



## Research paper

# Prevalence, incidence and years of life adjusted for disability due to depressive disorders in Mexico: Results of the Global Burden of Disease Study 2019



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## ABSTRACT

**Background:** Depressive disorders (DD) represent one of the most common contributors to non-fatal health loss in the world, especially in low- and middle-income countries. The objective of this study was to analyze the burden of DD in Mexico between 1990 and 2019 by sex, states, age groups and socio-demographic index (SDI).

**Methods:** Secondary analysis based on the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019. Data on prevalence, incidence, and years lived with disability (YLD) due to DD were obtained. A *joinpoint regression analysis* was performed to describe the changes in the trend of YLD rates due to DD.

**Results:** Nationwide prevalence of DD increased 121.5%, from 2.1 million persons (UI 1,8-2,3) in 1990, to 4.6 million persons (UI 4,1-5,0) in 2019. The standardized rate of YLD due to DD differs widely by age group and sex, with notably higher values in young people and women. Between 1990 and 2019, Campeche, Quintana Roo, Tabasco, and Yucatán have the highest rates, while the Estado de México, Sinaloa, and Ciudad de México have the lowest.

**Conclusions:** As part of the fundamental and universal access to health, attention to mental health, including DD, must be handled more effectively by the Mexican health system. Its care should be addressed on a regular basis at all levels of care.

## 1. Introduction

Depressive disorders (DD) are the most frequent mental diseases globally, disproportionately impacting developing economies (Liu et al., 2020; GBD 2019 Diseases and Injuries Collaborators, 2020; Jakovljevic and Milovanovic, 2015). They are associated to a variety of adverse outcomes, including disability and early mortality, and they interact synergistically and bidirectionally with other chronic disorders, such as cardiovascular disease, diabetes, and hypertension, exacerbating their negative effects (Liu et al., 2020; Luppino et al., 2010; Nanayakkara et al., 2018). Similarly, DD are linked to other disorders including as

anxiety, addiction, and suicide, and they have an impact on the individual, family, and community environment (Pavkovic et al., 2018; Brådvik, 2018; Kalin, 2020).

According to the World Health Organization (WHO), the global prevalence of DD in 2015 was 4.4%, with women having a greater prevalence (5.1%) than males (3.6%), resulting in 300 million individuals suffering from these disorders (World Health Organization, 2020a; World Health Organization 2020a). In 2019, DD accounted for approximately 47 million years lived with disability (YLD), or 6.1% of all YLDs, and were the second leading cause of non-fatal health loss (Institute for Health Metrics and Evaluation, 2021). In addition to sex,

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**Table 1**  
Age-standardized prevalence and incidence rates of depressive disorders, and percentage of change, by sex and states. México, 1990 and 2019 (Heatmap).

States	Prevalence						Incidence					
	Male		%	Female		%	Male		%	Female		%
	1990	2019		1990	2019		1990	2019		1990	2019	
AG	2338.4	2582.7	10.4	3743.4	4577.1	22.3	2437.0	2801.0	14.9	4386.6	5653.8	28.9
BC	2382.5	2458.5	3.2	3666.6	4407.5	20.2	2496.2	2616.4	4.8	4266.5	5402.0	26.6
BS	2528.5	2648.8	4.8	3724.0	4572.3	22.8	2714.5	2898.0	6.8	4358.4	5648.4	29.6
CH	2423.4	2576.0	6.3	3767.9	4627.9	22.8	2559.2	2792.7	9.1	4423.5	5733.8	29.6
CL	2456.6	2582.6	5.1	3705.6	4484.9	21.0	2610.1	2799.4	7.3	4328.0	5519.5	27.5
CM	2545.3	2756.5	8.3	4024.5	5096.3	26.6	2741.9	3057.6	11.5	4809.8	6437.0	33.8
CO	2406.1	2572.4	6.9	3714.9	4539.7	22.2	2536.6	2783.8	9.7	4344.8	5597.5	28.8
CS	2295.8	2479.6	8.0	3683.5	4473.9	21.5	2369.9	2647.1	11.7	4291.6	5500.7	28.2
CX	2357.9	2418.5	2.6	3873.1	4192.7	8.3	2461.7	2555.9	3.8	4577.8	5081.1	11.0
DG	2274.7	2457.0	8.0	3722.2	4541.6	22.0	2339.1	2614.0	11.8	4353.0	5604.6	28.8
EM	2194.7	2354.5	7.3	3659.0	4458.7	21.9	2220.3	2463.0	10.9	4259.0	5480.4	28.7
GR	2199.3	2334.9	6.2	3644.0	4449.1	22.1	2229.7	2432.0	9.1	4236.3	5465.1	29.0
GT	2284.8	2576.5	12.8	3689.4	4595.2	24.6	2352.3	2788.7	18.6	4303.1	5682.6	32.1
HG	2253.5	2384.9	5.8	3678.7	4456.5	21.1	2309.1	2507.9	8.6	4289.2	5477.7	27.7
JC	2351.8	2607.6	10.9	3739.5	4674.5	25.0	2454.5	2834.2	15.5	4378.9	5802.2	32.5
MI	2351.3	2487.8	5.8	3736.0	4555.1	21.9	2452.4	2659.8	8.5	4370.9	5627.2	28.7
MO	2268.3	2410.2	6.3	3705.0	4524.0	22.1	2327.0	2544.6	9.4	4327.2	5578.6	28.9
NA	2277.6	2414.4	6.0	3700.6	4533.0	22.5	2344.5	2550.0	8.8	4318.8	5592.2	29.5
NL	2340.8	2477.2	5.8	3671.0	4496.7	22.5	2438.0	2640.9	8.3	4278.0	5538.9	29.5
OA	2282.2	2396.3	5.0	3651.0	4356.0	19.3	2349.6	2524.6	7.5	4246.4	5325.6	25.4
PU	2232.1	2405.8	7.8	3687.0	4463.0	21.0	2276.5	2537.3	11.5	4300.4	5488.6	27.6
QR	2525.5	2756.7	9.2	3914.6	5049.8	29.0	2715.2	3058.1	12.6	4642.6	6369.7	37.2
QT	2358.2	2488.1	5.5	3739.9	4638.5	24.0	2463.5	2659.8	8.0	4377.8	5751.8	31.4
SI	2240.4	2367.0	5.6	3657.8	4390.2	20.0	2287.6	2481.9	8.5	4257.4	5375.9	26.3
SL	2377.8	2581.3	8.6	3694.8	4514.2	22.2	2492.6	2799.5	12.3	4313.0	5562.7	29.0
SO	2477.5	2637.6	6.5	3700.1	4521.8	22.2	2639.9	2880.5	9.1	4321.0	5576.5	29.1
TB	2714.0	2745.2	1.1	3962.4	4932.6	24.5	2986.2	3040.8	1.8	4712.2	6189.6	31.4
TL	2239.9	2340.2	4.5	3711.0	4469.3	20.4	2291.9	2440.3	6.5	4335.4	5496.0	26.8
TM	2444.2	2523.3	3.2	3693.6	4493.6	21.7	2592.2	2711.4	4.6	4313.3	5536.8	28.4
VE	2396.5	2567.2	7.1	3702.7	4597.3	24.2	2518.4	2781.8	10.5	4323.0	5685.2	31.5
YU	2507.6	2771.0	10.5	3833.3	4811.6	25.5	2685.1	3077.8	14.6	4519.8	6011.3	33.0
ZA	2269.8	2457.9	8.3	3648.4	4430.5	21.4	2332.1	2615.8	12.2	4243.5	5438.2	28.2

