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# Health Care Seeking and Mortality of Patients with Diabetes during the COVID-19 Pandemic in Colombia: a Nationwide Study

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ABSTRACT

**Introduction:** Besides the direct health implications of COVID-19, the pandemic and its containment measures have had multiple negative consequences, especially in the prevention and treatment of chronic diseases. This paper aimed to evaluate the effects of COVID-19 pandemic on mortality rates and health care seeking among individuals with diabetes in Colombia.

**Methods:** Nationwide ecological panel study of secondary data from the Colombian official records of mortality and medical attentions due to diabetes between 2015 and 2021. Aggregated data of hospitalizations, ambulatory and emergency care visits, as well as death rates due to diabetes were assessed once adjusted by health care infrastructure and rurality.

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**Results:** During the COVID-19 pandemic, the mortality rate from diabetes increased by 30.4% (pre-pandemic average by semester: 7.73 deaths per 100,000 inhabitants; pandemic average: 10.08 deaths per 100,000 inhabitants), the average rate of medical attention increased by 67.2% (pre-pandemic: 3163 per 100.000; pandemic: 5290 per 100.000), in which, ambulatory care arose by 44.6% and hospitalizations by 42.3%. Rurality was inversely associated with health visits, and the availability of tertiary care institutions was associated with both diabetes mortality and consultations.

**Conclusions:** An important increase in total number of consultations and mortality rates among diabetes patients was observed during the COVID-19 crisis in Colombia. Availability of high specialized health facilities is related to the number of medical consultations, which suggests that people that did not have access to specialized health services were neglected. Actual impact of COVID-19 pandemic in patients with diabetes remains unclear.

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**PUBLICACIÓN ADELANTADA**

# Búsqueda de atención en salud y mortalidad en pacientes con diabetes durante la pandemia de COVID-19 en Colombia: un estudio a escala nacional

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INFORMACIÓN ARTÍCULO

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RESUMEN

**Introducción:** la pandemia por COVID-19 y sus medidas de contención han tenido múltiples consecuencias negativas, especialmente en la prevención y tratamiento de enfermedades crónicas.

**Objetivos:** el objetivo de este manuscrito es evaluar el impacto de la pandemia de COVID-19 en la mortalidad y atención en salud de los pacientes con diabetes en Colombia.

**Métodos:** estudio panel ecológico nacional de mortalidad y atenciones médicas por diabetes entre 2015 y 2021. Se evaluaron las hospitalizaciones, consultas ambulatorias y de emergencia; las tasas de mortalidad, la disponibilidad de instituciones de salud especializados y ruralidad.

**Resultados:** durante la pandemia de COVID-19, la tasa de mortalidad por diabetes aumentó un 30,4 %, y la de atenciones

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médicas un 67,2 %, específicamente la atención ambulatoria aumentó en un 44,6 % y las hospitalizaciones en un 42,3 %. La ruralidad se asoció negativamente con las consultas médicas, y la disponibilidad de instituciones especializadas se asoció con la mortalidad por diabetes y las atenciones en salud. **Conclusiones:** los desenlaces generales en salud para pacientes con diabetes empeoraron durante la pandemia. Los resultados sugieren que las personas que no tenían acceso a servicios de salud especializados fueron desatendidas. El impacto real de la pandemia de COVID-19 en pacientes con diabetes está por esclarecer.

## INTRODUCTION

Amid of a growing crisis of metabolic diseases, the COVID-19 pandemic emerged with major impact on the human population on late 2019. At the time, the virus found fertile ground among people with preexisting metabolic diseases and due to its rapid transmission, it quickly evolved into a worldwide pandemic (1). Current evidence shows that during coronavirus pandemic, diabetes was a risk factor for severe clinical course or mortality (2); in parallel, COVID-19 infection was associated with the onset of hyperglycemia (3) and a greater risk of developing diabetes up to a year later (4). People living with risk factors for diabetes *mellitus* were thus considered a high-risk population (5), even during the post-vaccination era (6). Public health measures developed to limit the spread of the virus are also known to adversely influence the glycemic status of individuals with diabetes or the lifestyles of people at risk of developing it (7). Measures such as lockdown, social distancing and limiting outdoor activities may have had negative consequences in terms of diabetes prevention or treatment (8), including the disruption of health care services and the loss of continuum of care (9). The interruption of regular medical consultations, the limitation of sunlight exposure, the increased risk of mental health related concerns, and the affectation of physical activity levels, as well as the alteration of dietary habits, especially among individuals suffering from metabolic diseases or at risk, were major concerns during the COVID-19 pandemic (10).

