WOMEN INVENTORS PATENTING IN MEXICO

Results from 2017 to 2020

CAIINNO®
CENTRO DE ANÁLISIS PARA LA INVESTIGACIÓN EN INNOVACIÓN

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Motivation

The main motivation was the lack of statistical information in Mexico that would allow us to identify the number of Mexican women inventors. Fundamental information to support and justify changes that will allow Mexico to increase the participation of women in the research and development process for inventions. Further, these data allow decision-makers to understand the current situation to design better targeted policies and interventions. In addition, this research aims to give voice to the many women who have broken paradigms and challenges encountered in their lives to become inventors.

Scope and limitations

The study does not suggest that women should be forced to invent more, nor that the Mexican government should promote their growth by sacrificing possible support for men. As will be seen in the research, the collaboration between women and men has been a way that has allowed the participation of more female inventors. Neither promotes conflict between inventors; ideally, collaborations should continue because Mexico needs to have more inventions. A dispute between inventors is not beneficial for the country since the gap with other countries is growing every year.

Support for IMPI

This is an effort to support the work of the Mexican patent and trademark Institute “Instituto Mexicano de la Propiedad Industrial (IMPI)" The participation of organized civil society is key to makes a country better. CAIINNO seeks to contribute to the knowledge will help IMPI, the country, and other beneficiaries (academics, specialists, etc.).

Political notice

CAIINNO's work, along with this research and its researchers, is not related to any political party in Mexico or abroad. This study was developed because it was a topic of interest to the authors, as well as to help improve conditions in the country. Though this publication aims to be value to decision-makers and public officials, many of whom hold ties to political parties, it cannot be used for attacks between political parties or candidates, and its use for such purposes is prohibited.

Definition of gender and sex

To this research we considered terms from World Health Organization (2015). The term 'gender' refers to the socially conceived characteristics of women and men, while 'sex' focuses on purely biological differences.

1. Abstract.

This effort by organized civil society seeks to provide statistical information on the role of women in the areas of intellectual property, science, technology, and innovation. And to be used by governments and decision-makers for the design, implementation, and evaluation of programs, policies, or legislation. It is also relevant for academics, universities, national and foreign research institutions, or anyone interested in the subject.

In several of the Commissions focused on science and technology of the state Congresses in Mexico there are more female than male deputies.
Only in Baja California Sur and Durango all the members are men, and in Zacatecas 100% of the members are women.

In the legislative field, only 8 of the 32 state legislations on science and technology expressly contemplate women in their texts: Chihuahua, Coahuila, State of Mexico, Morelos, Oaxaca, Sinaloa, Tamaulipas, and Veracruz. Of these, only Morelos and Sinaloa make a clear and precise emphasis on promoting women's participation and also seek to measure the educational, social, and economic impacts of their involvement in science and technology.

Another issue related to science and technology in Mexico is their National System of Researchers (SNI for its acronym in Spanish). This research identified that the percentage of Mexican women and men members of the Mexican System remained almost the same with 36 percent in 2015 with respect to 2020 with 38 percent. A similar situation exists for the case of foreign women and men who are members of the System, increasing from 35 percent in 2015 to 36 percent in 2020.

The research focused on invention patents, its main objective was to identify the number of Mexican women who have applied and obtained invention patents in Mexico. Three groups were classified:

a. Mixed teams – Inventions in which at least one woman and one man participate as inventors of the same invention.
b. Only women – Inventions involving only women as inventors.
c. Only men – Inventions involving only men as inventors.

For patent applications analysis, data from 2017 to 2019 was considered, reviewing a total of 4.180 dossiers. It has not been possible to obtain information 100 percent of all files, so the percentage obtained for each year is 88,59 for 2017, 84,55 for 2018, and 18,58 for 2019. The results show significant collaboration between female and male inventors, which is reflected in the number of patent applications. The overall results are:

Applications	Only men	Only Women	Mixted teams	Total patents	Total women	Total men
2017	703	81	389	1.173	851	2.567
2018	714	75	525	1.314	978	2.941
2019	153	15	74	242	146	535

For granted patents, data from 2017 to 2020 were considered, reviewing a total of 1.710 files. For 2020, we collected 388 patent dossiers; only 2 dossiers were unobtainable. But, for the rest of the periods, we retrieved 100 percent of the patent dossiers. Moreover, as in the case of applications, we found significant collaboration between female and male inventors, which in percentage figures is higher than that observed for patent applications. The overall results are:

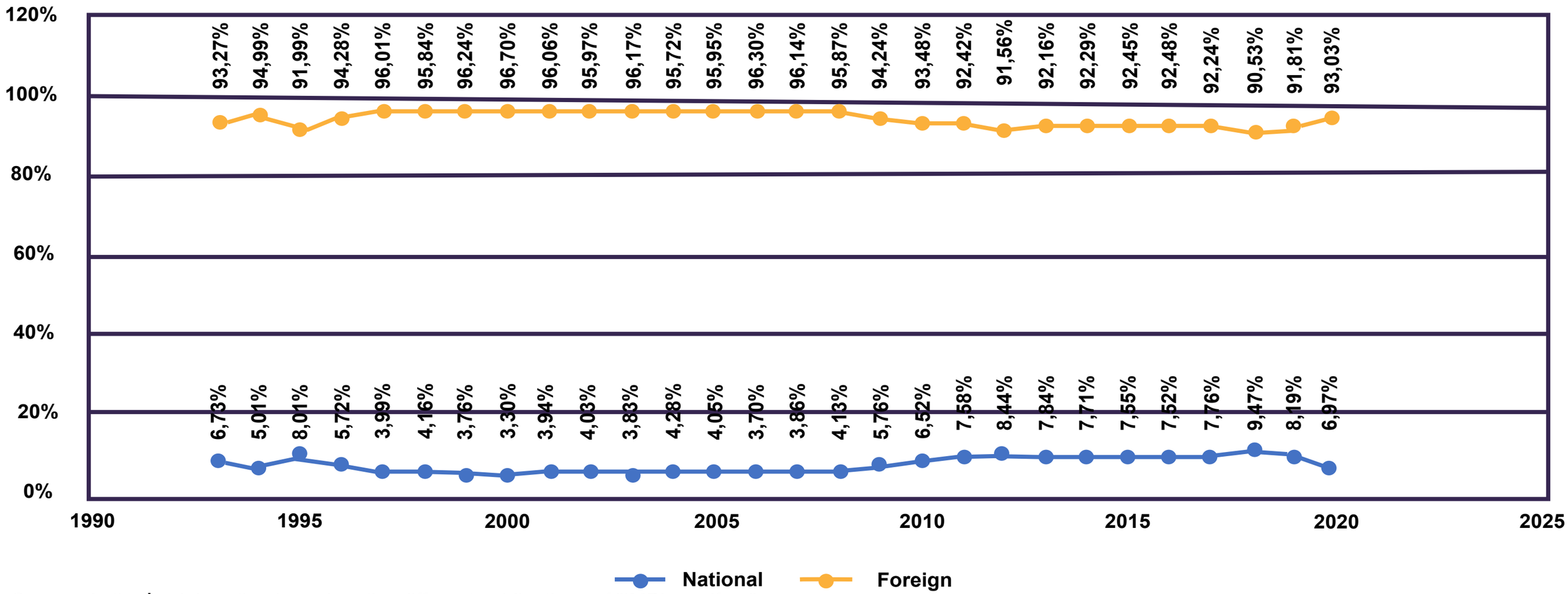
Granted	Only men	Only Women	Mixted teams	Total patents	Total women	Total men
2017	235	23	158	416	289	891
2018	238	23	196	457	385	1.039
2019	227	40	180	447	397	1.038
2020	207	17	164	388	321	951

2. An overview of industrial property in Mexico

The increase in patent applications and grants to Mexicans in the country has increased, but not as expected. According to official information from the Mexican Patent and Trademark Institute (IMPI), in 1999 they received 455 applications, and up to September 2020 they had received 720 applications. According to IMPI(2020), in the same reference years, only Mexico received 6.869 patent applications from the United States, 6.978 in 2019, and 4.484 by September 2020.

In percentages, patent applications have not exceeded 10 percent of the total received by IMPI from 1993 to 2020, as shown in the following calculation:

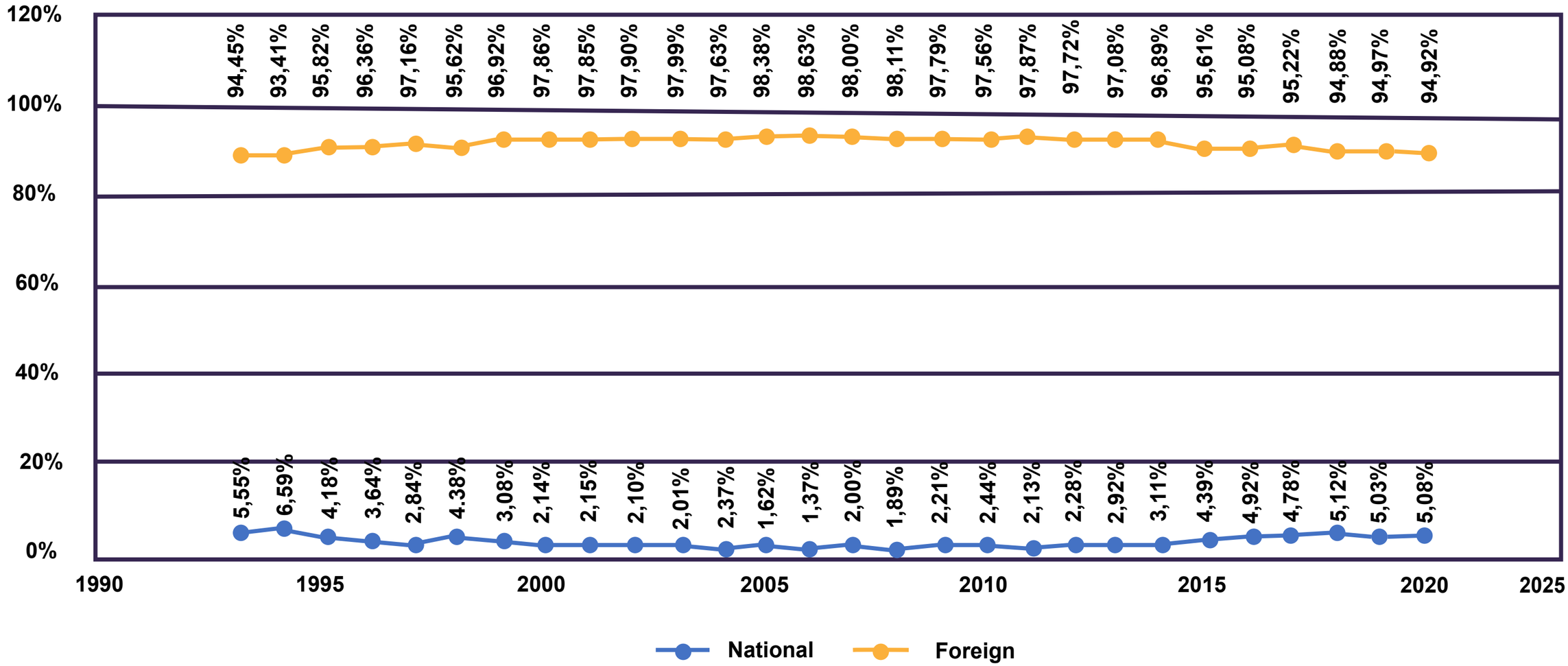
Graph 1. Comparison of patents applications from Mexicans and foreigners in Mexico



Source: Author's elaboration based on the different publications of "IMPI en cifras".
Note: Data from 2020 covers up to September due to the availability of information.

The situation is not different for patents granted in Mexico, 120 patents were granted to Mexicans in 1999 and 241[1] in 2020 (IMPI, 2021) On the other hand, 2.324 patents from the United States were granted in 1999, and 4.074 in 2019. The percentage of patents granted to Mexicans in Mexico did not exceed 7 percent from 1993 to 2019, as shown below:

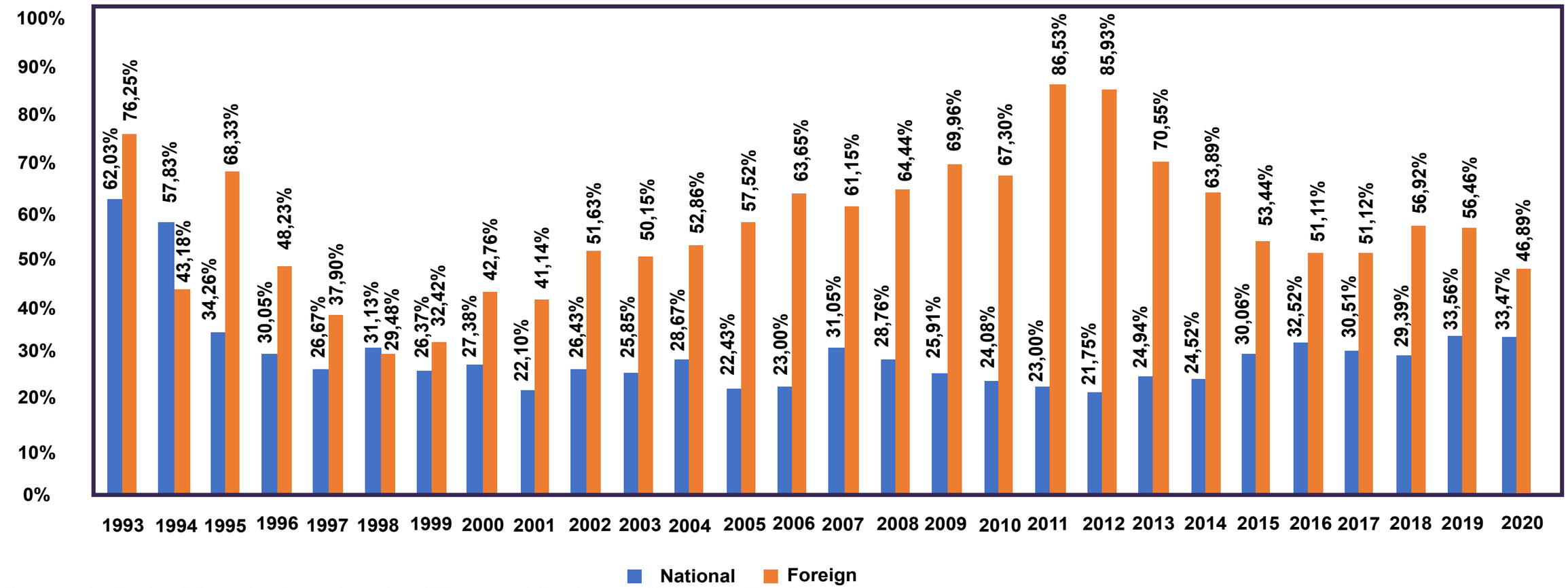
Graph 2. Comparison of patents granted to Mexicans and foreigners in Mexico.



Source: Author's elaboration based on the different publications of "IMPI en cifras".
Note: Data from 2020 covers up to September due to the availability of information

[1] Data for 2020 covers up to September due to the availability of information from the source.

Graph 3. Comparison of the success rate of patents granted to Mexicans and foreigners in Mexico.



Source: Author's elaboration based on the different publications of "IMPI en cifras".
Note: Data from 2020 covers up to September due to the availability of information.

