. Therefore, an ethics review was not required. However, all procedures were conducted with scientific rigor to ensure the integrity of the research.

Results

Geospatial Trends

Between 2004 and 2025, cannabis had the highest RSV in nearly all provinces, except for Hakkari, where heroin had the highest RSV (Figure 1). However, after GT's methodological improvements, cannabis had the highest RSV nationwide (Figure 2). The provinces with the highest RSVs for each psychoactive substance are summarized in Table 1.

Time Trend Analysis

Time series analysis of GT data and visualizations provided by GT revealed seasonal variations in RSVs for the five psychoactive substances. Search interest generally peaked in spring and summer, and queries related to substance use disorders also showed an upward trend during these periods, except for heroin and ecstasy.

Figure 3 shows the time series analysis results as plots for each psychoactive substance, including the trend (Tt) and seasonal (St) components. In addition, Supplementary File 2 presents the results of the time trend analysis provided by GT.

As shown in Figure 4B, the beginning and end points for cannabis, heroin, cocaine, amphetamine, and ecstasy were 29, 10, 9, 3, 8 and 56, 8, 21, 8, 10, respectively (Supplementary File 2). Thus, it can can be said that there was a growth in search interest for cannabis-related information using the Google search engine increased by more than 90%, cocaine by 130%, and amphetamine by 160% between 2011 and 2025.

As shown in Figure 4C, the beginning and end points for cannabis, heroin, cocaine, amphetamine, and ecstasy were 56, 4, 21, 8, 12 and 65, 11, 26, 10, 12, respectively (Supplementary File 2). Thus, it can be said that there was a growth in search interest

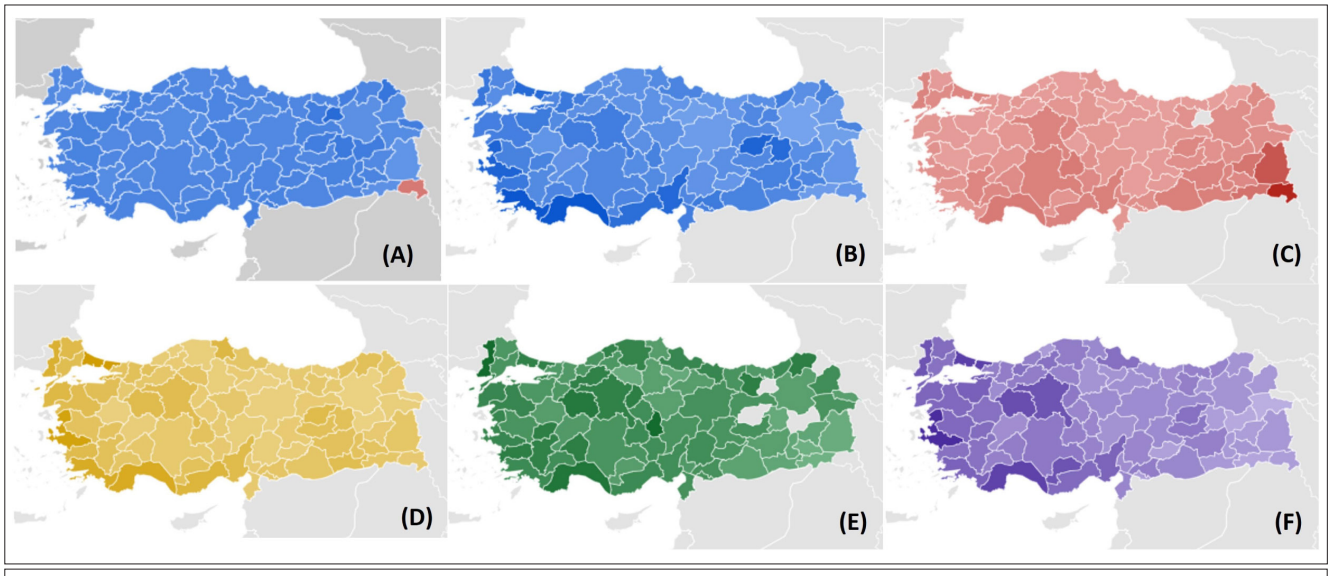

Figure 1. Geographic Distribution of Relative Search Volumes (RSVs) from 2004 to Date. (A) All Terms (Cannabis, Heroin, Cocaine, Amphetamine and Ecstasy); (B) Cannabis (blue); (C) Heroin (red); (D) Cocaine (yellow); (E) Amphetamine (green); (F) Ecstasy (purple). Greater Shading Indicate Higher RSVs. A Value of 0 (Unshaded Fields) Indicates that there is not Enough Data for this Term. (The Figure was Captured from Google Trends; Data Source: Google Trends (https://trends.google.com/trends/, accessed on 19 February 2025).

