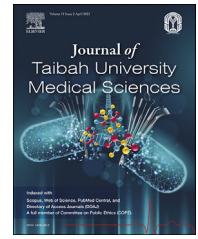




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Original Article

## Internet search patterns for psychoactive substance use prevention and treatment in Mexico: A cross-sectional study

Yessica Parissi-Poumian, M.Sc<sup>a</sup>, Xóchitl de San Jorge-Cárdenas, PhD<sup>b</sup>,  
Maricela López-Ornelas, PhD<sup>c</sup>, Javier López-Zetina, PhD<sup>d</sup>,  
Manuel S. Luzanía-Valerio, PhD<sup>a</sup>, María L. Mota-Morales, PhD<sup>a</sup> and  
María C. Ortiz-León, PhD<sup>a,\*</sup>

<sup>a</sup> Institute of Public Health, Veracruzana University, Xalapa, Veracruz, Mexico

<sup>b</sup> Institute of Health Sciences, Veracruzana University, Xalapa, Veracruz, Mexico

<sup>c</sup> Institute of Educational Research and Development, Universidad Autónoma de Baja California, Ensenada, Baja California, Mexico

<sup>d</sup> Department of Health Science, California State University, Long Beach, CA, USA

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### المخلص

**أهداف البحث:** لوصف أنماط البحث للحصول على معلومات حول الوقاية والعلاج من المخدر نفسي المفعول في المكسيك، سواء بالنسبة لعامة السكان أو للموظفين المتخصصين لمعرفة الوقاية والعلاج من هذا النوع من المواد في المكسيك.

**طريقة البحث:** تم إجراء دراسة استقصائية كمية مستعرضة باستخدام استبانة تم التحقق من صحتها عبر الإنترنت لجمع المعلومات الاجتماعية الديموغرافية والخلفية وأنماط البحث عبر الإنترنت المبلغ عنها ذاتيا حول الوقاية من استخدام المواد ذات المفعول النفسي، وتم حساب اختبار مربع كاي لتحديد الاختلافات بين المجموعات، وتم استخدام شجرة التصنيف لتحليل أنماط البحث. تم إدخال مجموعات معايير البحث مع موضوعات البحث في موقع مؤشرات غوغل.

**النتائج:** المشاركون (عدد 544 بالغا) كانوا في الغالب من النساء (65٪) الذين تتراوح أعمارهم بين 18 و 30 عاما، وحاملي درجة البكالوريوس (57٪)، والطلاب (32٪). الأفراد الذين بحثوا في الإنترنت عن الوقاية من تعاطي المخدرات أو العلاج (59٪) والمشاركون مهنيًا في الوقاية من تعاطي المخدرات أو العلاج (12٪).

**الاستنتاجات:** تم العثور على فروق ذات دلالة إحصائية بين عامة السكان والموظفين المتخصصين في خدمات امان المخدرات، وحددنا ستة أنماط بحث، حيث تم تصوير عملية صنع القرار للأشخاص الذين يسعون للحصول على معلومات حول الوقاية من المخدرات والعلاج على الإنترنت بشكل بياني باستخدام شجرة التصنيف، على الرغم من أن هذه الطريقة لم تسمح بالتمييز الواضح بين أنماط المجموعتين. تم التحقق من أنماط البحث بنجاح باستخدام موقع مؤشرات غوغل.

**الكلمات المفتاحية:** المخدرات؛ الإنترنت؛ سلوك البحث عن المعلومات؛ المكسيك؛ المداوة

### Abstract

**Objectives:** This study was aimed at describing the patterns of searches for information on the prevention and treatment of psychoactive drug use in Mexico, among both the general population and the personnel dedicated to the prevention and treatment of this type of substance use in Mexico.

**Methods:** An exploratory cross-sectional quantitative study was performed with a validated online questionnaire to collect sociodemographic information, background information and self-reported internet search patterns on psychoactive substance use prevention. A chi-square test was used to identify differences between groups, and a classification tree was used to analyze the search patterns. The combinations of the search criteria with the search topics were entered into Google Trends to validate the information.

\* Corresponding address: Dr. Castelazo Ayala s/n, Industrial Animas, 91190, Xalapa-Enriquez, Ver., Mexico.

E-mail: [cortiz@uv.mx](mailto:cortiz@uv.mx) (M.C. Ortiz-León)

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**Results:** The participants (n = 544 adults) were mostly women (65%), 18–30 years of age and bachelor's degree holders (57%). A total of 32% were students, 59% searched the Internet for drug use prevention or treatment, and 12% professionally engaged in drug use prevention or treatment.

**Conclusions:** Statistically significant differences were found between the general population and professionals dedicated to drug dependency services. We identified six search patterns used in the decision-making process by people seeking information on drug prevention and treatment on the Internet. These patterns were graphically visualized with a classification tree, although, this method did not allow clear differentiation of patterns between groups. The search patterns were successfully validated with Google trends.

**Keywords:** Drug; Information seeking behavior; Internet; Mexico; Therapeutics

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## Introduction

The public health problem related to consumption of psychoactive substances (PSs) worldwide has increased in the past 10 years (30%).<sup>1</sup> In Mexico, the National Commission Against Addictions (CONADIC) reported similar trends in 2019 and a 50% increase in the use of illegal drugs by women.<sup>2</sup> The excessive use of these substances is often associated with social exclusion, thus hindering access to preventive and curative care in conventional health services.