The calculations are based on the average patent prosecution time, from the filing of the application to its conclusion, whether granted or denied, which ranges from 3 to 5 years (IMPI, 2016). In this case, the minimum time to obtain a definitive response was 3 years, and from this the success rate in year t was calculated, which can be defined as the number of patents granted in year t, between the number of patents applied for in year t-3, in percentage terms.

3. Women in Congress, can change be generated from there?

Women's participation in science, technology, and innovation is not limited to universities or laboratories; their presence in the government is also relevant. As shown in the following table, in the Standing Committees of several Congresses, focused on science and technology topics, the presence of women is higher than that of men. In Baja California Sur and Durango, 100 percent of the members are men, and in Zacatecas, 100 percent of the members are women.

Table 1. Women and men in local committees on science and technology.

STATE	COMMITTEE NAME	MEN 2020	WOMEN 2020	% MEN	% WOMEN
AGUASCALIENTES	Science and technology committee	3	2	60,00%	40,00%
BAJA CALIFORNIA	Education, Culture, Science and Technology Committee	2	4	33,33%	66,67%
BAJA CALIFORNIA SUR	Science and Technology Committee	3	0	100%	0%
CAMPECHE	Science and Technology Committee	3	2	60,00%	40,00%
CHIAPAS	Science, Technology and Innovation Committee	4	3	57,14%	42,86%
CHIHUAHUA	Science and Technology Committee	1	2	33,33%	66,66%
COAHULILA	Science and Technology Committee	2	3	40,00%	60,00%
COLIMA	Science, Technology and Government Innovation	1	2	33,33%	66,67%
MEXICO CITY	Science, Technology and Innovation Committee	6	3	66,67%	33,33%
DURANGO	"Science, Technology and Innovation" Committee	5	0	100,00%	0,00%
GUANAJUATO	Committee on Education, Science, Technology and Culture.	3	2	60,00%	40,00%
GUERRERO	Committee on education, science and technology	3	2	60,00%	40,00%
HIDALGO	Science and Technology Committee	3	2	60,00%	40,00%
JALISCO	Committee on Competitiveness, Economic Development, Innovation and Employment	3	1	75,00%	25,00%

STATE OF MEXICO	Science, Technology and Innovation Committee	6	3	66,67%	33,33%
MICHOACAN	Science, Technology and Innovation Committee	2	1	66,67%	33,33%
MORELOS					
NAYARIT	Science, Technology and Innovation Committee	4	1	80,00%	20,00%
NUEVO LEON	Science, Technology and Innovation Committee	4	7	36,36%	63,64%
OAXACA	Education, Science, Technology and Innovation Committee	1	4	20,00%	80,00%
QUERETARO	Science, Technology and Innovation Committee	1	2	33,33%	66,67%
QUINTANA ROO	Education, Culture, Science and Technology Committee	2	2	50,00%	50,00%
SAN LUIS POTOSI	Education, Culture, Science and Technology Committee	5	2	71,43%	28,57%
SINALOA	Science and Technology Committee	3	2	60,00%	40,00%
SONORA	Science and Technology Committee	6	1	85,71%	14,29%
TABASCO	Committee on Education, Science and Technology, Culture, Children, Youth and Sport	3	4	42,86%	57,14%
TAMAULIPAS	Innovation, Science and Technology Committee	5	2	71,43%	28,57%
TLAXCALA	Education, Culture, Science and Technology Commitee	1	7	12,50%	87,50%
VERACRUZ	Science and Technology Committee	1	2	33,33%	66,67%
YUCATAN	Education, Science and Technology Committee	2	5	28,57%	71,43%
ZACATECAS	Education, Science, Technology and Innovation Committee	0	5	0,00%	100,00%

Source: Author's elaboration based on information available in the websites of the States Congresses. Date of last consultation: August 1, 2020.

4. An overview of women in Science, Technology, and Innovation in Mexico

Certainly, women have been gaining ground at STI, but there is still a long way to go. CAIINNO, therefore, made the decision to include an indicator within the Science, Technology, and Innovation indexes they have developed. Since the first edition of the index(CAIINNO, 2015), as well as in the second(CAIINNO, 2018), this mainstay has been questioned for two reasons (1) In the specialized literature, there is no similar precedent in which the participation of women is considered when measuring innovation and, (2) Because in the results, the states that usually rank the first places in STI, do not rank first place in this mainstay.
Despite the questions, CAIINNO decided to keep the mainstay among the 12 that make up the two editions of the Index:

Table 1. Results of the Gender Pillar in the National Indexes of Science, Technology and Innovation.

2018 Edition

Source: CAIINNO, National Index of Science, Technology and Innovation 2018, available at: https://www.caiinno.org/wp-content/uploads/2018/12/INDICE-2018.pdf

2015 Edition

Source: CAIINNO, National Index of Science, Technology and Innovation 2015, available at: https://www.caiinno.org/wp-content/uploads/2016/01/INCTI-CAIINNO2015.pdf

Within the gender dimension, indicators such as the number of women in the National System of Researchers, the number of women participating in the Science and Technology Commissions of the State Congresses, among others, were considered for evaluation. The results omit in this dimension the states that consistently rank at the top of these and other innovation indexes.

4.1. Women inventors: are they backed by the law?

Evidence in this research and various national and foreign resources, allow us to see that the participation gap between women and men in STEM areas, as well as in invention, has been decreasing in most areas, although at a very slow pace. Public policies are key, but they must go hand in hand with legislation that helps them to meet their objectives. In this case, to increase the number of women inventors.

Thus, for this research, we conducted a review of each state science and technology legislations to ascertain whether they consider support for women in two aspects (i) Promotion of women in science and technology, and (ii) Promotion of women in business and entrepreneurship. We identified that only 8 out of the 32 legislations expressly contemplate women in science and technology (Chihuahua, Coahuila, State of Mexico, Morelos, Oaxaca, Sinaloa, Tamaulipas, and Veracruz), and only 2 contemplate business and entrepreneurship.

On the other hand, we analyzed that only the states of Morelos and Sinaloa make a clear and precise emphasis on promoting women's participation. These last two states seek to measure the educational, social and economic impacts of women's participation in this field through their respective Science and Technology Systems. These data are shown in the table below:

Table 2. Explicit considerations for women in science and technology legislation.

State	Law name	Promotion of women in science and tecnhology		Promotion of women in business and entrepreneurship	
		Article	Text abstract	Article	Text abstract
Chihuahua	Law of Science, Technological Development and Innovation for the State of Coahuila de Zaragoza	Art. 1, Section XII	This Law is of public order and general interest and its purpose is to establish the bases and mechanisms to promote, encourage, strengthen, develop and consolidate scientific research, technological development and innovation in the State, through the following general objectives: XII. Promote gender inclusion with a cross-cutting vision in science, technology and innovation, as well as equal participation of both women and men in all areas of the State's Research, Technological Development and Innovation System;		
State of Mexico	Law of Science and Technology of the State of Mexico	3, section V	The following points are set as the basis of a state policy to support the integration of the State Science and Technology System: V. To provide special attention to people in extreme poverty, marginalized groups, the disabled, women, small and micro enterprises, State Government agencies and municipalities, public and private educational institutions of basic, intermediate and higher education.		

Morelos	Law of Innovation, Science and Technology for the State of Morelos	1, section IV	VI. Promote gender inclusion with an equitable cross-cutting vision of women and men in all areas of the Science and Technology System of the State;	40	The scientific and technological research that the State Executive supports under this Law shall seek to contribute to the development of a system of education, professional training of quality and high academic standards, with equal opportunities and access for women and men.
		2, second paragraph	The Innovation, Science and Technology System in the State shall promote equal participation of women and men in innovation, science and technology with a cross-cutting vision and, if feasible, the System shall include gender-differentiated information, in order to measure the impact on scientific and technological development and innovation.		
Oaxaca	Law of Science, Technology and Innovation for the State of Oaxaca	3, section VIII	This Law has the following specific objectives: VIII. To promote the inclusion of the gender perspective with a cross-cutting vision in science, technology and innovation, as well as equitable participation of women and men in all areas of the Science, Technology and Innovation Program for the State of Oaxaca.		
Sinaloa	Law of Science, Technology and Innovation of the State of Sinaloa	2, section XXIII	The objectives of this Law are: XXIII. To promote the inclusion of the gender perspective with a cross-cutting vision in science, technology and innovation, as well as equitable participation of women and men in all areas of the State System of Science, Technology and Innovation.	38 section II	The Consultative Forum is integrated as follows: II. Eleven entrepreneurs representing the productive sector that have coverage and statewide representation, each designated by consensus of each of the organizations they represent: Patronal Confederation of the Mexican Republic (Mexican Employers' Association), National Chamber of the Processing Industry in Sinaloa (Mexican Association of Manufacturers), National Chamber of Commerce of Sinaloa, Hotel Association, Confederation of Agricultural Associations of the State of Sinaloa, Mexican Chamber of the Construction Industry, Regional Livestock Union of Sinaloa, Sinaloa Council of Entrepreneurs, Council for the Economic Development of Sinaloa, Mexican Association of Women Entrepreneurs, National Chamber of the Restaurant and Seasoned Food Industry

		6, section IX	The key principles and procedures that will regulate the support that the State Government will grant to science, technology and innovation will be the following: IX. Results and Impact: Besides feasibility, relevance and quality of the proposals for support, special consideration will be given to the outcomes and impact that will have on the economic and social development of the State. To the extent possible, the information should be differentiated between women and men in order to measure the impact and incidence of the policies and programs in the area of scientific, technological and innovation development;		
		6, section XII	The key principles and procedures that will regulate the support that the State Government will grant to science, technology and innovation will be the following: XII. Policies revision and updating: Policies and strategies to support scientific research, technological development and innovation will be reviewed and updated every three years by the General Counsel, in accordance with a permanent effort to evaluate results and trends in scientific and technological progress, as well as their impact on the solution of needs. Likewise, they seek the greatest beneficial effect of such activities in the teaching and learning of science and technology, in the quality of education, particularly in higher education, the linkage with the services and productive sector; encouraging balanced participation without discrimination between women and men, and the development of new generations of researchers and technologists;		

Tamaulipas	LLaw for the Promotion of Scientific and Technological Research in the State of Tamaulipas	2, section VII	For compliance with the purpose of this law, the following actions will be implemented: Promote Gender Inclusion with A Cross-cutting Vision in Science and Technology and Innovation, as well as Equitable Participation of Women and Men in All Areas of Research in Which They Develop.		
		4, section XX	The principles that will regulate the support provided by the State Government to promote and develop scientific and technological research in general, and particularly the research activities carried out by the agencies and entities of the State Public Administration, shall be the following: XX.- Participation of women and men in the scientific and technological field, shall be balanced and without discrimination, and encouraging the impulse to the development of new generations of researchers.		
Veracruz	Law for the Promotion of Scientific and Technological Research in the State of Veracruz de Ignacio de la Llave	4, section III	The purpose of this Act is: III. Promote scientific and technological competencies in the State, as instruments to promote sustainable development, economic competitiveness, improvement of the population's quality of life, gender equality and non-discrimination, and cultural transformation of all sectors of society;		
		4, section X	The purpose of this Law is: X. Strengthen the Science and Technology System of the State through the formation, promotion and professional training with high academic and scientific level; always seeking equal participation between women and men		
		11, fracción III BIS	The Veracruz Council of Scientific Research and Technological Development (COVEICyDET by its Spanish initials) shall have the following attributions: III BIS. Promote gender inclusion with a cross-cutting vision in science, technology and innovation, and equal participation of women and men in all areas of the System;		

		11, section XX	XX. Design and finance scholarship programs and in general support programs for professional training, in its different modalities, and grant them directly, assuring equitable participation without discrimination between women and men, and integrating information on postgraduate scholarship programs offered by other national public institutions, or by international organisms and foreign governments, to optimize resources in this area with efficient coordination schemes, under the terms of the corresponding calls for proposals;		
		30, II BIS	The principles and criteria that will regulate grants awarded by COVEICYDET to promote scientific research, technological development and innovation in general, as well as for the promotion of science and technology projects, will be the following: II BIS. COVEICYDET shall ensure that the support is granted considering inclusion and non-discrimination, aiming to break the gap between women and men, as long as it meets the criteria of quality and relevance of the research;		
		33	COVEICYDET will establish norms and criteria for the development of programs for professional training of high academic level in the various areas of science and technology, considering gender equality in order to break the gap between women and men.		

Source: Author's elaboration based on the legislations indicated in each State. Date of last consultation: December 12, 2020.

Lastly, one legislation which could include certain measures aimed at increasing the number of women inventors is regarding industrial property. In May 2018, an initiative was presented to amend the Industrial Property Law, which proposed adding to the authorities of the Mexican Institute of Industrial Property to (Senado de la República, 2018):

> "g) To design, implement and evaluate public policies aimed at the promotion and protection of industrial property rights, mainly in the field of innovation and creation of inventions at the state level, as well as public policies aimed at increasing the participation of women primarily in the inventive activity. To achieve the above, it may enter into agreements with other agencies of both the federal government and the states, as well as with public or private institutions, whether domestic or foreign."

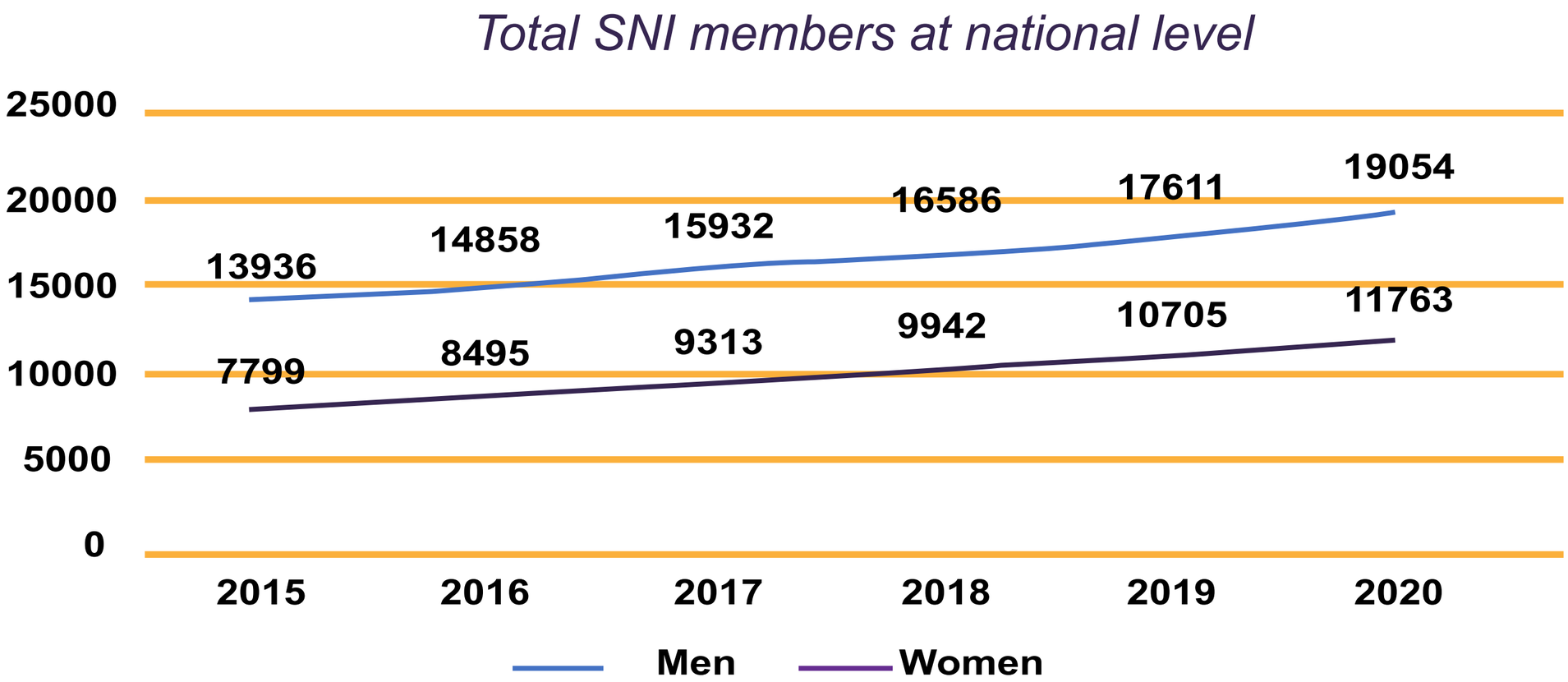
Although the literature shows the lack of women inventors in Mexico, the initiative was neither successful in the LXIII nor the LXIV. Recently, this law expired in favor of the new Federal Law for the Protection of Industrial Property, which also lacks provisions to design, implement and evaluate ad hoc public policies to help increase the number of women inventors in the country.