For people with diabetes, the availability of medicines, including insulin, self-monitoring and diagnostic tools could have been affected, especially in low-middle income settings. However, aspects such as maintenance of the prescribed medications regimen, changes in dose or time, or even the omission of any of them, are challenging to measure (11). The effect of region-level variables like the availability of supplies and its distribution

during periods of lockdown is also unclear (12). In this regard, rurality, health care infrastructure and services affordability could have been determinant for guaranteeing diabetic patients access to health care services (13). In Colombia, around 40% of the population diagnosed with diabetes lived in non-capital cities in 2020 (14). However, while cities like Bogotá registered 62 physicians per 10,000 habitants, more rural regions such as Vaupés, Vichada and Guainía registered 1 to 3 physicians for each 10,000 habitants (15).

Despite the above, the extent to which interruptions in some care services or changes in lifestyle induced by public health measures affected the monitoring of people with diabetes during the COVID-19 pandemic has yet to be established. This study aims to quantify the impact of the COVID-19 pandemic on health care utilization (consultations and hospitalizations) and mortality among patients with diabetes in Colombia from 2015 to 2021.

## METHODS

### Design and settings

A nationwide retrospective ecological panel study based on open, anonymized, state-level aggregated data of inpatient and outpatient consultations and deaths due to diabetes from the Colombian Ministry of Health and Social Protection records from 2015 to 2021 (The ICD-10 codes: E10 to E14 were used). Aggregated data from the capital city, Bogotá, and for each of the 32 states of the country, were obtained from the Colombian Ministry of Health through a request sent to the institutional email address ‘correo@minsalud.gov.co’. The databases did not include individual characteristics of the patients, and no selection criteria were considered.

### Variables

Biannual mortality and medical consultations rates (per 100,000 inhabitants) from 2015 to 2021 were considered as outcome variables. Consultations were classified as follows: hospitalizations, ambulatory care, emergency care, and total consultations, including non-medical. Dummy variables for each half-year period were used to assess the temporal variation in the numbers as well as the effect of COVID-19 pandemic. These records include consultations by all health service providers, both public and private, including independent professionals as well as institutions. The numbers for every outcome in Bogotá and each of the 32 states of the country were aggregated semi-annually. Therefore, each semester contained 33 data points, resulting in 66 data points per year.

State level counts of independent health care professionals, and the number of tertiary care institutions (categorized as: none, from 1 to 10, and more than 10), reported from the Special Registry of Health Service Providers (16) were considered as explanatory variables. Rurality, defined as the proportion of rural residents on each state, obtained from the Rural Statistical Bulletin of the Rural Development Agency (17), was included in the adjusted models.

**Statistical analysis**

Differences in the average of each outcome were assessed using Wald tests. The Im-Pesaran-Shin unit-root test was applied to evaluate stationarity in the panel datasets (18). Linear panel regression models were used to assess the effect of explanatory variables. P-values $<0.05$ were considered the threshold for statistical significance. All analyses were carried out via STATA V.17 (19).

**Research Ethics Approval**

Ethics approval was granted by the Institutional Committee of Human Ethics of the Fundación Santa Fe de Bogotá Hospital. The approval ID is CCEI-13931-2022.

## RESULTS

The average mortality rate due to diabetes across Colombian states was of 8.13 deaths per 100,000 inhabitants by semester (SD=3.35), ranging from a minimum of 6.93 (SD=3.28) in the first semester of 2017 to a maximum of 11.40 (SD=4.02) in the second semester of 2020; during pandemic, diabetes mortality rate increased by 30.40% (2020 average/2015-2019 average).