In Mexico, over 2 years (from 2017<sup>3</sup> to 2019<sup>4</sup>) the number of internet users increased from 71.3 to 80.6 million people, thus indicating an increase in the availability of ICT. Therefore, the Internet has emerged as an alternative route for seeking information and identifying the health services that this vulnerable population requires, while preserving users' personal identity and avoiding societal stigma.<sup>5–9</sup>

The age of the Internet has given rise to new terms and created new ways of categorizing individuals. Some researchers refer to “digital natives” as people who speak the “digital language,” owing to exposure to technologies from birth, and “digital migrants” as those who were not born in the “digital world”; that is, were born before 1990 and have had to adapt to Internet use.<sup>10</sup>

The Internet is a digital network that enables communication and interaction, and the transmission of unlimited information on all subjects and topics, at all hours of the day. Any search for information aims to satisfy a need.<sup>8</sup> Search patterns can be defined as the cognitive process of seeking, gathering and accessing information, which requires steps to obtain the desired data, and depends on an ability to prioritize received information; these patterns can be as diverse as the hardware and software options available.<sup>11</sup>

The objective of this study was to obtain a preliminary portrait of how health information is accessed in Mexico regarding a topic that affects national health and security. Thus, we focused on the search patterns used to obtain information on PS prevention and treatment on the Internet, and we compared differences in the patterns between the general population and professionals dedicated to drug use research, prevention and treatment.

Two complementary approaches can be used to determine information search patterns on the Internet. The first approach uses Google Trends, a tool providing limited Internet search patterns according to geographic region, time period and user search criteria.<sup>12</sup>

The second approach involves directly asking users about the characteristics of their environment<sup>5–8,13,14</sup> and their preferences in searching for Internet information, such as the theme of the research and the motivation, among other decisions that users must make when seeking for information, such as the search criteria, i.e., the words entered into the search engine.<sup>15</sup> Both approaches are complementary, allowing visualization of micro (the user's perspective<sup>16</sup>) and the macro (regional<sup>12</sup>) level results of the information search process.

Under the first approach, we identified 12 studies on PS use. However, only two were associated with prevention or treatment. This tool allowed us to describe, infer and perform epidemiological surveillance. However, the results were limited by not permitting generalization, because the Google Trends tool considers only certain populations and the popularity of the terms used over time. Moreover, it does not indicate users' preferences and motivations.<sup>12,17–28</sup>

Under the second approach, we identified only a few studies with an international scope that addressed the topic of this work. The results of these studies centered on users' motivations and preferences, and agreed that young people use the Internet to search on this subject through the Google search engine.<sup>5,15,29</sup>

In Mexico, only two studies were found that discussed Internet health search patterns.<sup>30,31</sup> No studies specifically relating to the approaches of this article were found in Mexico or Latin America, thus underscoring the importance of this study's integrating the two approaches to strengthen the results.

## Materials and Methods

### *Study design and participants*

This was a non-probabilistic exploratory cross-sectional quantitative study implemented from October 1 to December 31, 2020. Participants were men and women over 18 years of age, with Internet access, who were residents in Mexico and voluntarily agreed to answer the online questionnaire. Participants who closed the URL survey link without completing the questionnaire were excluded.

Recruitment of participants was accomplished by publication of the questionnaire link on social networks such as Facebook, Instagram and Twitter. In addition, messages were distributed to people known to meet the inclusion criteria by email and electronic messaging applications, such as WhatsApp. Local drug treatment agencies, including the

Addiction Primary Care Centers (CAPA), the Statewide Youth Integration Centers CIJ and the State Center Against Addictions “Cúspide,” were invited to participate in the dissemination of the project, and the questionnaire URL link was also released and posted on the official website portal of Veracruzana University.

### Tools

The INDEXA questionnaire<sup>5</sup>, created by Segura et al., was adapted to the Mexican context to meet the objectives of this research<sup>13</sup>. It consisted of 22 questions and was named INDEXA-MEX. The first question pertained to voluntary participation in the study, and subsequent questionnaire items addressed sociodemographic characteristics (age, sex, place of residence, level of education and occupation), prior knowledge regarding drugs, information sources and possible Internet searches on this subject. For eligible participants, items were displayed to determine Internet search patterns, which were understood as the systematic and methodological process used to obtain Internet information on PS use prevention and treatment (Table 1).<sup>15</sup>

Participants were informed that all questions needed to be answered. Because an online instrument was used, the data-gathering software SurveyMonkey, which allows information to be collected through personalized surveys, was used for the design and publication of the questionnaire. Participants who closed the URL survey link without completing the questionnaire were excluded.

### Pilot test

The INDEXA-MEX questionnaire was validated through an online pilot test in October 2020. A total of 33 volunteers, all from the state of Veracruz, agreed to participate at this stage. After the pilot test, the opportunities for improvement detected allowed to improve the comprehension and readability of the questions, and the following modifications were made:

- The age question was modified so that the participants entered their ages as two-digit numbers.
- The items “pensioner/retired” and “self-employment” were added to the occupation question.
- In the search topic question, the answer “pills (ecstasy, synthetic drugs)” was eliminated and replaced by “amphetamines.”
- The answer options “wikis,” “articles,” “books” and “databases” were added to the question on search preferences.
- The answer “once in a lifetime” was added to the search frequency question.

### Information analysis

An Excel 2010 file generated from the SurveyMonkey platform was used for conducting preliminary analyses of the information, which was later processed with the statistical program International Business Machines Corporation

(IBM) Statistical Package for Social Sciences (SPSS, version 22).