4.2. Women in the National Research System

If we think about the innovation cycle behind an invention in 2021; it is common for a woman with technical and scientific expertise to be behind the research and development activities that lead to innovations. Therefore, it could be stated that the increase of women in the National System of Researchers (SNI) may increase the number of women inventors in Mexico.

For this reason, in the country, a reference to know how many women are engaged in these research, development and innovation activities is the SNI. As can be seen in the following graph, although there is a constant increase in the number of women who are part of the SNI, the gap with respect to men persists. This is not necessarily negative, as it may be the result of several factors such as the number of women who complete a doctorate in relation to men.

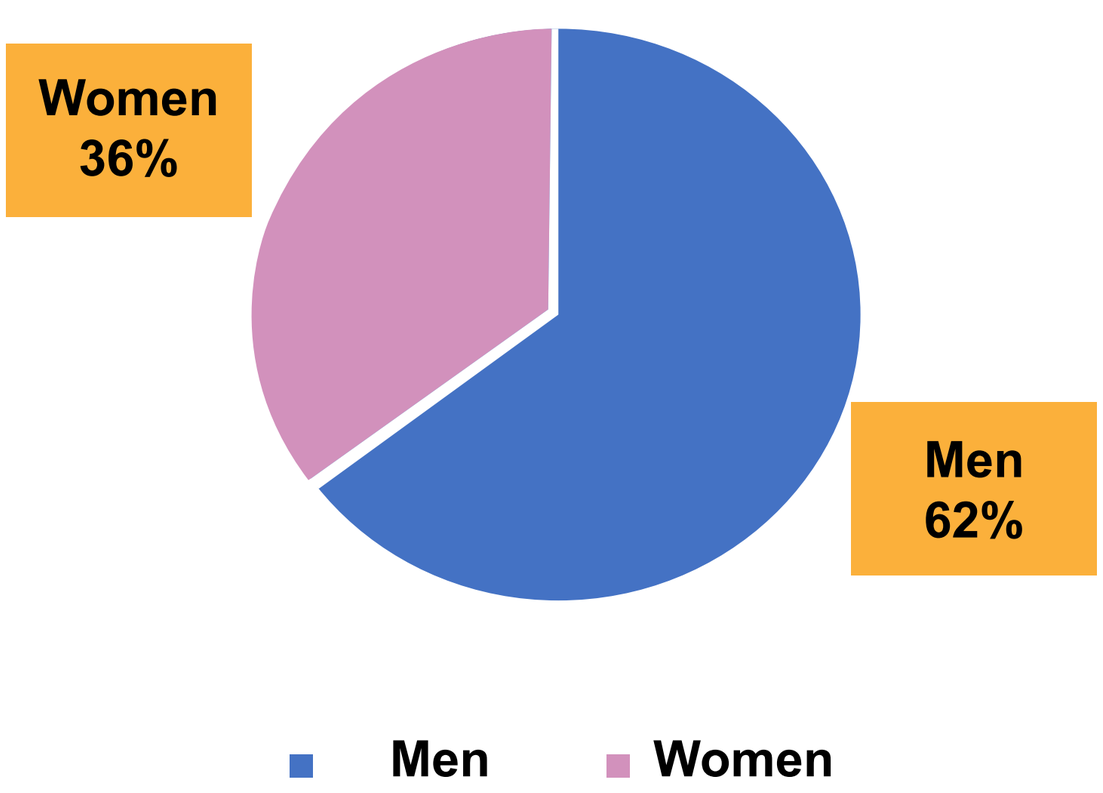
Graph 4. Total number of members by gender.



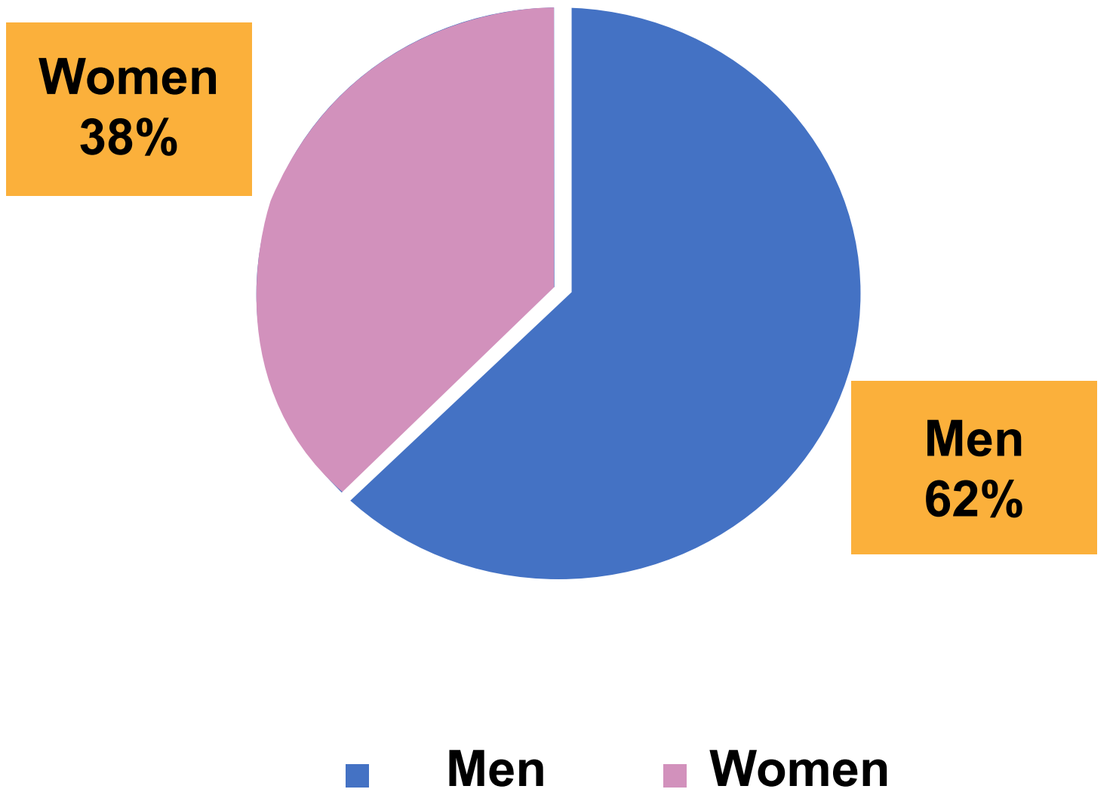
Source: Author's elaboration based on the information delivered in response to information request number 1111200063420, dated January 22, 2021.
Note: All members of the SNI are included, regardless of their level.
Note: The total of the sum of the SNI levels is considered.
Note: To estimate the number of male and female SNI researchers, the following nationalities were considered: Mexican, Mexican-Spanish, and Mexican by naturalization.

In percentages, the gap has remained relatively constant between 2015 and 2020, with a lower percentage of women members of the SNI, as shown in the following graphs. This finding does not allow us to identify the causes of this situation, since it only expresses the percentage difference, but serves as a reference to identify the importance of working on the design of ad hoc policies to increase the number of women members of the SNI.

Graph 5. Percentage of Mexican women and men members of the SNI at the national level for 2015.



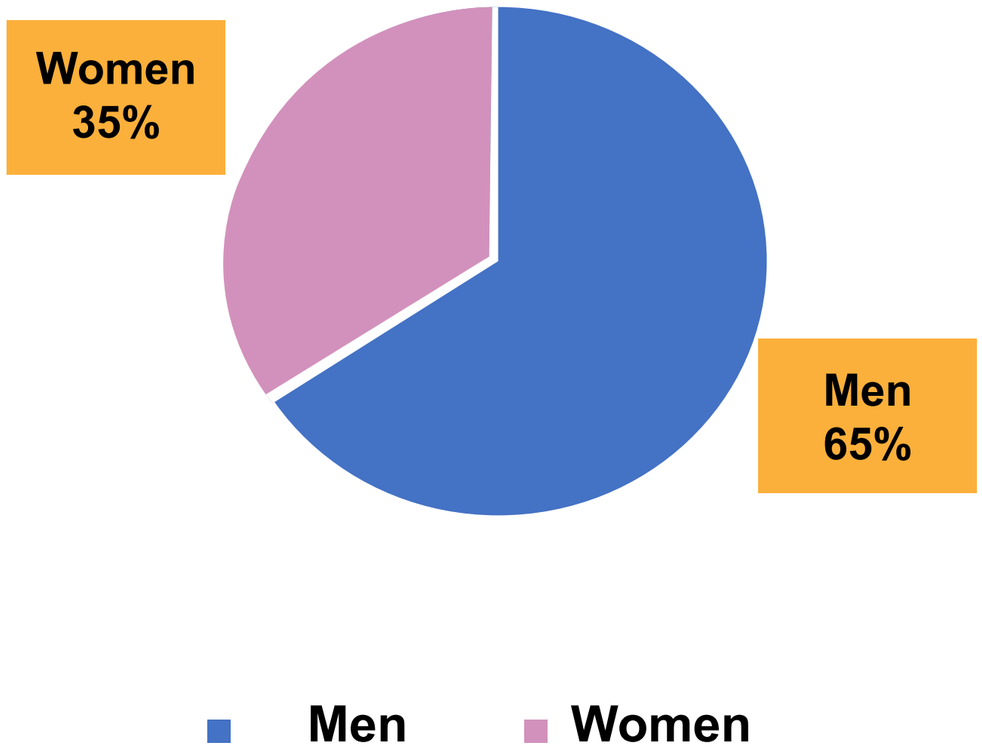
Graph 6. Percentage of Mexican women and men members of the SNI at the national level for 2020.



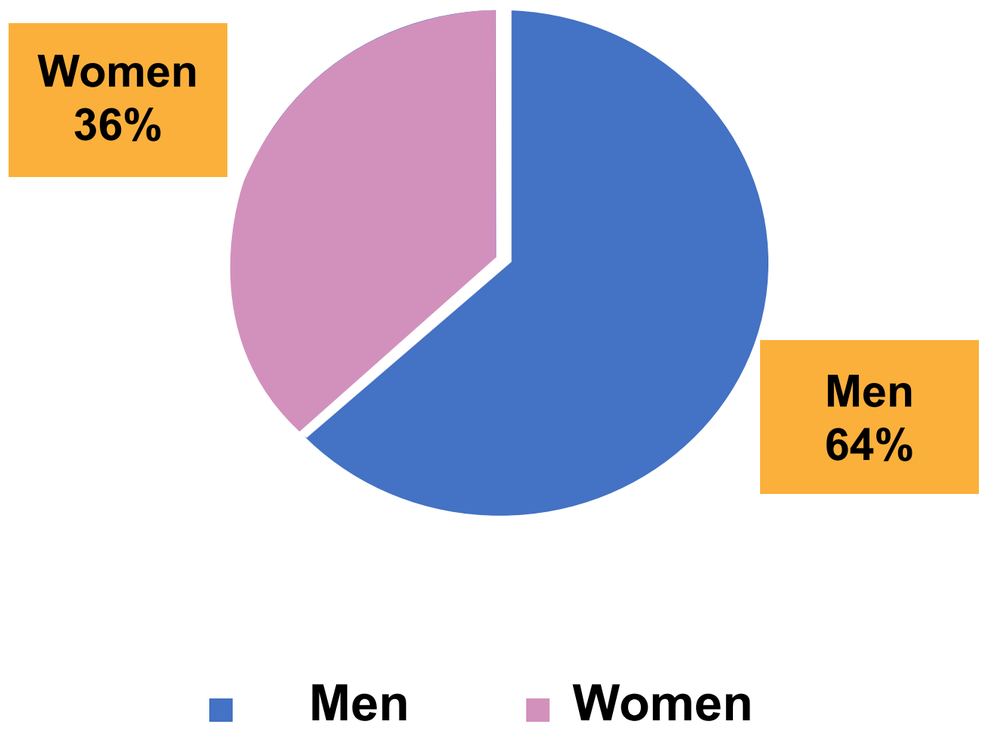
Source of graphs 5 and 6: Author's elaboration based on the information provided in response to information request number 1111200063420, dated January 22, 2021.
Note: All SNI members are included regardless of their level.
Note: The total of the sum of the SNI levels is considered.
Note: To estimate the number of male and female SNI researchers, the following nationalities were considered: Mexican, Mexican-Spanish, and Mexican by naturalization.

The percentages of foreign SNI members are very similar to the nationals. In 2015 there were 547 foreign women and 1.034 foreign men. As shown in the following graph by 2020, the figure rose to reach 853 foreign women and 1.495 foreign men SNI members.

Graph 7. Percentage of foreign women and men, members of the SNI at national level corresponding to 2015.



Graph 8. Percentage of foreign women and men members of the SNI at national level corresponding to 2020



Source of graphs 7 and 8: Author's elaboration based on the information provided in response to information request number 1111200063420, dated January 22, 2021.
Note: All members of the SNI are included, regardless of their level.
Note: The total of the sum of the SNI levels is considered.

That said, for this research we also identified that the gap persists at the subnational level, as in the previous edition of this report(CAIINNO, 2018). Taking 2020 as a reference year, at least three groups of states are identifiable: i. Mexico City with the majority of members with 8.238; ii. States with more than one thousand members but less than 2.000 (Guanajuato, Jalisco, State of Mexico, Morelos, Nuevo Leon and Puebla), and iii. The rest of the states, with less than 1.000 members Those classified by CONACYT as "without institution" are not considered, with a total of 2.529 by 2020, which would place them in second place nationally if they were considered as a state. A fact about the members “without institutions” is that in 2015 they had only 355.

Table 3. Comparison of female and male members of the SNI.