Regarding health care visits, a state level average of around 3700 consultations per 100,000 inhabitants was reported between 2015 and 2021. The most frequent consultation was the ambulatory care with an average rate of 2172.1 (SD=1386.3), followed by emergency care and hospitalizations with 29.3 (SD=18.1) and 20.6 (SD=14.5), respectively. Throughout the study period, total consultations showed a steady increase from approximately 2000 per 100,000 inhabitants in 2015 to 4500 per 100,000 in 2021, with the highest peak observed during the first semester of the COVID-19 pandemic (2020-1) at 6998 (SD=3640.1) consultations per 100,000 inhabitants. On average, total health care consultations increased by 67.24% during the pandemic (Table 1).

**Table 1. States average of consultations and mortality rates (per 100,000 inhabitants) by semester**

| | **Ambulatory consultations** | **Emergency consultations** | **Hospitalizations** | **Total of attentions** | **Mortality** |
|---|---|---|---|---|---|
| | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) |
| 2015-1 | 1759.49 (899.52) | 36.85 (20.97) | 23.96 (12.94) | 2672.86 (1480.76) | 7.68 (3.51) |
| 2015-2 | 1322.22 (636.37) | 30.18 (18.71) | 16.34 (8.75) | 2022.35 (1225.43) | 7.79 (2.60) |

| | | | | | |
|---|---|---|---|---|---|
| 2016-1 | 1266.34 (915.79) | 22.78 (12.90) | 10.31 (8.21) | 1822.22 (1499.71) | 7.80 (2.75) |
| 2016-2 | 1046.63 (745.67) | 19.40 (13.14) | 8.64 (7.12) | 1608.42 (1471.60) | 7.14 (2.63) |
| 2017-1 | 1397.27 (843.45) | 25.74 (14.85) | 9.36 (6.36) | 2362.60 (1751.03) | 6.93 (3.28) |
| 2017-2 | 2424.01 (1353.90) | 34.18 (19.85) | 18.90 (14.80) | 3586.09 (2127.76) | 7.42 (2.84) |
| 2018-1 | 2614.85 (1641.58) | 27.88 (16.54) | 20.19 (11.43) | 4327.28 (2578.21) | 7.86 (2.91) |
| 2018-2 | 1961.38 (1381.04) | 22.03 (12.50) | 18.92 (10.52) | 3405.07 (2158.49) | 8.47 (3.61) |
| 2019-1 | 2535.70 (1087.05) | 35.78 (18.56) | 29.43 (14.81) | 4523.45 (2184.29) | 7.91 (2.82) |
| 2019-2 | 2937.86 (1414.05) | 35.67 (19.40) | 27.70 (13.61) | 5303.37 (2738.37) | 8.34 (3.83) |
| 2020-1 | 3501.26 (1697.79) | 48.42 (23.04) | 35.83 (17.09) | 6998.17 (3640.11) | 8.77 (3.29) |
| 2020-2 | 2433.36 (1185.16) | 26.30 (12.36) | 26.30 (16.48) | 5044.90 (2870.21) | 11.40 (4.02) |
| 2021-1 | 2786.07 (1326.40) | 24.52 (12.65) | 22.03 (12.74) | 4702.51 (2204.47) | N/A* |
| 2021-2 | 2422.83 (1268.53) | 21.05 (11.52) | 20.45 (13.96) | 4416.19 (2249.84) | N/A* |
| Overall | 2172.09 (1386.25) | 29.34 (18.13) | 20.60 (14.48) | 3771.11 (2675.26) | 8.13 (3.35) |

* Not available.
Source: Prepared by authors

Rates of ambulatory medical attentions and hospitalizations increased during pandemic by 44.6% and 42.3%, respectively. Ambulatory rates varied from a minimum of 1046.6 (SD=745.7) per 100,000 inhabitants in 2016-2 to 3501.3 (SD=1697.8) in the first semester of 2020 (2020-1). Hospitalizations average rates ranged between 8.6 (SD=7.1) in 2016-2 to 35.8 (SD=17.1) in 2020-1. Emergency consultations rates varied from 19.4 in 2016-2 (SD=13.1) to 48.4 in 2020-1 (SD=23.0) (Table 1).