For the description of the sociodemographic profile, the Mexican state of origin was grouped according to the geographical regions established by the Autonomous University of the state of Hidalgo.<sup>32</sup>

Descriptive and analytical statistics, including a chi-square test, were calculated according to the measurement scales of the variables. Furthermore, responses from participants that enabled the characterization of the reported search patterns to be compared according to occupation to determine differences between participants who were professionally engaged in drug addiction services (dedicated to drug addiction, DDA) and participants in the general population (people in general, PG).

Only the final values with the highest percentages were retained, and the following indicators were recoded according to responses to the INDEXA-MEX questionnaire: ICT of preference (cell phone, desktop computer, laptop or tablet), Preferred web platforms (general websites, institutional web pages of associations or foundations, or government websites), search preferences (has a bibliography, provides examples, images or videos, or provides additional external links to corroborate the information), search topics (alcohol, tobacco, marijuana, cocaine, crystal methamphetamine or amphetamines) and search criteria (drugs, effects, consumption, treatment or addiction).

The search patterns were classified with a classification tree, on the basis of the CHAID-exhaustive algorithm<sup>33</sup>, which automatically regroups variables with more than two categories for the optimal separation of categories according to a chi-square test.

In the analysis of open-ended questions, after the search criteria, prefixes, articles and pronouns were eliminated from the responses, two open access web platforms were used—the text analysis instrument Voyant Tools and the word cloud generator Wordclouds—to determine the frequency of words and to graph the information obtained, respectively.

### Validation of search criteria and search topic result combinations

After the search patterns were obtained, we determined whether the components of the search criteria and search topics related to the words entered by users in the search engine corresponded to real-world searches. The 30 combinations of these two components were searched in Google Trends, with Mexico as the geographical limit, and a temporality of 2020, because this survey was performed in that year.

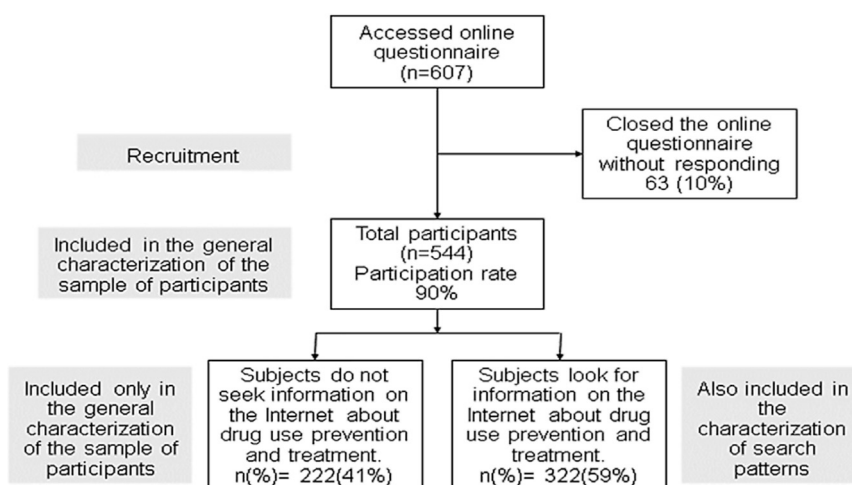
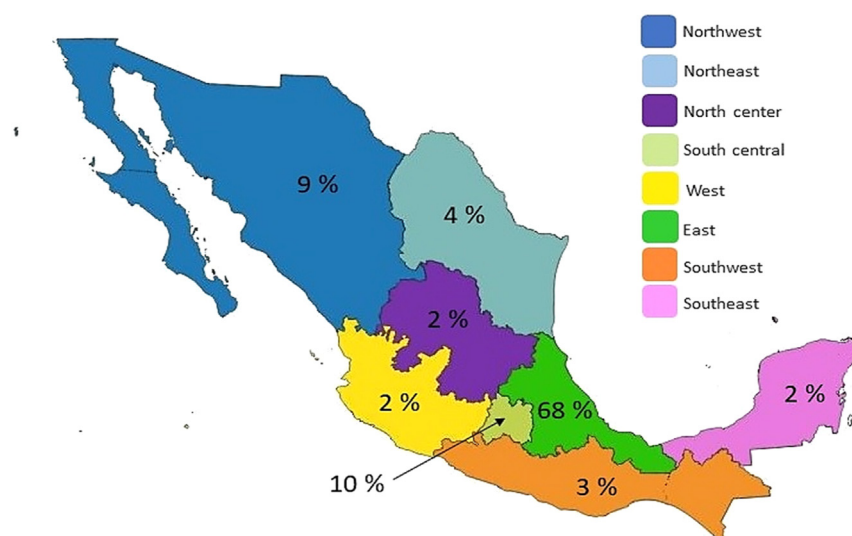
## Results

### Participants

A total of 607 participants answered the online questionnaire, but 63 were excluded because they closed the survey link before finishing the questionnaire. Thus, a final sample of 544 participants was retained, and 10% of the questionnaires were incomplete. For examination of search

**Table 1: Search pattern characteristics according to the bibliographic review, 2020.**

Characteristics	Description
Search frequency	Periodicity of searching for information on the Internet
Reason for search	Participant's motive for searching for information on psychoactive substance use prevention and treatment on the Internet
ICT of preference	Information and communication technologies used to access the Internet
Preferred search engine	Search engine from which the information was accessed
Preferred web platforms	Type of platform that the participant prefers to access when searching for information on the Internet
Search topic	Psychoactive substances initially searched to gain information
Specialized websites	Knowledge of a website on psychoactive substance use prevention and treatment
Search preferences	Personal preferences of the participant regarding the search for information
Search criteria	Keywords entered by the participant in the search engine

**Figure 1:** Flow chart of participants who answered the INDEXA-MEX online questionnaire, October to December 2020.**Figure 2:** Geographic distribution of participants who answered the INDEXA-MEX online questionnaire, October to December 2020.