State	Women SNI 2015	Women SNI 2020	Men SNI 2015	Men SNI 2020	TOTAL 2015	TOTAL 2020
AGUASCALIENTES	49	81	117	195	166	276
BAJA CALIFORNIA	188	342	456	635	644	977
BAJA CALIFORNIA SUR	73	82	164	168	237	250
CAMPECHE	35	48	85	127	120	175
CHIAPAS	88	130	165	262	253	392
CHIHUAHUA	122	217	248	386	370	603
MEXICO CITY	2936	3442	4299	4796	7235	8238
COAHUILA	83	182	241	374	324	556
COLIMA	62	79	111	130	173	209
DURANGO	56	81	97	156	153	237
GUANAJUATO	186	285	531	724	717	1009
GUERRERO	34	65	65	122	99	187
HIDALGO	110	195	198	307	308	502
JALISCO	428	748	706	1141	1134	1889
STATE OF MEXICO	457	647	848	1105	1305	1752
MICHOACÁN	176	241	452	531	628	772
MORELOS	363	421	554	597	917	1018
NAYARIT	39	67	76	103	115	170
NUEVO LEÓN	323	545	586	889	909	1434
OAXACA	82	116	171	230	253	346
PUEBLA	262	430	555	746	817	1176
QUERÉTARO	193	284	378	525	571	809
QUINTANA ROO	39	51	69	89	108	140
SAN LUIS POTOSÍ	166	266	376	457	542	723

SINALOA	107	211	247	374	354	585
SONORA	183	302	320	476	503	778
TABASCO	54	101	95	173	149	274
TAMAULIPAS	67	156	119	221	186	377
TLAXCALA	54	81	88	91	142	172
VERACRUZ	238	329	425	542	663	871
YUCATÁN	182	265	336	452	518	717
ZACATECAS	52	99	134	186	186	285
Without institutions	130	1048	225	1481	355	2529

Source: Author's elaboration based on the information delivered in response to information request number 1111200063420, dated January 22, 2021.
Note: All members of the SNI are included, regardless of their level.
Note: The total of the sum of the SNI levels is considered.
Note: To estimate the number of male and female SNI researchers, the following nationalities were considered: Mexican, Mexican-Spanish, and Mexican by naturalization.

In conclusion, if we want to have more women inventors, increasing the number of women who are part of the SNI is a positive way forward, without necessarily lowering the requirements to be part of it. However, the increased number of women members of the SNI does not necessarily translate into an increase of patents, as no evidence was found in the literature to support this premise. Finally, in addition to the gap of SNI women, it is urgent to address the gap at the subnational level, as this other challenge has remained for several years, and the new data shows that it has increased, leaving some states ever farther behind.

5. Women inventors patenting in Mexico, how are we doing?

This research aims to follow up on the previous edition that included data from 2014 to 2016 (CAIINNO, 2018). For this edition, we reviewed patent files from 2017 to 2020. We implemented the following methodology:

1.- Review of public databases to identify Mexican patent file numbers.

2.- Submission of information requests to IMPI to obtain data that could not be placed in public databases.

3.- Review of information provided by IMPI.

4.- Search for information on patent files on the IMPI website, to identify the participation of inventors.

5.- Review of the results from the first search, to confirm that the data obtained was correct.

Before continuing, it is important to explain how the results obtained were classified:

a. Mixed teams – Inventions in which at least one woman and one man participate as inventors of the same invention.

b. Only women – Inventions involving only women as inventors.

c. Only men – Inventions involving only men as inventors.

The results are divided into three sections: **i)** Patents applied from 2017 to 2019; **ii)** Patents granted from 2017 to 2020, and; **iii)** Comparison of results based on the classification of “mixed teams”, “Only women” and “Only men”.

5.1. *Patents applications*

We need to point out that it was not possible to obtain information on the total number of patent applications for the years under study. For several consultation attempts from at least three different dates, the Information System of the Industrial Property Gazette did not provide results or did not show the necessary information for this research, nor was it possible to consult the file. It was not part of the investigation to identify the reasons for the non-availability of information on such requests, but it is inferred that in most cases non-publication of information is normal, as requests do not yet arrive at the time when their information can and should be published. Therefore, the total number of files reviewed and considered is the following:

Year	Total number of patent applications	Files without information available at the time of the research	Files consulted (with information available at the time of the research)	Percentage revised of the total number of aplications per year
2017	1.324	151	1.173	88,59%
2018	1.554	240	1.314	84,55%
2019	1.302	1.060	242	18,58%
Total	4.80	1.442	2.738	65,50%

The overall result of patents applications with the available data was as follows:

Table 4. Total patents applications.

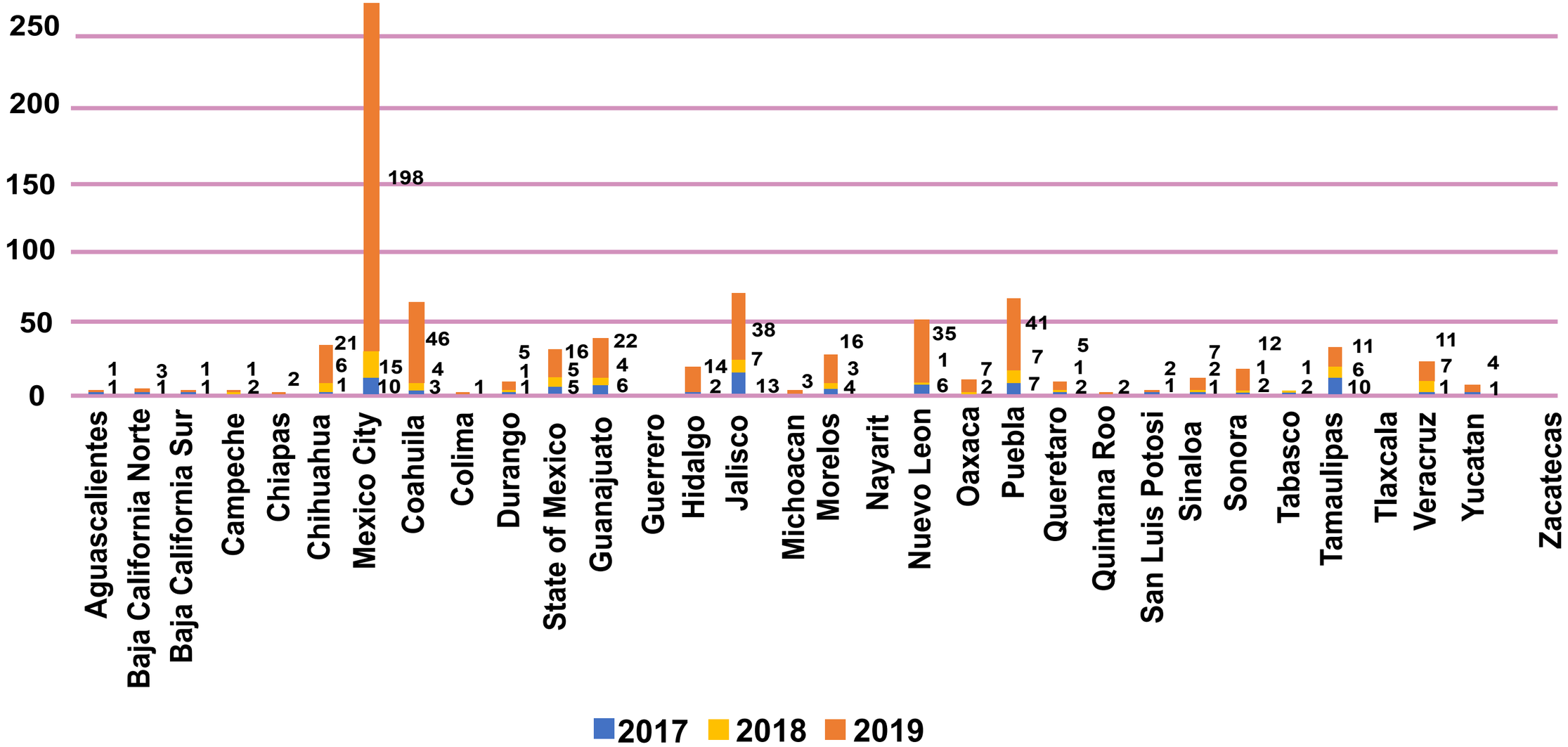
Applications	Only men	Only Women	Mixted teams	Total patents	Total Women	Total Men
2017	703	81	389	1.173	851	2.567
2018	714	75	525	1.314	978	2.941
2019	153	15	74	242	146	535

Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.
Note: The column “total women” and “total men” considers the sum of all women and men identified in each patent application, so it is possible that the same inventor participates as such in more than one patent application.

Given the lack of information on patent applications for the years 2017, 2018 and 2019, the conclusions can be drawn may not be conclusive, especially for 2019, however, those of the other two years can serve as a reference to know how many Mexican women are applying for patents in Mexico. The largest gap is seen when comparing the “only men” group with the “only women” group. This gap narrows when the “mixed teams” group is considered, which shows that there is significant collaboration between men and women in research and development, which eventually led to patent applications.

The graph below shows the total number of patent applications in which only women appear as inventors. Mexico City is the leader, being the only one with more than 100 applications. A second group formed by Jalisco, Puebla, and Coahuila with more than 50 but less than 100 applications. A third group could be confirmed by the rest of the states with less than 50 applications, within which some states had 0 applications. These data are inconclusive because not all applications are considered, but for 2017 and 2018 they are a good reference. As it has been the case with similar studies, there is a significant gap between a few states and the rest of the country.

Graph 9. Total number of patents applications Only women

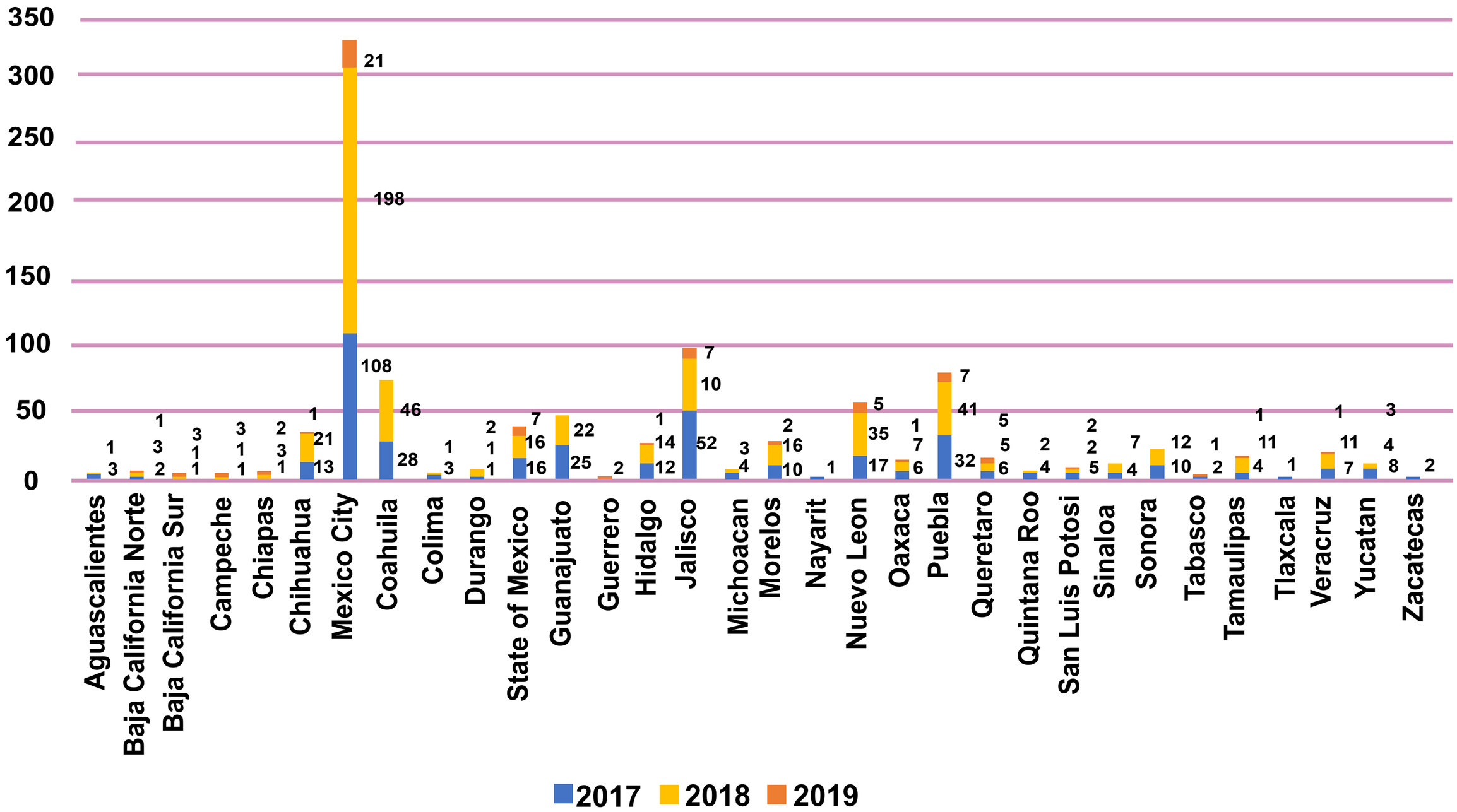


Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021

A significant increase in Mexican female inventors is observed in mixed teams patent applications, where at least one man and at least one woman participate. As a first finding, Mexico City has the highest number of applications for this type of study, far surpassing the rest of the country.

In fact, we could add all applications from 15 states and still they would still be below Mexico City. A second group could consider Jalisco, Puebla, Coahuila, Guanajuato, and Nuevo Leon that have 40 or more but less than 100 applications considering the 3 years of study. The third group could be made up of states with less than 40 applications.

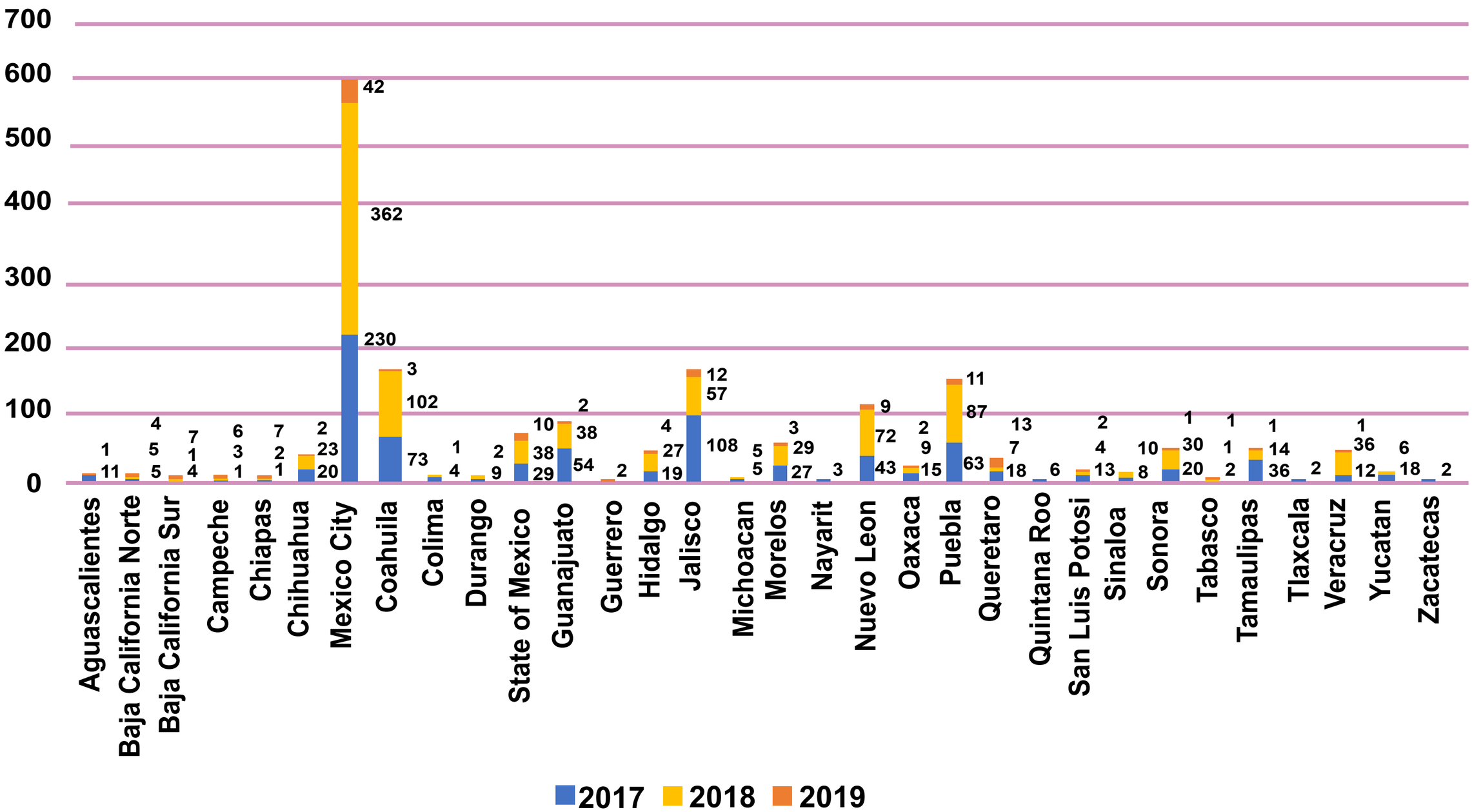
Graph 10. Total number of patents applications in the mixed teams



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021

Finally, the following graph shows the total number of women inventors who appear in the 2.738 files of requests for information consulted. As we can see, the gap also is present in this case, with Mexico City concentrating the highest number of Mexican women inventors with 634, much higher than second place Coahuila with 178 and third place Jalisco with 177 inventors, respectively. It is worth noting that in the years under study all states had women inventors.