Among states, Vaupés and Guaviare had the highest increase between 2015 and 2020 in total of medical consultations. In Vaupés, the average rate between semesters increased from 10.6 consultations per 100,000 inhabitants in 2015, to 1358.7 per 100,000 inhabitants in 2020. The states with the lowest increase between 2015 and 2020 were Putumayo and

Antioquia. In Putumayo, medical consultations were from 2130.5 per 100,000 inhabitants in 2015 to 3158.6 per 100,000 inhabitants in 2020 (Appendix 1).

The adjusted analyses showed that the number of tertiary care institutions (category: "1 to 10 tertiary care hospitals in the state"), together with the first year of pandemic (2020) were positively associated to the number of deaths among diabetic patients, in opposition to the number of independent health care professionals and rurality which associated inversely with mortality rates (Table 2).

**Table 2. Adjusted effects of pandemic and health facilities on diabetes mortality rates**

| | Coefficient | 95%CI | | p-value |
|---|---|---|---|---|
| Independent health care professionals | -0.0003 | -0.0006 | -0.00001 | 0.046 |
| 1 to 10 tertiary care institutions* | 1.65 | 0.05 | 3.24 | 0.043 |
| More than 10 tertiary care institutions* | 0.06 | -5.86 | 5.99 | 0.983 |
| 2020 first semester | 1.04 | 0.37 | 1.70 | 0.002 |
| 2020 second semester | 3.66 | 2.99 | 4.33 | <0.001 |
| Rurality | -0.10 | -0.15 | -0.05 | <0.001 |
| Constant | 10.88 | 8.53 | 13.22 | <0.001 |

*Reference category= no tertiary care institutions
Source: Prepared by authors

About the total of health consultations for diabetes, results showed an increase associated with the number of tertiary care institutions (category: "1 to 10 tertiary care hospitals in the state"); on the contrary, rurality was inversely associated (Table 3).

**Table 3. Adjusted effects of pandemic and health facilities on the total of health care consultations due to diabetes**

| | Coefficient | 95%CI | | p-value |
|---|---|---|---|---|
| 1 to 10 tertiary care institutions* | 1573.36 | 510.74 | 2635.96 | 0.004 |
| More than 10 tertiary care institutions* | 745.43 | -2286.07 | 3776.93 | 0.630 |
| 2020 first semester | 3834.80 | 3237.30 | 4432.29 | <0.001 |
| 2020 second semester | 1881.53 | 1284.04 | 2479.03 | <0.001 |
| 2021 first semester | 1539.14 | 941.64 | 2136.63 | <0.001 |

| | | | | |
|---|---|---|---|---|
| 2021 second semester | 1252.82 | 655.32 | 1850.31 | <0.001 |
| Rurality | -46.14 | -78.46 | -13.83 | 0.005 |
| Constant | 3975.01 | 2411.15 | 5538.88 | <0.001 |

*Reference category= no tertiary care institutions
Source: Prepared by authors

Similar results were found for the ambulatory services, in which, a significant increase in outpatient diabetes consultations was associated with the number of tertiary care institutions (category: "1 to 10 tertiary care hospitals in the state"). Results also showed a negative association between outpatient visits and rurality (Table 4).

**Table 4. Adjusted effects of pandemic and health facilities on the number of ambulatory consultations due to diabetes**

| | **Coefficient** | **95%CI** | | **p-value** |
|---|---|---|---|---|
| 1 to 10 tertiary care institutions* | 829.96 | 285.08 | 1374.86 | 0.003 |
| More than 10 tertiary care institutions* | -43.32 | -1597.83 | 1511.18 | 0.956 |
| 2020 first semester | 1574.68 | 1267.57 | 1881.79 | <0.001 |
| 2020 second semester | 506.78 | 199.66 | 813.89 | 0.001 |
| 2021 first semester | 859.49 | 552.38 | 1166.61 | <0.001 |
| 2021 second semester | 496.25 | 189.14 | 803.37 | 0.002 |
| Rurality | -30.62 | -47.19 | -14.05 | <0.001 |
| Constant | 2585.20 | 1783.27 | 3387.14 | <0.001 |

