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Scientific collaboration between Latin America and the European Union (2001-2010) on drug abuse from the ISI Web of Science

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Original article

SUMMARY

Background

The importance of collaboration among research groups in the drug abuse field has been increasingly reinforced. These collaborations consolidate scientific activity and ensure the improvement of methods and outcomes. This study aims to analyze the collaboration networks on drug abuse between Latin American and European countries by means of applying bibliometric methods and collaboration networks analysis.

Methods

The search was conducted through the Science Citation Index Expanded and the Social Sciences Citation Index from the ISI Web of Science database. A total of 228 articles were found by using a specific drug abuse search strategy during the period 2001-2010. Articles belonging to WOS categories unrelated to health sciences were excluded.

Results

The countries with the highest amount of collaborative articles were Spain in Europe (n=69) and Brazil in Latin America (n=73). The United States of America had an active role in the collaboration networks (n=85). The most productive institution and author were both from Mexico. The collaborative work between Latin America and Europe has increased from 2001 (n=4) to 2010 (n=50). The collaboration networks analysis showed that Spain and Brazil (n=27) as well as Spain and Colombia (n=23) were the countries with the highest joint production.

Conclusions

The last decade has seen a significant increase in scientific collaboration between Latin America and Europe in drug addiction studies, and Brazil and Mexico stand out among Latin American countries, as do Spain and Italy in Europe. The role of the United States leadership in international research networks is emphasized and identified, occupying an intermediary role in the collaboration between different countries and continents.

Key words: Scientific collaboration networks, drug abuse, bibliometrics.

RESUMEN

Antecedentes

La colaboración entre investigadores tiene una gran importancia, pues permite compartir conocimiento, garantiza la mejora de los métodos empleados y de los resultados obtenidos y, en definitiva, consolida el quehacer científico. Este estudio tiene como objetivo analizar las redes de colaboración en drogodependencias entre países latinoamericanos y de la Unión Europea, aplicando metodologías procedentes de la bibliometría y del análisis de redes sociales.

Métodos

Las bases de datos consultadas fueron Science Citation Index Expanded y Social Sciences Citation Index de la ISI Web of Science (WOS). Se utilizaron ecuaciones de búsqueda específicas en drogodependencias basadas en estudios previos. Los resultados de las búsquedas se depuraron con la exclusión de artículos correspondientes a categorías WOS que no eran propiamente sanitarias, así como los que no abordaban directamente aspectos biopsicosociales de drogodependencias. Se identificaron 228 artículos colaborativos durante la década 2001 y 2010.

Resultados

El país europeo con mayor cantidad de artículos de colaboración fue España (n=69) y Brasil el latinoamericano (n=73). Estados Unidos tuvo un papel muy activo en las redes de colaboración, participando en 85 artículos. La institución y el autor más productivo correspondieron a México. La colaboración entre América Latina y la Unión Europa se ha incrementado desde 2001 (n=4) a 2010 (n=50). El análisis mostró que la colaboración fue mayor entre España y Brasil (n=27), así como entre España y Colombia (n=23).

Conclusiones

En la última década se ha observado un incremento significativo de la colaboración científica entre los países latinoamericanos y europeos en drogodependencias, entre los que sobresalen Brasil y México, por un lado, y España e Italia por el otro. Destaca el papel de liderazgo de los Estados Unidos en las redes internacionales de investigación identificadas, ocupando un papel de intermediación en la colaboración entre diferentes países y continentes.

Palabras clave: Redes de colaboración científica, drogodependencia, bibliometría.

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INTRODUCTION

In recent years, the field of drug dependency has experienced a marked increase in scientific production tackling a wide spectrum of aspects related to the prevention, diagnosis, and treatment of disorders related to drug consumption, as well as public policy. The boom of research in this field is a consequence of the work of numerous professionals and experts who carry out their work in various public and private institutions.[1-3]

The phenomenon of drug dependency is characterized by its multifaceted and multidisciplinary nature, being present in all countries and affecting people of all ages and social, economic, and cultural backgrounds.[4-6] In this scientific field, as in others, collaboration between different groups of researchers and institutions has become ever more important, as it allows for a consolidation of the scientific task, and guarantees improvement in research methods and the quality of the results obtained.[7-9] Comparative studies that analyze collaboration between countries, communities, and groups provide information that can help to clarify the similarities and differences between drug consumption and the biopsychosocial context of the same.

Through bibliometric analysis of scientific publications, data can be obtained on the characteristics of the investigations, the researchers and centers that carry it out, and the development of scientific disciplines.[10] It also allows for the scientific production of a certain country to be studied, areas in which studies are concentrated can be detected, and the evolution of collaboration between professionals, researchers, and countries can be verified. Furthermore, working networks that make up the research front in a scientific area can be represented.[11-14]

Collaboration between researchers and institutions from different countries is a practice that is increasingly required in the assessment of scientific production. In this way, the determining factors of phenomena can be better understood, especially in the field of health – an area in which social, environmental, and public policy conditions, among others, are heavily involved in its makeup.[8,11,15] The incentive to form groups and networks that unite scientists, technologists, and other social actors, and the joint use of their knowledge, is a central aspect of collaboration strategies.[16,17]

Due to its economic, political, and social context, the planting of this scientific and technology policy in Latin America occurred years after developed countries became aware of its importance. Previous studies have demonstrated that development indicators in science in terms of publications and impact are traditionally a long way from those in countries with greater development in science and technology,[18] although progress has been shown in research results since the 1990s. During this decade, a new context emerged in which Latin American countries sought to keep up with global trends, and at that time, information and knowledge took up a central role, generating new plans for development and new financial policies for scientific production in the Americas.[13,16]

The development in Latin America was especially evident in Brazil, where scientific production has increased considerably since 2005.[19-21] This fact could encourage Latin American countries to adopt scientific policies that drive collaboration with countries from other continents. It has also been noted that scientific collaboration in the field of drug dependency is more intense among researchers affiliated to European and English-speaking institutions than those in other continents.[2,3]

The aim of this work is to analyze the collaboration between Latin American and European authors, institutions, and countries in the field of drug dependency, applying methodologies based on bibliometry and analysis of social networks, with the aim of identifying consolidated and emerging institutional groups. This type of analysis allows for the identification and graphic representation of existing collaborative relationships in scientific production, their institutions and countries, as well as for the intensity of these relationships to be quantified and the most relevant members highlighted.

