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Review

Systematic review of self-medication in students of medical and biological sciences careers

[Revisión sistemática de la automedicación en estudiantes de carreras de ciencias médicas y biológicas]

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Abstract

Context: Self-medication is a self-care practice. It is a frequent and widespread habit in all societies and does not distinguish between sex and age. Therefore, students are not exempt from using this practice.

Aims: To carry out a systematic review of scientific articles published between 2010 and 2020 on self-medication in university students of careers related to medical and biological sciences with PRISMA guidelines.

Methods: A standardized search was performed in four databases with the following terms: *Automedicación* (in Spanish), *Self-medication*, *Automedication*, *University Student*, and *Students*. For the selection of studies, the Rayyan® tool was used. The most relevant information on self-medication of university students was collected.

Results: Fourteen articles were included and evaluated as high, medium, and low quality with the AXIS tool. The results of the study reflected a high self-medication in university students of careers related to medical and biological sciences, with a higher prevalence of self-medication in women than in men. The more knowledge these students have, the greater their self-medication and, thus, they always maintain this practice, being the most indicated causes for it the problems in the respiratory tract, headaches, and gastrointestinal problems. The main reasons for these students to practice self-medication are the knowledge they have acquired in their curricula, due to past experiences with the same symptoms and minor illnesses. Pharmacies, through friends, relatives or neighbors and home medicine cabinets are the most common places for the acquisition of medications by these students, indicating that analgesics/anti-inflammatories, antibiotics, and antipyretics are the most used medications among them.

Conclusions: These students practice self-medication because they consider they have sufficient knowledge about diseases and their treatments, which gives them more confidence in making the decision to self-medicate. Subsequently, self-knowledge is a decisive reason for self-medication. Moreover, self-medication patterns regarding the use of drugs from various therapeutic categories vary among medical and biological sciences university students from different countries.

Keywords: drug knowledge; self-medication; systematic review; university student.

Resumen

Contexto: La automedicación es una práctica de autocuidado. Es un hábito frecuente y extendido en todas las sociedades y no distingue sexo ni edad. Por lo tanto, los estudiantes no están exentos de utilizar esta práctica.

Objetivos: Realizar una revisión sistemática de artículos científicos publicados entre 2010 y 2020 sobre automedicación en estudiantes universitarios de carreras relacionadas con las ciencias médicas y biológicas con las directrices PRISMA.

Métodos: Se realizó una búsqueda estandarizada en cuatro bases de datos con los siguientes términos: *Automedicación*, *Automedication*, *University Student* y *Students*. Para la selección de los estudios se utilizó la herramienta Rayyan®. Se recogió la información más relevante sobre automedicación de estudiantes universitarios.

Resultados: Se incluyeron 14 artículos que fueron evaluados como de calidad alta, media y baja con la herramienta AXIS. Los resultados del estudio reflejaron una elevada automedicación en estudiantes universitarios de carreras relacionadas con las ciencias médicas y biológicas, con una mayor prevalencia de automedicación en mujeres que en hombres. Cuantos más conocimientos tienen estos estudiantes, mayor es su automedicación y, por tanto, mantienen siempre esta práctica, siendo las causas más indicadas para ello los problemas en las vías respiratorias, dolores de cabeza y problemas gastrointestinales. Las principales razones para que estos estudiantes practiquen la automedicación son los conocimientos adquiridos en sus planes de estudio, debido a experiencias pasadas con los mismos síntomas y enfermedades leves. Las farmacias, a través de amigos, familiares o vecinos y los botiquines caseros son los lugares más comunes para la adquisición de medicamentos por parte de estos estudiantes, indicando que los analgésicos/antiinflamatorios, antibióticos y antipiréticos son los medicamentos más utilizados entre ellos.

Conclusiones: Estos estudiantes practican la automedicación porque consideran que tienen conocimientos suficientes sobre las enfermedades y sus tratamientos, lo que les da más confianza a la hora de tomar la decisión de automedicarse. Consecuentemente, el autoconocimiento es una razón decisiva para la automedicación. Además, los patrones de automedicación en relación con el uso de fármacos de diversas categorías terapéuticas varían entre los estudiantes universitarios de medicina y ciencias biológicas de distintos países.

Palabras Clave: automedicación; conocimiento sobre fármacos; estudiante universitario; revisión sistemática.

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INTRODUCTION

Self-medication is defined as the use of medications without a prescription, on one's own initiative (Cecilia et al., 2018). This is a practice that represents a public health problem worldwide, mainly in developing countries, being an important issue for health systems. The World Health Organization (WHO) defines self-medication as the selection and use of medications by individuals to treat self-recognized illnesses or symptoms (Urrunaga-Pastor et al., 2019).

In a broad sense, self-medication implies the use of non-prescription medications (Subastini and Udayanga, 2020), including the consumption of any type of medication, regardless of its synthetic, herbal or homeopathic origin (Hernández Chávez and Mercado Sesma, 2014) and Over the Counter (OTC) medications, which are to treat recognized minor ailments without consulting a doctor, thus obtaining medications without a prescription (Subastini and Udayanga, 2020).

Self-medication is also influenced by sharing medications with others or the use of drugs that are already available in the residence, including leftovers from previous prescriptions (Subastini and Udayanga, 2020); but the act of self-medication covers everything that affects the prescription made by a doctor, that is, the acquisition, use of medicines from home or elsewhere, interruption or prolongation of a treatment or the increase and decrease of the recommended doses (Hernández Chávez and Mercado Sesma, 2014).

In addition, the concept of responsible self-medication is based on the treatment of diseases and conditions using medicines that do not require a prescription for sale, due to their safety and efficacy when used correctly (Cecilia et al., 2018).

Self-medication is part of the self-care carried out by human beings since the beginning of the use of medicines in health care. In the past, this action was carried out through personal care, the use of herbs or other types of therapies to relieve symptoms or cure certain pathologies. Such empirical knowledge was transmitted verbally from one generation to another (Hernández Chávez and Mercado Sesma, 2014). Currently, the behavior of self-medication is widely spread throughout the world, with percentages between 40.0% and 90.0% (Vera-Romero et al., 2019).

It is important to point out that the inappropriate use of medications brings with these situations of risk to health. Among the best-known negative effects of self-medication are adverse reactions, allergies, intoxications, risk of dependence, interactions, bacterial resistance, between others (Veliz-Rojas et al., 2017).

The main conditions associated with the practice of self-medication are demographic, social, cultural, personal and health system factors, age, sex, socioeconomic level, educational level, having previously experienced similar symptoms, fear of being diagnosed with a serious illness and/or the need to relieve symptoms before seeking health services are frequently related to this practice (Urrunaga-Pastor et al., 2019).

Regarding the health system, it has been described that self-medication is related to easy access to medications in drugstores and pharmacies and lack of access to health services, which in turn is associated with the lack of health insurance. Thus, the multifactorial nature of the practice of self-medication is confirmed (Urrunaga-Pastor et al., 2019).

In a study, it was reported that the behavior of self-medication in health sciences students had a prevalence between 55.0-97.3%. This practice in university students is more frequent in the female gender and between 20 and 21 years of age. It has been reported that the higher frequency of self-medication is influenced by their social and cultural environment of origin, as well as the knowledge obtained in the university environment through the curriculum, especially in those from advanced semesters (Zevallos Escobar et al., 2022). However, there is little information about these facts of the problem.

University students, specifically those in the medical and biological sciences careers, resort to this practice on a regular basis. However, there are few studies that show the behavior of self-medication in university students of these careers, especially those that establish whether there are differences between the groups of drugs used to self-medicate according to country, frequency, places, and reasons.

Given this lack of knowledge, some questions arise: What is the self-medication behavior of university students in the health area in medical and biological sciences careers? How is the sociodemographic behavior in self-medicated university students in the medical and biological sciences area? What are the reasons and places of self-medication of the university students of medical and biological sciences? Do self-medication knowledge and patterns vary among medical and biological sciences university students from different countries? For this reason, in this work a systematic review of self-medication studies in university students of these careers was carried out, with the aim of knowing their self-medication behavior in the decade of 2010 to 2020.

MATERIAL AND METHODS

Type of study

In this work, a documentary, retrospective, descriptive investigation was carried out that corresponds to a systematic review of selected studies, which included university students of the career in the area of medical and biological sciences such as Pharmacy, Dentistry, Medicine, Nursing, Obstetrics and Gynecology, Physiotherapy, Psychiatry and Psychology, Nutritionist and Occupational Therapy who practiced self-medication. The systematic review was carried out following the Preferred Reporting Items of Systematic Reviews and Meta-analyses (PRISMA) guidelines to ensure the correct development of the systematic review of the literature (Moher et al., 2009; Urrútia and Bofill, 2013).

Search strategy

Preliminary searches were carried out in reference databases such as Pubmed, Scopus, Web of Science and Science Direct using the keywords "Automedicación" (in Spanish), "Self-medication", "Automedication", "University Students", "Students", united by the Boolean operators "OR" and "AND". Because, in these databases, they have different metric indicators, so they allow evaluating the behavior of the information sources, also maintaining a quality in the articles and their content, guaranteeing their reliability. The result yielded a large number of articles that showed a general vision about the research topic. The final search strategy was as follows:

((Self-medication OR Automedication OR Automedicación) AND (University Students AND Students) AND (2010-2020)).

Eligibility criteria

The search for the research questions was carried out by suggesting the structural criteria to carry out a systematic review in accordance with those collected in PROSPERO (Centre for Reviews and Dissemination, 2016) using the PICO format, corresponding to Population (university students of science careers and biological), Intervention (self-medication), Comparison (self-medication among university students of medical and biological sciences from different countries) and Outcomes (knowledge and patterns of self-medication in university students of medical and biological sciences). The results obtained in the search were exported to the RAYYAN® application (Ouzzani et al., 2016).