**Table 2: Education and occupations of participants who answered the INDEXA-MEX online questionnaire, October to December 2020.**

Characteristics	Total N = 544
<b>Education<sup>a</sup></b>	
Technical career	33 (6)
Bachelor's degree	<b>307 (57)</b>
Postgraduate	166 (31)
Other	38 (6)
<b>Occupation<sup>a</sup></b>	
Student	<b>173 (32)</b>
Teacher	75 (4)
Employee	94 (17)
Health worker	111 (21)
Other	91 (16)

<sup>a</sup> Data are represented as n (%).

patterns, a subset of 322 (55%) participants who searched for information on the Internet about PS use prevention and treatment (Figure 1) was retained.

#### Demographic characteristics of participants

Overall, 352 women (65%) and 192 men (35%) participated in the survey, mostly from the eastern region of the country (68%), particularly from the state of Veracruz (63%) (Figure 2).

Regarding age, 55% were 18–30 years old, with a median of 29 years (40–25 interquartile range); however, this variable did not meet normality assumptions. Table 2 shows that the participants' educational level was mostly bachelor's degree (57%), followed by postgraduate degree (31%). Among occupations, those who defined themselves as students comprised 32% of the sample, and health workers comprised 21%.

#### Background information

Among eligible participants, 69% considered themselves to have prior knowledge regarding PS use prevention and

**Table 3: Background information obtained from participants who answered the INDEXA-MEX online questionnaire, October to December 2020.**

Feature	Total N = 544
Previous knowledge <sup>a</sup>	<b>374 (69)</b>
Receipt of information in the last year <sup>a</sup>	272 (50)
Source of information received <sup>a,b</sup>	
Television or radio	155 (29)
Internet	<b>380 (70)</b>
People who have had contact with a psychoactive drug	165 (30)
Institutions	222 (41)
Search for information in the last year <sup>a</sup>	<b>302 (56)</b>
Use of the Internet for research <sup>a</sup>	<b>322 (59)</b>

<sup>a</sup> Data are represented as n (%).

<sup>b</sup> Multiple-choice question; percentages may sum to more than 100%.

treatment, and 50% had received information in the past year through the Internet (70%), institutions (41%), psychoactive drug users (30%), and mass media (29%), such as television or radio. Notably, although 56% had not searched for data on this subject in the past year, 59% had searched with this approach at some time in their lives (Table 3).

#### Internet search patterns

Table 4 shows that 39% of participants performed searches at a frequency of once or twice per year, 48% were motivated by "expanding their general culture," 85% used a cell phone, and 97% used the Google search engine and entered the words "drugs," "effects," "consumption," "treatment" or "addiction" (Figure 3). Most respondents accessed government institutional pages (59%); reported obtaining information on marijuana (68%), alcohol (65%) or tobacco (48%); and preferred web pages with a bibliography (53%).

The focus of analysis was the comparison between the searches performed by DDA versus PG participants. We found that 38% of the DDA and 64% of the PG seeking information were "digital natives" 31 years of age or younger. Table 4 shows similarities in both groups, such as the preferred search engine (Google), preferred ICT (cellular) and search preferences (bibliography and top search engine results).

Among the other variables, statistically significant differences were found. Participants generally performed searches once or twice per year (45%) for the purpose of "expanding general culture" (54%), whereas professionals performed searches weekly (45%) for the purpose of "being specialists in the field" (97%). PG respondents usually accessed general websites (not institutional) (57%) or government pages (55%), whereas specialists preferred government pages (74%), such as the Youth Integration Centers (CIJ) (76%).

Regarding the search topic, the PSs searched by the DDA participants included both popular drugs and those whose use is rising in Mexico, whereas the PG participants conducted searches for the most popular drugs in the media, such as marijuana (66%) (Table 4). The graphical representation of the search criteria, according to reported frequency, is shown in Figure 3.

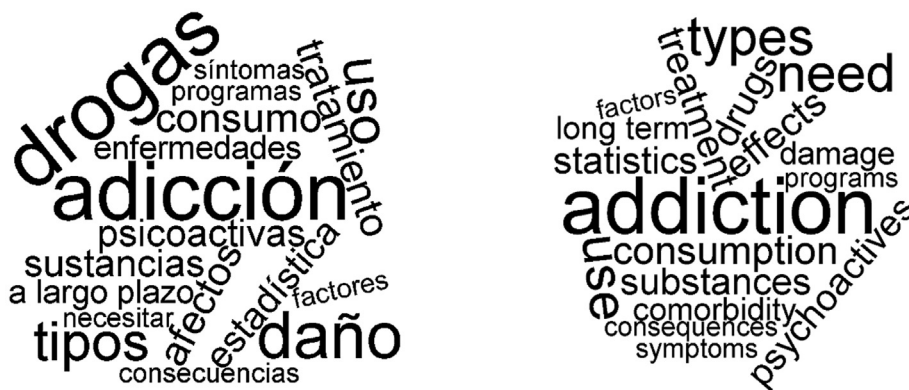
The classification tree presenting the predictive variables for searching information on PS use prevention and treatment (Figure 4) comprised nine nodes and six terminals. The response variable for segmentation was occupation. The variable that occupied the first level was search topic ( $\chi^2 = 6.871$ ,  $p = .008$ ,  $df = 1$ ); on the right side, the preferred web platform was found at the second level ( $\chi^2 = 5.63$ ,  $p = .017$ ,  $df = 1$ ), whereas the third level on the left side was occupied by search preferences ( $\chi^2 = 10.23$ ,  $p = .001$ ,  $df = 1$ ), and that on the right side was occupied by ICT of preference ( $\chi^2 = 11.20$ ,  $p = .001$ ,  $df = 1$ ). The estimated risk was 0.214 (standard error of 0.040).