METHOD

Search profile, gathering of information, selection of articles

The sources consulted in order to obtain the necessary records were the databases *Science Citation Index Expanded* (SCI-E) and the *Social Sciences Citation Index* (SSCI) of the ISI *Web of Science* (WOS), of Thomson Reuters. SCI-E and SSCI are regularly used in studies that analyze scientific activity because they include publications from all areas of science and technology and this allows for the repercussions or impact of the publications to be known from the citations that published works receive. On the other hand, they have the advantage of recording all institutional affiliations of contributing authors, which allows studies of scientific collaboration, and in particular, facilitates the cross-referencing of information in terms of contributions between countries; the primary objective of this study.[13,22,23]

The documents analyzed were both original and revised documents. Summaries of communications to conferences were excluded, along with corrections, reprints, and notices, in order to strictly center the study on works of research. The time covered was the decade 2001–2010.

With the aim of obtaining all of the scientific collaboration between Latin American and European researchers on drug dependency, the following strategy was used: 1. The search reused an equation from previous studies,[2] comprised of 46 lexemes and terms related with drug dependency (Ap-

pendix 1), entered in the TOPIC field. 2. Each of the European Union member countries, plus Switzerland and Norway, were entered in the ADDRESS field. 3. In another ADDRESS field, each country in Latin America* was included. 4. The search period was limited to the years 2001 through 2010. An intersection was made with the Boolean algorithm AND between all of the equations from previous searches. 5. In order to clean the search results, the records obtained were manually supervised, excluding the articles corresponding to the WOS categories that were not strictly health-related, such as physics, material engineering, agriculture, astronomy, and mathematics, among others, as well as articles that did not directly tackle biopsychosocial aspects of drug dependency. The search was carried out in October 2011. After data cleaning, 228 articles were selected that met the defined criteria.

Preparing the database and normalizing the records

Records resulting from the search were transferred to a relationship database in Microsoft Access through the software *Bibliométricos*, developed by the Unit for Social and Health Information and Investigation (UYSIS) at the Universidad de Valencia.

Data from the records was submitted to a quality control process that consisted of a normalization of authors and working institutions, given that many variations of the same name or location came up. In terms of the authors, the fundamental criteria used for normalization was coincidence in the affiliation of the institution or firm associated with the different variations of names and surnames. In terms of the institutions, the different variations of names for hospitals, health centers, teaching centers, research institutions, etc. were unified. When necessary, the official name on the organizations' websites were used, or failing that, the most frequently-cited name in the works themselves were used.

Analysis of results

After obtaining a definitive database, a descriptive and frequency analysis was carried out on the *Bibliométricos software*, which allowed the following variables to be determined: number of articles published by authors and institutions and their distribution by country; number of citations received; citation count per article (CPA), which allows the absolute product to be relativized in terms of the citations received; journals with more than three articles and their distribution per country, language, and impact factor; annual assessment of collaboration index. Furthermore, the analysis of institutional and co-author collaboration networks was carried out with the Pajek software and graphically represented through UCINET.[25]

RESULTS

Number of articles

Through the analysis of the 228 articles, an increasing temporal evolution was observed in international collaboration between Latin American and European authors, and 2010 was the year in which the most works were published (n=50). Between the first (2001) and the last (2010) year analyzed with full production, the number went from four (1.75%) to 50 (22%) works, respectively (Figure 1).

Author analysis

The articles chosen included 1,979 name credits corresponding to 1,316 authors. The vast majority of the authors (n=1039; 79%) were credited on a single work, 163 authors (13%) were credited on two, and 40 (3%) were credited on three. Only 1% of the authors were credited on between four and eight works, and the maximum number of articles published by any one author was 14.

In analyzing scientific collaboration, it is important to verify how many name credits are present for each work. The majority of articles (46%) had between four and seven authors; the work with the most authors had the collaboration of 51 researchers. The credits/works index or collaboration index (CI) behaved irregularly in the first half of the decade studied, with a maximum value in 2003 (CI=8.75) and a minimum in 2005 (CI=5.88). After 2006, the index gradually increased until it reached its highest value in 2010 (CI=11.22). The median value in the entire period was 8.68 (Figure 2).

In terms of author productivity (Table 1), the authors with ten or more works published in collaboration were Guilherme LG Borges, of the National Institute of Psychiatry Ramón de la Fuente Muñiz in Mexico, with 14 articles in collaboration with European researchers, 314 citations received, and a citation count per article (CPA) of 21.71. He is followed

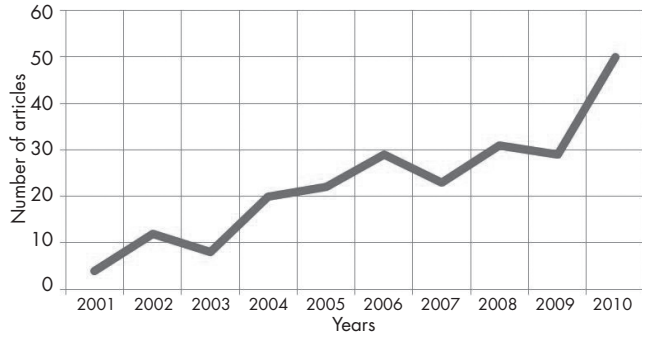

Figure 1. Annual development of articles published collaboratively between Latin America and the EU.

* According to the Real Academia Española (2005), Latin America is the name that encompasses the set of countries in the American continent in which languages spoken derive from Latin (Spanish, Portuguese, and French).[24]

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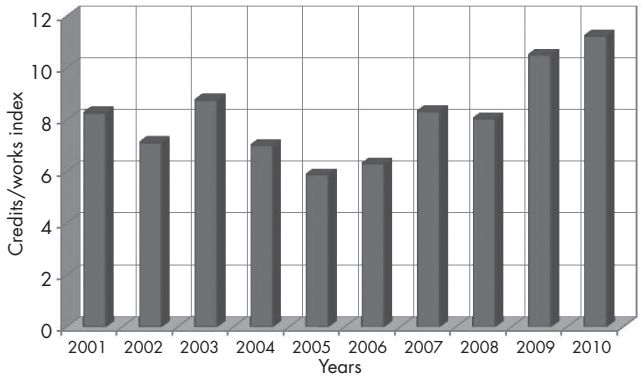

Figure 2. Annual development of collaboration index of articles published collaboratively between Latin America and the EU.

by José Posadas Villa, of the Colegio Mayor Cundinamarca in Colombia, with 13 works, 259 citations, and a CPA of 19.92, and Giovanni de Girolamo, of the Azienda Unità Sanitaria Local di Bologna, Italy. Both authors worked in close collaboration, and they have the same indexes: 13 articles published, 259 citations received and a CPA of 19.92. The following three authors have 12 articles: Rocío Martín Santos, of the Hospital Clínico Universitario de Barcelona, Spain (99 citations and CPA=8.25); Ronald C. Kessler, of Harvard Medical School, United States (345 citations and CPA=28.75), and José Alexandre S. Crippa, seconded to the Universidade de São Paulo, in Ribeirão Preto, Brazil (99 citations and CPA=8.25).