Note: AC, Aguascalientes; BC, Baja California; BS, Baja California Sur; CM, Campeche; CS, Chiapas; CH, Chihuahua; CO, Coahuila; CL, Colima; CX, Ciudad de México; DG, Durango; EM, Estado de México; GT, Guanajuato; GR, Guerrero; HG, Hidalgo; JC, Jalisco; MI, Michoacán; MO, Morelos; NA, Nayarit; NL, Nuevo León; OA, Oaxaca; PU, Puebla; QT, Querétaro; QR, Quintana Roo; SL, San Luis Potosí; SI, Sinaloa; SO, Sonora; TB, Tabasco; TM, Tamaulipas; TL, Tlaxcala; VE, Veracruz; YU, Yucatán; ZA, Zacatecas. %, Change in prevalence or incidence rate between 1990 and 2019.

the prevalence varies by age group and socioeconomic level; nonetheless, everyone, regardless of their characteristics, is at risk of developing DD at some point in their lives (Pan American Health Organization, 2018). It should be noted that low- and middle-income nations accounted for more than 80% of the non-fatal illness burden caused by DD (Liu et al., 2020; Pan American Health Organization, 2018; World Health Organization, 2020a).

In Mexico, according to the 2018–19 National Health and Nutrition Survey (Ensanut, by its acronym in Spanish), the prevalence of depressive symptoms was 8.8% in men and 17.6% in women, with two women for every male (Cerecero-García et al., 2020; Shamah-Levy et al., 2020). Adults aged 36 to 49 years old were the most affected, with an 18.3% prevalence. Poverty, marital status, having a child during adolescence, unemployment, past episodes of depression, violence, trauma, situations of extreme stress, instability, homelessness, and disability were the primary risk factors for depression (Cerecero-García et al., 2020; Pan American Health Organization, 2018; World Health Organization, 2020a).

Despite the fact that DD are a persistent public health concern, they

remain mostly unnoticed and stigmatized (González and Álvarez, 2016). While Mexico has statistics on DD, there is currently no disaggregated information at the state level that incorporates variables, such as those supplied by the GBD. (GBD 2019 Diseases and Injuries Collaborators, 2020a; Liu et al., 2020). Similarly, other studies in the country have concentrated on assessing DD in certain population groups (women, older adults, young people, etc.) utilizing distinct data sources and measuring methods, making it difficult to compare findings directly or track trends over time (Alvarez-Cisneros et al., 2020; Belló et al., 2005; Cerecero-García et al., 2020; González-Forteza et al., 2015).

The objective of this study is to analyze the burden of DD in Mexico between 1990 and 2019 by sex, age groups and socio-demographic index (SDI) at a national and subnational scale. This approach attempts to provide a comprehensive overview of DD in Mexico that policymakers could use to develop and implement country-appropriate public policies.