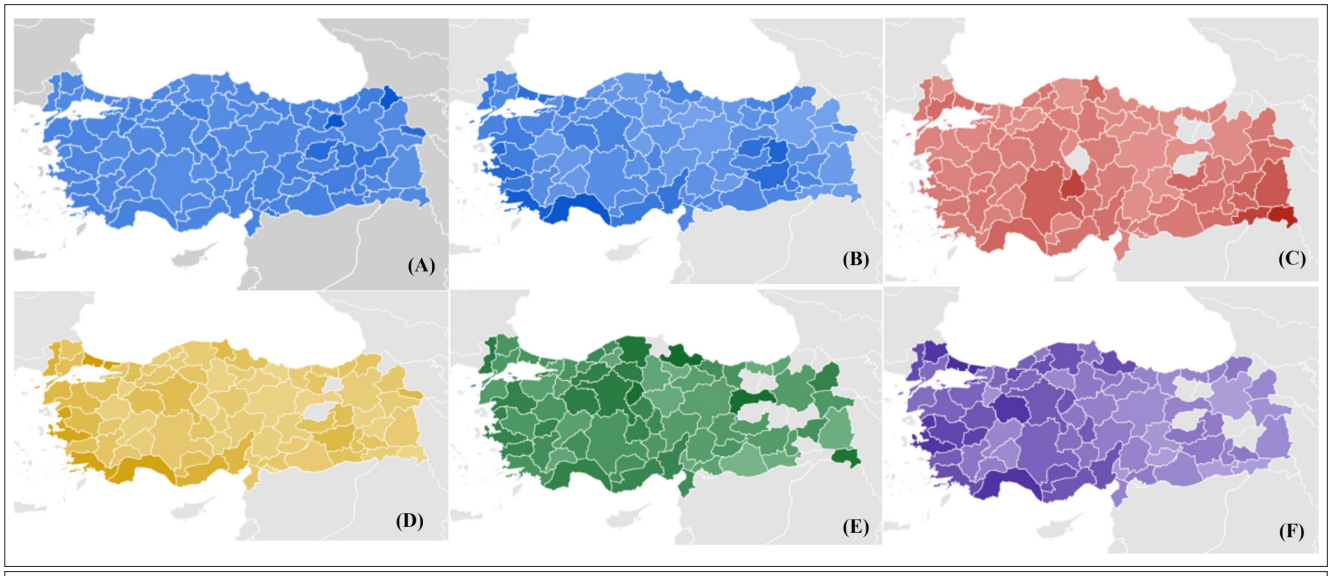

Figure 2. Geographic Distribution of Relative Search Volumes (RSVs) from 2022 to Date. (A) All Terms (Cannabis, Heroin, Cocaine, Amphetamine and Ecstasy); (B) Cannabis (blue); (C) Heroin (red); (D) Cocaine (yellow); (E) Amphetamine (green); (F) Ecstasy (purple). Greater Shading Indicate Higher RSVs. A Value of 0 (Unshaded Fields) Indicates that there is not Enough Data for this Term. (The Figure was Captured from Google Trends; Data Source: Google Trends (https://trends.google.com/trends/, accessed on 19 February 2025).

for cannabis-related information using the Google search engine increased by more than 15%, heroin by 175%, cocaine by 20%, and amphetamine by 25% between 2022 and 2025.

Questions related to search terms were also looked at ("users who searched for your term also searched for these queries"):

- Cannabis: "Is cannabis addictive?", "Changes in the body after quitting cannabis", "How many days does cannabis stay in urine?", "What to do to prevent cannabis in urine?", "Does cannabis appear in blood?", "When is cannabis cleared from the blood?", "Lyrica".
- Heroin: "Corex."
- Cocaine: "How to sleep after cocaine use?", "How to relieve nasal congestion after cocaine?", "Signs of cocaine use", "Cocaine prices 2023", "'*some celebrities' names* and cocaine."
- Amphetamine: "Adderall", "Ritalin."
- Ecstasy: "User experiences with ecstasy", "Is Xanax a drug?"