Table 5 presents the characteristics of the six search patterns, as generated from the terminal nodes of the

**Table 4: Self-reported internet search patterns on psychoactive substance use prevention and treatment according to PG and DDA occupation status, INDEXA-MEX, October to December 2020.**

Features	Total N = 322	PG n = 260	DDA n = 62	p
Search frequency <sup>a</sup>				
Weekly	52 (16)	24 (9)	<b>28 (45)</b>	<b>0.001</b>
Once or twice per year	<b>124 (39)</b>	<b>116 (45)</b>	8 (13)	
Reason for search <sup>a</sup>				
To help a friend	79 (25)	73 (28)	6 (10)	0.002
General culture	<b>155 (48)</b>	<b>141 (54)</b>	14 (23)	<b>0.001</b>
Academic	128 (40)	99 (38)	29 (47)	0.209
Work	111 (34)	73 (28)	38 (61)	<b>0.001</b>
Being a specialist in the field	60 (19)	0 (0)	<b>60 (97)</b>	<b>0.001</b>
ICT of preference <sup>a</sup>				
Smartphone	<b>273 (85)</b>	223 (86)	50 (81)	0.313
Laptop	211 (66)	168 (65)	43 (69)	0.480
Preferred search engine <sup>a</sup>				
Google	<b>312 (97)</b>	252 (97)	60 (97)	0.952
Preferred web platform <sup>a</sup>				
General websites	181 (56)	<b>149 (57)</b>	32 (52)	0.417
Government, institutional	<b>189 (59)</b>	143 (55)	<b>46 (74)</b>	<b>0.006</b>
Associations, institutional	151 (47)	113 (43)	38 (61)	0.011
Social networks	76 (24)	59 (23)	17 (27)	0.431
Articles	158 (49)	126 (48)	32 (52)	0.656
Books	102 (32)	77 (30)	25 (40)	0.103
Search topic <sup>a</sup>				
Alcohol	<b>209 (65)</b>	159 (61)	<b>50 (81)</b>	<b>0.004</b>
Tobacco	156 (48)	117 (45)	39 (63)	0.011
Marijuana	220 (68)	<b>171 (66)</b>	49 (79)	0.044
Cocaine	115 (36)	86 (33)	29 (47)	0.043
Amphetamines	107 (33)	76 (29)	31 (50)	0.002
Tranquilizers	84 (26)	64 (25)	20 (32)	0.218
Crystal methamphetamines	97 (30)	61 (23)	36 (58)	<b>0.001</b>
Specialized websites <sup>a</sup>				
CONADIC	136 (42)	98 (38)	38 (61)	<b>0.001</b>
SSA	<b>137 (43)</b>	105 (40)	32 (52)	0.108
CIJ	132 (41)	85 (33)	47 (76)	<b>0.001</b>
Search preferences <sup>a</sup>				
Top positions	145 (45)	119 (46)	26 (42)	0.586
Bibliography	<b>171 (53)</b>	132 (51)	39 (63)	0.085
Check multiple pages	142 (44)	109 (42)	34 (55)	0.107
Search criteria <sup>a</sup>				
Drugs	<b>149 (46)</b>	110 (42)	39 (63)	0.003
Effects	82 (25)	55 (21)	27 (44)	<b>0.001</b>
Consumption	60 (19)	54 (21)	6 (10)	0.043
Treatment	40 (12)	25 (10)	15 (24)	<b>0.001</b>
Addiction	33 (10)	20 (8)	13 (21)	<b>0.001</b>

<sup>a</sup> Data are represented as n (%). Bold indicates a statistically significant comparison. PG, people in general; DDA, dedicated to drug addictions; CONADIC, Comisión Nacional Contra las Adicciones; SSA, Secretaría de Salud; CIJ, Centro de Integración Juvenil; NIDA, National Institute on Drug Abuse; IMSS, Instituto Mexicano del Seguro Social.