*Reference category= no tertiary care institutions
Source: Prepared by authors

Regarding the emergency consultations, the first semester of 2020 was associated with increased number of visits, and an inverse association was identified with 2021 period (Table 5). Likewise, first year of pandemic (2020-1, 2020-2) and the first semester of 2021 were significantly associated with the number of hospitalizations (Table 6). Rurality did not

have significant effects on emergency consultations or hospitalizations for diabetes during study period.

**Table 5. Adjusted effects of pandemic and health facilities on the number of emergency consultations due to diabetes**

| | Coefficient | 95%CI | | p-value |
|---|---|---|---|---|
| 2020 first semester | 19.62 | 15.53 | 23.71 | <0.001 |
| 2021 first semester | -4.28 | -8.37 | -0.19 | 0.040 |
| 2021 second semester | -7.75 | -11.84 | -3.66 | <0.001 |
| Constant | 28.80 | 24.20 | 33.39 | <0.001 |

Source: Prepared by authors

**Table 6. Adjusted effects of pandemic and health facilities on the number of hospitalizations due to diabetes**

| | Coefficient | 95%CI | | p-value |
|---|---|---|---|---|
| 2020 first semester | 17.26 | 13.83 | 20.69 | <0.001 |
| 2020 second semester | 7.74 | 4.30 | 11.17 | <0.001 |
| 2021 first semester | 3.46 | 0.03 | 6.89 | 0.048 |
| Constant | 18.57 | 15.05 | 22.08 | <0.001 |

Source: Prepared by authors

## DISCUSSION

A noticeable increase in total consultations due to diabetes was observed during the study period. More than a threefold rise in the numbers from 2016 to 2020 confirms that diabetes has become a serious health concern for Colombia due to the large and increasing number of individuals with this disease. As reported elsewhere, diabetic patients are particularly vulnerable to dying from COVID-19, which suggests that this population faced a major health crisis during the pandemic and constitute one of the most defying challenges to public health nowadays. In fact, our analyses showed a global escalate in diabetes-associated mortality greater than 30% during the COVID-19 crisis in Colombia. Similar results were seen for ambulatory consultations and hospitalizations.

On the contrary, during the study period emergency consultations were reduced, however, it is not clear if this reduction really reflects an improvement in the disease management at population level, or if, quite the reverse, the superimposing of COVID-19 and diabetes suggests that preexisting complications or pathologies in patients with diabetes could aggravate the infection course and make it difficult or impossible to promptly access the emergency services for those who died (20).

Regarding the services availability, the non-significant associations between having more than 10 high complexity hospitals with mortality (once compared with states with no tertiary hospitals), suggests an important lack of access to specialized health services in less favored settings. Likewise, the reason for the decrease in the search for or access to specific diabetes-related third-level care needs to be established, however, it could be related to the urgency of other medical/social needs related to COVID-19 pandemic.

Similar hypothesis can be made about rurality. The negative association of this variable with the number of health consultations could be an indicator of the existence of barriers to receive, seek or access to specialized health care during pandemic including competing priorities, limited access to healthy food, and inadequate health care resources among the patients with diabetes (21).

The findings up this point revealed important issues about diabetes health care in Colombia, however, some limitations should be considered. Information availability and the study design prevented to consider individual and cultural variables that could better explain our results, including sociodemographic characteristics and comorbidities. Situations such as the mobility of patients from one point to another to receive adequate health attention were omitted, therefore, the numbers for most rural regions could be underestimated. Furthermore, due the type of records used in the analysis, the cause of death or consultation could be

imprecise or insufficient to rightly identify the total of patients suffering from diabetes during COVID-19 crisis.