Discussion

This study utilized GT to evaluate public interest in the five most commonly used psychoactive substances in Türkiye. It analyzed geographic distribution, monthly and weekly trends, and related queries. To the authors' knowledge, this is the first study to apply GT for this purpose in Türkiye.

The findings revealed regional differences in search interest. Hakkari had the highest RSV for heroin, Antalya for cannabis, Istanbul for cocaine and ecstasy, and Samsun for amphetamine. These variations may reflect regional patterns in substance use, treatment-seeking behavior, or the media influences. However, direct conclusions about actual substance use should be drawn cautiously, as RSVs reflect population-level search behavior that can be influenced by media coverage and other external factors rather than actual prevalence or intent. Future studies should compare GT data with official epidemiological reports to validate its reliability as a surveillance tool.

In this study, search interest in psychoactive substances showed a fluctuating yet generally increasing trend over time. Peaks in interest often occurred during the spring and summer months. This seasonal variation may be associated with increased travel, festivals, and nightlife during these periods, which could drive greater curiosity or concern about substance-related topics. A study on the seasonal use of psychedelics and party drugs among festival attendees found that summer was a risk factor for the use of common psychedelics, especially among individuals attending electronic dance music events (Palamar et al., 2024). Similarly, research examining temporal and spatial patterns of methamphetamine and amphetamine in wastewater in Beijing reported significantly higher methamphetamine loads in urban areas and in summer compared to winter. The researchers suggested that increased entertainment activities and a higher socioeconomic status in urban regions may contribute to this seasonal trend (Li et al., 2014). Understanding these patterns is crucial for public health planning, as it highlights the importance of timing in prevention efforts.

Cannabis, cocaine, and amphetamine-related searches increased by approximately 30% over the study period. This rise may be attributed to growing media coverage, cultural references (e.g., songs), and shifts in public perception. These findings align with global trends showing an increase in online searches about mental health (Zhao et al., 2022) and substance use disorder (SUD)-related topics (Alibudbud, 2023). These findings may be interpreted as an increase in public interest and the need for accessible resources. However, it needs to be ensured that the public's expectations regarding information on substance use disorders are accurately met on online platforms. In addition, there is a need to reach the most affected population. The internet appears to be a viable option for delivering up-to-date prevention information.

Table 1.
Cities with the Highest Search Interest for Each Psychoactive Substance (i.e., with the Highest RSV) in the Specified Period (Geographical Distribution)

	2004 – To Date Top Five Provinces	RSV	2022 – To Date Top Five Provinces	RSV
Cannabis				
	Antalya	100	Antalya	100
	Muğla	96	Muğla	94
	İzmir	88	Bingöl	88
	Tunceli	88	İzmir	84
	Adana	84	Diyarbakır	80
Heroin				
	Hakkari	100	Hakkari	100
	Van	67	Şırnak	81
	Şırnak	48	Aksaray	81
	Bitlis	45	Van	66
	Antalya	42	Konya	60
Cocaine				
	İstanbul	100	İstanbul	100
	İzmir	91	Muğla	90
	Antalya	81	Antalya	90
	Muğla	79	İzmir	87
	Edirne	72	Mersin	72
Amphetamine				
	Edirne	100	Samsun	100
	Nevşehir	100	Erzincan	97
	Antalya	91	Kırıkkale	97
	Eskişehir	88	Hakkari	93
	Gümüşhane	83	Kastamonu	91
Ecstasy				
	İzmir	100	İstanbul	100
	İstanbul	88	Antalya	96
	Antalya	86	Eskişehir	95
	Eskişehir	79	Kırklareli	95
	Karaman	76	İzmir	95

Note: RSV = Relative search volume.

GT also highlights the types of questions people commonly seek answers online. The analysis found that cannabis-related searches frequently involved inquiries about detection in urine and blood, while searches for cocaine included concerns about nasal congestion and substance prices. These insights may help public health officials customize online education and harm-reduction strategies to address common concerns more effectively. Furthermore, news related to substance use among celebrities frequently appears in search trends, highlighting the impact of media on public perception and behavior. Studies suggest that celebrity drug use reports may contribute to normalization or increased interest in substances, particularly among younger populations (Shaw et al., 2010).