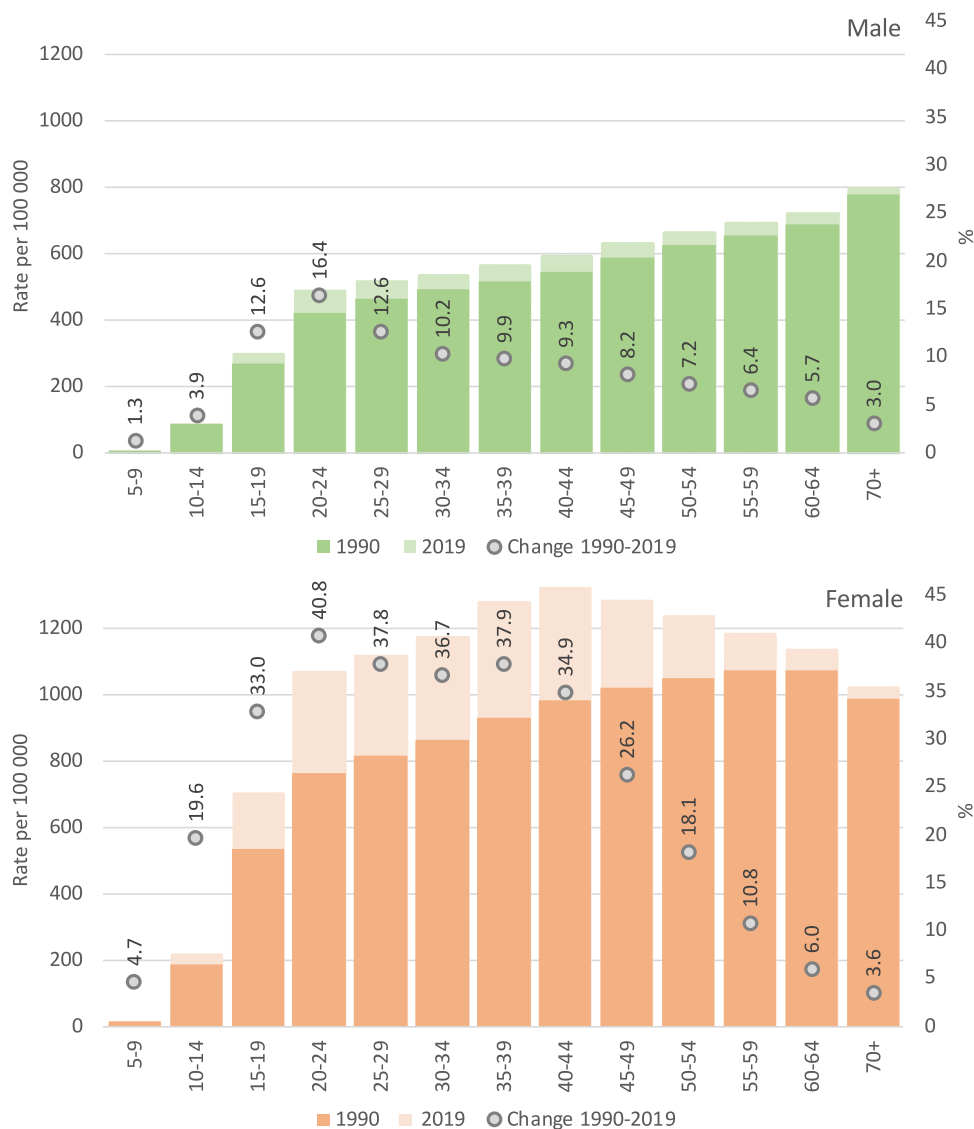


Fig. 1. Age-standardized rates of years lived with disability of depressive disorders, and percentage of change, by sex and group of age. México, 1990 and 2019. % Change in YLD rate between 1990 and 2019.

2. Method

2.1. Overview

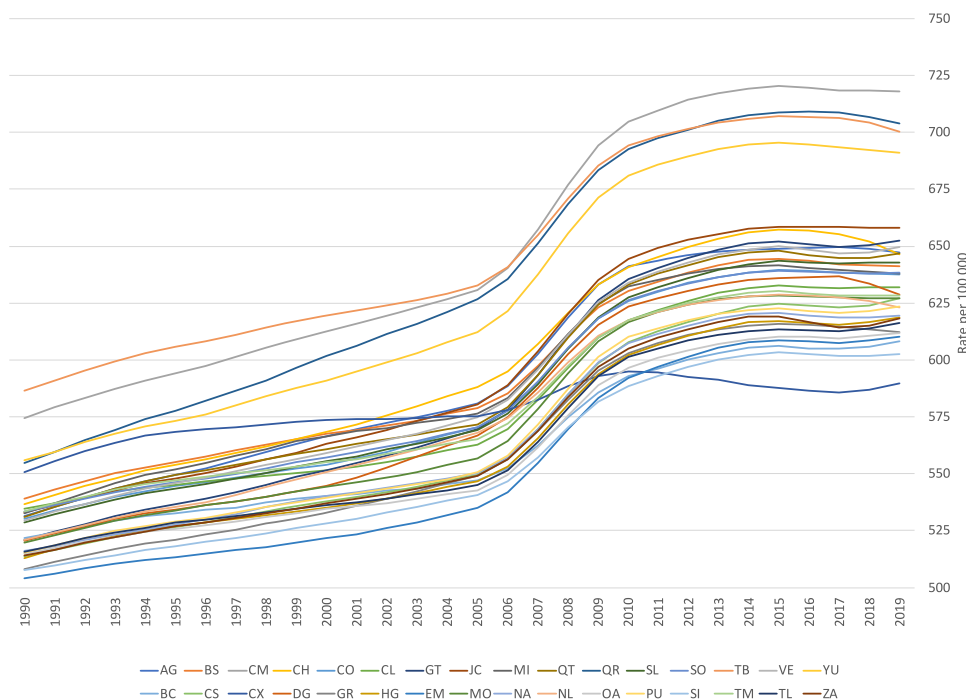
Secondary analysis based on the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019, which is a project of the Institute for Health Metrics and Evaluation at the University of Washington. The GBD provides a rules-based synthesis of the available evidence on levels and trends in health outcomes, a diverse set of risk factors, and health system responses. The study estimates the incidence, prevalence, mortality, years of life lost (YLL), years lived with disability (YLD), and disability-adjusted life-years (DALY) due to 369 diseases and injuries, for both sexes (GBD 2019 Diseases and Injuries Collaborators, 2020; GBD 2019 Viewpoint Collaborators, 2020b).

The GBD-2019 covered 204 countries and territories, as well as first administrative level disaggregation's for 22 countries, from 1990 to 2019, including Mexico. The information from the GBD comes mainly from censuses, surveys, hospital records and administrative records. The GBD uses a standardized, replicable approach in adherence to the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) (GBD 2019 Diseases and Injuries Collaborators, 2020; GBD 2019 Viewpoint Collaborators, 2020).

2.2. Depressive disorders definition and classification

The International Classification of Diseases Tenth Revision (ICD-10) codes used by the GBD 2019 for modeling DD are F32-F33 (Major Depressive Disorders [MDD]) and F34.1 (dysthymia) (GBD 2019 Viewpoint Collaborators, 2020). A depressive episode might be mild, moderate, or severe, with the patient experiencing a drop-in mood, energy, and activity. Capacity for enjoyment, interest, and concentration is diminished, and noticeable tiredness occurs after even minimal exertion. Typically, sleep is disturbed, and appetite is lessened. Self-esteem and confidence are diminished, and even in moderate cases, feelings of shame or worthlessness are frequently present. The depressed mood is persistent, indifferent to circumstances, and may be accompanied by so-called "somatic" symptoms such as loss of interest and pleasure sensations, awakening several hours earlier than normal in the morning, depression that is worse in the morning, substantial psychomotor retardation, agitation, loss of appetite, weight loss, and loss of libido. A depressive episode can be classified as mild, moderate, or severe depending on the quantity and intensity of symptoms (American Psychiatric Association, 2013).

Meanwhile a recurrent DD is characterized by repeated episodes of depression as described for depressive episode, without any history of



**Fig. 2.** Age-standardized rates of years lived with disability of depressive disorders by state. México, 1990–2019. AC, Aguascalientes; BC, Baja California; BS, Baja California Sur; CM, Campeche; CS, Chiapas; CH, Chihuahua; CO, Coahuila; CL, Colima; CX, Ciudad de México; DG, Durango; EM, Estado de México; GT, Guanajuato; GR, Guerrero; HG, Hidalgo; JC, Jalisco; MI, Michoacán; MO, Morelos; NA, Nayarit; NL, Nuevo León; OA, Oaxaca; PU, Puebla; QT, Querétaro; QR, Quintana Roo; SL, San Luis Potosí; SI, Sinaloa; SO, Sonora; TB, Tabasco; TM, Tamaulipas; TL, Tlaxcala; VE, Veracruz; YU, Yucatán; ZA, Zacatecas.

independent episodes of mood elevation and increased energy (mania). There may, however, be brief episodes of mild mood elevation and overactivity immediately after a depressive episode, sometimes precipitated by antidepressant treatment. Lastly, dysthymia is defined as a chronic depression of mood, lasting at least several years, which is not sufficiently severe, or in which individual episodes are not sufficiently prolonged, to justify a diagnosis of severe, moderate, or mild recurrent DD (American Psychiatric Association, 2013).