This study included: Original articles published between the years 2010 to 2020; full text articles; articles in Spanish, English and Portuguese; articles with the validation of the questionnaire and/or approval of the Ethics and Research Committee; articles involving university students of medical and biological sciences careers such as Medicine, Pharmacy, Dentistry, Nursing, Physiotherapy, Psychiatry and/or Psychology, Obstetrics and Gynecology, Nutritionist and Occupational Therapy; articles that reflected the patterns of self-medication in university students and articles that met the AXIS criteria with a score equal to or greater than 14. While they were excluded: Articles published outside the study period; review articles or those that did not have full text; articles with languages other than Spanish, English or Portuguese and articles that the population under study were not university students.

Selection of studies

To indicate the different stages of the systematic review process methodology, the PRISMA diagram (Moher et al., 2009) was used, which was generated using Software Advice – Opera Reviews & Ratings. All search results were exported to the Rayyan application (Ouzzani et al., 2016) in ".ris", ".bib" and ".txt" formats. The application was also used to detect duplicate articles. Subsequently, the articles were analyzed and selected with this program, reading the keywords, the title of the articles, abstract and if they were full text. Thus, it was possible to define if the article was useful for the review.

Data extraction

To meet the objectives of the research, the Excel of the Microsoft Office 2010 program was used to make tables according to the study variables shown below.

Data extraction variables for qualitative analysis

Authors: All authors who participated in the research of the article.

Main Author: Most important author and the one who led the investigation.

Country: Country in which the research of the article was carried out.

Journal: Journal to which the article belonged.

Year of publication: Specifies the year in which the research article was published.

Source category of the article: Category in which the journal is found.

Relevance variable of the JIF journal: Journal impact factor, Quartile (Q) and percentile (Pn) of the quartile, JCI: Journal cites indicator, Scopus H-index and WoS.

Variables considered in data extraction

Type of study: The classification criteria of the researchers based on the analysis they carried out in the article.

Form of study: The way in which the study was carried out through a survey, through an interview, in writing, online and if it was self-administered.

Survey and ethics committee validation: Validation of the questionnaire and/or validation by the Ethics and Research Committee

Informed consent: If the study declared that there was oral, written or online informed consent.

Sample: The total number of students responders.

Age: The reported age of the students.

Gender: The gender by which the students felt identified, either female or male or not reported.

Marital Status: Whether the students were single, married, divorced, or widowed.

Residence: If the students lived in a rural, urban or other area.

Economic income: Information on the economic income of the students and their families.

Student careers: The medical and biological sciences careers such as Medicine, Pharmacy, Dentistry, Nursing, Physiotherapy, Psychiatry and/or Psychology, Obstetrics and Gynecology, Nutritionist and Occupational Therapy to which the students belonged.

Undergraduate: The undergraduate year that the study sample was studying.

Self-medication: The total number of students who declared self-medication.

Self-medication by gender: The reported amount of self-medication but classified by gender of the study sample.

Self-medication by knowledge: The total number of students who declared self-medication with knowledge or without knowledge.

Self-medication by economic income: The number of students who declared self-medication according to economic income.

Frequency and time of self-medication: The frequency and time in which the students self-medicated.

Medications administered in self-medication: The total number of medications declared by the study sample to self-medicate.

Medications most used in self-medication: Medications mostly consumed by students.

Cause of self-medication: Causes declared in the study why they self-medicated.

Place of obtaining medicines: Where the students declared that they acquired the medicines to carry out self-medication.

Reasons for self-medication: Reasons why students made the decision to self-medicate.

Conclusions of the article: Conclusions of the results of each article.

Additionally, a basic-complementary statistical analysis of the variables was carried out, performing a qualitative analysis, using graphs made with the Microsoft Excel 2010, Visme (https://my.visme.co) and UCINET 6 Social Network Analysis Software (Borgatti et al., 2002) programs. The results of the analyzes were expressed in frequency and percentage.

Qualitative assessment

The AXIS tool (Downes et al., 2016) was used to determine the quality of evidence of the articles with the aim of reducing the bias generated by the selection of studies. 17 questions of the 20 described for each aspect of the articles were evaluated and used, such as: Introduction, methodology, results, discussion, and others. The quality questions were answered following the criteria: Yes (complies), No (does not comply) and Does not apply (N/A), depending on the situation of each article, a maximum score of 17 points was considered. The quality of the articles was defined as: High quality for articles that obtained ≥16 points, medium quality between 14-15 points, and low quality for articles that obtained ≤13 points.

The review was carried out by peer reviewers to avoid bias in the selection of studies, and when necessary, it was solved with the opinion of a third party. Each author's assessment of the quality of the selected articles was done independently using the AXIS tool, which is a critical appraisal tool that evaluates the quality and risk of bias of a study (Downes et al., 2016). It was developed via the Delphi panel that consisted of 20 components (Mat Sharil et al., 2022; Pérez-Loyola et al., 2022). Selected articles that meet the AXIS criteria with a score greater than 12.5 were selected, as declared in the inclusion criteria.

RESULTS AND DISCUSSION

Selected and excluded studies

The systematic search carried out in the four databases used are "Pubmed", "Science Direct", "Scopus" and "Web of Science", resulting in a total of 392 articles. The collected articles were exported to the Rayyan application, where 45 duplicate articles were excluded, leaving 347 articles. Of these, when reading the title and abstract, 240 were eliminated, making sure that the articles were about self-medication in university students. The remaining 107 articles were evaluated for their eligibility, of which 92 were excluded according to the exclusion criteria. Subsequently, an AXIS analysis was performed on the 15 selected articles, and one article that did not meet the quality criteria (score greater than or equal to 14) was excluded, therefore, 14 articles were selected for qualitative analysis. Fig. 1 details the processing of the information and the stages carried out for the systematic review of the literature. Data obtained from the 14 articles chosen, through the inclusion criteria, were used to make a summary table (Table 1).

Study quality analysis

The quality analysis carried out on the 14 articles selected for the systematic review, using the AXIS tool (Downes et al., 2016), revealed that five articles obtained a score between 14-15, so they were included in the medium quality category. On the other hand, nine articles obtained a score between 16-17, giving it a high-quality category, this being the predominant.

The analysis of the relevance of the information contained in the selected articles was carried out using the Journal Citation Reports and Scimago Journal & Country Rank tools, to identify the journal quartiles (Q) in which the citations were found. As a result, one Q1 journal article, five Q2 journal articles, four Q3 journal articles and four Q4 journal articles were obtained. The quality analysis was varied in the studies, because the AXIS tool is mainly aimed at cross-sectional studies *in vivo* due to the characteristics of the questions established in the said tool (Downes et al., 2016). Therefore, this tool was adapted to the study using only 17 questions that met the characteristics to analyze the quality of the 14 selected articles, resulting in a maximum of 17 points. Questions 7, 13 and 14 were not taken into account and were not answered, giving them a N/A (Not Applicable) category, nor were their scores added. The quality score scale was the same for all articles, resulting in six articles with a score of 16 and four articles with a maximum score of 17, giving it a high-quality category between 94.1% and 100%, respectively, with positive answers. Regarding the articles of medium quality, there were two articles with a score of 14 and two articles with a score of 15, giving 82.4% and 88.2%, respectively, with positive responses.

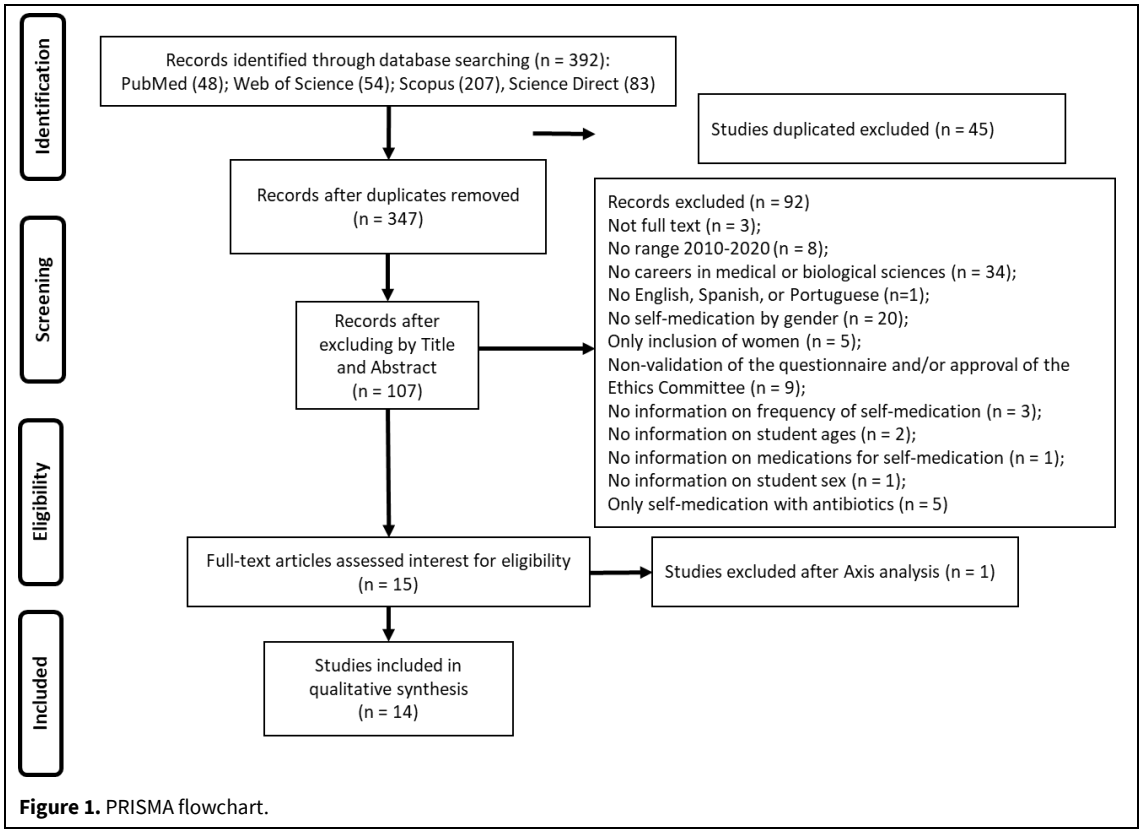

Figure 1. PRISMA flowchart.