Although this study could not compare its findings with national data, beyond monitoring the existing situaition, it highlights the potential of GT to detect emerging trends in new psychoactive substances as shown in the studies from other countries (Al-Imam et al., 2022; Livingston et al., 2022). In Türkiye, GT could serve as a complementary early warning system, helping policymakers respond proactively to emerging drug trends.

Several limitations should be considered in this study. Despite its advantages, GT has several limitations that stem from itself. First, due to GT providing RSV rather than absolute search numbers, actual numbers of searches cannot be accessed, and neither can the popularity of terms be measured. This may cause misinterpretation of the results. Second, the specific terms or idioms grouped under topic keywords are not transparent due to GT's algorithmic limitations (Nuti et al., 2014), and the street names of drugs may be different and not be included in topic-based searches. Third, the context behind search terms, such as user intent or motivation, remains unknown; searches may be driven by curiosity, news events, or prevention efforts rather than actual drug use. Additionally, GT-based studies exclude data from non-Google platforms and individuals who lack internet access. This may lead to an underrepresentation of certain populations, such as the elderly or those in socioeconomically deprived or rural areas. This digital divide and unknown sociodemographic characteristics of users, may skew the study results. Further limitations include the inability to account for governmental controls on search engines and language barriers, which may affect the representativeness of data. Google Trends also does not capture searches from users who utilize IP masking, virtual private networks, or anonymous browsers like Tor and DuckDuckGo, nor can it identify repeated searches from the same IP address (Bergeron et al., 2022). This may limit the generalizability of the findings. Another limitation of this study is that correlation analyses could not be performed due to the lack of up-to-date official data for the provinces. Finally, the decision to restrict searches to the "health" category to exclude unrelated queries, such as song lyrics, may have inadvertently filtered out some relevant searches.

Despite all these limitations the strength of GT data lies in its standardized measurement across time and regions. Additionally, bias in reporting related to the stigma against psychoactive substances may be less of a concern, as individuals might feel more comfortable searching anonymously from their private homes. Future research should incorporate data from multiple search engines and cross-reference GT data with national health records or survey-based substance use prevalence studies. Additionally, studies that could investigate how sociodemographic and cultural factors influence online search behavior would further improve the interpretability of GT data.

In conclusion, this study provides the first GT-based analysis of psychoactive substance-related searches in Türkiye. It offers insights into regional and seasonal variations in public interest concerning these substances. The findings revealed that different provinces had the highest search volumes for all five substances. It should be kept in mind that online interest does not necessarily reflect actual intentions or behaviors. While GT data cannot