2.3. Measures and analysis

We obtained data on prevalence, incidence, and YLD due to DD. The information was disaggregated by sex, states (32 in total), age groups and SDI. We used the SDI as a subnational composite metric of overall development which is strongly correlated with health outcomes. The SDI specific methodology has been described in more detail elsewhere (GBD 2019 Diseases and Injuries Collaborators, 2020). In brief, the index incorporates three different aspects of development and is the weighted geometric mean of the indices of total fertility rate under the age of 25, mean education for those aged 15 and older, and income per capita. The index is evaluated on a scale of 0 (or lowest development achieved with the lowest income, fewest years of schooling, and highest fertility) to 1 (or highest development attained with the highest income, most years of schooling, and lowest fertility) (GBD 2019 Diseases and Injuries Collaborators, 2020; World Health Organization, 2020b).

The YLD are the result of estimating the prevalence of a sequela multiplied by the disability weight for that sequela without age weighting or discounting. The YLD arising from DD are the sum of the YLD for each of the sequelae associated with that disease. For most sequelae, the GBD 2019 study used a Bayesian meta-regression method, DisMod-MR 2.1, designed to address key limitations in descriptive epidemiological data, including missing data, inconsistency, and large methodological variation between data sources (GBD 2019 Diseases and Injuries Collaborators, 2020; World Health Organization 2020b).

Information is displayed in terms of YLD numbers or age-standardized rate. In some cases, the percentages of change in the indicators between 1990 and 2019 are presented, and uncertainty intervals (UI) were generated for every metric using the 25th and 975th ordered 1000 draw values of the posterior distribution (World Health

Organization, 2020b).

Additionally, we conducted a segmented regression analysis (*joinpoint regression*) using a log-linear model. This approach quantifies the changes in the trend of YLD in successive segments over time, as well as the magnitude of each change. The annual percent change (APC) between each cut-off point is calculated using the slope of the line in that segment and the average annual percent change (Gillis and Edwards, 2019). These models begin with a minimum of zero nodes (a straight line) to a maximum of six nodes (which generates a maximum number of four periods in which the trend is divided) and determine if the slope of the trend in each segment is statistically different from the slope of the trend in the preceding segment (Gillis and Edwards, 2019; National Cancer Institute, 2021). A statistical significance level of 5% was used. The analysis was performed using the *Joinpoint Regression 4.6.0.0 program* (National Cancer Institute, 2021).

2.4. Ethical considerations

Patients and public were not involved in the recruitment and conduct of this study. Therefore, the approval of an ethics committee was not requested. The data used in this study are publicly available at: <https://vizhub.healthdata.org/gbd-compare/>

3. Results

3.1. National prevalence, incidence of DD and state variations

At the national level, the prevalence of DD increased by 121.5% from 2.1 million persons (UI 1,8–2,3) in 1990 to 4.6 million individuals (UI 4,1–5,0) in 2019. The adjusted incidence, on the other hand, increased from 2.3 million persons (UI 2,0–2,6) in 1990 to 5.4 million persons (UI 4,7–6,0) in 2019, a 129.6% increase. Men’s age-adjusted prevalence grew by 6.8%, while female prevalence grew by 21.2%. Men’s adjusted incidence rates increased by 9.8%, while women’s rates increased by 27.7%.

States with the greatest rates of DD prevalence and incidence for both sexes included Ciudad de México, Quintana Roo, Tabasco, and Yucatán. However, the biggest rises in male prevalence and female incidence rates occurred in Guanajuato and Quintana Roo, respectively.



**Fig. 3.** Age- standardized rates of years lived with disability of depressive disorders by sex and state. México, 1990 and 2019. % Change in YLD rate between 1990 and 2019. AC, Aguascalientes; BC, Baja California; BS, Baja California Sur; CM, Campeche; CS, Chiapas; CH, Chihuahua; CO, Coahuila; CL, Colima; CX, Ciudad de México; DG, Durango; EM, Estado de México; GT, Guanajuato; GR, Guerrero; HG, Hidalgo; JC, Jalisco; MI, Michoacán; MO, Morelos; NA, Nayarit; NL, Nuevo León; OA, Oaxaca; PU, Puebla; QT, Querétaro; QR, Quintana Roo; SL, San Luis Potosí; SI, Sinaloa; SO, Sonora; TB, Tabasco; TM, Tamaulipas; TL, Tlaxcala; VE, Veracruz; YU, Yucatán; ZA, Zacatecas.

Prevalence and incidence rates were greater in women than in males in all states between 1990 and 2019. Additionally, females had the greatest increase in these rates as compared to males (Table 1).

3.2. Differences in YLD by sex and age groups, 1990–2019

DD was the fourth leading non-fatal cause of death in the Mexico in 2019. MDD accounted for 86.2% of all YLD caused by DD in the same year. Between 1990 and 2019, the adjusted rate of YLD due to DD rose by 19.7%, from 526.6 per 100,000 people (UI 370.2–717.1) in 1990 to 630.6 per 100,000 people (UI 441.2–856.4) in 2019. For MDD, the adjusted rate of YLD was 439.8 in 1990 and 543.5 in 2019, but for dysthymia it was similar in both years (86.9 and 87.0, respectively). At the state level, DD were the second leading cause of YLD in Yucatán and Quintana Roo in 2019, whereas they were third or fourth in the other states. DD, on the other hand, were the primary cause of YLD in women from Campeche, Yucatán, Quinta Roo, and Nuevo León (data not shown).