Table 1. General data of the 14 selected articles.

Title	Principal author (year)	Study type	Study form	Informed consent	Objective	Respondents (n)	Self-medicated students (n)
Self-medication practice and associated factors among university of Gondar college of medicine and health sciences students: A cross-sectional study	Zeru N (2020)	Transversal	Self-Administered Written Questionnaire	Written	To assess the magnitude and factors associated with self-medication practices among medical and health sciences students at the University of Gondar.	792	415
Self-medication practices among undergraduate university students in Northeast Ethiopia	Zewdie S (2020)	Descriptive, Transversal	Self-Administered Written Questionnaire	Written	To assess self-medication practices and associated factors among undergraduate pharmacy students at the University of Wollo.	341	167
Evaluation of self-medication practice among university students	Puay Luan T (2020)	Transversal	Self-Administered Written Questionnaire	Written	To determine which classes of drugs are most frequently used as self-medication by pharmacy and medical students.	367	239
Prevalence, practice, and pattern of self-medication among medical students in Al-Iraqia Medical College, Baghdad, Iraq	Khalil NS (2019)	Descriptive, Transversal	Self-Administered Written Questionnaire	Verbal (Recorded)	To assess the prevalence of self-medication among medical students and to describe self-reported medication practice and pattern by medical students.	400	340
Behavior of self-medication in students of the Chemistry and Pharmacy career of the Universidad Católica del Norte	Valdés González M (2018)	Descriptive, Transversal y Retrospective	Self-Administered Written Questionnaire	Written	To determine the behavior of self-medication in students of the Chemistry and Pharmacy career at the Universidad Católica del Norte.	168	159
Assessment of self-medication practices and its associated factors among undergraduates of a private university in Nigeria	Tolulope Esan D (2018)	Descriptive, Transversal	Self-Administered Written Questionnaire	Written	To assess the practice of self-medication among undergraduate medical students at a private university in Nigeria.	363	297
Implications of self-medication among medical students - A dilemma	Gul Kanwal Z (2018)	Transversal	Self-Administered Written Questionnaire	Verbal (Recorded)	To assess the knowledge, attitude and practice of self-medication in undergraduate medical students.	300	297
Self-medication among nursing students in the state of Amazonas - Brazil	Gama ASM (2017)	Transversal	Self-Administered Written Questionnaire	Written	To determine the prevalence of self-medication and associated factors among nursing students.	116	88

Table 1. General data of the 14 selected articles (continued...)

Title	Principal author (year)	Study type	Study form	Informed consent	Objective	Respondents (n)	Self-medicated students (n)
Self-medication practice among undergraduate medical students of a Saudi tertiary institution	Albasheer OB (2016)	Transversal	Self-Administered Written Questionnaire	Written	To assess the knowledge, attitude, and magnitude of self-medication among Jazan University medical students.	300	251
Self-medication practices among undergraduate nursing and midwifery students in Australia: a cross-sectional study	Williams A (2016)	Transversal	Self-Administered Written Questionnaire	Online (Written)	To explore the self-medication practices of Australian nursing and obstetric students.	120	110
High prevalence of self-medication practices among medical and pharmacy students: A study from Jordan	Alkhatatbeh MJ (2016)	Transversal	Self-Administered Written Questionnaire	Verbal (Recorded)	To assess self-medication practices and the impact of gaining medical knowledge about self-medication among medical and pharmacy students at the Jordan University of Science and Technology.	1317	1034
Self-medication with analgesics among medical students and interns in King Abdulaziz University, Jeddah, Saudi Arabia	Khamis Ibrahim N (2014)	Transversal	Self-Administered Written Questionnaire	Uninformed	To determine the prevalence and predictors of self-medication among final-year medical students and interns at King Abdulaziz University.	504	279
Self-medication among university students: The influence of the field of study	Galato D (2012)	Transversal	Interview	Written	To investigate the influence of the field of study of university students on self-medication.	342	330
Self-medication and health academic staff	Silva de Aquino D (2010)	Transversal	Self-Administered Written Questionnaire	Written	To evaluate the behavior of future health professionals in relation to the use of medications, in particular, the practice of self-medication.	223	129

The analysis of the relevance of the journals where the publications of the selected articles were found, indicated that four articles belonged to Q4 journals, where three of them (Albasheer et al., 2016; Alkhatatbeh et al., 2016; Valdés González et al., 2018) were classified as high-quality articles with the AXIS tool and the remaining one (Gul Kanwal et al., 2018) was classified, according to the AXIS tool, with medium quality.

On the other hand, it was reflected that in the article by Zeru et al. (2020) was evaluated as high quality according to the AXIS tool criteria, and the journal was Q1 high visibility. Therefore, it should be noted that the quality of the articles is not related to the quartile of the journals where they are published, showing that the articles are not affected by the quartiles of the journals. This may be due to the fact that scientific journals also require that articles must comply with the clarity and transparency of information before publication.

Qualitative analysis and data extraction

The articles that were included in the systematic review corresponded to studies published between the years 2010 and 2020, of which three articles were published in the year 2016, three in the year 2018, and another three in 2020, these three years being the ones that obtained most posts (9/14). The remaining five articles corresponded to one article per year, corresponding to the years 2010, 2012, 2014, 2017, and 2019.

The origin of the 14 articles was established according to the country where the study was carried out. These came from ten countries, with Brazil being the country with the largest number, with three articles (21.4%), followed by Saudi Arabia and Ethiopia with two articles each (14.3%), and finally, Australia, Chile, Iraq, Jordan, Malaysia, Nigeria, and Pakistan with one item each (7.1%) (Fig. 2).

The total size of the analyzed sample was 5653 university students. The sample with the largest number of participants was 1317 university students from Alkhatatbeh et al. (2016), and the least amount was 116 from Gama and Secoli (2017), with 23.3% and 2.1%, respectively (Tables 1 and S1).

Age range of respondents

The ages of the students varied from 18 to 54 years old. Most of them 99.5% were in the age range between 18-29 years (Table 2), which reflects college student averages' ages. This result is in correspondence with a study carried out in Spain (Guillem Sáiz et al., 2010), in which the average age of university students was between 18-28 years. Another self-medication study carried out in Saudi Arabia (Benameur et al., 2019) mentions that the students ranged between 18-30 years. In this, it is stated that the age range between 18-29 years is the most prevalent since they are the usual ones that university students have.

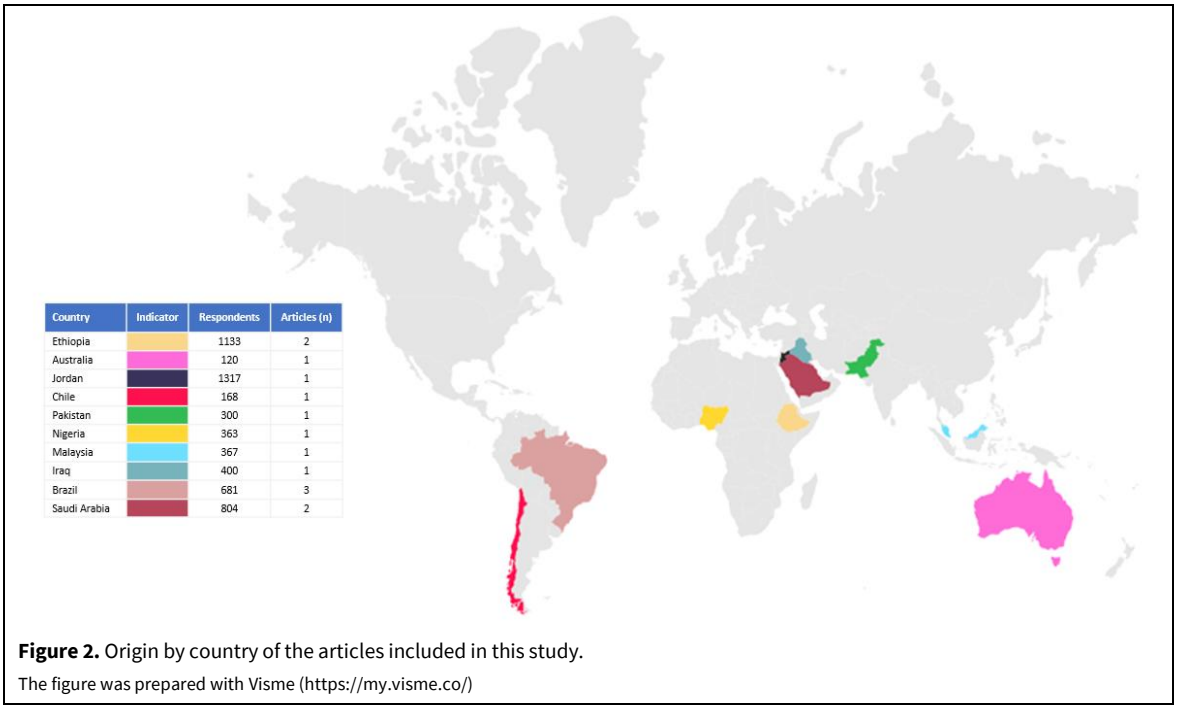

Figure 2. Origin by country of the articles included in this study.
The figure was prepared with Visme (https://my.visme.co/)

Table 2. Age range and gender of the samples in the studies.