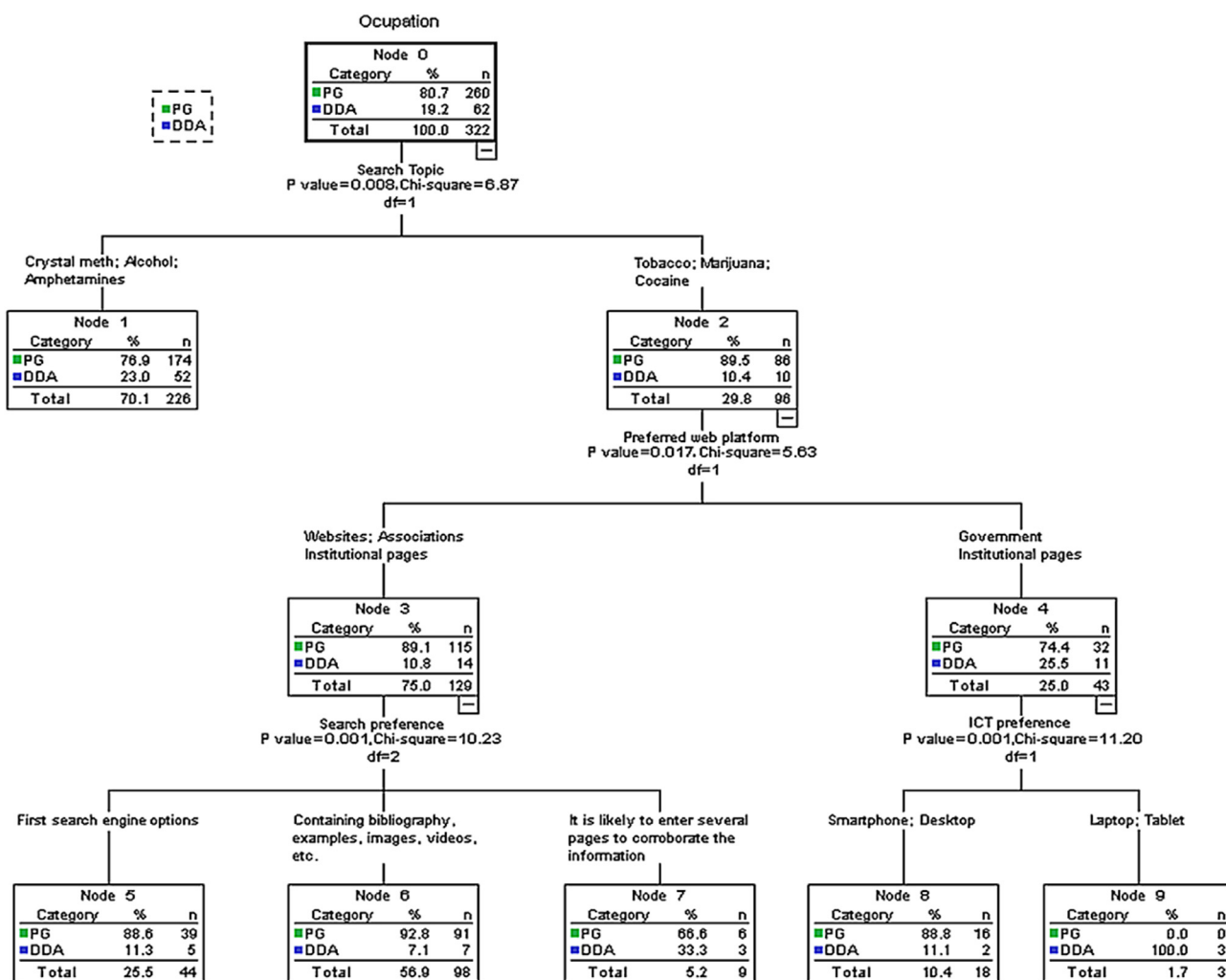


**Figure 3:** Word cloud based on the search criteria of participants who answered the INDEXA-MEX online questionnaire, October to December 2020 (original in Spanish on the left; English translation on the right).

decision tree previously presented. Pattern six had the highest percentage in DDA and was defined by the following components: searches on tobacco, marijuana and cocaine; institutional government pages; and using a laptop or tablet (100%). This was followed by pattern four and its respective components: searches on

tobacco, marijuana and cocaine; the web or institutional pages of foundations or associations; and preferring to access several pages to corroborate the information (33.3%).

Figure 5 represents the validation of combinations of search criteria and search topic results with Google Trends,



**Figure 4:** Classification tree of self-reported internet search patterns for psychoactive substance use prevention and treatment in Mexico, October to December 2020, according to occupation.

**Table 5: Characteristics of search patterns for information on drug use prevention and treatment on the Internet in Mexico, October to December 2020, generated in the segmentation analysis.**

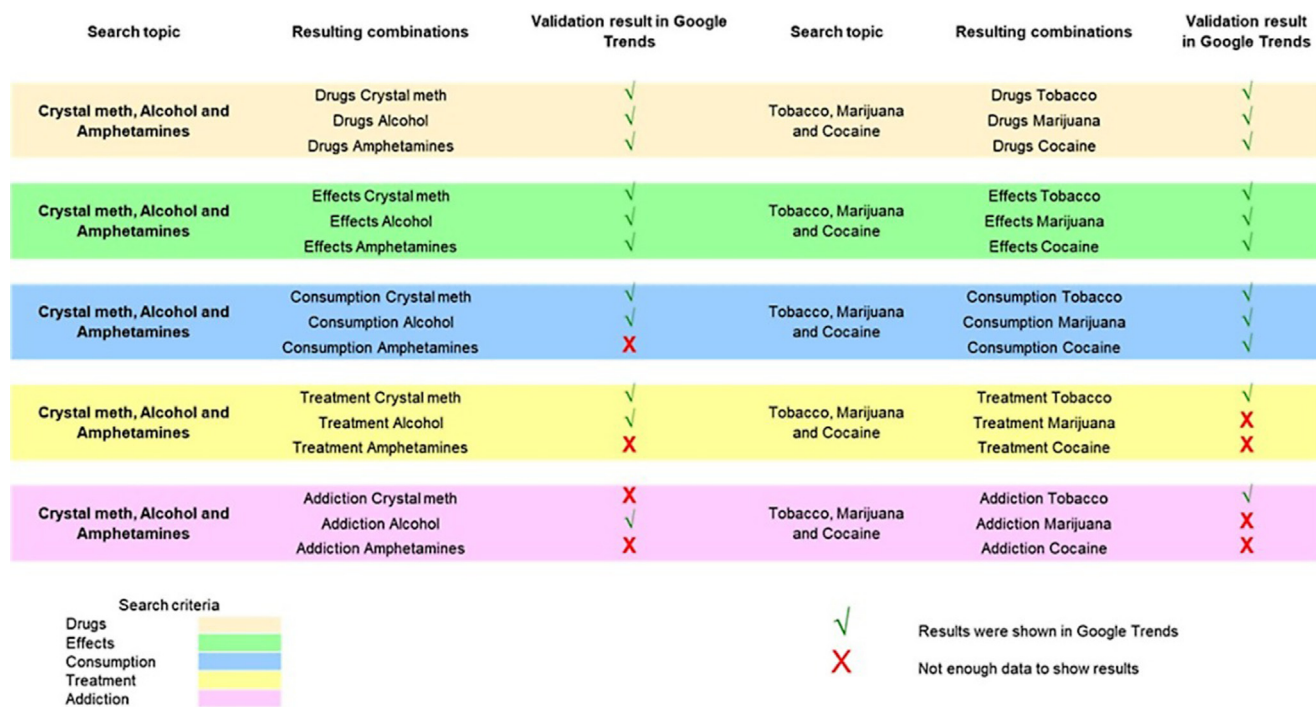
P	N	Search topic	Preferred platform	Search preferences	ICT preference	f	%	PG %	DDA %
1	1	Crystal methamphetamines, alcohol and amphetamines	—	—	—	226	70.1	76.9	23.0
2	5	Tobacco, marijuana and cocaine	Websites, associations institutional pages	First search engine options	—	44	25.5	88.6	11.3
3	6	Tobacco, marijuana and cocaine	Websites, associations institutional pages	Containing bibliography, examples, images, videos, etc.	—	98	56.9	92.8	7.1
4	7	Tobacco, marijuana and cocaine	Websites, associations institutional pages	Likely to read several pages to corroborate the information	—	9	5.2	66.6	<b>33.3</b>
5	8	Tobacco, marijuana and cocaine	Government institutional pages	—	Smartphone or desktop	18	10.4	88.8	11.1
6	9	Tobacco, marijuana and cocaine	Government institutional pages	—	Laptop or tablet	3	1.7	0.0	<b>100.0</b>