The standardized rate of YLD due to DD differs widely by age group and sex, with notably higher values in women. Indeed, women had a greater prevalence across all age categories, which was most prominent between the ages of 10 and 49. Additionally, it is notable that the rate of YLD in women between the ages of 15 and 44 was greater than 33%,

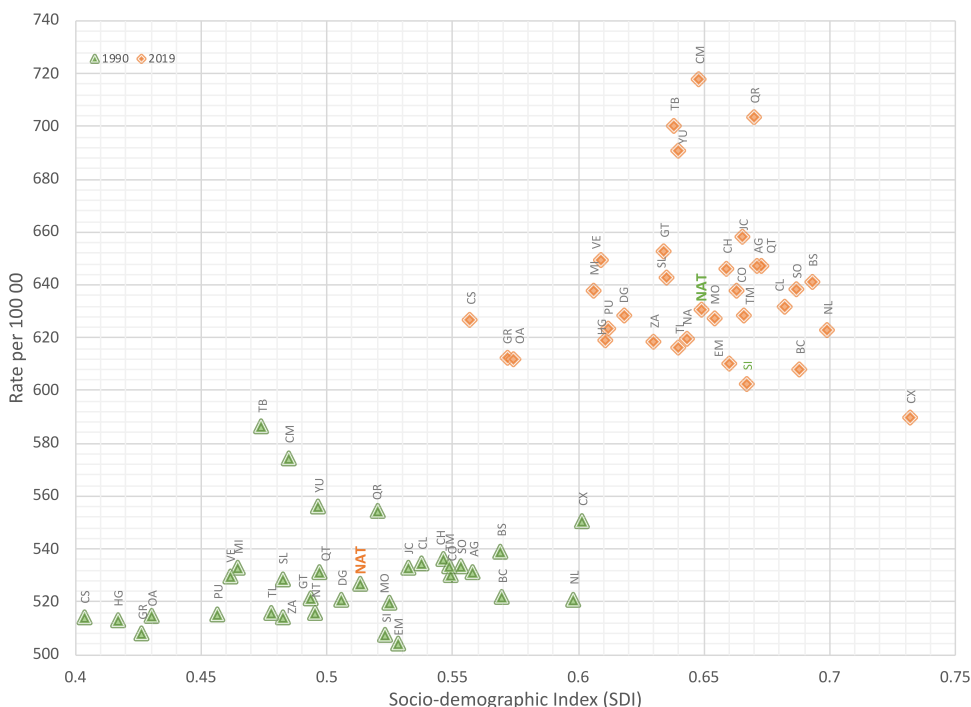
with the prevalence being highest in the 20 to 44 age range. In males, the rate increases with age, reaching a peak in seniors 70 years and older (Fig. 1).

Fig. 2 depicts the trend in the standardized rate of YLD due to DD per state between 1990 and 2019. Campeche, Quinta Roo, Tabasco, and Yucatán have the highest rates, while the State of Mexico, Sinaloa, and Ciudad de México have the lowest. In 2019, half of the states (Aguascalientes, Baja California Sur, Ciudad de México, Chihuahua, Coahuila, Colima, Guanajuato, Jalisco, Michoacán, Querétaro, Quintana Roo, San Luis Potosí, Sonora, Tabasco, Veracruz, and Yucatán) had rates higher than the national average.

In 2019, Campeche had the greatest rate of YLD among females and Ciudad de México had the lowest; Yucatán had the highest and Guerrero had the lowest standardized rates, respectively. While the rate grew by 1.3% in Tabasco and 16.3% in Guanajuato for males, it jumped by 10.3% in Ciudad de México and 34.1% in Quintana Roo for women (Fig. 3).

Between 1990 and 2019, the SDI improved significantly in all of the country’s states, while the standardized rate of YLD also increased. Chiapas, Guerrero, and Oaxaca (three of the country’s poorest states) trailed behind in the SDI, despite the fact that their YLD due to DD rates were comparable to those of states with less lag in this indicator. While Campeche, Quintana Roo, Tabasco, and Yucatán had the highest YLD





**Fig. 4.** Age-standardized rates of years lived with disability of depressive disorders by state and sociodemographic index. México, 1990 and 2019. AC, Aguascalientes; BC, Baja California; BS, Baja California Sur; CM, Campeche; CS, Chiapas; CH, Chihuahua; CO, Coahuila; CL, Colima; CX, Ciudad de México; DG, Durango; EM, Estado de México; GT, Guanajuato; GR, Guerrero; HG, Hidalgo; JC, Jalisco; MI, Michoacán; MO, Morelos; NA, Nayarit; NL, Nuevo León; OA, Oaxaca; PU, Puebla; Q, Querétaro; QR, Quintana Roo; SL, San Luis Potosí; SI, Sinaloa; SO, Sonora; TB, Tabasco; TM, Tamaulipas; TL, Tlaxcala; VE, Veracruz; YU, Yucatán; ZA, Zacatecas; NAT, National.

rates in 2019, their rates were more homogenous in 2019 than in 1990. On the other side, Ciudad de México is an outlier in comparison to the rest of the states, since it has the greatest SDI and the lowest rate of YLD due to DD, notably in 2019. In 1990 there was a non-significant correlation between the DD of YLD rates and the SDI ( $r = 0.20$ ;  $p = 0.25$ ), and in 2019 there was even a weaker correlation ( $r = 0.01$ ;  $p = 0.97$ ). These results show that there was no statistical association between YLD rate due to DD burden and SDI in the states of Mexico (Fig. 4).

### 3.3. Rates of YLD by sex and state, 1990-2019

Table 2 presents the results of the *joinpoint regression analysis* of the standardized rate of YLD attributable to DD. In men, all entities had a trend that was separated into four or five phases. Similarly, with the exception of Ciudad de México and Tabasco, all states saw a large increase in the YLD rate between 1990 and 2005; however, all states experienced a large decrease between 2005 and 2011, with the exception of Guanajuato and Yucatán. In general, a new substantial rise in rates was recorded in 2010. In the case of women, five states (Guanajuato, Jalisco, Nuevo León, Quintana Roo, Sonora, and Yucatán) had a trend separated into three groups, while the remainder had four or five. Between 1990 and 2005, there was a considerable growth in the rate in all states, albeit with an annual percentage change (APC) of less than 1%. However, there was a growth with a higher APC of 3% in nearly all states between 2005 and 2010. As of 2010, there was some stability in the YLD rates due to DD.

## 4. Discussion

### 4.1. Contributions of the study

This is the first study in Mexico that quantify the burden of DD at the subnational level and by various sociodemographic factors of the population. The main contribution is the granularity of the analysis over a period of 30 years. There is a scarcity of comprehensive and representative national research in Mexico that allow for the analysis of the evolution of this category of disorders. Given this, the GBD Study produces comparable and comprehensive estimates of the mortality,

prevalence, incidence, risk factor exposure, mortality and morbidity attributable to these risks by cause, age, sex, using a highly standardized analytical approach (GBD 2019 Diseases and Injuries Collaborators, 2020).