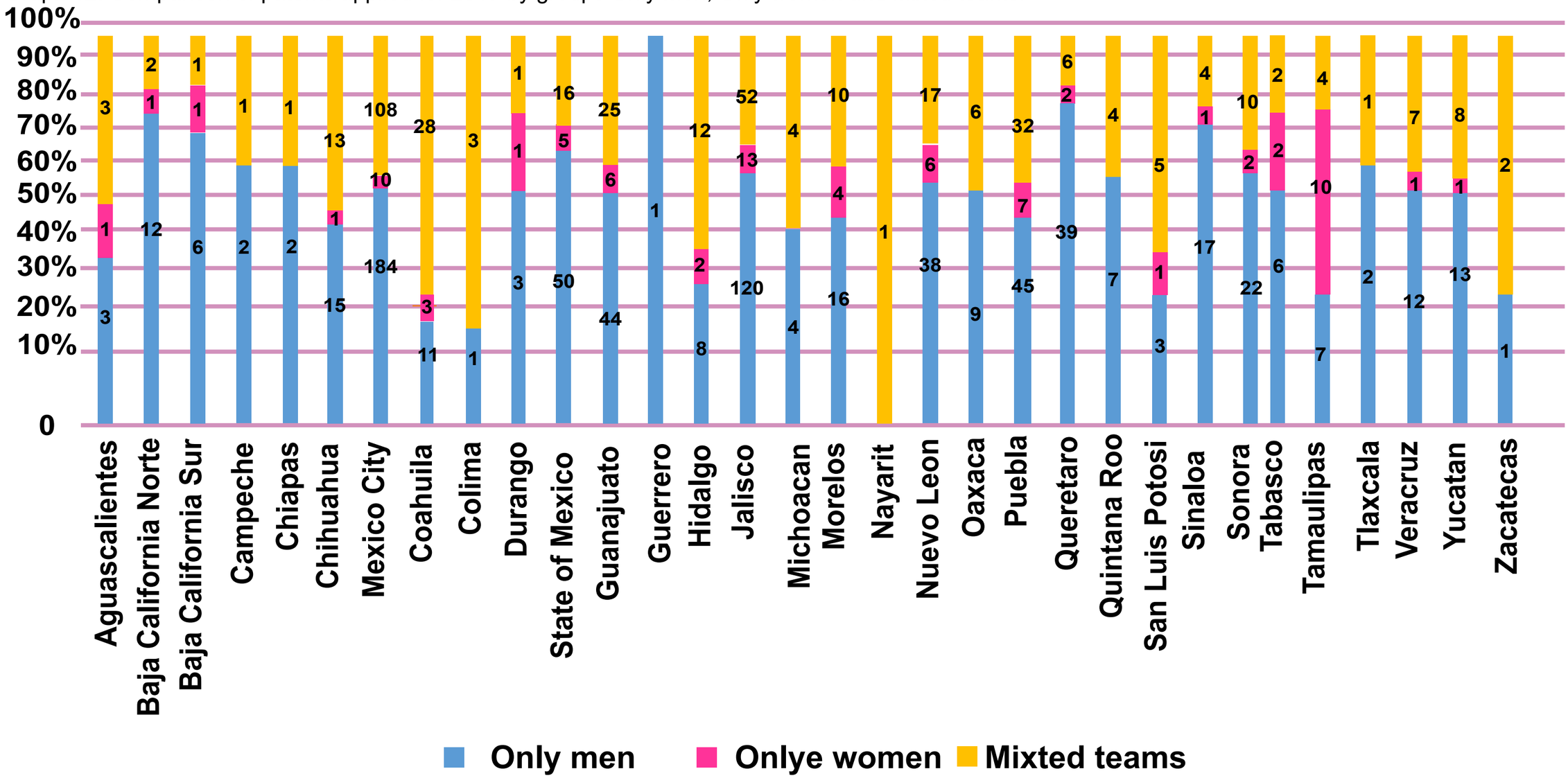
Graph 11. Total number of women inventors who requested a patent



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021

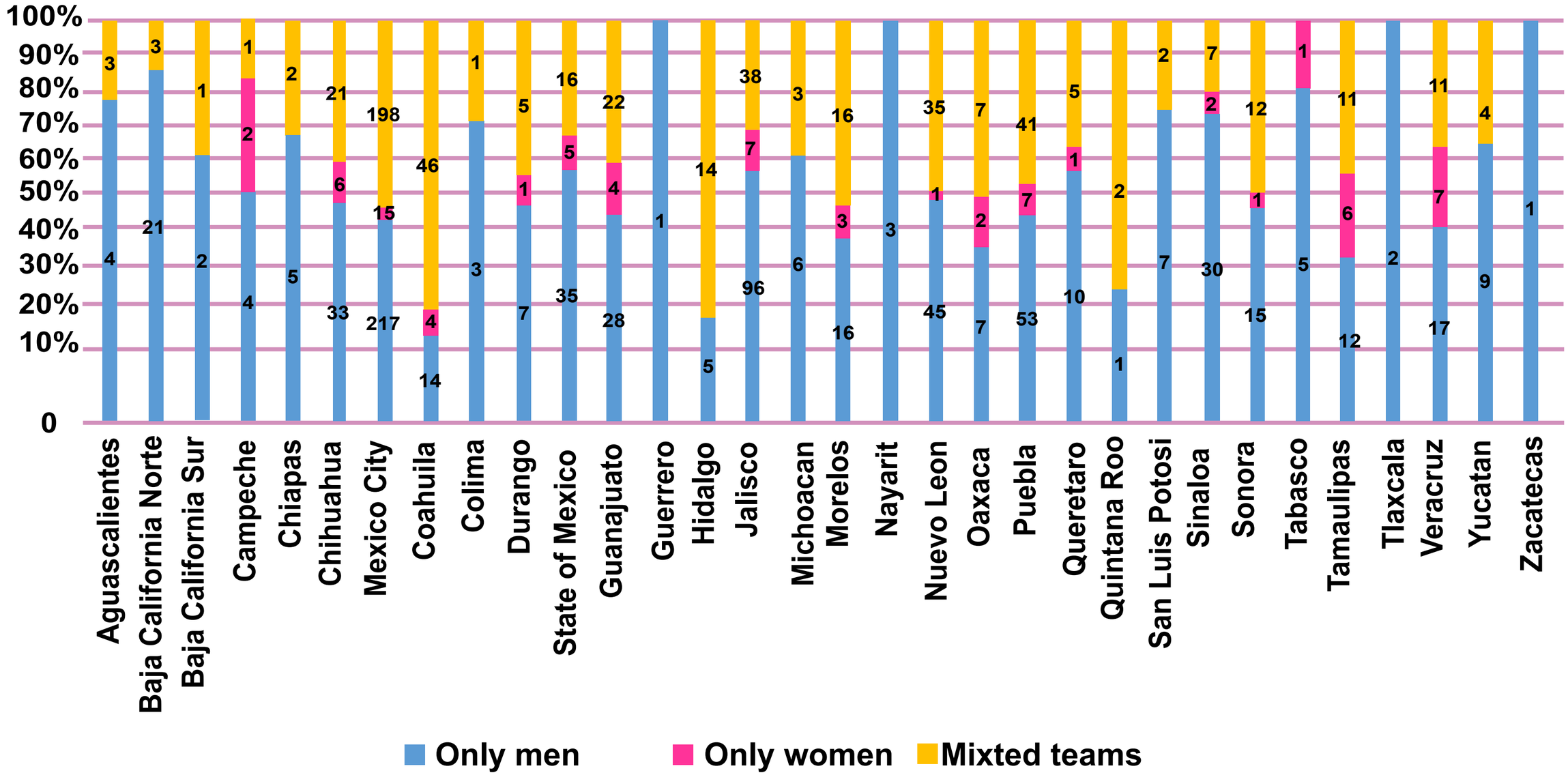
The following 3 graphs show a comparison of the number of patents applied for considering the 3 analysis groups (Only women, Only men and Mixed teams), for the 3 years of study. In most cases, the number of “Only men” is higher, although in 2017 and 2018 there is a greater balance with the group of “mixed teams”, which shows that there are a significant number of cases where research and development activities are carried out collaboratively, showing that the union of men and women is possible, feasible and useful for the increasing presence of women inventors.

Graph 12. Comparison of patents applied for 2017 by groups Only men, Only women and Mixed teams.



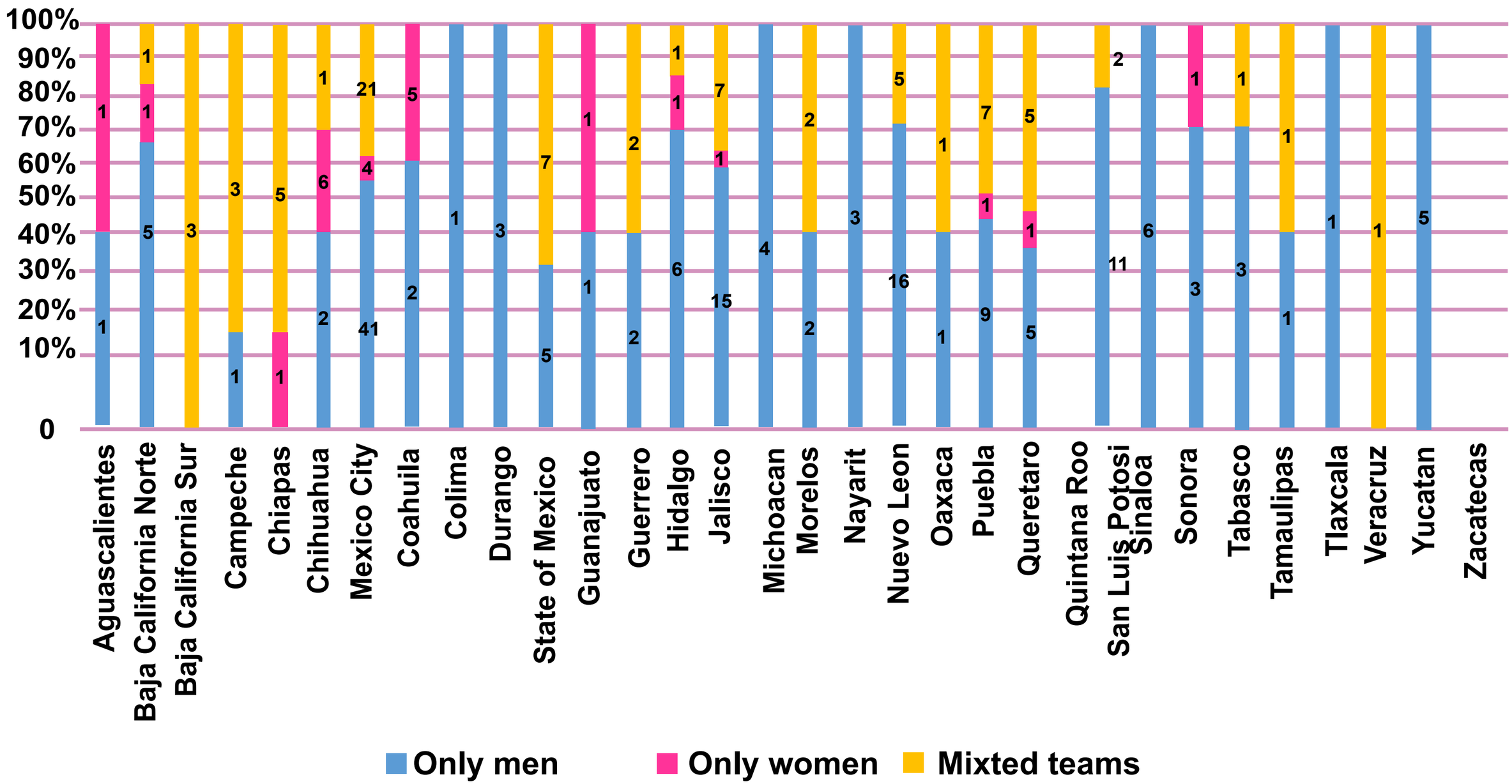
Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.

Graph 13. Comparison of 2018 patent applications by Only men, Only women, and Mixed-team groups.



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.

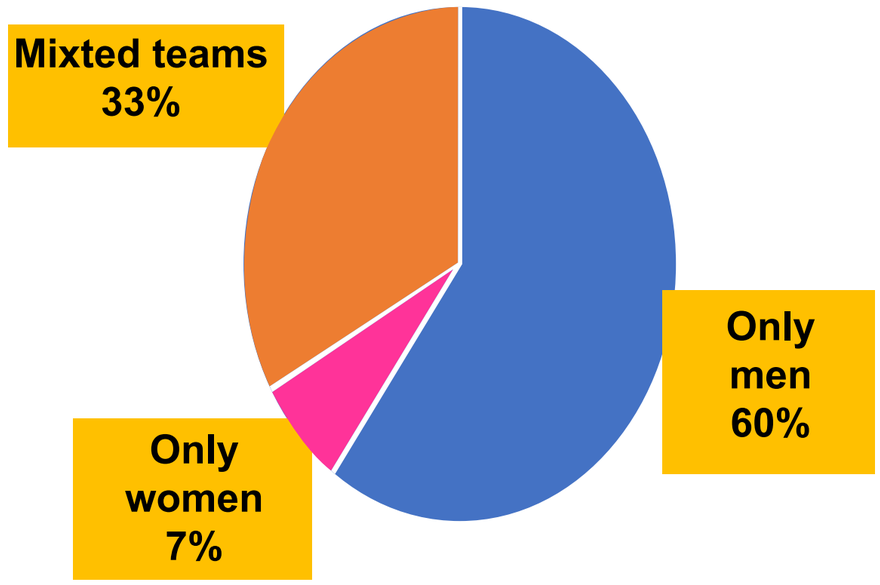
Graph 14. Comparison of 2019 patent applications by Only men, Only women, and Mixed-team groups.