The presence of authors and institutions from countries outside Latin America and Europe that have participated in collaboration networks was also noted, such as that of the aforementioned Ronald C. Kessler, Matthias C. Angermeyer (Germany), Oye Gureje (Nigeria), Jose de Leon, and Francisco J. Diaz, both from Eastern State Hospital, USA.

The authors with greater production in collaboration mostly publish works in publications outside of their country or origin, with the exception of the North Americans.

Analysis of institutions and countries

The articles were signed by 595 different institutions, of which 17 published 10 or more works. The National Institute of Psychiatry Ramón de la Fuente Muñiz in Mexico (n=31) was the biggest exponent from Latin American countries with 365 citations, followed by the Universidad de Buenos Aires, Argentina (n=16) with 216 citations. This is followed by two Brazilian universities: the Universidade de São Paulo (USP) - São Paulo (n=15 and 305 citations) and the USP – Ribeirão Preto (n=14 and 106 citations). In terms of European countries, the most productive institution was the Centro de Investigaciones Biomédicas en Red en el Área de Salud Mental (CIBERSAM), in Spain (n=16), with 127 citations, followed by the World Health Organization based in Switzerland, which participated in 15 works with 306 citations. This is followed by King's College London in the UK, and the Instituto Municipal de Investigación Biomédica, in Barcelona, Spain, both of which participated in 14 works (Table 2).

The North American institution with the most articles in these collaboration networks was Harvard University (n=17), which was also the one which received the most citations (n=572).

The majority of the articles were signed by three or four different institutions (n=134; 57%), and there was one work which had the participation of 35 institutions. Some 25 EU countries and 14 Latin American countries participated in

Table 1. Most productive authors, number of citations, and citations per article index in collaborative articles between Latin America and the EU

Author's name	Institution	Country	Art.	Nat. Pub.	Foreign Pub.	WOS Citation	CPA*
Borges, Guilherme LG	Nat. Inst. of Psych. Ramón de la Fuente Muñiz	Mexico	**14**	1	13	304	21.71
Posada Villa, José	Azienda Unitá Sanitaria Local di Bologna	Italy	**13**	0	13	259	19.92
De Girolamo, Giovanni	Colegio Mayor Cundinamarca Universidad	Colombia	**13**	0	13	259	19.92
Martin Santos, Rocío	Hospital Clínico Universitario de Barcelona	Spain	**12**	0	13	99	8.25
Kessler, Ronald C	Harvard Medical School	USA	**12**	8	4	345	28.75
Crippa, José Alexandre S	Universidade de São Paulo - Ribeirão Preto	Brazil	**12**	0	12	99	8.25
Angermeyer, Matthias C	Universität Leipzig	Germany	**11**	0	11	248	22.55
Gureje, Oye	University College Hospital, Ibadan	Nigeria	**11**	0	11	184	16.73
Medina-Mora, María Elena	Nat. Inst. of Psych. Ramón de la Fuente Muñiz	Mexico	**10**	0	10	118	11.80
De León, José	Eastern State Hospital	USA	**10**	2	8	146	14.60
Díaz, Francisco J	Eastern State Hospital	USA	**10**	2	8	146	14.60

*CPA: citations per article index.

Table 2. Most productive Latin American and European institutions and number of citations in collaborative articles between Latin America and the EU

Latin American and European Institutions	Country	Art.	WOS citations
Nat. Inst. Psych. Ramón de la Fuente Muniz	Mexico	**31**	365
Univ Buenos Aires	Argentina	**16**	216
Centro de Investigaciones Biomédicas en Red en el área de Salud Mental (CIBERSAM)	Spain	**16**	127
Univ São Paulo - São Paulo	Brazil	**15**	305
World Health Org	Switzerland	**15**	306
Univ São Paulo - Ribeirão Preto	Brazil	**14**	106
Kings College London	UK	**14**	208
Inst Municipal Invest Méd Barcelona	Spain	**14**	170
Univ Nac Autónoma de México	Mexico	**14**	164
Univ Hosp Gasthuisberg	Belgium	**13**	259
Univ Granada	Spain	**11**	120
Hospital Clin Univ Barcelona	Spain	**10**	67
Univ Nac Colombia - Medellín	Colombia	**10**	146
Institutions on other continents			
Harvard Univ	USA	**17**	572
State University of New York	USA	**13**	222
Mental Hlth Serv of Minist Hlth Israel	Israel	**10**	227
Univ Melbourne	Australia	**10**	99

collaborative networks. Among these, Brazil (n=73) and Spain (n=69) published the most articles. In terms of collaborative articles, Italy (n=39), France (n=35) and Germany (n=34) stand out among the European countries. Among the Latin American countries, Mexico stood out with 49 works, as well as Colombia (n=29) and Argentina (n=26) (Table 3).

Some 25 countries participated in collaboration with Latin American and EU countries. In terms of number of articles, the United States (n=85), Australia (n=17), Japan (n=14), Israel (n=14), China (n=13), South Africa (n=11), Nigeria (n=10), and Canada (n=10) are notable (Table 3).

The annual evolution of collaborative production by countries shows a significant increase in nearly all Latin American and European countries after 2004 and 2005, with this increase being even greater in 2010.