Variable	Respondents	Percentage (%)
Age range		
18-29	5627	99.54
30-39	16	0.28
40-49	8	0.14
≥50	2	0.04
TOTAL	**5653**	**100**
Gender		
Female	3380	59.79
Male	2258	39.94
Uninformed	15	0.27
TOTAL	**5653**	**100**

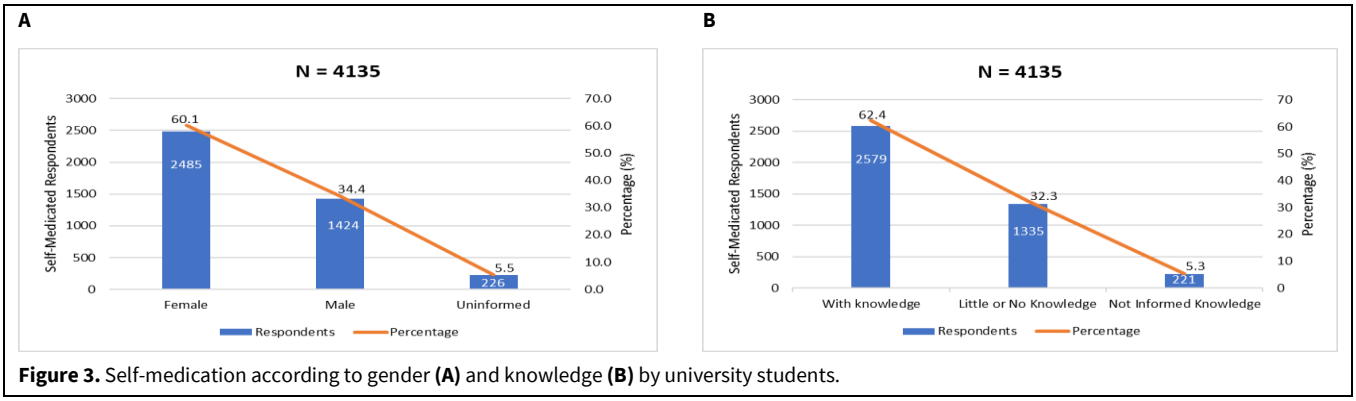

Figure 3. Self-medication according to gender **(A)** and knowledge **(B)** by university students.

Gender of respondents

According to the selected studies, the population of each of the studies was classified by gender, both female and male, and those students who did not identify with any gender (Fig. 3A). Table 2 shows that female students had higher participation in the studies (59.8%). However, the studies of Zeru et al. (2020) and Zewdie et al. (2020), both from Ethiopia, in which they showed higher participation of the male gender. This could be due to the area and culture of the article's country of origin, where the opportunity to study a university career is greater in men than women. Only two articles, Zewdie et al. (2020) from Ethiopia and Gul Kanwal et al. (2018) from Pakistan, declared that some students did not identify with a gender. If we compare the information on gender with other articles on self-medication in university students, it can be observed that the trend of greater participation is for women, as reflected in a study from Brazil (Corrêa Da Silva et al., 2012) and another from Malaysia (Haque et al., 2019). In these, it was concluded that the participation of women is greater than 60.0% and that the female gender is the majority in careers in the area of medical and biological sciences. However, females had a higher prevalence of pain, which could be impacted according to the causes of self-medication in the present study (Keogh, 2022). Other studies show the opposite behavior, that is, that the participation of men is higher than 50.0%, as shown in the articles by Zhu et al. (2016) from China and El-Ezz et al. (2011) from Egypt. On the other hand, a study by Haque et al. (2019) from Malaysia mentions that 0.2% of the student respondents do not identify with any gender, a similar result to the present review.

Classification according to behavior

One of the main questions, when choosing the articles for this research, was "if university students with a career in the area of medical and biological sciences self-medicated or not". A total of 5653 university students participated in the studies, of which 4135 (73.0%) students confirmed that they self-medicated and 1518 (27.0%) confirmed that they did not self-medicate. This result corresponds to 13 articles affirmatively declaring self-medication among their students, and only one article (Zewdie et al., 2020), reported that most students did not self-medicate (Table 1S). The trend is that the majority,

more than 50.0% practiced self-medication. This behavior is also in agreement with two articles, one from Nepal (Banerjee et al., 2016) and the other from Poland (Krajewska-Kułak et al., 2019), in which they show that university students of careers in the health area regularly self-medicate, with a higher prevalence in women.

Careers in the area of medical and biological sciences

In the 14 articles, nine careers were identified: Nursing, Pharmacy, Physiotherapy, Medicine, Nutritionist, Obstetrics and Gynecology, Dentistry, Psychiatry and/or Psychology and finally Occupational Therapy (see Table 3). The students of the Medicine, Pharmacy and Nursing careers were the ones with the highest participation in the self-medication studies, corresponding to the university students who were studying professional courses and clinical internships, this can be seen more clearly in the graph in Fig. 1S. In two studies (2/14), one from Saudi Arabia (Mustafa and Rohra, 2017) and the other from Egypt (Helal and Abou-ElWafa, 2017), showed that a participation of 50.0% corresponded to Medicine students, followed by Pharmacy and later, by Nursing.

Knowledge to self-medicate

In the selected studies, the university students who agreed to self-medicate were 4135 in total, who stated that they did so because they had knowledge of diseases, medications and dosages, which they had acquired during different years of study. Fig. 3B shows the distribution of students according to their knowledge of self-medication. A total of 2579 (62.4%), third-year students and higher who had professional branches, stated that they had the appropriate knowledge to practice self-medication.

Around of 1335 students (32.3%) declared little or no knowledge, either of diseases, medications and dosage. These were studying the first or second year of the race without having professional branches. Finally, 221 students (5.3%) did not declare the level of knowledge they had (Table 1S).

The previous results show a high percentage of self-medication in students of careers in the area of medical and biological sciences. This could be because they feel more confident because of the knowledge acquired during their academic training. Similar results were reported by Klemenc-Ketis et al. (2010) from Slovenia and Sharma et al. (2015) from India, who found that self-medication of university students was greater than 51.0% and 57.0%, respectively. The university students declared that they self-medicated correctly because they had sufficient knowledge.

With respect to the students who declared having little or no knowledge, also those who did not report having the knowledge to self-medicate, it is because this group of students was starting a career in the area of medical and biological sciences or was just in the second year, where they did not have the knowledge that is taught in the professional health branches. Similar results were published by Zhu et al. (2016) from China, and Gunawardhana et al. (2015) from Sri Lanka.

Self-medication frequency

In this study, it was determined that of the 4135 university students who practiced self-medication, 60.6% self-medicated occasionally, 25.8%, always, and 13.6% frequently (see Table 4). The frequency was classified in various ways: By the number of times, by the days mentioned, and by weeks or months that the university students reported the frequency in which they self-medicated (Table 2S).

Table 3. Careers in the medical and biological sciences area declared in the selected articles.

Career	Frequency	Respondents	Percentage (%)
Medicine	10	2845	68.50
Pharmacy	7	1380	33.23
Nursing	3	236	5.68
Psychiatry and/or Psychology	1	67	1.61
Physiotherapy	2	44	1.06
Odontology	1	30	0.72
Obstetrics and Gynecology	1	21	0.51
Nutritionist	1	16	0.39
Occupational Therapy	1	11	0.26

Frequency: are the mentions of the race in each of the 14 selected articles; **Respondents**: the sample of each article depending on the race; and **Percentage**: Percentage of respondents with respect to the total self-medicated sample (4135 students).

Table 4. Classification of how often selected university students self-medicate and causes of self-medication.

Variable	Frequency	Respondents	Percentage
Frequency self-medication			
Occasional	-	2506	60.60
Frequent	-	563	13.62
Always	-	1066	25.78
TOTAL		**4135**	**100**
Causes for self-medication			
Respiratory tract disorders	13	2917	70.54
Headache	12	2197	53.13
Gastrointestinal disorders	10	1614	39.03
Fever	9	1179	28.51
Skeletal and/or muscular pain	10	1176	28.44
Infections	3	524	12.67
Menstrual disorders	7	375	9.07
Skin disorders	6	306	7.40
Prophylaxis	3	140	3.39
Cuts/wound	1	98	2.37
Stress	2	92	2.22
Sleep disorder	3	80	1.93
Depression	1	41	0.99
Eating problems	1	37	0.89
Contraception	4	23	0.56
Parasitic problems	1	12	0.29

Frequency: number of times the cause of self-medication is mentioned in each article; **Respondents**: number of students who indicated the cause per article; **Percentage**: number of respondents for the total self-medicated sample (4135 students).

The frequency of occasional self-medication was higher because the students reported that when they presented some health problems such as flu, fever, headaches, stomach pain, and others, they preferred to self-medicate to relieve symptoms immediately and thus be able to continue with their university and social life. Similar behavior was seen in other studies by El-Ezz and Ez-Elarab (2011) from Egypt, and Ghaieth et al. (2015) from Libya. They concluded that occasional self-medication was more frequent since students preferred to self-medicate to relieve their sporadic pain.