P, pattern; N, node; f, frequency; PG, people in general; DDA, dedicated to drug addictions.

when entering these two variables in different combinations on the search engine, it showed 22 of 30 possible combinations (73.3%); the rest did not have sufficient data to display results. Importantly, Google Trends shows results based on the “relative search volume” as the normalized indicator, which is used by the tool to show the popularity of a search term. Thus, an absence of results for a term does not mean that the term has not been searched, but that the searches have not met the parameters established to be displayed.<sup>34</sup> Therefore, we can affirm that the criteria or profiles reported by the participants correspond to real search patterns.

**Discussion**

In this study, we identified search patterns on prevention and treatment of PS use among PG and DDA. The participation resembles to that in 2018 study by the Central Media Digital Agency.<sup>30</sup> Both studies included participants 18–70 years of age and thus could indicate use of ICT and Internet in both migrants and digital natives. In addition, the population of this study is similar to those obtained in 2019<sup>31</sup> and 2021<sup>35</sup> in Mexico in a study on Internet use, with participation mainly in the center–south of the country. This bias must be resolved to obtain information on the entire country.



**Figure 5:** Validation of combinations of search criteria and search topic results in Google Trends.



The results of this research are closely aligned with those of the National Survey on Availability and Use of Information Technologies in Households (Spanish acronym ENDUTIH) of 2019<sup>4</sup>, which have shown that the Internet user population in Mexico is mostly women 25–34 years of age; prefers a mobile phone as the main device; and uses it mainly to search for information. These results are a clear example of the “Google generation”<sup>16</sup> comprising young people who access the Internet for information instead of using means that were previously considered conventional, such as books or asking professionals. Although this generation is brought closer to information, it is also at risk of finding information of dubious origin.

A directly proportional relationship has been found between higher education and use of the Internet in both ENDUTIH surveys, similarly to the findings observed in this study, in which the users’ highest education levels were typically a bachelors’ degree followed by a postgraduate degree.<sup>4,36</sup> This finding may be associated with Hayles’s layer theory,<sup>37</sup> because similarities were found in the sociodemographic characteristics of the participants, thus reinforcing the idea that the availability of resources is associated with greater access to information.

This work is in agreement with that of Segura et al.,<sup>5</sup> in which more than half of the participants considered themselves as being well informed after having obtained information in the past year through communication media, such as the Internet. According to Lewis,<sup>38</sup> this mechanism for obtaining information is important, because it was accessed by 58% of the Mexican population in 2019, according to the Internet MX Association<sup>31</sup> and 59% in 2020.

Aguilar,<sup>15</sup> Lewis<sup>38</sup> and the Internet MX Association<sup>31,35</sup> have demonstrated that PG and health professionals obtain health information on the web. In the past 10 years, the population has been drawn to ICT and therefore to Internet searches on the prevention and treatment of PS use; this growth is indicated by the 10% of participants reported by Segura in 2010<sup>5</sup> versus the 56% observed in this study, and is associated with technology<sup>4,39</sup> and PS use<sup>1</sup>.

The findings from this study coincide with those from previous surveys indicating that the preferred search engine is Google (97%), and this engine is accessed with smartphones.<sup>5,15,31,34,38</sup> These findings justify the use of Google Trends for search pattern validation. Other similarities with prior studies include the preference for the top search results, thus complying with the law of least effort,<sup>16</sup> and that the substances most frequently searched—alcohol, marijuana and tobacco<sup>5,15,38</sup>—were the three substances that emerged as the top search terms among Mexicans searching for PS information according to Google Trends. The methods offer a clear approach to health information that may enable government agencies to take advantage of the tools offered by search engines to locate information within the first results of commonly used search engines and on topics of interest to target populations.