### 4.2. Main findings

Between 1990 and 2019, the country's and all states' standardized rate of YLD due to DD grew, in contrast to Brazil, where this rate declined by 9.01% between 1990 and 2017 (Bonadiman et al., 2020) and China, where it decreased by 12.5% over the same period (Ren et al., 2020). Within the country, there was considerable variation in DD behavior, highlighting that women had much greater rates than males in all states in both years (1990 and 2019). Additionally, for women, the disparities in rates were more pronounced across years, implying a more rapid increase. Despite the fact that men's rates have been more steady over time, between 1990 and 2019, the rate grew by more than 10% in eight states. These sex disparities have received much attention, with biological, environmental, and social variables accounting for the majority of the high incidence of DD disorders in women (Rafful et al., 2012; Salk et al., 2017); nonetheless, it is critical to include males as an interest group with distinct features that must be addressed (Salk et al., 2017). It is probable that men's DD cases are underreported, as they are less ready to disclose their experiences and emotions and seek treatment (Addis, 2008; Seidler et al., 2016).

On the other hand, the findings by age group and sex underline the need of a life course strategy that addresses the needs of individuals at each stage of life and takes into account the underlying variables linked with these diseases (Funsalud, 2019). DD often manifest themselves throughout infancy and adolescence and can last into maturity and old age (Fundación Mexicana para la Salud, 2019).

Additionally, we discovered that some states with the greatest levels of marginalization in the country also had the greatest rates of YLD due to DD in 2019, including Tabasco, Yucatán, and Campeche (all in the south of the nation), which also had the greatest rates of suicide deaths (Dávila-Cervantes and Pardo-Montaño, 2020). While suicide rates have declined by about 30% internationally, they climbed by 97.6% in Mexico between 1990 and 2019 (Institute for Health Metrics and

**Table 2**

Joinpoint analysis of age-standardized years lived with disability of depressive disorders by sex and states. México, 1990–2019.

Male States	Period 1		Period 2		Period 3		Period 4		Period 5	
	Years	APC	Years	APC	Years	APC	Years	APC	Years	APC
AG	1990–1996	0.4*	1996–2004	0.7*	2004–2011	−0.0*	2011–2014	1.3*	2014–2019	0.1*
BC	1990–1994	0.4*	1994–2005	0.1*	2005–2010	−0.8*	2010–2014	1.0*	2014–2019	0.2*
BS	1990–2000	0.4*	2000–2005	0.2*	2005–2010	−0.6*	2010–2014	1.0*	2014–2019	0.00
CM	1990–2005	0.4*	2005–2011	−0.2*	2011–2014	1.3*	2014–2019	0.10	–	–
CS	1990–1995	0.3*	1995–2004	0.4*	2004–2011	−0.2*	2011–2014	1.4*	2014–2019	0.3*
CH	1990–1999	0.5*	1999–2005	0.8*	2005–2010	−0.8*	2010–2015	1.2*	2015–2019	−0.6*
CX	1990–1994	0.8*	1994–2006	−0.1*	2006–2010	0.2*	2010–2017	−0.2*	2017–2019	0.7*
CO	1990–2000	0.3*	2000–2005	0.6*	2005–2010	−0.4*	2010–2015	0.8*	2015–2019	−0.1
CL	1990–2000	0.1*	2000–2005	0.3*	2005–2010	−0.2*	2010–2015	1.0*	2015–2019	0.00
DG	1990–2000	0.3*	2000–2005	1.1*	2005–2010	−0.4*	2010–2015	1.1*	2015–2019	−0.3*
GT	1990–1996	0.4*	1996–2004	0.7*	2004–2011	0.2*	2011–2014	1.6*	2014–2019	0.2*
GR	1990–1998	0.2*	1998–2005	0.7*	2005–2010	−0.5*	2010–2015	0.9*	2015–2019	−0.2*
HG	1990–2001	0.2*	2001–2005	0.4*	2005–2010	−0.5*	2010–2014	1.1*	2014–2019	0.3*
JC	1990–1996	0.4*	1996–2005	0.6*	2005–2010	−0.1	2010–2014	1.1*	2014–2019	0.2*
EM	1990–1999	0.1*	1999–2005	0.5*	2005–2010	−0.2*	2010–2014	1.2*	2014–2019	0.3*
MI	1990–2001	0.5*	2001–2005	0.2*	2005–2010	−0.7*	2010–2015	0.9*	2015–2019	−0.1*
MO	1990–2006	0.2*	2006–2010	−0.3*	2010–2014	1.1*	2014–2019	0.2*	–	–
NA	1990–1994	0.1	1994–2005	0.4*	2005–2010	−0.4*	2010–2014	1.1*	2014–2019	0.1*
NL	1990–1997	0.4*	1997–2005	0.7*	2005–2010	−0.8*	2010–2015	1.0*	2015–2019	−0.3*
OA	1990–2000	0.3*	2000–2005	0.2*	2005–2010	−0.5*	2010–2015	0.9*	2015–2019	0.1*
PU	1990–2004	0.4*	2004–2011	−0.2*	2011–2014	1.4*	2014–2017	0.00	2017–2019	0.8*
QT	1990–1994	0.5*	1994–2005	0.2*	2005–2010	−0.6*	2010–2015	1.1*	2015–2019	0.00
QR	1990–1997	0.5*	1997–2005	0.6*	2005–2010	−0.4*	2010–2015	1.0*	2015–2019	−0.2*
SL	1990–2005	0.4*	2005–2010	−0.3*	2010–2015	1.1*	2015–2019	0.1	–	–
SI	1990–2000	0.3*	2000–2005	0.7*	2005–2010	−0.7*	2010–2015	1.1*	2015–2019	−0.4*
SO	1990–2005	0.3*	2005–2010	−0.3*	2010–2014	1.0*	2014–2019	0.1*	–	–
TB	1990–2000	0.3*	2000–2005	−0.2*	2005–2010	−0.8*	2010–2015	0.9*	2015–2019	−0.3*
TM	1990–2001	0.1*	2001–2005	0.3*	2005–2010	−0.7*	2010–2015	0.9*	2015–2019	−0.1
TL	1990–2005	0.2*	2005–2010	−0.6*	2010–2014	1.0*	2014–2017	0.2*	2017–2019	0.6*
VE	1990–2005	0.4*	2005–2010	−0.5*	2010–2014	1.1*	2014–2019	0.1*	–	–
YU	1990–1996	0.4*	1996–2004	0.7*	2004–2011	0.00	2011–2014	1.5*	2014–2019	0.00
ZA	1990–2005	0.4*	2005–2010	−0.3*	2010–2014	1.1*	2014–2017	−0.1	2017–2019	0.5*
NAL	1990–2000	0.3*	2000–2005	0.4*	2005–2010	−0.4*	2010–2014	1.0*	2014–2019	0.1*