Analysis of scientific collaboration networks

Through establishing a threshold of five works carried out in collaboration, five networks of scientific activity were identified, which highlights a front made up of 22 members. The authors who occupy a central position in this network; that is, those who maintain most collaborative links with other researchers and who establish mediation between different groups and institutions are José Posada Villa of the Colegio Mayor Cundinamarca Universidad, Colombia; Matthias C. Angermeyer of the Universität Leipzig, Germany; Giovanni de Girolamo of the Azienda Unità Sanitaria Local di Bolo-

Table 3. Number of collaborative articles published between Latin American and the EU, grouped by set of countries

	Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total articles
Latin America	Brazil	1	5	1	6	7	10		11	14	18	**73**
	Mexico	2	2	1	2	4	4	9	9	4	12	**49**
	Colombia			2	3	3	2	4	2	5	8	**29**
	Argentina	1			4	1	3	1	5	2	9	**26**
	Chile		1		1	2	2	3	1		6	**16**
European Union	Spain	1	2	2	4	7	5	6	11	11	20	**69**
	Italy	1	1		2	3		3	8	9	12	**39**
	France		1		3	1	3	4	6	6	11	**35**
	Germany		2	2	2	2	4	3	5	4	10	**34**
	Switzerland		1		1	1	3	1	4	5	13	**29**
	UK		1		3		3	2	1	6	8	**24**
	The Netherlands	1	1		2			3	3	2	6	**18**
	Belgium						1	2	3	2	4	**12**
	Sweden			2		1	2	2		1	3	**11**
Other countries	USA	3	3	3	10	11	7	8	10	11	19	**85**
	Australia		1				1	1	2	2	10	**17**
	Japan							2	3	3	6	**14**
	Rep. China						1	3	2	1	6	**13**
	Israel		1			1		2	2	3	5	**14**
	New Zealand							3	2	2	4	**11**
	South Africa							1	2	2	6	**11**
	Nigeria							1	2	2	5	**10**
	Canada	1	1				2	1	2	1	2	**10**

gna, Italy; Ronald C. Kessler of Harvard Medical School, United States; and Oye Gureje of the University College Hospital Ibadan, Nigeria (Figure 3). The other four groups (Figure 4) showed an organizational model that does not usually include any central researcher or leader, but rather a network in which each of the authors usually collaborates with nearly everybody else. Among these, the one with the highest number of researchers had 10 members: five from the UK (Sagnik Bhattacharyya, Zerrin Atakan, Philip McGuire, Marc Seal, and Paul Allen, from King's College London), two from Brazil (Jose Alexandre Crippa and Antonio Zuardi, of the Universidade de São Paulo - Ribeirão Preto), one from Switzerland (Stefan Borgwardt of the University Basel Hospital), one from Italy (Paolo Fusar Poli of the Universidad de Pavia), and one from Spain (Rocío Martín Santos, Hospital Clínico Universitario de Barcelona). The other groups had between four and six participants.

The collaborative network of institutions (Figure 5) shows two primary groups, also with a threshold of five joint works. The largest includes 35 institutions in 19 different countries. The institutions which occupy a central position with most links are the University Hospital Gasthuisberg in Belgium and the National Institute of Psychiatry Ramón de la Fuente Muñiz in Mexico. Two institutions also stand out that do not belong to the sets of countries studied: Harvard University in the United States, and University College Hospital Ibadan, Nigeria. In this network, the institutions that lead collaboration between European and Latin American centers are the University Hospital Gasthuisberg y el Instituto Nacional de Psiquiatría Ramón de la Fuente Muñiz, which jointly published 10 articles in the decade studied.

In this same network, the Centro de Investigaciones Biomédicas en Red en el Área de la Salud Mental (CIBERSAM), in Spain, holds a position of intermediation or linkage with another part of the system, containing a further seven institutions from various countries, among them the Institut d'Investigacións Biomédiques August Pi i Sunyer and the Hospital de Clínico de Barcelona (Spain), the Universidade de São Paulo – Ribeirão Preto (Brazil), King's College London (United Kingdom), the University Basel Hospital (Switzerland), the Universidad de Pavia (Italy), and the University of Melbourne (Australia) (Figure 5). The second nucleus of these collaboration networks is comprised of three institutions: the Universidad Nacional de Medellín (Colombia);

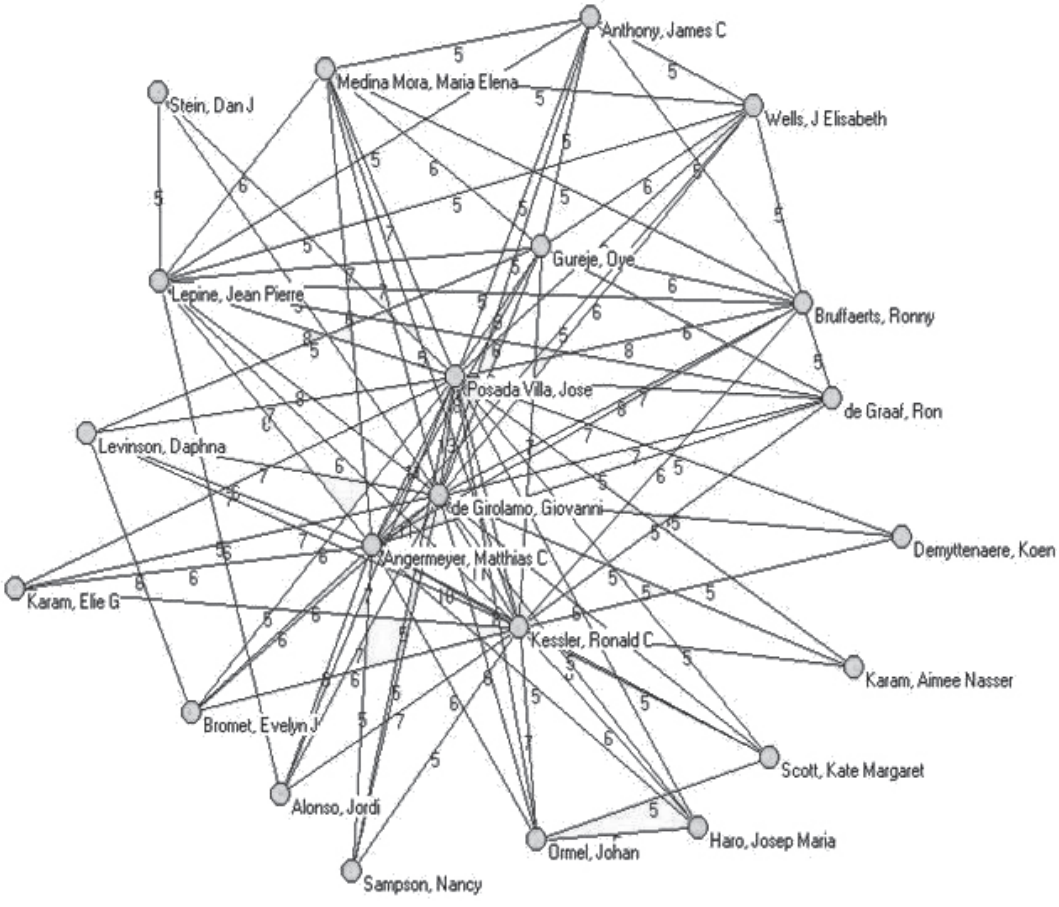

Figure 3. Primary nucleus of researchers (threshold of five articles) in the collaboration network between Latin America and the EU.