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.

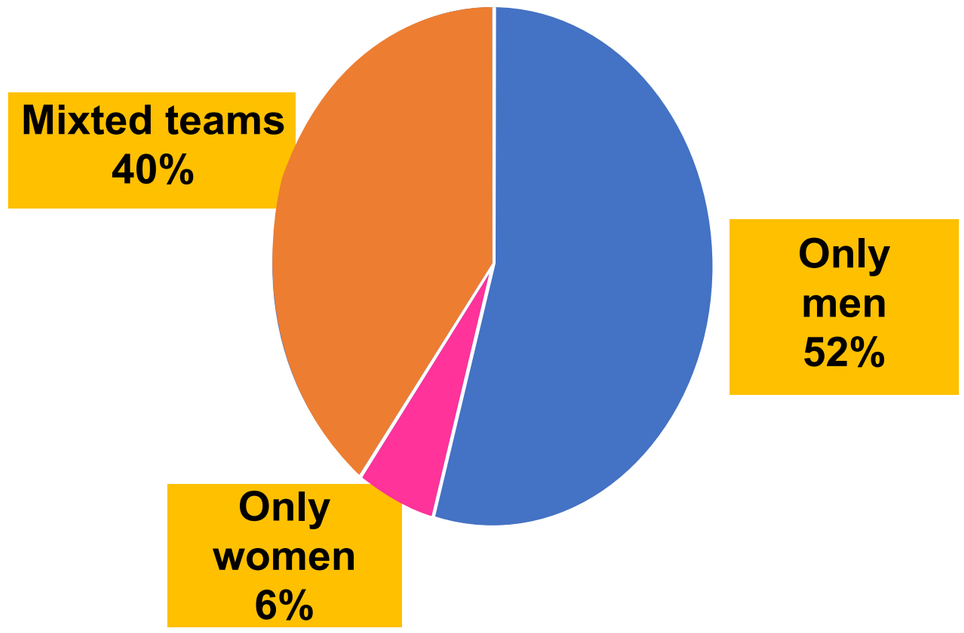
That said, in percentages, we can see that the number of "Only women" applications is lower than the other two groups. Nevertheless, it is noteworthy that the mixed team applications had an increase from 2017 to 2018.

Graph 15. Comparison of percentages of patents applications in 2017 by Only men, Only women, and Mixed-teams.



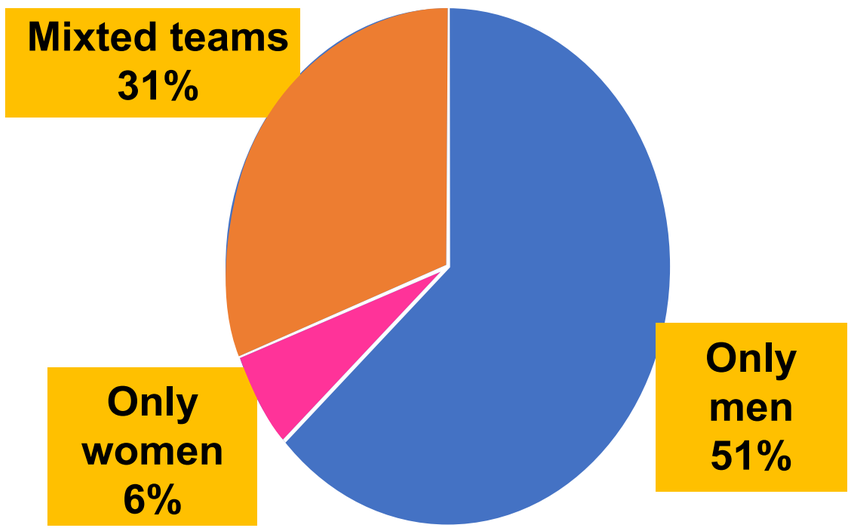
Source: Author's elaboration based on the data obtained from the request for information number 1026500000821 dated January 19, 2021.

Graph 16. Comparison of percentages of patents applications in 2018 by Only men, Only women, and Mixed-teams.



Source: Author's elaboration based on the data obtained from the request for information number 1026500000821 dated January 19, 2021.

Graph 17. Comparison of percentages of patents applications in 2019 by Only men, Only women, and Mixed-teams.



Source: Author's elaboration based on the data obtained from the request for information number 1026500000821 dated January 19, 2021.

5.2. *Patents granted*

It was possible to obtain information on almost all the patents granted for the years studied. In those we could not, it was because we could not identify whether the inventor was a man or a woman, despite having reviewed several sources. Another reason could be that in the Information System of the Intellectual Property Gazette, we identified that the inventor was not Mexican, although the information provided by the IMPI shows him/her as such. Therefore, the total number of files reviewed and considered is the following:

Year	Total invention patents granted	Files without information available at the timeof the research	File consulted (with information available at the time of the research)	Percentage resived of the total number of applications per year
2017	416	0	416	100%
2018	457	0	457	100%
2019	447	0	447	100%
2020	390	2	388	99,48%
Total	1.710	0	1.708	99,88%

The overall result of patents applications with the available data was as follows:

Table 5. Total patents gratend.

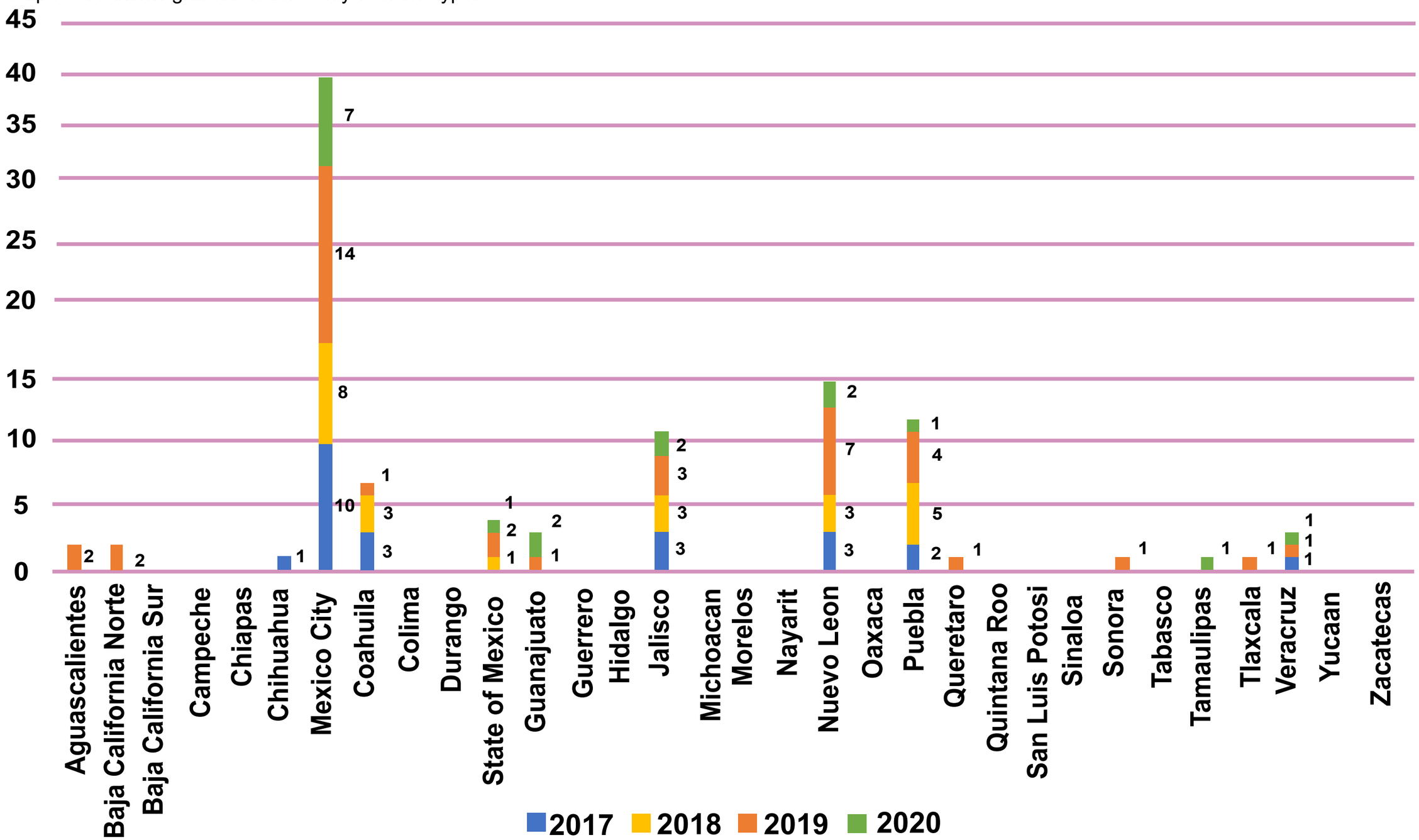
Granted	Only men	Only women	Mixted teams	Total patents	Total women	Total men
2017	235	23	158	416	289	891
2018	238	23	196	457	385	1.039
2019	227	40	180	447	397	1.038
2020	207	17	164	388	321	951

Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021
Note: The column “total women” and “total men” considers the sum of all women and men identified in each patent application, so it is possible that the same inventor participates as such in more than one patent application.

For granted patents, we were able to review and obtain information on almost the total of files, which makes it possible to make various conclusions and future analyses. The difference between the "Only men" and "Only women" groups is evidently wide, but if we consider the "mixed teams" group, this gap is significantly reduced. Another important finding is that the total number of women exceeded 300 after 2017 and remained above that number for the following years, despite remaining the gap with men's total.

The first finding was that there are few patents granted where only women participate as inventors. In addition, as shown in the following graph, half of the country (16 states) did not have any inventions of this type during the studied period. The second finding was the existing gap between states, given that four states account for almost all the patents granted. Out of the 103 granted patents to the group of "Only women", Mexico City had 39, and in second place Nuevo Leon with 15 granted patents of this type.

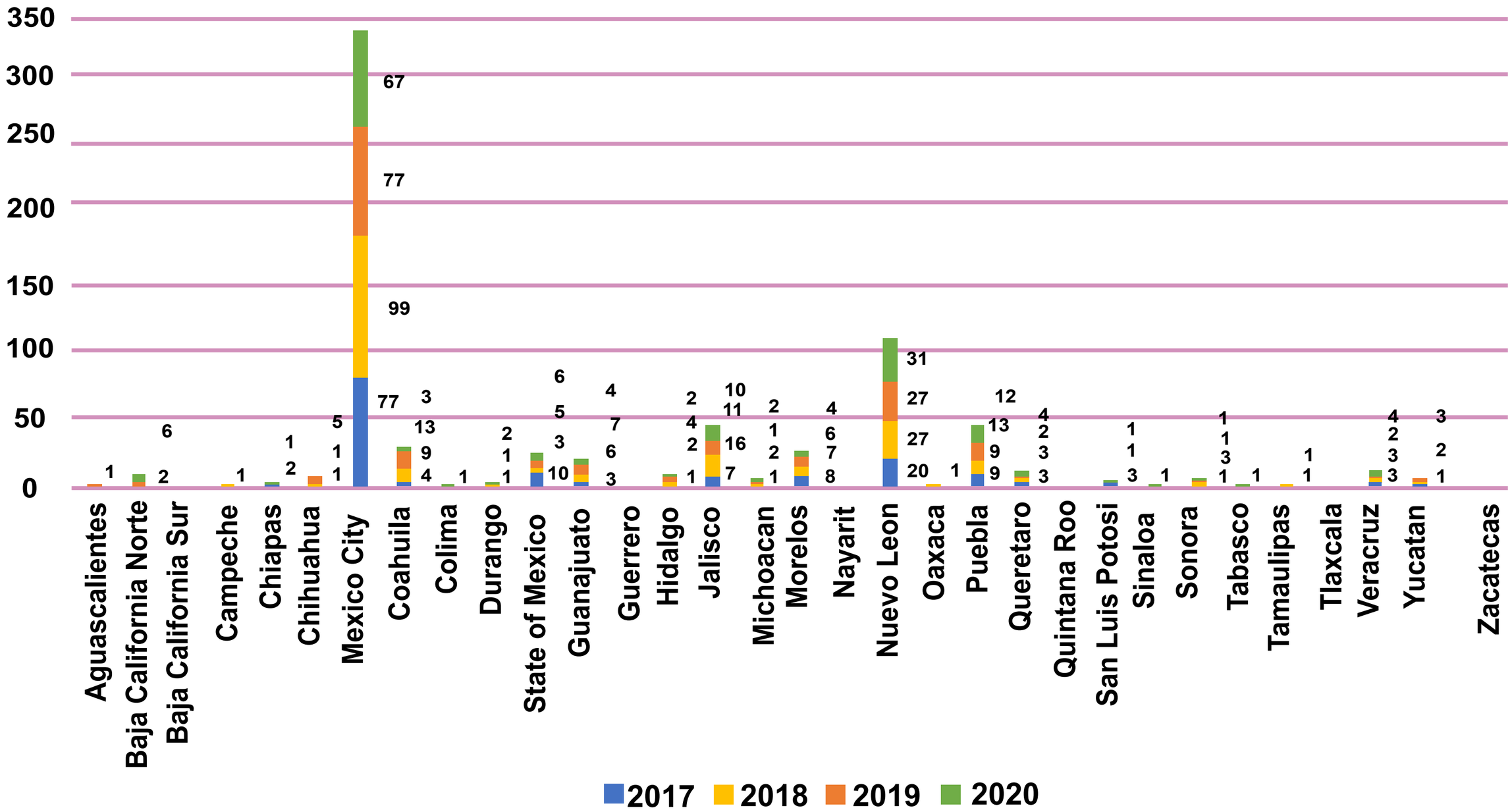
Graph 18. Patents granted of the "Only women" type.



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.

The results for mixed teams, where at least one woman and one man participate as inventors, show a significant increase in the number of patents granted involving women. The results show that only five states had 0 patents of this type. However, the gap at the subnational level is still alarming and continues to increase. Since just a few states concentrate most mixed-team patents, for example, from the total of 698 patents, 320 were granted in Mexico City, nearly half of them.