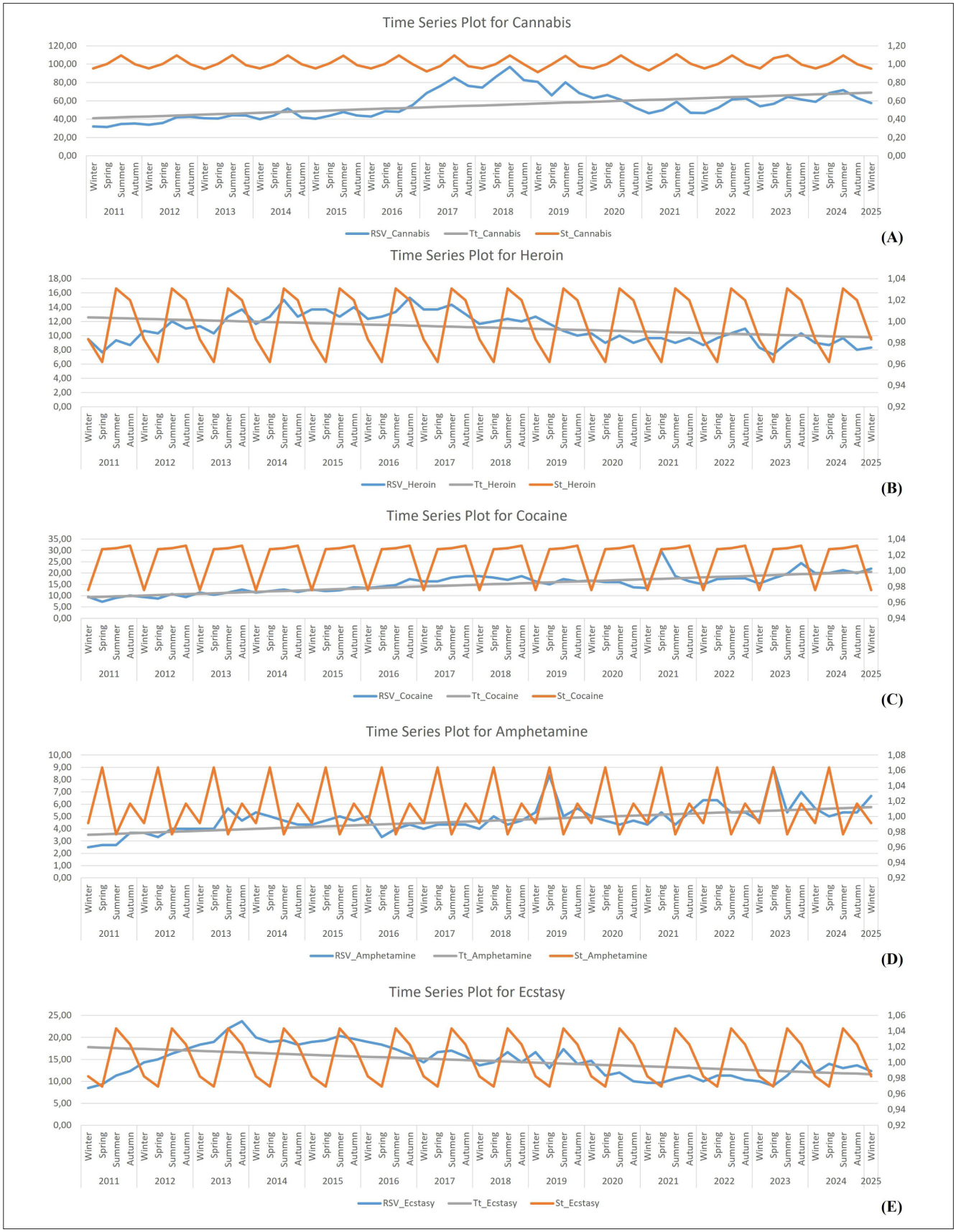

Figure 3. Time Series Analysis Results

replace traditional epidemiological methods, it offers a cost-effective and real-time tool for monitoring trends, identifying emerging substances, and informing public health strategies. By analyzing online search patterns, policymakers can develop targeted prevention campaigns, improve harm-reduction initiatives, and address public concerns more effectively. In the future, more comprehensive health service records and nationwide statistical data could help better determine the relationships between search volumes and real-world trends.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: All data used in this study were publicly accessible and anonymized, containing no personal health information. Therefore, an ethics review was not required. However, all procedures were conducted with scientific rigor to ensure the integrity of the research.

Informed Consent: All data used in this study were publicly accessible and anonymized, containing no personal health information. Therefore, an informed consent was not required. However, all procedures were conducted with scientific rigor to ensure the integrity of the research.

Peer-review: Externally peer-reviewed.

Declaration of Interests: The author has no conflict of interest to declare.

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Supplementary File 1. The link of the Google Trends search

<scripttype="text/javascript"src="https://ssl.gstatic.com/trends_nrtr/4004_RC01/embed_loader.js"></script><scripttype="text/javascript"> trends.embed.renderExploreWidget("GEO_MAP", {"comparisonItem":[{"keyword":"/m/054yc0","geo":"TR","time":"2004-01-01 2025-02-19"},{"keyword":"/m/03n5b","geo":"TR","time":"2004-01-01 2025-02-19"},{"keyword":"/m/0256b","geo":"TR","time":"2004-01-01 2025-02-19"},{"keyword":"/m/0_0j","geo":"TR","time":"2004-01-01 2025-02-19"},{"keyword":"/m/02qpq","geo":"TR","time":"2004-01-01 2025-02-19"}],"category":45,"property":""}, {"exploreQuery":"cat=45&date=all&geo=TR&q=%2Fm%2F054yc0,%2Fm%2F03n5b,%2Fm%2F0256b,%2Fm%2F0_0j,%2Fm%2F02qpq&hl=tr","guestPath":"https://trends.google.com:443/trends/embed/"}); </script>

Supplementary File 2. The figure of the time trend analysis provided by Google Trends