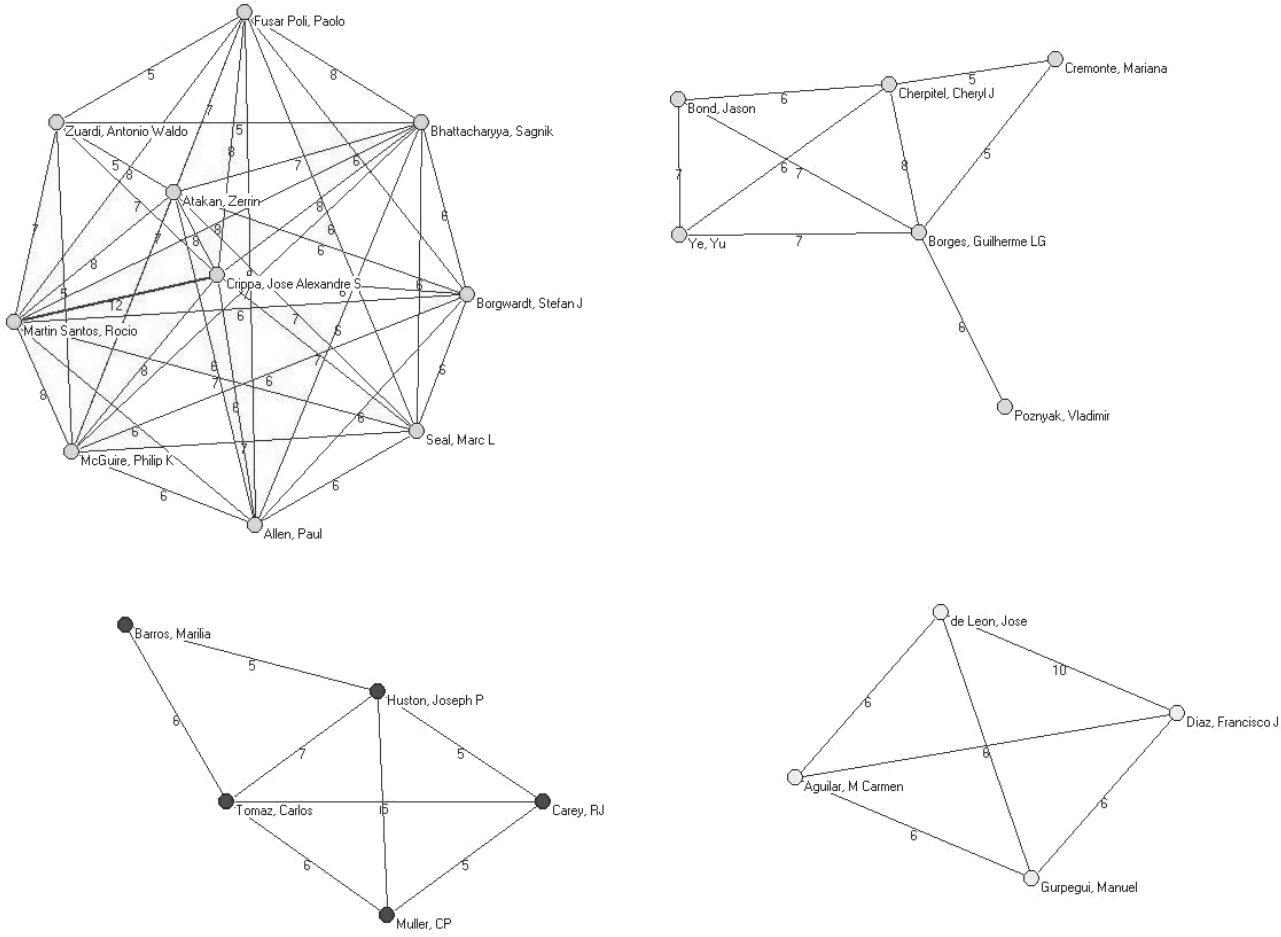

Figure 4. Other nuclei of researchers (threshold of five articles) in the collaboration network between Latin America and the EU.

the Universidad de Granada (Spain), and the Eastern State Hospital (United States), with a maximum of seven links.

The collaboration network between countries (with a threshold of at least eight articles published in collaboration) shows that the United States holds a central position, having established links with 20 countries. Spain occupies second place, with collaborative works with 18 countries. In order of European countries with most scientific contributions, Italy stands out with 17 links to other countries, followed by France (16), The Netherlands (13), and the UK (7). Among Latin American countries, Mexico established the most links to different countries (17), followed by Colombia (13) and Brazil (8). Argentina only collaborated with three countries (Switzerland, Spain, and the USA) and Chile only collaborated with Spain.

The collaborative network of European and Latin American countries shows that Spain is the most active, with 27 works in collaboration with Brazil, 23 with Colombia, and 18 with Mexico. Among Latin American countries, first place goes to Brazil, which apart from 27 works published in collaboration with Spain, also published 22 articles with Italy, 19 with the UK, 19 with France, 18 with Germany, and 16 with Switzerland (Figure 6).

Among countries not belonging to the groups we studied, the USA is the most active, and holds a central place in the network with greatest productivity with Spain (n=39), followed by Brazil (n=37), Mexico (n=34), Italy (n=29), Colombia (n=28), and France (n=25).

Analysis of journals

The 228 works were published in 132 journals, 22 of which stand out for publishing more than three articles. Of these, 19 were published in English, two in various languages, and one in Spanish. The majority (n=13) were published in Europe and two are Latin American (Mexican). The seven remaining publications are North American. Those that published the most articles were *Alcoholism - Clinical and Experimental Research* (n=11), with an impact factor (IF) in 2001 of 3.468, followed by *Neuropsychofarmacology* (IF=6.685), *European Journal of Pharmacology* (IF=2.737) and *Alcohol* (IF=2.423), with six articles each. *Addiction* (IF=4.145), *Schizophrenia research* (IF= 4.374), *Tobacco control* (IF=3.077), and *Substance use & Misuse* (IF=1.06) had five articles each (Table 4).