Students who self-medicated always stated that they did so because they suffered from heartburn, migraines, allergies, infections, skin and menstrual problems, among others, so they preferred to self-medicate and thus be able to alleviate their ailments. Similar results were stated by Al-Zidan et al. (2020) from Iraq and Lopes Cândido et al. (2018) from Brazil. However, those university students who declared having self-medicated frequently did so for muscle, lumbar and dental pain to avoid discomfort. Contrasting the results of the present study with those of Masud et al. (2020) from Malaysia, it was found that university students with a career in the area of medical and biological sciences have a tendency to self-medicate.

Causes of self-medication

The most common causes for which students self-medicated were allergies, flu, headaches, fever, dental infection, musculoskeletal pain, eating problems, and stress, among others. All the causes mentioned above were classified into 14 groups that are detailed in Table 3S. Table 4 shows the "Frequency" of the causes of self-medication, named by the students "Respondent".

Table 4 also shows that seven of the 14 causes of self-medication were the most common among university students. The first cause was respiratory tract problems associated with common colds, rhinitis, and sore throat. The second cause of self-medication was headaches or migraines, followed by gastrointestinal

problems, which included heartburn, reflux, stomach ulcers, and stomach pain. Fever was the fourth cause, and the fifth was musculoskeletal pain. The sixth cause of self-medication were infectious eye, ear, dental, and urinary tract problems. Finally, the seventh cause, declared by university women, was associated with menstrual problems due to colic or dysmenorrhea. Other studies on self-medication in university students also showed that the reasons why students carry out this practice were like those of the present study. For example, in the article by Cecilia et al. (2019), from Spain, it is mentioned that the most common causes for self-medication in Spanish students were fever, common cold, cough, headaches, diarrhea and vomiting, dysmenorrhea, heartburn, contraception, and obesity. In the work of Sharma et al. (2015) from India, university students indicated that the causes for which they self-medicated were fever, common cold, cough, headache, dental and eye infection, diarrhea, menstrual cramps, constipation, and body aches. Al Flaiti et al. (2014) from Oman found that the causes for which students self-medicated were common cold, cough, fever, otitis, headaches, skin problems due to infection or allergic reaction, eye infection, diarrhea, and gastric ulcers. On the other hand, Alshahrani et al. (2019) from Saudi Arabia indicated that the causes of self-medication were cold, migraines, fever, skin infection, colitis, dysmenorrhea, infections, body pain, heartburn, contraception, insomnia, and the presence of hemorrhoids. Meanwhile, Alsous et al. (2018), from Jordan revealed that university students who self-medicate did so for reasons like those mentioned above, such as colds, coughs, headaches, fever, diarrhea, skin problems, cuts, and wounds, suffering from anxiety, malnutrition, and other students for obesity. Although there is evidence of a slight difference in the causes according to the country of publication, as a common factor is the cause associated with the respiratory and gastrointestinal systems, headaches, and pain. This reflects that the causes mentioned by the 14 articles of the systematic reviews are the ones that most frequently lead the university population to self-medicate. Interestingly, these medical conditions in self-medicated young university students habitually share with some type of pain or inflammation, which is also in concordance with the high prevalence of young adult chronic pain (Murray et al., 2022).

Self-medication reasons

In addition to the above, there are also various reasons why university students in the area of medical and biological sciences make the decision to self-medicate. In this systematic review, 29 reasons were identified among which university students carry out this practice (Table 5). The main reason, expressed in 12 of the 14 articles, was that they felt they had adequate and indicated knowledge of diseases, treatment, and dosage (40.5%), for which they considered that they could self-medicate. In the second place, with 36.7%, were previous experiences with the same symptoms and signs, for which they associated disease and treatment, thus performing self-medication. The third reason was that they self-medicated for minor or momentary illnesses, specifically for digestive or menstrual cramps and headaches (26.6%).

Two of the reasons for the 29 mentioned drew attention. One of them was that they were embarrassed to talk about the symptoms. This corresponds to the study conducted by Puay Luan et al. 2020 from Malaysia, in which nine students stated that it was difficult for them to talk about their symptoms due to the embarrassment of what others would say. The other reason was not wanting to overwhelm the doctor, as mentioned by Williams and Crawford (2016) from Jordan, in which 42 students stated that doctors were very important, so they would not bother them for simple things. From the aforementioned results, it can be deduced that countries with orthodox cultures tend to have reasons of this nature. This approach is reaffirmed by what is published in the article by Ibrahim Sharif et al. (2012) from the Arab Emirates, in which it was found that one of the reasons declared by university students for self-medication was shame when talking about their symptoms of pressures by their culture. In addition, the fact that they considered having knowledge of diseases, treatment, and dosages, being able to save time, not having money to go to a doctor's office, the advice of health officials such as nurses, and medical technologists, among others, being able to relieve pain quickly and not trusting the doctor for poor care, all these reasons lead students to make the decision to self-medicate. Although in the curricula of these careers there must be subjects that offer tools for good performance in patient care and to be able to repertorize or diagnose them, it is striking that the same students are not prepared to talk about their health problems with specialists in this area.

In other publications, it was shown that the reasons for the self-medication of university students were similar to those determined in the present study. In research from Brazil (Ferreira Souza et al., 2011), India (Sharma et al., 2015), Pakistan (Mumtaz et al., 2011), and Rwanda (Tuyishimire et al., 2019), students indicated the following reasons for their self-medicated: (1) enough knowledge, (2) to save money and time, (3) lack of money to pay for medical consultation, (4) information delivered by the media, (5) advice from relatives, friends or neighbors, (6) pharmacist's recommendation, (7) recommendation from nurses, (8) some experience with the same symptoms,

(9) previous prescriptions or read the drugs leaflets, (10) the self-criteria about the necessity to go to the doctor for a simple pain, (11) previous lousy experience with a doctor, (12) lack of credibility in the doctor, (13) the difficulty accessing a health care center, and (14) the possibility they have of reading books and articles about medication.

Consequently, the reasons for self-medication in university students identified in the articles included in this systematic review are common and recurrent in this type of student. It should be noted that some of these reasons why university students carry out this practice are counterproductive and could further harm their health. At this point, questions arise: Are the curricula of the students of the health and biological sciences careers exerting the expected effect on their students? Are these students being taught the correct use of responsible self-medication?

Table 5. Reasons that influence the decision of university students to self-medicate.

	Reasons to self-medicate	Frequency	Respondents	Percentage (%)
1	Medication knowledge	12	1674	40.48
2	Past experience with the same symptoms	10	1516	36.66
3	Minor illness	4	1100	26.60
4	Pharmacist recommendation	9	1002	24.23
5	Advice from a family member/friend/neighbor	12	949	22.95
6	Medication prospectus brochure	6	941	22.76
7	Non-serious illness	4	664	16.06
8	Emergency use	5	590	14.27
9	Time saving	8	475	11.49
10	Fast pain relief	4	409	9.89
11	Distance and/or difficulty to get to hospital/clinic	6	389	9.41
12	Saving money	8	364	8.80
13	On the advice of doctor or other health personnel	6	338	8.17
14	Information from the internet or mass media	7	304	7.35
15	Old recipes	4	293	7.09
16	High medical consultation cost	4	236	5.71
17	Convenience	2	224	5.42
18	Own decision	4	196	4.74
19	Easy access to purchase medicines	2	177	4.28
20	Textbook	2	171	4.14
21	Drug inefficiency	4	164	3.97
22	Poor care from health staff	2	126	3.05
23	Avoid lines in hospitals or clinics	2	123	2.97
24	Do not trust doctors	4	93	2.25
25	It is not necessary to go to the doctor for simple pain	2	74	1.79
26	Do not overwhelm the doctor	1	42	1.02
27	No health system available	3	41	0.99
28	Embarrassed to talk about symptoms	1	9	0.22
29	Scientific literature	1	5	0.12

Frequency: number of times the reason for self-medication is mentioned in each article; **Respondents**: number of students who indicated the reason per article; **Percentage**: number of respondents for the total self-medicated sample (4135 students).

Table 6. Places where university students acquire medications to self-medicate.

Place	Frequency	Respondents	Percentage (%)
Pharmacy	13	2828	68.39
Friends/neighbors/family	9	425	10.28
Home kit	6	312	7.55
Herbalist	3	105	2.54
Supermarket	1	72	1.74
Clinics - Hospitals	2	17	0.41
Fairs or street market	2	5	0.12
Pharmaceutical warehouses	1	4	0.10
Neighborhood warehouse	1	2	0.05

Place of acquisition of medications for self-medication

When analyzing self-medication in university students, it is important to refer to the places where they acquire medications. In this study, nine places were identified where they obtained the drugs to self-medicate (Table 4S). First, they declared pharmacies, identified in 13 of the 14 selected articles and mentioned by 2828 (68.4%) surveyed students (Table 6). They recognized that, in this place, they had easier access to acquire medicines and regularly sold the drugs they needed. In the second place, the acquisition of medicines was through a family member, friend and/or neighbor, found in nine of 14 publications and declared by 425 (10.3%) students, who commented that they turned to people close to them when they needed something medicine and thus avoided buying them. In third place were the home kits, recognized in 6 of the 14 publications and reported by 312 (7.5%) of the respondents. They expressed that it was the easiest place because they were looking for the medicine or some alternative they had at home for a certain ailment, alluding to the knowledge they had about the condition and thus being able to consume it without any qualms. The remaining six places, as well as the number of articles in which they were identified, the number of respondents and their percentage, with respect to the total number of self-medicated respondents (4135), are shown in Table 6.