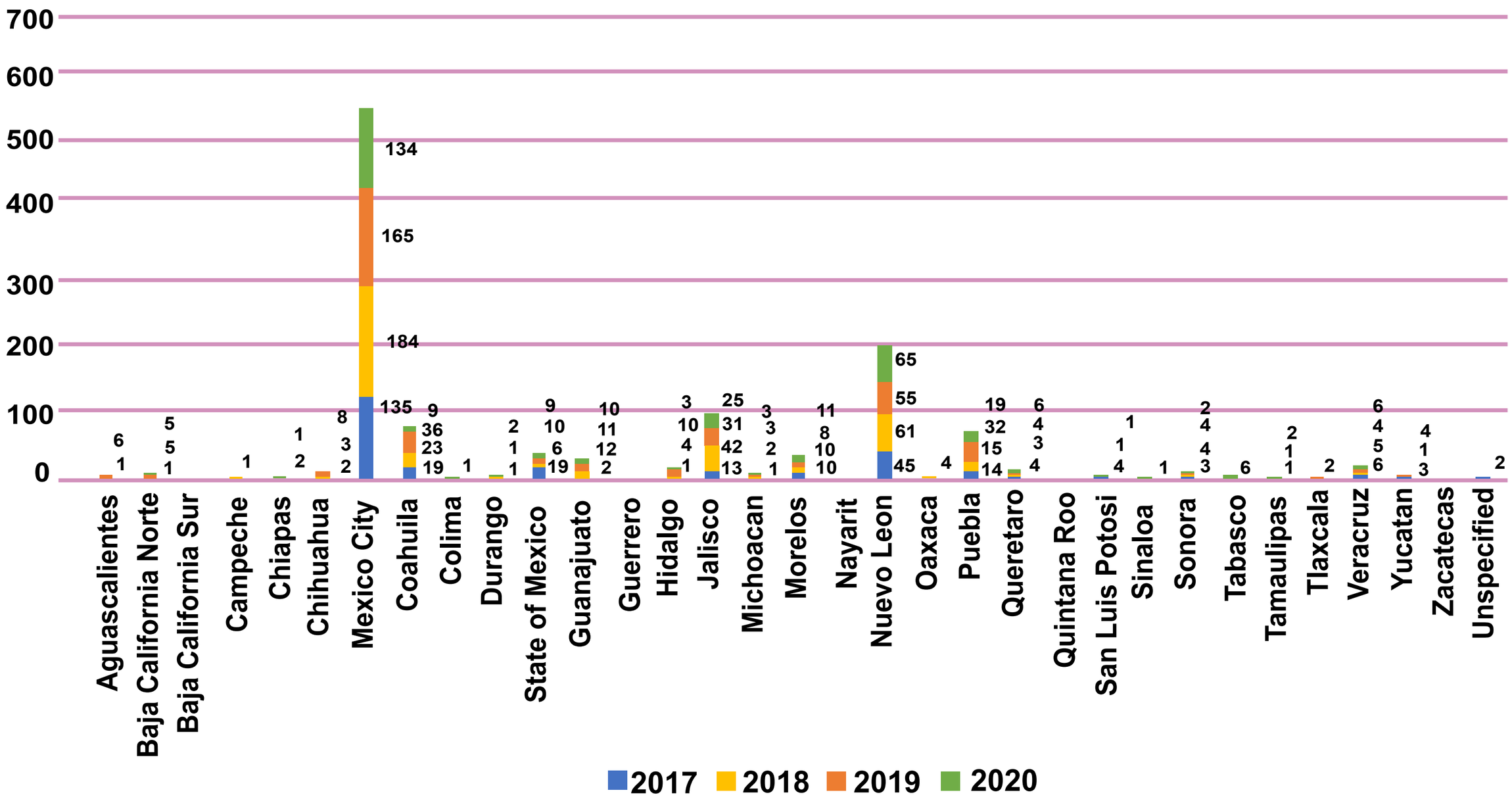
Graph 19. Patents granted for "Mixed teams".



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.

However, another finding that we obtained from the research is the total number of women inventors in the years under study. The following graph shows the total number of women who participated in both the "Only women" and "Mixed teams". Under the 4 years of the study, there were 1.392 women inventors in the patent applications. In Mexico City, Nuevo Leon and Jalisco concentrated more than 50 percent of the women inventors, 619, 226 and 111 respectively.

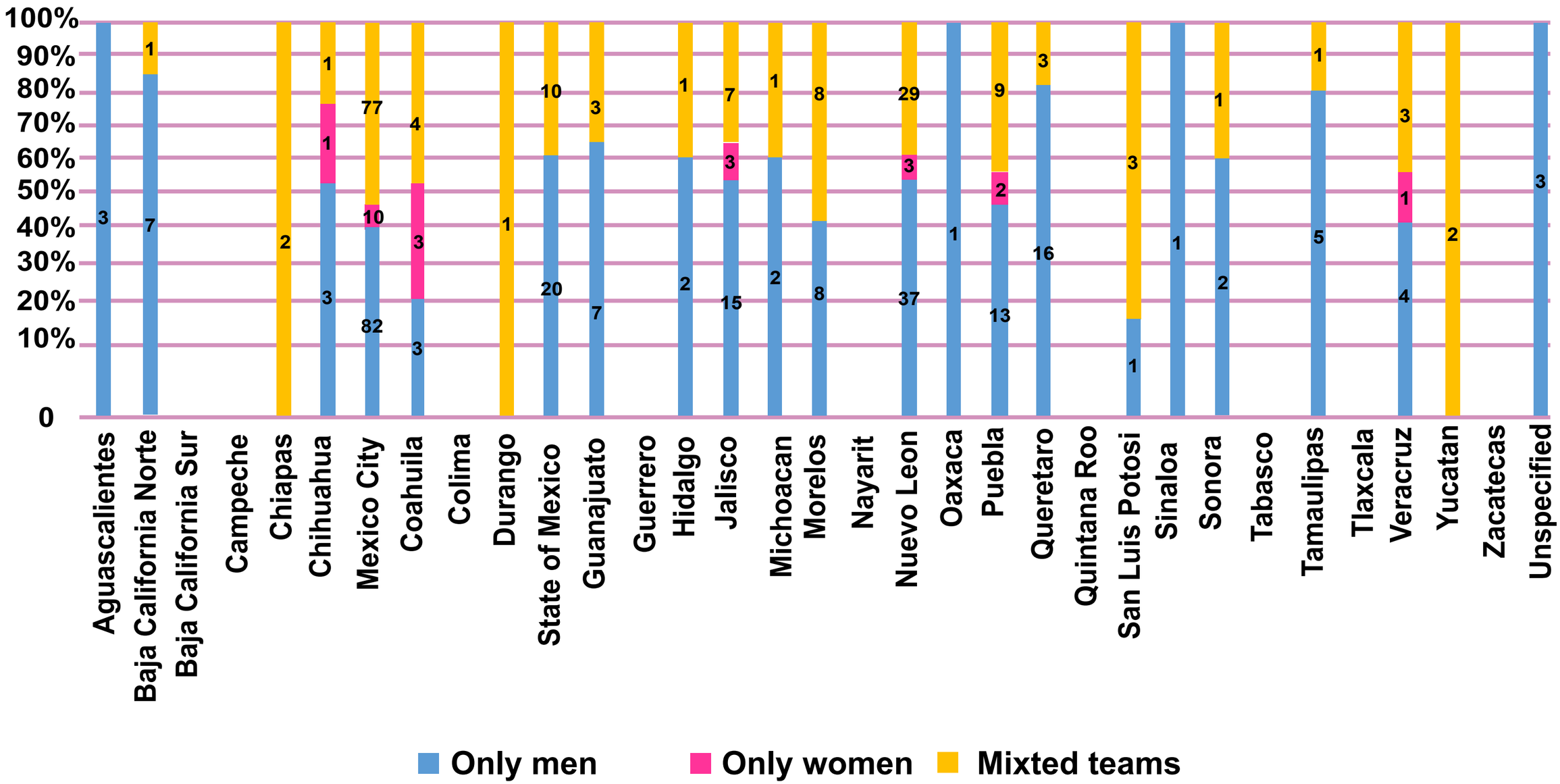
Graph 20. Total number of women inventors.



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.

The following four graphs show a comparison of the number of patents granted considering the three groups (Only women, Only men, and Mixed teams), for the four years of study. This analysis is useful since the patents created from the mixed teams are the ones that have more women inventors in the total national percentage. In 2017 we found that 235 patents were granted to "Only men", 23 to "Only women" type, and 158 to "Mixed teams". Yet again, the gap phenomenon is visible, as five states concentrated the highest percentage.

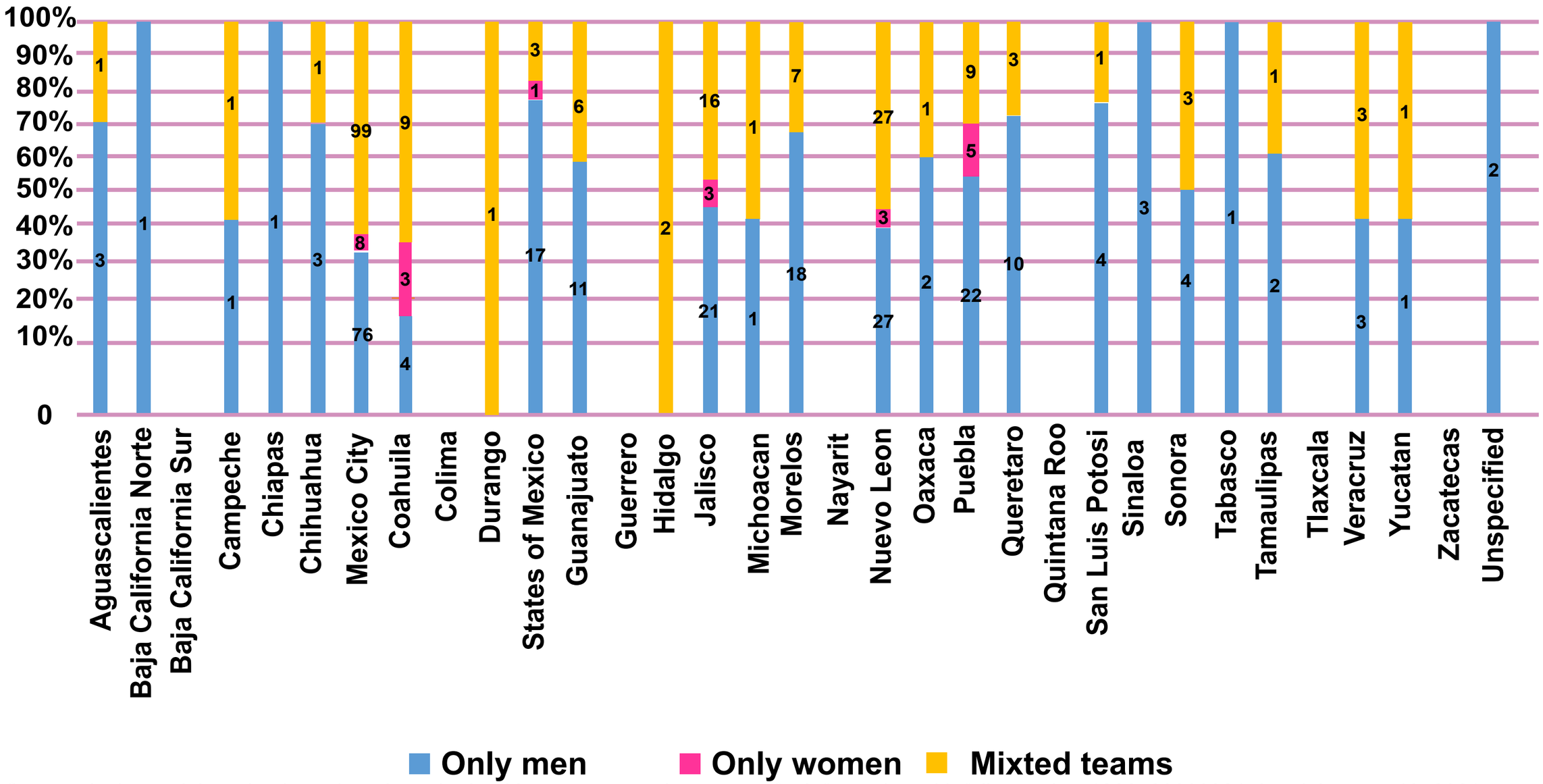
Graph 21. Comparison of 2017 granted patents by Only men, Only women and Mixed-team groups.



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.

Regarding 2018, we identified 238 patents for Only men, 23 for Only women, and 196 for mixed teams. In the following graph, we can see thatMexico City concentrates the highest number of patents with 183, representing more than half of the total. Notably, this year in Mexico City thenumber of "mixed team" patents is higher than the "Only men" type. This type of collaboration might be a change trend that comes with theparticipation of women.

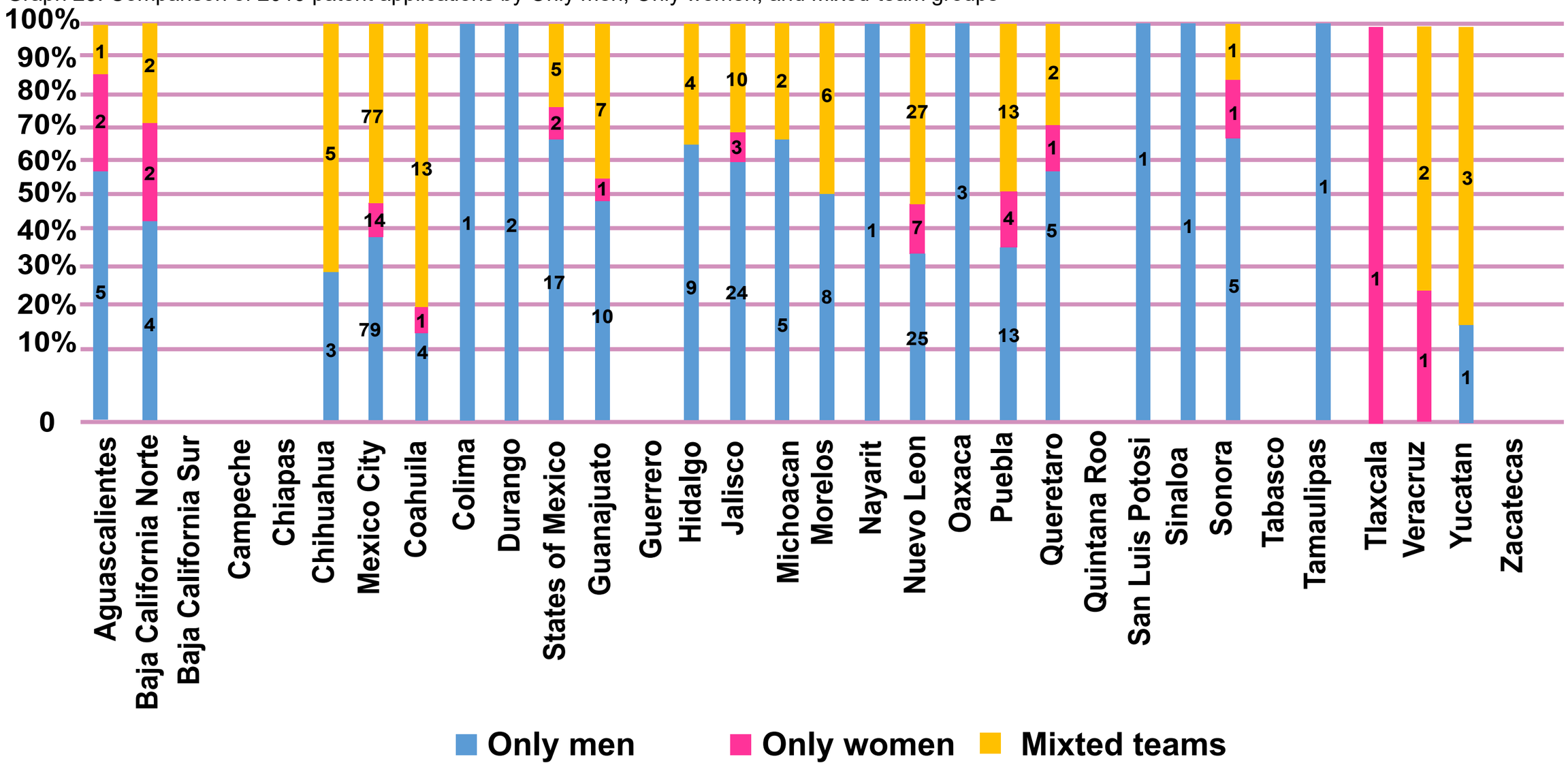
Graph 22. Comparison of 2018 patent applications by Only men, Only women, and Mixed-team groups.