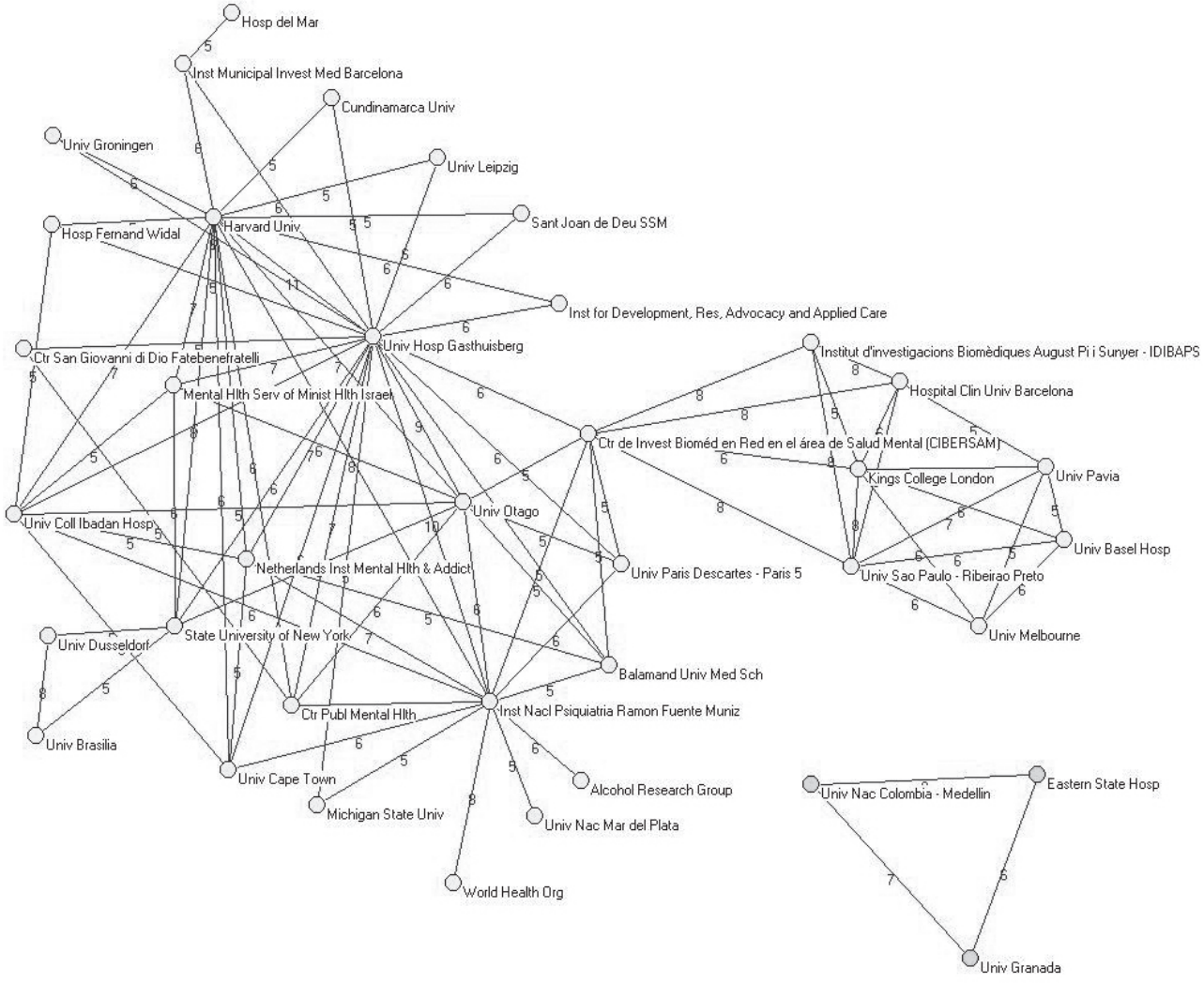

Figure 5. Nucleus of institutions (threshold of five articles) in the collaboration network between Latin America and the EU.

DISCUSSION

Drug dependency constitutes a complex area with problems that require multidisciplinary approaches carried out effectively through the scientific collaboration of professionals from diverse areas.[2,23,26,27] The analysis of joint publications on drug dependency between Latin American and European countries shows a growing increase in collaborations within the period of 2001-2010, which is a little more pronounced in the later years. Previous studies that analyzed scientific production on drug dependency in Europe between the years 1976 and 2000 and again between 2002 and 2006 have already shown this rising trend in both productivity and collaboration,[3,28] and our own work corroborates these findings. However, the publication of 228 works in 10 years cannot be considered high if it is compared with the data from other studies that analyze global productivity on drug dependency or in certain countries.[1,3]

The fact that three quarters of the authors collaborated on just one article each could indicate that collaboration between Latin America and Europe is still in its early stages. However, certain scientists stand out due to their roles as leaders, with a higher number of links and a more accentuated production, both in Latin America and Europe.

On the other hand, a solid indicator of the level of cooperation in this field is the value of the collaboration index, given that 46% of the articles had four to six name credits, indicating a profile of collaboration that has intensified over time. In other studies, median scientific collaboration between authors has shown somewhat disparate results. As such, in psychology there were eight authors per work, a higher number than in other disciplines, while other areas show two or three as the most common median number of authors per article.[29,30] In the case of the present study, the general index of name credits/work or collaboration in other years studied can be considered high (8.68) in comparison to other studies