Female States	Period 1		Period 2		Period 3		Period 4		Period 5	
	Years	APC	Years	APC	Years	APC	Years	APC	Years	APC
AG	1990–1995	0.8*	1995–2005	0.4*	2005–2010	3.3*	2010–2019	−0.1*	–	–
BC	1990–1994	0.6*	1994–2005	0.3*	2005–2010	3.1*	2010–2013	0.3*	2013–2019	0.00
BS	1990–1993	0.9*	1993–2005	0.4*	2005–2010	3.4*	2010–2013	0.3	2013–2019	−0.1*
CM	1990–2000	0.7*	2000–2005	0.5*	2005–2010	3.8*	2010–2019	0.00	–	–
CS	1990–1994	0.7*	1994–2005	0.3*	2005–2010	3.3*	2010–2013	0.3*	2013–2019	−0.1*
CH	1990–1993	0.9*	1993–2005	0.5*	2005–2010	3.3*	2010–2015	0.2*	2015–2019	−0.4*
CX	1990–1994	0.8*	1994–2005	0.2*	2005–2010	1.1*	2010–2016	−0.2*	2016–2019	0.1
CO	1990–1993	0.7*	1993–2005	0.4*	2005–2010	3.3*	2010–2013	0.3	2013–2019	−0.1
CL	1990–1993	0.7*	1993–2005	0.3*	2005–2010	3.2*	2010–2013	0.3	2013–2019	0.00
DG	1990–2005	0.5*	2005–2010	3.3*	2010–2017	0.1	2017–2019	−0.5	–	–
GT	1990–2005	0.5*	2005–2010	3.5*	2010–2019	0.1*	–	–	–	–
GR	1990–2005	0.5*	2005–2010	3.2*	2010–2013	0.3	2013–2019	−0.1*	–	–
HG	1990–1994	0.7*	1994–2005	0.3*	2005–2010	3.2*	2010–2013	0.4*	2013–2019	0.00
JC	1990–2005	0.6*	2005–2010	3.5*	2010–2019	0.1*	–	–	–	–
EM	1990–2003	0.4*	2003–2006	0.9*	2006–2009	4.1*	2009–2012	1.2*	2012–2019	0.00
MI	1990–1995	0.8*	1995–2005	0.4*	2005–2010	3.3*	2010–2019	−0.1*	–	–
MO	1990–1993	0.8*	1993–2005	0.4*	2005–2010	3.4*	2010–2019	0.00	–	–
NA	1990–1995	0.7*	1995–2005	0.4*	2005–2010	3.4*	2010–2013	0.4*	2013–2019	−0.1*
NL	1990–2005	0.6*	2005–2010	3.2*	2010–2019	0.00	–	–	–	–
OA	1990–1994	0.5*	1994–2005	0.2*	2005–2010	3.2*	2010–2019	0.1*	–	–
PU	1990–1993	0.8*	1993–2005	0.3*	2005–2010	3.3*	2010–2013	0.2	2013–2019	−0.1*
QT	1990–1995	0.8*	1995–2005	0.4*	2005–2010	3.5*	2010–2013	0.3	2013–2019	−0.1*
QR	1990–2005	0.8*	2005–2010	3.5*	2010–2019	0.00	–	–	–	–
SL	1990–1993	0.7*	1993–2005	0.4*	2005–2010	3.3*	2010–2013	0.3	2013–2019	−0.1*
SI	1990–2003	0.4*	2003–2006	0.7*	2006–2009	3.9*	2009–2012	1.0*	2012–2019	0.00
SO	1990–2005	0.4*	2005–2010	3.4*	2010–2019	0.00	–	–	–	–
TB	1990–1993	1.0*	1993–2005	0.5*	2005–2010	3.5*	2010–2019	−0.1*	–	–
TM	1990–1994	0.8*	1994–2005	0.4*	2005–2010	3.2*	2010–2013	0.2	2013–2019	−0.1*
TL	1990–1994	0.7*	1994–2005	0.3*	2005–2010	3.3*	2010–2019	0.0*	–	–
VE	1990–1993	0.8*	1993–2005	0.5*	2005–2010	3.4*	2010–2013	0.3	2013–2019	−0.1
YU	1990–2005	0.6*	2005–2010	3.7*	2010–2019	−0.1*	–	–	–	–
ZA	1990–1993	0.6*	1993–2005	0.3*	2005–2010	3.3*	2010–2013	0.40	2013–2019	−0.1
NAL	1990–1993	0.8*	1993–2005	0.4*	2005–2010	3.1*	2010–2013	0.3*	2013–2019	−0.1*

Note: AC, Aguascalientes; BC, Baja California; BS, Baja California Sur; CM, Campeche; CS, Chiapas; CH, Chihuahua; CO, Coahuila; CL, Colima; CX, Ciudad de México; DG, Durango; EM, Estado de México; GT, Guanajuato; GR, Guerrero; HG, Hidalgo; JC, Jalisco; MI, Michoacán; MO, Morelos; NA, Nayarit; NL, Nuevo León; OA, Oaxaca;

PU, Puebla; QT, Querétaro; QR, Quintana Roo, SL, San Luis Potosí; SI, Sinaloa; SO, Sonora; TB, Tabasco; TM, Tamaulipas; TL, Tlaxcala; VE, Veracruz; YU, Yucatán; ZA, Zacatecas; NAL, National. APC: annual percent change. \*  $p < 0.05$ .

**Evaluation, 2021**). This is a concerning signal, as suicide is frequently the most extreme manifestation of DD (Brådvik, 2018).