Although the statistics describing these behaviors in Google Trends and other tools, as well as the achievements of artificial intelligence, are valuable, the opinions of participants should not be deprecated.

To provide evidence of the need for the complementary use of these approaches, authors<sup>12,16</sup> have prioritized obtaining preferences from the same user, given that users’

decision-making processes cannot be fully known otherwise.<sup>12,17–28</sup>

Unlike the PG, who were mostly “digital natives, most DDA were “digital migrants,” and a large proportion incorporated Internet use into their professional practice, and academic and daily life. These findings reinforced those of Prensky<sup>10</sup> regarding the adaptation of “digital migrants” to the use of TIC. Our results agree with those of Aguilar et al.,<sup>15</sup> who have found similarities between the responses of people dedicated to drug addiction and those of the general population.

The above findings may be attributable to the lack of incorporation of prevention and treatment of PS use in Mexico in nursing, psychology or medicine curricula.<sup>40</sup> Moreover, in universities, no courses are taught on digital literacy<sup>40,41</sup>. Therefore, the findings that the personnel in this area have similarities in some components of the patterns with those of users in general was not surprising.

The general population searches for the most popular drugs, such as marijuana, alcohol and tobacco, whereas professionals in the field search for information on both the most common drugs and those whose use is increasing, such as amphetamines, crystal methamphetamine or inhalants.<sup>1</sup> This finding may explain why no results were returned when the terms “amphetamines,” “crystal” and “cocaine” were entered in combinations in Google, given that this research was conducted primarily by specialized personnel and not the general population.

The topic “marijuana” was searched by both DDA and PG; however, when combined with the criteria “treatment” and “addiction,” this term did not generate results in Google Trends. The low popularity of these searches might have been due to the extensive debate that has existed for several years regarding the legislation of this substance in the country. Specifically, this drug has been suggested to have less toxicity, and those who consume might be less likely to develop addiction and thus may not require treatment.<sup>42</sup> These beliefs have been confirmed by the perceptions among Mexican university students regarding the consumption of this PS.<sup>43</sup> The great risk to health is evidenced by normalization of the use of PSs by digital media, thus indicating that the infodemic secondary to the COVID-19 pandemic has greatly influenced people’s beliefs and practices.<sup>44</sup>

Limitations of this study include the use of a non-randomized sample, which resulted in over-representation of participants in the state of Veracruz (where the core researcher team was located); the diversity of the recruitment options used in this study might have suggested that the selection of participants would be dispersed. In addition, as is inherent to Internet surveys with voluntary participation, the limitation of self-selection bias must be considered. Likewise, owing to the “weights” and “co-occurrences” of grouping factors used in classification trees, differences between groups cannot be observed in small samples.

Despite these limitations, the present study provides difficult-to-find evidence of how Internet users seek and obtain information associated with two of the fastest growing threats to public health in Mexico: drug use and questionable health information on the Internet. The results provide a preliminary portrait of the current health situation. Nevertheless, further examination is necessary to generate strategies to address PS use.

For future research, the questionnaire should be expanded, and studies could be conducted in specific groups or as a census to target a more inclusive geographic distribution, to address areas underrepresented in this work. Likewise, important variables should be included, such as aspects describing the use of the Internet (including the type of network and number of hours of daily use), and other drug addiction behavioral domains, such as patterns of drug acquisition and searches on drug use risk reduction strategies.

Owing to the paucity of literature on Internet search patterns, as evidenced by the limited number of studies found, this line of research is highly relevant and even necessary in the age of pervasive digital information. Understanding how information on the subject of this study is acquired would support the formulation of public policies based on scientific data to identify and reduce the dangers associated with receiving information of doubtful scientific and therapeutic value, and the development of tools to motivate self-care and bring people closer to health services or valuable information on the internet.

## Conclusions

In this project, the examination of search patterns provided important data on how information on PS use prevention and treatment is sought in Mexico, including the means used, the decisions made, and the valuations made by users that led them to access information.<sup>44</sup> The information was validated with AI. This study is the first of its kind performed in Mexico and Latin America. The examination of search patterns should contribute to better understanding of health information-seeking behavior within the rapidly growing domain of digital repositories of information, and may serve as the first step to understanding how to improve public health in the digital era.

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## Conflict of interest

The study was performed within the framework of the Master's in Public Health program offered by the Public Health Institute of the Veracruzana University, and the authors declare that they have no past or current conflicts of interest.

## Ethical approval

The study was conducted according to the guidelines of the Declaration of Helsinki and was approved on October 27, 2020 by the research ethics committee of the Public Health Institute of Veracruzana University, under registration number CEI-ISP-R10/2020.

## Consent

Participation in this study entailed little or no risk to participants; however, a brief description of the study was provided, emphasizing voluntary participation,

confidentiality, and the freedom to leave at any time. At the beginning of the questionnaire, a checkbox was included with the following text, in Spanish: "I have read the Informed consent letter, I am 18 years of age or older, I reside in Mexico, and I agree to participate in this study by trustfully responding to this questionnaire."

## Authors contributions

YPP: conceptualization, methodology, formal analysis, investigation, writing—original draft, writing—review & editing, project administration, visualization. XSJC: validation, writing—review & editing. MLO: validation, writing—review & editing. JLZ: validation, writing—original draft, writing—review & editing. MSLV: validation, writing—review & editing, visualization. MLMM: validation, writing—review & editing. MCOL: conceptualization, methodology, validation, formal analysis, resources, writing—original draft, writing—review & editing, project administration, supervision. All authors have read and agreed to the published version of the manuscript. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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