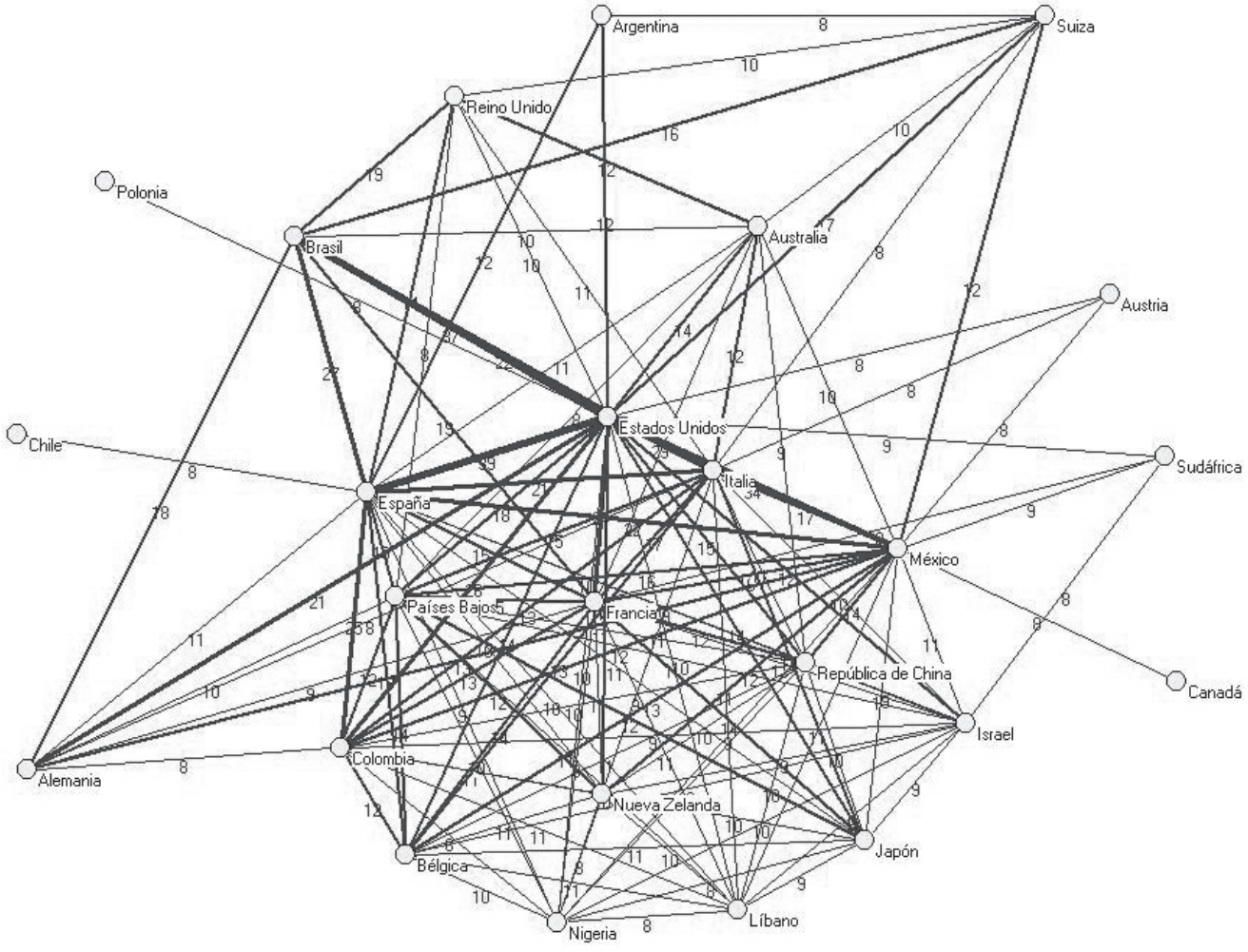

Figure 6. Collaboration network of countries (threshold of eight articles) on drug dependency.

such as that of Vidal-Infer,[3] whose research into production in drug dependency between the year 2002-2006 found a credits/work index of 4.18 authors. This disparity may be due to the fact that in works published in international collaboration, it is normal for various researchers to participate, belonging to each one of the research teams for the participating countries, which increases the collaboration index.[9] On the other hand, the indicator could be considered clumsy in this study, due to the existence of various articles with a high number of name credits. Some 60 articles were included with more than 10 authors and 16 articles had more than 20, which includes one work with 51 name credits, and another with 40.

The identification of groups that make up collaboration networks between authors and institutions is extremely important as it gives newer professionals the chance to meet others and widen their circle of contacts with more established researchers.[3] It should be pointed out that Brazil and Spain, leaders in productivity between the two sets of countries analyzed, establish a collaboration between a wide variety of research centers, universities and hospitals, while other countries like Mexico, Argentina, the UK, and Germany have their collaborations centered in certain institutions. Among these, the National Institute of Psychiatry Ramón de la Fuente Muñiz in Mexico stands out, which corroborates the previous working data on the scientific production in Mexican social science in the WOS.[13]

Among European countries, Spain holds a leading position in collaborative works with Latin America, which is logical for various reasons, whether due to the weighty global position occupied by Spanish science, or the close relationships it maintains with Latin America, sharing cultural and linguistic links which is a factor that ultimately favors scientific communication. In a study published in 2005 which analyzed the productivity of the EU between 1976-2000 on the use and abuse of alcohol and other drugs, the UK was the country with the greatest productivity with 38.6%, while Sweden, Germany, and Spain together represented 30%.[28] While our study presents a more specific approach centered

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Table 4. Journals with more than three articles, country, and impact factor of articles collaboratively published between Latin America and the EU

No. Art.	Journal name	Country	Language	*IF
11	Alcoholism-Clinical and Experim. Res.	USA	English	3468
6	Neuropsychopharmacology	UK	English	6685
6	European Journal of Pharmacology	The Netherlands	English	2737
6	Alcohol	USA.	English	2423
5	Schizophrenia Research	The Netherlands	English	4374
5	Addiction	UK	English	4145
5	Tobacco Control	UK	English	3077
5	Substance Use & Misuse	USA	English	106
4	Archives of General Psychiatry	USA	English	10782
4	American Journal of Epidemiology	USA	English	5745
4	Behavioural Brain Research	The Netherlands	English	3393
4	Drug and Alcohol Dependence	Switzerland	English	3365
4	Bmc Public Health	UK	English	2364
4	Pharmac. Biochemistry and Behavior	UK	English	2624
4	Salud Publica de México	MExico	Varios	0852
3	Proceedings of the National Academy of Sciences of the USA	USA	English	9771
3	Journal of Neurochemistry	UK	English	4337
3	European Neuropsychopharmacology	The Netherlands	English	4201
3	Journal of Affective Disorders	The Netherlands	English	374
3	Behavioural Pharmacology	USA	English	253
3	Adicciones	Spain	Spanish	1127
3	Salud Mental	Mexico	Varios	0311
2	18 Journals with 2 articles			
1	96 Journals with 1 article			

*132 journals in total; *IF: impact factor.

on scientific collaboration with Latin American countries, the most productive country was also Spain, while the UK was in sixth place among the European countries. It is worth noting the role played by Spanish research in drug dependency above other health areas in recent years among European countries, such as cardiology which occupies sixth place.[22]

Another noteworthy fact is the low collaboration maintained between the Latin American countries themselves, in contrast to their collaboration between the United States and Europe. Mexico and Colombia collaborate with a greater number of countries than Brazil, even if it is Brazil that has the highest overall productivity. These results suggest the need for Latin American countries to widen their network of mutual collaboration, as well as with other countries and continents. This work takes into account the bias of predominance of English-language journals on the databases consulted, as well as the low coverage of journals published in Spanish and Portuguese; predominant languages in these Latin American countries.