It is noteworthy that Williams and Crawford (2016) from Australia mentioned that the places of acquisition of medicines were supermarkets, indicating that the legal provision in this country allows the sale of medicines in this type of establishment. On the other hand, Valdés González et al. (2018) from Chile declared two other places: Pharmaceutical and neighborhood stores. According to the Chilean legal provision, updated in 2014 (BCN, 2014), drugs can be sold in pharmaceutical stores but not in neighborhood stores. The latter indicates a breach of the legal provision of the Chilean Sanitary Code.

When consulting several publications on self-medication in university students from different countries, it was found that the students indicated the same places of acquisition of medications that are mentioned in Table 6. Students from the Arab Emirates, Iran, Jordanian, Malaysia, Peru, and Slovenia indicated that the preferred similar places for acquiring medicines (Sharma et al., 2015; Jamshed et al., 2016; Al-Kubaisi et al., 2018; Alshogran et al., 2018; Ahmadi et al., 2014; Núñez et al., 2016). This could indicate that university students generally obtain medications to self-medicate in places where they find it easy to access.

Drugs most used in self-medication

The drugs used by university students in the medical and biological sciences area to self-medicate were grouped by therapeutic category (Brunton et al., 2017), as shown in Table 7.

The previous results indicate that the university students of the 14 selected articles and other publications from different countries tend to use almost the same therapeutic categories of drugs to practice self-medication. In order to specify which were the most used therapeutic groups, the articles selected for the systematic review were analyzed in detail. Table 7 shows the 12 principal identified therapeutic groups. Those that occupied the first three positions were, in the first place, the analgesic/anti-inflammatories declared by 2816 (45.5%) students; in second place, antibiotics reported by 1233 (19.9%) and in third place, antipyretics, with 643 (10.4%) of university students. In percentages lower than 10.0% are antitussives, and antihistamines, among others. Vitamins, food supplements and herbals here are considered as other alternatives that students used without medical prescriptions to modulate their immune system.

Table 7. Therapeutic groups and other products most consumed by students to self-medicate.

Therapeutic group	Respondents	Percentage (%)
Analgesic/anti-inflammatory	2816	45.5
Antibiotic	1233	19.9
Antipyretic	643	10.4
Antitussive	491	7.9
Antihistaminic	222	3.6
Antiacid	181	2.9
Sedative	176	2.8
Antispasmodic	157	2.5
Contraceptive	118	1.9
Decongestant	68	1.1
Antimalarial	66	1.1
Antiemetic	11	0.2
TOTAL	**6182**	**100**
Others		
Vitamin	645	64.82
Food supplement	195	19.60
Herbs	157	15.78
TOTAL	**997**	**100**

The results showed a wide variety of medications to alleviate different ailments, supporting this consumption in the notions they had about diseases and their treatments through the knowledge acquired in the respective curricula of careers in medical and biological sciences. Such behavior was confirmed in university students in Brazil (Martínez et al., 2014; Iuras et al., 2016), Croatia (Brlic et al., 2014), Ethiopia (Belachew Gutema et al., 2011), Malaysia (Jamshed et al., 2016), Nigeria (Sapkota et al., 2010), Poland (Krajewska-Kulak et al., 2019), Saudi Arabia (Mustafa et al., 2017), and Spain (Cecilia et al. al., 2018), who declared self-medication with analgesics, antacids, antibiotics, oral contraceptives, antidepressants, antidiarrheals, antiemetics, antispasmodics, anti-flu, antihistamines, anti-inflammatories, antimalarials, antiparasitic, antipyretics, cough suppressants, eye and ear drops, herbs, NSAIDs, opioids, psychostimulants, muscle relaxants, sedatives, and vitamins. They also used topical ointments and creams; some revealed that they practiced self-medication by obtaining over-the-counter medications. However, it is noteworthy that in the present study, the use of opioid analgesics was very low (0.1%). Only codeine use was reported in the Australian study, where this weak opioid is dispensed as an OTC medication (Williams and Crawford, 2016). This fact could be interpreted as a favorable factor for responsible self-medication linked to the curricular knowledge of these students. Given that the study programs of these careers include the undesirable effects in the short and long term of these drugs, as well as other educational activities that familiarize them with the phenomenon of the 21st-century opioid crisis and its impact on society (Sobczak and Goryński, 2020).

On the other hand, non-opioid analgesics, like NSAIDs or paracetamol, are the most commonly used drugs for self-medication in the general population (Moore et al., 2015). The present results show that university students in the medical and biological sciences have similar preferences. Nevertheless, an inappropriate (misuse) of NSAIDs and paracetamol in this population could not exempt from risks since gastrointestinal, cardiovascular, pulmonary, cerebral, hepatic, and renal complications have been reported (Bindu et al., 2020; Rauschert et al., 2022). In particular, paracetamol is the most common cause of drug-induced liver injury in the United States. Its toxicity has recently become more difficult to identify precociously given the increased use of OTC analgesic combinations containing paracetamol (Rotundo and Pyrsopoulos, 2020). Then this is an element of concern that should be monitored in these students.

Regarding antitussives, in the list of the most consumed drugs they are in the fourth position, and in the list of the most used, they are in the sixth position; finally, antihistamines are in the fifth position of the

drugs most consumed by students, while in the general list, there is a clear trend regarding the type of drugs used by students when practicing self-medication.

Similar results have been reported by university students in India (Sharma et al., 2015), United Arab Emirates (Ibrahim Sharif et al., 2012; Al-Kubaisi et al., 2018), Pakistan (Mumtaz et al., 2011), Ethiopia (Belachew Gutema et al., 2011), and Jordan (Malak and Moh'd. AbuKamel, 2019).

Finally, using the UCINET software, an association network was created between the medications used by university students for self-medication and the countries to which the 14 studies selected for the systematic review belong. Fig. 4 shows the relationship between the medications used by students and how they are linked to the different countries. Nodes in the form of colored circles indicate the number of relationships that countries have with drug groups. While the squares represent the different therapeutic categories. In this association network, it can be seen that, in the central part, there are five groups of drugs and a nutritional supplement (squares highlighted in blue), which reflect greater connectivity, as they are the most widely used in different countries. In this group, analgesics, antibiotics, antihistamines, antacids, antipyretics, and vitamins stand out. With respect to the 10 countries identified in the selected studies, those with the largest diameter circles stand out. The country that stands out the most, at first glance, is Brazil for having connectivity with the 15 nodes of the therapeutic groups, followed by Malaysia with 14 connectivity nodes, Chile and Ethiopia, both have the same size, with 13 connectivity nodes, then Jordan, with 12 connectivity nodes, followed by Australia and Saudi Arabia, both countries with 10 connectivity nodes, followed by Iraq with nine nodes, then Nigeria with six nodes, and finally Pakistan with five drug connectivity nodes.

Also, the specific connectivity of some countries with certain therapeutic categories of drugs can be appreciated, as is the case of antimalarials that are associated with Ethiopia and Nigeria, countries in which malaria exists for which they regularly use these drugs (Zewdie et al., 2020; Tolulope Esan et al., 2018). The connectivity between Brazil, Ethiopia, and Nigeria can be seen because, in these countries, there is a higher prevalence of parasites, so university students self-medicate to eliminate them (Silva de Aquino et al., 2010; Zewdie et al., 2020; Tolulope Esan et al., 2018). The connectivity of sedatives with Saudi Arabia and Iraq, countries in constant internal or external conflicts, was observed (Albasheer et al., 2016; Khalil et al., 2019), which could explain the self-medication with sedatives in these students.

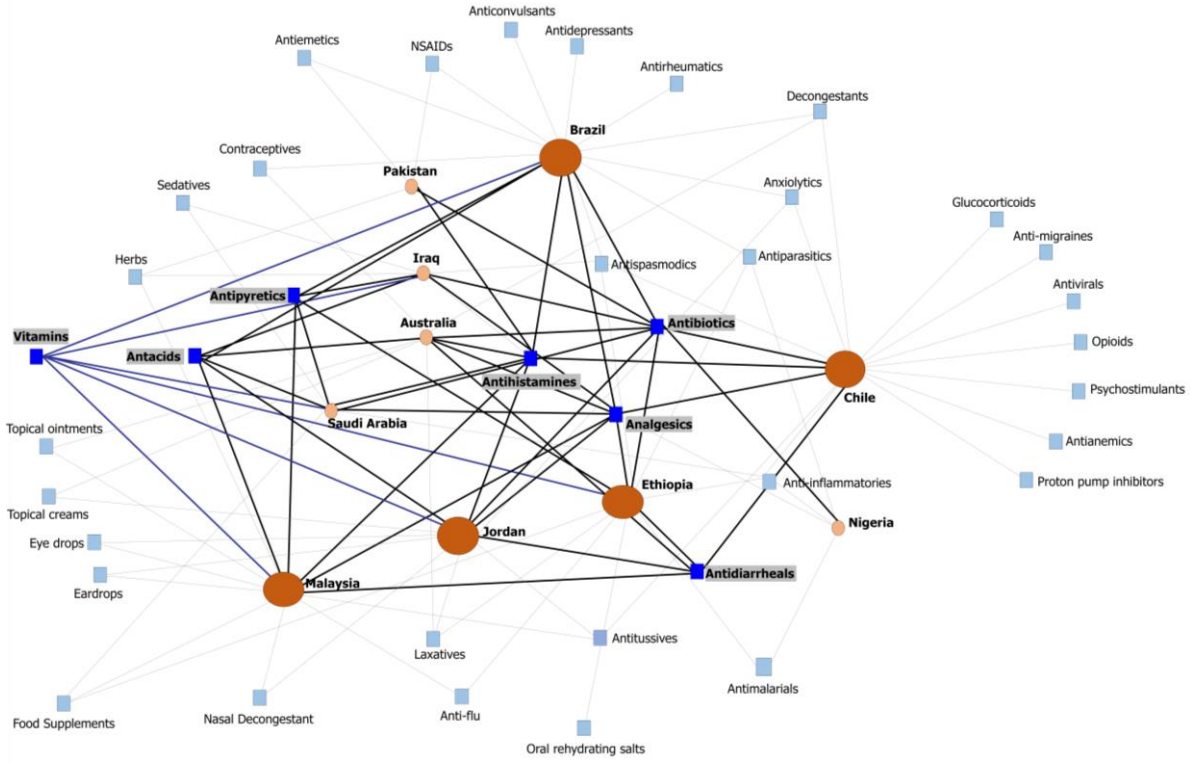

Figure 4. Association network between the medicines consumed by students and the country to which the articles belong.
The figure was prepared with UCINET