#### 4.3. Health system and challenges in terms of mental health

In Mexico, the epidemiological transition is unequal, with chronic degenerative, noncommunicable, and external illnesses coexisting, all of which contribute to the loss of healthy years of life (Dávila-Cervantes and Agudelo-Botero, 2019; Gómez-Dantés et al., 2016). Diabetes, chronic kidney disease, and homicides stand out as the primary reasons of life expectancy stagnation in this epidemiologic profile (Agudelo-Botero et al., 2020; Canudas-Romo et al., 2017, 2015). Depression and chronic illnesses have been shown to have a bidirectional association, which implies that their linking leads to mutually aggravating their symptoms and negative consequences, as well as lowering persons' quality of life (Bădescu et al., 2016; Domènech-Abella et al., 2021; Juárez-Rojop et al., 2018; Luppino et al., 2010; Palmer et al., 2013; Sevilla-González et al., 2017). However, depression is under-recognized, commonly misdiagnosed, and under-treated among people with chronic conditions (Funsalud, 2019; World Health Organization, 2020a).

On the other hand, mental health in general, and DD in particular, have not been identified as national public policy priorities (Berenzon et al., 2013; Funsalud, 2019; González and Álvarez, 2016). The country lacks a comprehensive mental health care statute. Until now, efforts in this area have been few, fragmented, and dispersed (Valdez-Santiago et al., 2021). While the 2019–2024 Health Sector Program targets mental health and addictions, the suggested methods focus primarily on the provision of comprehensive and high-quality services, with no explicit promotion or preventative approaches (Secretaría de Salud, 2020). This document makes no specific mention of depression, however it does discuss suicide and addiction (Secretaría de Salud, 2020). Only 14 of the 32 states have a mental health law, and those that do are disconnected, have disparate methodologies and fiscal resources, and lack leadership and governance (Valdez-Santiago et al., 2021).

All of this is compounded by a scarcity of infrastructure and human resources dedicated to mental health treatment, as well as the concentration of these services in big cities (Berenzon and Juárez, 2005; González-Block et al., 2020; Heinze et al., 2016). This last factor may account for the observed behavior of the standardized rate in YLD due to DD in Ciudad de México, which is significantly different from the rest of the states. In 2016, Mexico had an estimated average of 4393 psychiatrists, translating to a rate of 3.68 psychiatrists per 100,000 inhabitants; 60.3% of these health professionals are concentrated in Ciudad de México, Jalisco, and Nuevo León (three of the country's major states). These statistics deviate significantly from international recommendations (Heinze et al., 2016).

Mexico's health system is dealing with a serious structural, operational, and fiscal deficiency as it attempts to tackle the issues of depression. Only 2% of the entire health budget is allocated to mental health, and of that, 80% goes to psychiatric institutions, leaving the first level of care without adequate funding to promote, prevent, diagnose, and manage psychological or psychiatric diseases and disorders (Funsalud, 2019). The concentration on psychiatric care precludes cost-effective community treatments that may assist a greater number of individuals with more prevalent mental health issues, such as depression. In this regard, it has been suggested that the cost of treating depression in Mexico would be significantly less than the cost of continuing with the existing state of inattention, implying a reduction in absenteeism and labor productivity (Funsalud, 2019).

The causes and consequences of DD must be recognized and treated in terms of its social and structural factors. Mexico is defined by profound socioeconomic and health disparities (Dávila-Cervantes and Agudelo-Botero, 2019; Gómez-Dantés et al., 2016), which manifest as

injustices that exacerbate the vulnerability of some demographic groups. Thus, poverty, domestic violence, homicides, and a high frequency of chronic illnesses, such as obesity, pervade people's everyday lives, negatively impacting their well-being. Additionally, because Covid-19 is expected to have exacerbated these diseases, it will be necessary to analyze the pandemic's short- and medium-term impacts on the overall health of Mexicans, including DD (Organisation for Economic Co-operation and Development, 2021).

#### 4.4. Implications for public policy

The magnitude of the DD burden mandates the consolidation of a comprehensive mental health policy that takes regional variances into account, as well as gaps in human and physical resource availability. Similarly, states must link their strategy with the national vision, while considering the unique characteristics of each context. As with other chronic illnesses, DD must be expressly stated as a priority axis in health and social plans and programs. As with any other health issue, developing mental health policy requires consensus among all actors in society, with a particular emphasis on people and their needs. Additionally, it is critical that sufficient resources are committed to ensure that this strategy is implemented properly. This comes concurrently with the strengthening of health personnel's capacities and technical competencies at all levels of care. An immediate goal for decision-makers is to establish a continuous registry of persons with mental disorders in general, but specifically of those with DD, which will form the basis for monitoring, follow-up, and timely treatment. As far as epidemiology surveillance and public policy are concerned. In this regard, strengthening health information systems is a priority in order to generate more accurate estimates and quantify the burden of DD (Brhlikova et al., 2011), which will also contribute to the achievement of the Sustainable Development Goals (SDG), through the definition of objectives and the measurement of indicators with an emphasis on "leaving no one behind" (Votruba et al., 2020).

#### 4.5. Limitations

The in-depth analysis of the 2019 GBD data on DDs across a 30-year period is a strength of this work. One limitation is that the data come from a variety of statistical sources rather than primary sources, as there is no national registry for mental diseases that can accurately assess the prevalence, incidence, and other markers of illness burden and severity. However, the GBD is an effective but underutilized tool for estimating the phenomena and its features. It is critical to conduct longitudinal research in order to have a better understanding of the epidemiology of DD and the variables that influence its progression.

### 5. Conclusion

Because national statistics do not accurately reflect the landscape of DD in the country, this study serves as a critical input for policymakers developing policies and programs on the issue. In Mexico, these problems vary significantly by sex, age group, state, and SDI, with considerable disparities across these factors. The observed trend shows that DD will continue to dominate the health profile of Mexicans, emphasizing the critical need for unambiguous promotion, prevention, treatment, and follow-up efforts, as well as a solid budget; expanded technical abilities (including education and training of health workers); and equitable redistribution of human and physical resources. As part of the fundamental and universal access to health, attention to mental health, including DD, must be handled more effectively by the Mexican health system. Its care should be addressed on a regular basis at all levels of care.



## Contributions

Substantial contributions to conception and design were made by MA and CD. Processing of data was done by MA, CD, JB and DC. Analysis and interpretation of data was performed by MA, CD and LG. Drafting the manuscript or revising it critically for important intellectual content was done by MA, CD, LG, MG and MR. Final approval of the version to be published was given by all the authors. They agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Each author participated sufficiently in the work to take public responsibility for appropriate portions of the content.

## Declaration of Competing Interest

The authors declare that they have no conflicts of interests with respect to the authorship and/or the publication of this paper.

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