The productivity ranking of the Latin American countries found in our study is similar to that found in other works on Latin American scientific production, both in studies that analyze all scientific areas[31] as well as those centered on specific areas like psychology.[18] Brazil is observed to be the leader in both cases, followed by Mexico, Argentina, and Chile. Other works that analyzed international visibility of institutions in Latin America and the Caribbean also observed leadership of Brazilian universities, followed by those of Mexico, Colombia, Argentina, Chile, and Venezuela (Ramírez; Aguillo).[13,32]

The results of the present study have also shown the presence of authors and institutions from other countries that do not belong either to Latin America or the EU, which are known as three-way collaborations (one Latin American country, one European country, and one country from another region), demonstrating that international scientific collaboration in the area has multiple networks that cross the boundaries between countries. This is the case in the US, which is at the center of the majority of institution networks. This information corroborates previous research that shows US dominance in impactful scientific literature on drug dependency,[3] as well as in all scientific fields.[16] One study which analyzed scientific collaboration between Argentina and Spain also showed that the most collaboration was established with the US, followed by France, the UK, Italy, and Brazil. The first three countries are the primary collaborators with Spain and they are also among the primary collaborators with Argentina.[25] In another study centered on Argentinean universities, a greater link was observed with the US and Finland, present in 39% and 18% of international collaborative works, respectively, as well as 37% of works carried out in European countries, where the UK, Spain, and France were the most represented.[33]

In the context of scientific collaboration, it is interesting to analyze the investment of these regions in research and development (R+D). The EU has shown its concern with driving policies that allow expenditure on R+D to be raised to approach the levels of countries such as the US, Japan, and Finland,[3] since this will lead to improving its position in the world. A previous study showed that in 2001, the US and Canada spent 43% of all global investment in R+D, while the EU spent 25% and Latin America merely 1.7%.[16] This data justifies both the US leadership in global scientific production, as well as the secondary role played by Europe, and it allows us to understand the difficulties Latin America has

in taking up more central roles in scientific development. The situation has been changing in the latter half of the early 2000s, as after 2005, an increase has been observed in the scientific production of these countries, and more intensively, in Brazil, Mexico, Colombia, and Argentina.[32]

In terms of the journals that have driven research, the most productive are also those that have been identified in previous studies.[3] An analysis of the subjects of these journals shows that drug dependency in general, alcoholism, and smoking are problems that have been at the center of research, as well as in aspects related to psychology, psychiatry, pharmacology, and public health, all of which shows the multi-disciplinary focus in approaching the problem. On the other hand, the majority of the most productive journals are US and British ones with a high impact factor; an indicator that, along with citations received, is a good exponent of quality.[3] Two Mexican publications stand out among these quality journals: *Salud Pública de México* and *Salud Mental*.

In terms of the works' impact, various studies have shown that scientific collaboration between countries and institutions increases the number of citations received, and a positive correlation is observed between the number of countries participating in international articles, and the number of citations these articles receive.[34,35] On the other hand, publication in English and international collaboration on the publication are also associated with more citations. Certainly, it is recognized that the gradual increase in international collaboration in the last few years is an important factor in attracting citations, and members of a collaboration network that already have many connections will be preferentially chosen by new research groups to start a scientific collaboration.[36,37]

This work does have some limitations. Our study has centered on research published in scientific journals with impact in the SCI-E and SSCI which, as previously indicated, only constitute one part of global scientific production, given the thematic and language bias, and the scarce representation of publications from non-English speaking countries.[25] It should also be noted that there is a bias resulting from the search carried out itself, given that this did not take into account the collaboration between Latin American countries exclusively, but rather, the works with name credits between Latin America and Europe, meaning that other works published collaboratively between Latin American and European countries could exist without being included in this study. It should also be considered that publications constitute just one facet of scientific research, and that scientific literature is only one part of the much wider and more complex system that is science. However, the publication of research results in scientific journals is one of the basic principles on which the scientific system is based, meaning that this work constitutes a good approximation for knowing the state of scientific collaboration in the area studied.

CONCLUSIONS

In recent years, a significant increase has been observed in collaborative works, with a general increasing trend. It would be interesting for future studies to observe if this trend is confirmed in the coming years. The leading roles played by Brazil, Mexico, and Spain are particularly clear, as well as the intermediary role played by the US, occupying an intermediary position in the collaboration between different countries and continents.

As directives for future research, and to complement the result of this work, the study could be widened to other databases, primarily those that include more journals from Latin American and European countries, such as Scopus and SciELO,[31,38] which would allow for a broader vision of international collaboration. It would also be interesting to analyze more deeply the extent to which collaboration and publication between certain institutions and countries favors citation and publication in high-impact journals.

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APPENDIX 1

Terms and lexemes used in the search profile for articles on drug dependency in the ISI Web of Science database

Alcohol*, Ecstasy, Nicotine, Amphetamine, Hallucinogens, Opiates, Benzphetamine, Heroin, Opioid, Buprenorphine, Hydromorphone, Opium, Cannab*, Marijuana, Oxymorphone, Cigarettes, Mescaline, Psychedelic drug, Coca*, Methadone, Smoking, nicotine*, Codein, Methamphetamine, Stimulant*,Crack, Morphin*, Substance*, Designer drugs, Nalbuphine, Substance* disorder*, Dextroamphetamine, Naloxone, Tetrahydrocannabinol, Dom, Naltrexone, Thebaine, Drug*, Narcotic*, Abstinenc*, Dependenc*, Abuse Disorder*, Addiction, Substance abuse, Codependenc*, Withdrawal.