It is noteworthy that in the Chilean study, a variety of connectivity can be seen with various groups of drugs, especially some that are sold under medical prescriptions stipulated by the Chilean Health Code (BCN, 2014), such as anxiolytics, antibiotics, glucocorticoids, antivirals, opiates, psychostimulants, and proton pump inhibitors, revealing that the regulations for the dispensing of medicines are not being complied with, where the aforementioned medicines have to be purchased in pharmacies, health establishments or pharmaceutical stores through a prescription. It is named in the article by Valdés González et al. (2018), that several medications are purchased by university students at neighborhood fairs, causing the prevalence of self-medication in students to continue to increase.

Study limitations

There were several limitations in this review. The first was the number of articles that had to be excluded for not meeting the established inclusion criteria, as well as the age range of the students; then an adjustment had to be made to be able to declare this indicator, since in some articles a limited or extended age range was reported. Another limitation was how the self-medication frequencies of the university students were declared, making their classification complex and having to be classified by relating time by months, days or years. Therefore, future studies could consider the economic situation of the students, the inclusion of marital status, places of residence, and the number of people with whom they live, as well as studies that provide health forecast information in order to be able to determine if this influences the practice of self-medication.

In the same way, the curricula of students in the area of the medical and biological sciences could better encourage the proper use of medications as part of some study plans in academic training programs, incorporating educational practices on the correct use of medications, the risks and benefits of the drugs, the risks of overdose and poisoning, the adverse reactions and the expenses that this entails for the health system if a hospitalization occurs due to problems with the drugs. This would help future professionals to be more competent and concerned, to be able to play a more welcoming role and guide their patients in the future, thus avoiding manifestations among themselves about distrust in doctors.

CONCLUSION

The information found through the 14 articles selected for this systematic review allowed us to establish self-medication behavior in university students in the area of medical and biological sciences. It was found that self-medication was higher in women than in men, as they had a higher prevalence of pain. More than 99.0% were in the age range of 18-29 years. Most participants (74.0%) belonged to medicine and pharmacy careers. They mainly self-medicate occasionally to treat health problems related to the respiratory, gastrointestinal, and musculoskeletal systems, also when they suffer infections, fever, headaches or migraines, and menstrual problems. That is, medical conditions which habitually share some type of pain or inflammation; subsequently, analgesic/anti-inflammatory agents were the most utilized, followed by antibiotics and antipyretics, many of which are easily accessible OTC drugs.

These students practice self-medication because they consider they have sufficient knowledge about diseases and their treatments, which gives them more confidence in making the decision to self-medicate. Subsequently, self-knowledge is a decisive reason for self-medication. They generally obtain medications in places where they have easy access, such as pharmacies, through people close to them, and through the home medicine cabinet. Moreover, self-medication patterns regarding the use of drugs from various therapeutic categories vary among medical and biological sciences university students from different countries.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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AUTHOR CONTRIBUTION:

Contribution	Azócar P	Valdés-González M	Garrido-Suárez BB	Fernández-Alfonso MS	Garrido G
Concepts or ideas	x	x	x	x	x
Design	x	x	x		x
Definition of intellectual content	x	x	x		x
Literature search	x	x	x		x
Experimental studies	x	x	x		x
Data acquisition	x				
Data analysis	x				
Statistical analysis	x				
Manuscript preparation	x		x		x
Manuscript editing		x	x	x	x
Manuscript review	x	x	x	x	x

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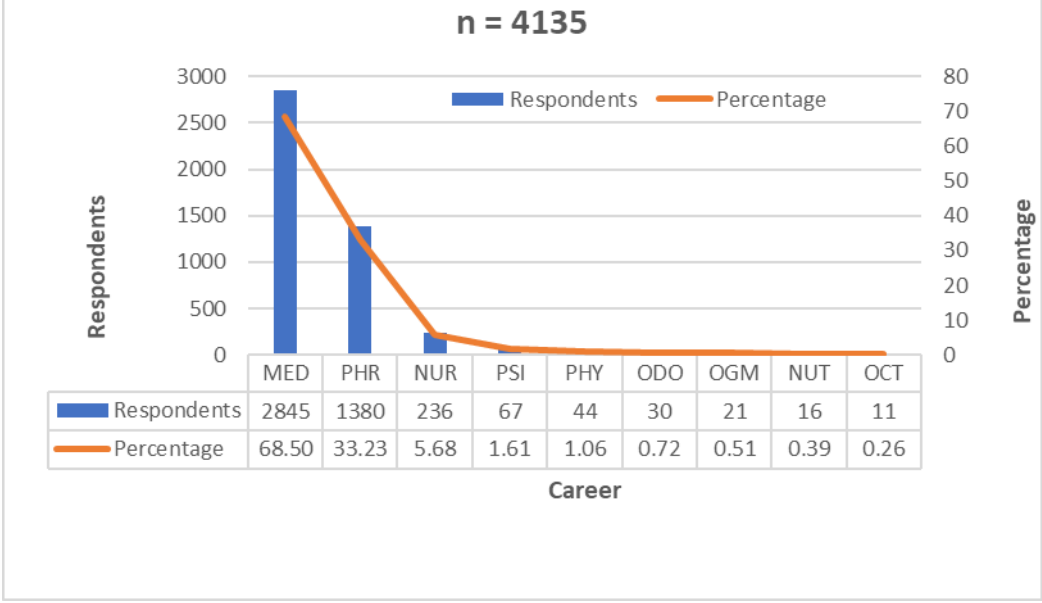
Supplementary data

Table 1S. Information on self-medication from studies and self-medication classified by gender.

Article	Self-medicated students	Non self-medicated students	Self-medicated by gender			Self-medication		
			Women	Men	Uninformed	With knowledge	Little or no knowledge	Uninformed knowledge
Zeru N, Fetene D, Geberu DM, Melesse AW, Atnafu A (2020) Self-medication practice and associated factors among University of Gondar College of Medicine and Health Sciences students: A cross-sectional study. Patient Prefer Adherence 10(14): 1779-1790. https://doi.org/10.2147/PPA.S274634	415	377	178	237	0	415	0	0
Zewdie S, Andargie A, Kassahun H (2020) Self-medication practices among undergraduate university students in Northeast Ethiopia. Risk Manag Healthc Policy 8(13): 1375-1381. https://doi.org/10.2147/RMHP.S266329	167	174	59	99	9	49	118	0
Puay Luan T, Alakhali K, Keshavarzi F, Oladuntoye Fatokun O (2020) Evaluation of self-medication practice among university students. Curr Trends Biotechnol Pharm 14(5): 92 -100. https://doi.org/10.5530/ctbp.2020.4s.10	239	128	138	101	0	239	0	0
Khalil NS, Haddad RA, Hassan IT, Tawfeeq RS (2019) Prevalence, practice, and pattern of self-medication among medical students in Al-Iraqia Medical College, Baghdad, Iraq. Int J Drug Deliv Technol 39(3): 483-489. https://doi.org/10.25258/ijddt.v9i3.29	340	60	226	114	0	181	159	0
Valdés González M, Salazar Silva E, Garrido G (2018) Behavior of self-medication in students of the Chemistry and Pharmacy career of the Universidad Católica del Norte. J Pharm Pharmacogn Res 6(5): 326-348. https://doi.org/10.56499/jppres18.394_6.5.326	159	9	100	59	0	159	0	0
Tolulope Esan D, Akinwande Fasoro A, Esther Odesanya O, Olaide Esan T, Funmilayo Ojo E, Oluwafemi Faeji C (2018) Assessment of self-medication practices and its associated factors among undergraduates of a private university in Nigeria. J Environ Public Health 2018: 5439079. https://doi.org/10.1155/2018/5439079	297	66	201	96	0	127	154	16
Gul Kanwal Z, Fatima N, Azhar S, Chohan O, Jabeen M, Arfat Yameen M (2018) Implications of self-medication among medical students-A dilemma. J Pak Med Assoc 68(9): 1363-1367. https://pubmed.ncbi.nlm.nih.gov/30317266/	297	3	207	90	0	223	74	0
Gama A, Secoli SR (2017) Self-medication among nursing students in the state of Amazonas - Brazil. Rev Gaucha Enferm 38(1): e65111. https://doi.org/10.1590/1983-1447.2017.01.65111	88	28	54	24	10	31	57	0
Albasheer OB, Salih Mahfouz M, Masmali BM, Ageeli RA, Majrashi AM, Hakami AF, Hakami ZH, Hakami AA, Douf TA (2016) Self-medication practice among undergraduate medical students of a Saudi tertiary institution. Trop J Pharm Res 15(10): 2253-2259. http://dx.doi.org/10.4314/tjpr.v15i10.26	251	49	129	122	0	203	48	0

Table 1S. Information on self-medication from studies and self-medication classified by gender (continued...)