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.

For 2019, we identified 227 "Only men" patents, 40 "Only women" patents, and 180 "mixed teams" patents. We would like to highlight that in 2019, 5 states the mixed teams were above the other 2 types (Chihuahua, Coahuila, Nuevo Leon, Veracruz, and Yucatan) This is an important finding since it shows an increase in the participation of women as inventors.

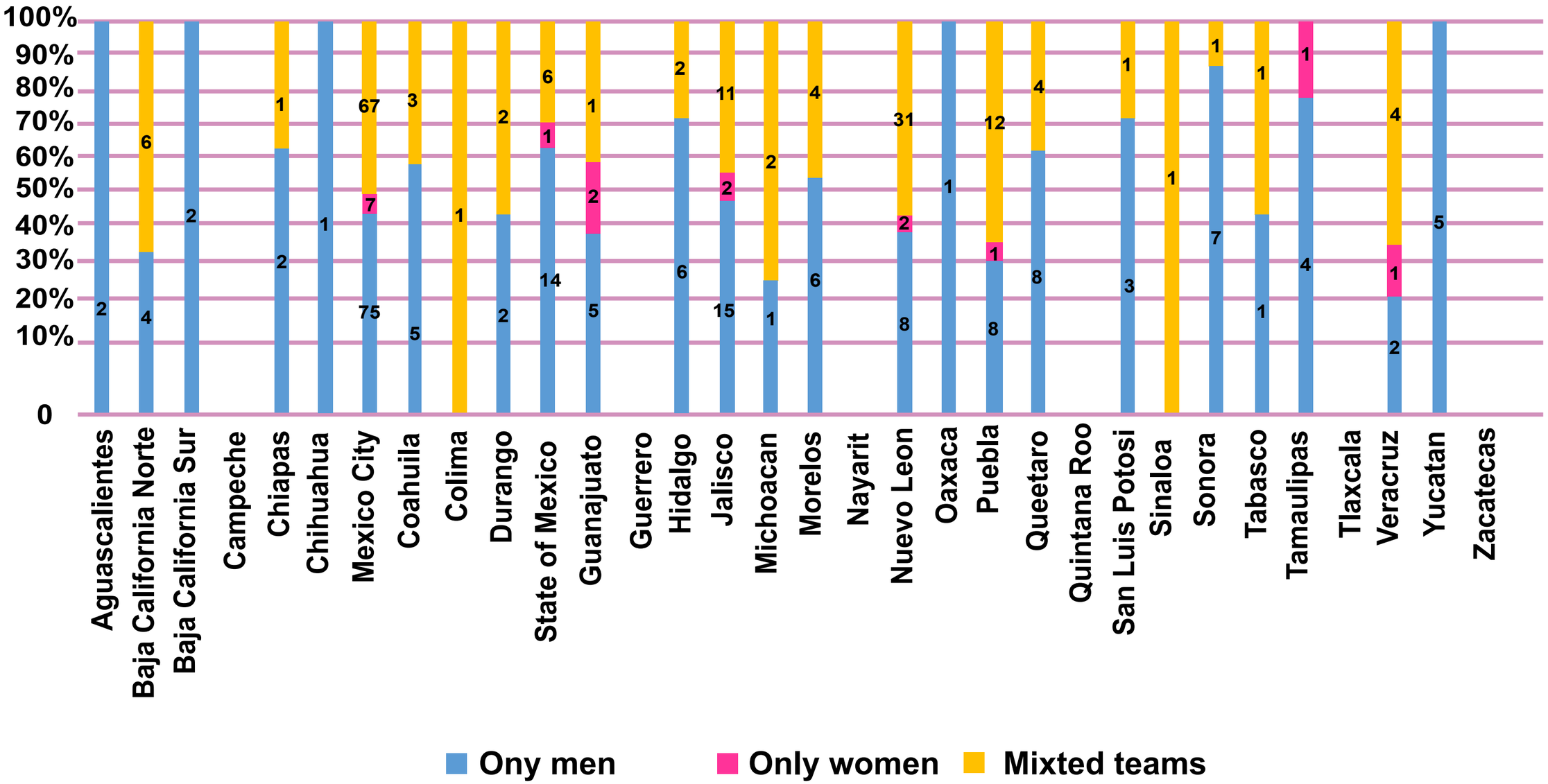
Graph 23. Comparison of 2019 patent applications by Only men, Only women, and Mixed-team groups



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.

The last comparison shows that almost all states granted patents for inventions where at least one woman was an inventor. Indeed, in some states such as Nuevo Leon and Baja California, more “mixed teams” patents were granted than "Only men" patents. The gap between Mexico City and the rest of the country persists, but almost the same number of patents were granted to "mixed teams" as to "Only men" inventions.

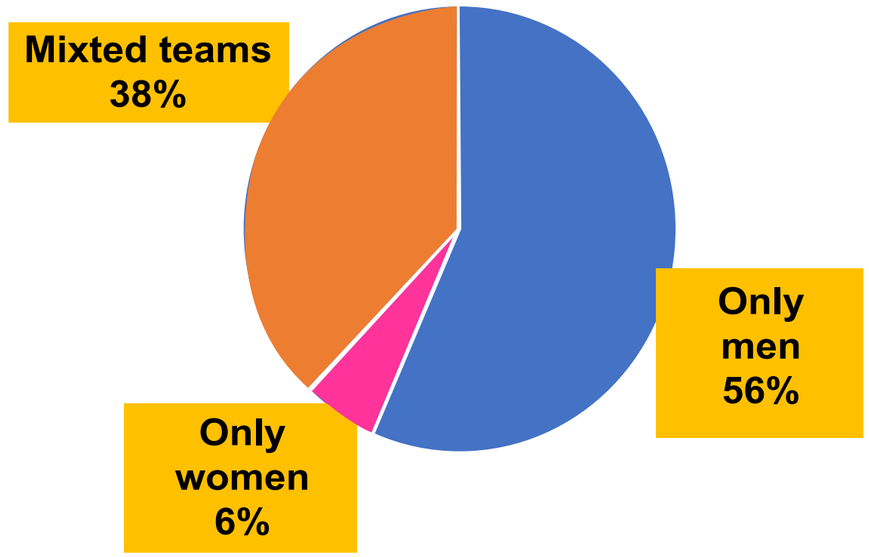
Graph 24. Comparison of 2020 patent applications by Only men, Only women, and Mixed-team groups.



Source: Author's elaboration based on data obtained in response to the request for information with folio number 1026500000821 dated January 19, 2021.

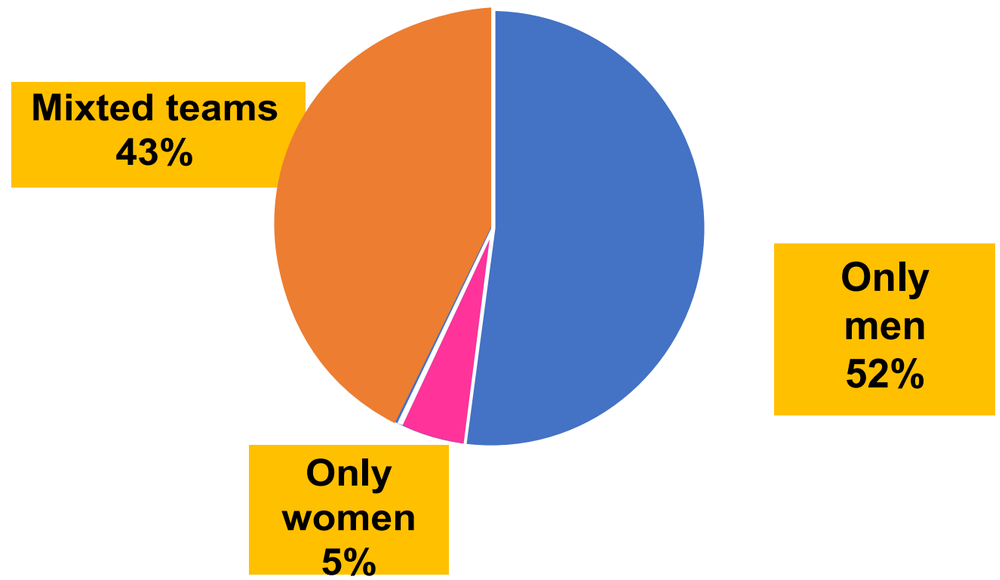
Now, in percentages, we could identify that as of 2018 the percentage of “Mixed teams” patents granted exceeded 40%, and since then there has not been a decrease. The percentages for "Only women" has remained below 10%, far lower than the "Only men" but women's participation has been increasing through collaboration, which is a good indicator.

Graph 25. Comparison of percentages of patents granted in 2017 by Only men, Only women and Mixed teams.



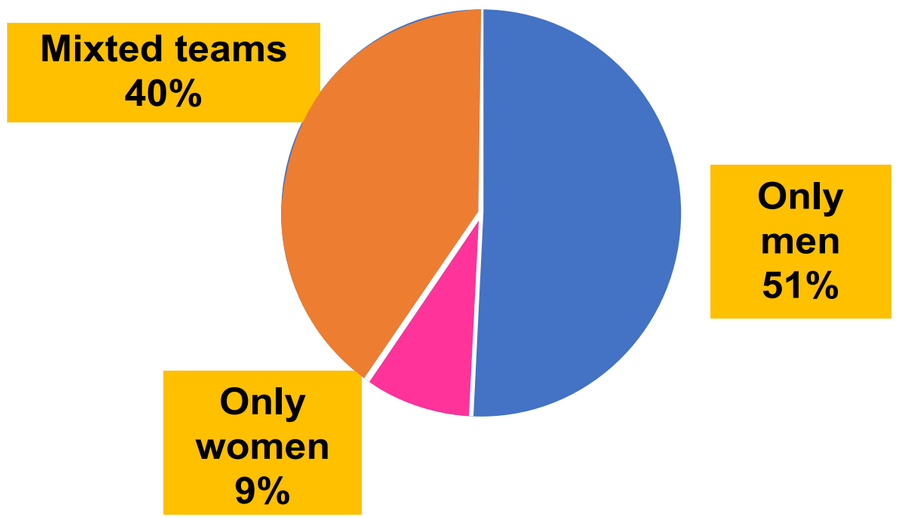
Source: Author's elaboration based on the data obtained from the request for information number 1026500000821 dated January 19, 2021.

Graph 26. Comparison of percentages of patents granted in 2018 by Only men, Only women and Mixed teams.



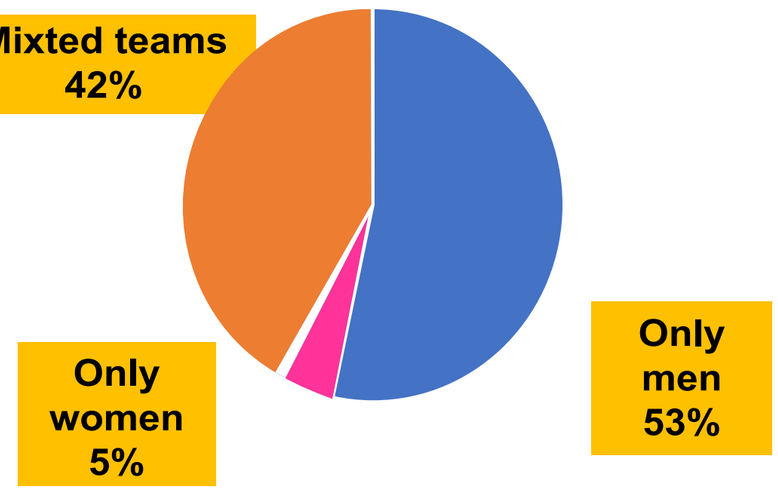
Source: Author's elaboration based on the data obtained from the request for information number 1026500000821 dated January 19, 2021.

Graph 27. Comparison of percentages of patents granted in 2019 by Only men, Only women and Mixed teams.



Source: Author's elaboration based on the data obtained from the request for information number 1026500000821 dated January 19, 2021.

Graph 27. Comparison of percentages of patents granted in 2019 by Only men, Only women and Mixed teams.



Source: Author's elaboration based on the data obtained from the request for information number 1026500000821 dated January 19, 2021.

6. Conclusions

We identified there is an intense collaboration between women and men to generate research and development activities that result in patents. Research shows that this phenomenon must be at least 3-5 years old, since it is the average time, a patent is granted in Mexico. A similar situation was found for applications, at least for those that could be considered in this study. It is not possible to identify the reasons why this is happening, but it is a demonstration of the benefits to the country of working together between women and men.

Another finding is the gap between states. Mexico City is far ahead in most of the scenarios considered for this research. In some cases, even adding up almost the total of the rest of the states, the figure is still lower than the number of inventors and patents that Mexico City has. A second group of states are those that are below that city, but above the average, such is the case of states such as Nuevo Leon or Jalisco.

Another notable gap is between patents in which only women are inventors, compared to those in which only men are the inventors. In all the scenarios shown, the number and percentage of inventions with one or more women inventors is well below that of men. The investigation did not aim to identify the cause of this situation.

Considering the performance of the states for the years of study, we found that the rate of growth in the number of patents applied for does not show a significant increase. As a result, the patent gap between Mexico and other countries continues to grow year after year.

One of the efforts to improve the conditions of women inventors is seen in legislation, where only a few states have enacted legislation. In local science and technology legislations that promote women's participation, there was no consistent trend regarding the criteria, forms and styles of legislation. Possibly because the Science and Technology Law does not provide for a guideline, as does the defunct Industrial Property Law or the new Federal Law for the Protection of Industrial Property. Unfortunately, the bill that sought to promote the design of ad hoc policies to encourage more female inventors was not passed and was ignored in the industrial property law.

The presence of women in the State Commissions on Science and Technology has not meant there are more or better initiatives or legal reforms in favor of women in science. We found that women legislators are represented on the above-mentioned commissions, but their presence did not mean that they have promoted actions from their own sphere to increase the number of women inventors in their states. The Federal Congress and the Senate of the Republic are no exception.

7. Recommendations to Governments

1. Do not reduce or condition support for male inventors in order to transfer this support to women, since there has been a natural partnership between women and men. In Mexico, where support for science and technology is so limited, it is not feasible to take some away to give others; on the contrary, it is ideal to expand and optimize support.

2. Identify through a serious study, what are the ways that would help more women inventors, as well as identify the barriers they face. Ideally, it is suggested to start from a broad perspective, considering issues that encompass both genders, and then move on to the specific issues of women inventors. Some challenges or barriers may be similar for both.

3. Promote and encourage the participation of women outside Mexico City. It is ideal to identify ways to narrow the gap between states, because that is an additional problem that federal and local governments have not solved.

4. While the focus of the study is on patents for inventions, it should be encouraged to take advantage of other features of the law to protect inventions as well. Patents are not the only way to innovate, nor should they be promoted as the only way to represent the presence or absence of innovation.

5. Design public policies ad hoc and with the support of stakeholders, leaving aside ideological issues that may bias or condition women's freedom to conduct research and development.

6. To take legislative action that influences laws and regulations. Many events are organized to discuss the importance of women in science, but when reviewing reform initiatives or laws, one can identify the lack of concrete proposals that have moved from the event to the paper.

7. Collaborate with organized civil society, business chambers and trade associations in the field of intellectual property. The impact that all government actors involved in patenting (IMPI, Congress, state governments, etc.) can be even greater if they collaborate with other actors, many of whom are willing to donate part of their time and expertise to improve the conditions for innovation in Mexico.

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