Article	Self-medicated students	Non self-medicated students	Self-medicated by gender			Self-medication		
			Women	Men	Uninformed	With knowledge	Little or no knowledge	Uninformed knowledge
Williams A, Crawford K (2016) Self-medication practices among undergraduate nursing and midwifery students in Australia: A cross-sectional study. Contemp Nurse 52(4): 410–420. https://doi.org/10.1080/10376178.2016.1197782	110	10	105	5	0	43	67	0
Alkhatatbeh MJ, Alefan Q, Alqudah MA (2016) High prevalence of self-medication practices among medical and pharmacy students: a study from Jordan. Int J Clin Pharmacol Ther 54(5): 390-398. https://doi.org/10.5414/CP202451	1034	283	756	278	0	477	557	0
Khamis Ibrahim N, Mohammad Alamoudi B, Omar Baamer W, Mohammad Al-Raddadi R (2014) Self-medication with analgesics among medical students and interns in King Abdulaziz University, Jeddah, Saudi Arabia. Pak J Med Sci 31(1): 14-18. https://doi.org/10.12669/pjms.311.6526	279	225	147	132	0	279	0	0
Galato D, Madalena J, Pereira GB (2012) Self-medication among university students: The influence of the field of study. Cien Saude Colet 17(12): 3323-3330. https://doi.org/10.1590/S1413-81232012001200017	330	12	94	29	207	24	101	205
Silva de Aquino D, Cabral de Barros JA, Paes da Silva MD (2010) Self-medication and health academic staff. Cien Saude Colet 15(5): 2533-2538. https://doi.org/10.1590/S1413-81232010000500027	129	94	91	38	0	24	101	205



	MED	PHR	NUR	PSI	PHY	ODO	OGM	NUT	OCT
Respondents	2845	1380	236	67	44	30	21	16	11
Percentage	68.50	33.23	5.68	1.61	1.06	0.72	0.51	0.39	0.26

Figure 1S. University careers declared in the 14 selected articles.

MED: Medicine, PHR: Pharmacy, NUR: Nursing, PSI: Psychiatry and/or Psychology, PHY: Physiotherapy, ODO: Odontology, OGM: Obstetrics and Gynecology, NUT: Nutritionist, OCT: Occupational Therapy.

Table 2S. Frequency and time of self-medication in the studies.

Ref.	Article	Respondents	Self-medicated students	Frequency self-medication	Self-medication time	Classification
Zeru et al., 2020	Self-medication practice and associated factors among university of Gondar college of medicine and health sciences students: A cross-sectional study	792	184	1 time	12 months	Occasional
			159	2 times		Occasional
			45	3 times		Occasional
			12	4 times		Occasional
			6	5 times		Occasional
			9	>5 times		Frequent
Zewdie et al., 2020	Self-medication practices among undergraduate university students in Northeast Ethiopia	341	167	12 months	12 months	Always
Puay Luan et al., 2020	Evaluation of self-medication practice among university students	367	214	1 week	12 months	Occasional
			25	>1 week		Occasional
Khalil et al., 2019	Prevalence, practice, and pattern of self-medication among medical students in Al-Iraqia Medical College, Baghdad, Iraq	400	340	12 months	12 months	Always
Valdés González et al., 2018	Behavior of self-medication in students of the Chemistry and Pharmacy career of the Universidad Católica del Norte	168	148	Occasionally	12 months	Occasional
			11	Always		Always
Tolulope Esan et al., 2018	Assessment of self-medication practices and its associated factors among undergraduates of a private university in Nigeria	363	297	30 times	1 month	Always
Gul Kanwal et al., 2018	Implications of self-medication among medical students - A dilemma	300	95	1 time	6 months	Occasional
			63	2 times		Occasional
			139	>2 times		Frequent
Gama and Secoli, 2017	Self-medication among nursing students in the state of Amazonas - Brazil	116	88	30 times	1 month	Always
Albasheer et al., 2016	Self-medication practice among undergraduate medical students of a Saudi tertiary institution	300	115	<5 times	12 months	Occasional
			136	>5 times		Frequent
Williams and Crawford, 2016	Self-medication practices among undergraduate nursing and midwifery students in Australia: a cross-sectional study	120	110	12 months	12 months	Always
Alkhatatbeh et al., 2016	High prevalence of self-medication practices among medical and pharmacy students: A study from Jordan	1317	1034	12 months	12 months	Always
Khamis Ibrahim et al., 2014	Self-medication with analgesics among medical students and interns in King Abdulaziz University, Jeddah, Saudi Arabia	504	279	6 months	12 months	Frequent
Galato et al., 2012	Self-medication among university students: The influence of the field of study	342	330	15 times	15 days	Always
Silva de Aquino et al., 2010	Self-medication and health academic staff	223	129	15 times	15 days	Always

Table 3S. Classification of the causes of self-medication.

Causes	Frequency	Respondents	Cause classification
Heartburn/ulcers	4	415	Gastrointestinal disorders
Allergies/rhinitis	8	424	Respiratory tract problems
Contraception	4	23	Contraception
Headache/migraine	12	2197	Headache
Cuts/wound	1	98	Cuts/wound
Depression	1	41	Depression
Body pain	10	1157	Skeletal and/or muscular pain
Bone and joint pain	2	19	Skeletal and/or muscular pain
Skin Disease/acne/skin rash	6	306	Skin problems
Eye disease or infection	3	258	Infections
Stress	2	92	Stress
Fatigue	1	70	Gastrointestinal disorders
Fever	9	1179	Fever
Infection and/or dental pain	3	121	Infections
Infections	3	64	Infections
Urinary tract infection	2	17	Infections
Malaria	1	12	Parasitic problems
Obesity	1	37	Food problems
Otitis	1	64	Infections
Menstrual problems	7	375	Menstrual problems
Prophylactic	3	140	Prophylaxis
Common cold	13	1694	Respiratory tract problems
Cough/tonsillitis (sore throat)	7	799	Respiratory tract problems
Digestive system disorder (diarrhea, constipation, vomiting)	10	1129	Gastrointestinal disorders
Sleep disorder	3	80	Sleep disorder

Table 4S. Locations and number of students obtaining medications.

Title	First author (year)	How to obtain medications without prescriptions																	
		Pharmacy		Pharmaceutical stores		Neighborhood warehouse		Supermarket		Clinics - hospitals		Fairs or street market		Friends/ neighbors/ family		Home kit		Herbalist	
		Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.
Self-medication practice and associated factors among university of Gondar college of medicine and health sciences students: A cross-sectional study	Zeru N (2020)	1	396	0	0	0	0	0	0	0	0	0	0	1	86	1	103	1	12
Self-medication practices among undergraduate university students in Northeast Ethiopia	Zewdie S (2020)	1	98	0	0	0	0	0	0	0	0	0	0	1	18	1	42	0	0
Evaluation of self-medication practice among university students	Puay Luan T (2020)	1	145	0	0	0	0	0	0	0		1	4	1	4	1	60	1	26
Prevalence, practice, and pattern of self-medication among medical students in Al-Iraqia Medical College, Baghdad, Iraq	Khalil NS (2019)	1	340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Behavior of self-medication in students of the Chemistry and Pharmacy career of the Universidad Católica del Norte	Valdés González M (2018)	1	150	1	4	1	2	0	0	0	0	1	1	1	10	0	0	0	0
Assessment of self-medication practices and its associated factors among undergraduates of a private university in Nigeria	Tolulope Esan D (2018)	0	0	0	0	0	0	0	0	1	12	0	0	0	0	1	12	0	0
Implications of self-medication among medical students - A dilemma	Gul Kanwal Z (2018)	1	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4S. Locations and number of students obtaining medications (continued...)

Title	First author (year)	How to obtain medications without prescriptions																	
		Pharmacy		Pharmaceutical stores		Neighborhood warehouse		Supermarket		Clinics - hospitals		Fairs or street market		Friends/ neighbors/ family		Home kit		Herbalist	
		Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.	Fre.	Res.
Self-medication among nursing students in the state of Amazonas - Brazil	Gama ASM (2017)	1	47	0	0	0	0	0	0	1	5	0	0	1	9	1	27	0	0
Self-medication practice among undergraduate medical students of a Saudi tertiary institution	Albasheer OB (2016)	1	242	0	0	0	0	0	0	0	0	0	0	1	9	0	0	0	0
Self-medication practices among undergraduate nursing and midwifery students in Australia: a cross-sectional study	Williams A (2016)	1	102	0	0	0	0	1	72	0	0	0	0	1	48	1	68	0	0
High prevalence of self-medication practices among medical and pharmacy students: A study from Jordan	Alkhatatbeh MJ (2016)	1	776	0	0	0	0	0	0	0	0	0	0	1	67	0	0	1	67
Self-medication with analgesics among medical students and interns in King Abdulaziz University, Jeddah, Saudi Arabia	Khamis Ibrahim N (2014)	1	279	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Self-medication among university students: The influence of the field of study	Galato D (2012)	1	175	0	0	0	0	0	0	0	0	0	0	1	174	0	0	0	0
Self-medication and health academic staff	Silva de Aquino D (2010)	1	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Fre.: Frequency, **Res.**: Respondent. The Frequency that was mentioned in each study is shown and the Respondent is the number of samples per study that mentioned the place where they obtained the medicines.