Despite the above, the findings confirmed the existence of several challenges about diabetes treatment and care. The role of the specialized health services and the rise in the number of consultations and mortality during pandemic revealed undoubtedly a sanitary emergency. These situations are common to most developing countries (22); hence, the lessons learned from Colombia's experience with diabetes are likely to be of immense global relevance. Further, diabetes-related morbidity and mortality continue to increase due to population expansion, urban migration, declining physical activity, and dietary aspects (23), factors that probably worsened during the pandemic and in lower-middle income countries may become long-lasting due resources scarcity. For Colombia, the organization of diabetes care seems poorly distributed, especially at the tertiary level, with consequent poor outcomes. Further research is needed to better understand the pandemic consequences beyond direct mortality and prepare health systems to face future massive challenges as a pandemic, for vulnerable groups as the population with diabetes *mellitus*.

## REFERENCES

1. Meo SA, Alhowikan AM, Al-Khlaiwi T, Meo IM, Halepoto DM, Iqbal M, et al. Novel coronavirus 2019-nCoV: prevalence, biological and clinical characteristics comparison with SARS-CoV and MERS-CoV. Eur Rev Med Pharmacol Sci [Internet]. 2020;24(4):2012-9. Available from: https://www.europeanreview.org/wp/wp-content/uploads/2012-2019.pdf

2. Peric S, Stulnig TM. Diabetes and COVID-19: Disease-Management-People. Wien Klin Wochenschr [Internet]. 2020;132(13-14):356-61. https://doi.org/10.1007/s00508-020-01672-3

3. Unnikrishnan R, Misra A. Diabetes and COVID19: a bidirectional relationship. Nutr Diabetes [Internet]. 2021;11(1):21. https://doi.org/10.1038/s41387-021-00163-2

4. Xie Y, Al-Aly Z. Risks and burdens of incident diabetes in long COVID: a cohort study. Lancet Diabetes Endocrinol [Internet]. 2022;10(5):311-21. https://doi.org/10.1016/S2213-8587(22)00044-4

5. Marín-Sánchez A. Características clínicas básicas en los primeros 100 casos fatales de COVID-19 en Colombia. Rev Panam Salud Publica [Internet]. 2020;44:e87. https://doi.org/10.26633/RPSP.2020.87

6. Vasilev G, Kabakchieva P, Miteva D, Batselova H, Velikova T. Effectiveness and safety of COVID-19 vaccines in patients with diabetes as a factor for vaccine hesitancy. World J Diabetes [Internet]. 2022;13(9):738-51. https://doi.org/10.4239/wjd.v13.i9.738

7. Barone MTU, Harnik SB, de Luca PV, Lima BLS, Wieselberg RJP, Ngongo B, et al. The impact of COVID-19 on people with diabetes in Brazil. Diabetes Res Clin Pract [Internet]. 2020;166:108304. https://doi.org/10.1016/j.diabres.2020.108304

8. Kruse MH, Durstine A, Evans DP. Effect of COVID-19 on patient access to health services for noncommunicable diseases in Latin America: a perspective from patient advocacy organizations. Int J Equity Health [Internet]. 2022;21(1):45. https://doi.org/10.1186/s12939-022-01648-x

9. World Health Organization. Pulse survey on continuity of essential health services during the COVID-19 pandemic: interim report, 27 August 2020 [Internet]. World Health Organization; 2020. Available from: https://www.who.int/publications/i/item/WHO-2019-nCoV-EHS_continuity-survey-2020.1

10. Cuschieri S, Grech S. COVID-19 and diabetes: The why, the what and the how. J Diabetes Complications [Internet]. 2020;34(9):107637. https://doi.org/10.1016/j.jdiacomp.2020.107637

11. Silva-Tinoco R, González-Cantú A, De la Torre-Saldaña V, Guzmán-Olvera E, Cuatecontzi-Xochitiotzi T, Castillo-Martínez L, et al. Effect in self-care behavior and difficulties in coping with diabetes during the COVID-19 pandemic. Rev mex endocrinol metab nutr (En línea) [Internet]. 2021;8(1):13-9. https://doi.org/10.24875/RME.20000063

12. Beran D, Aebischer-Perone S, Castellsague-Perolini M, Chappuis F, Chopard P, Haller DM, et al. Beyond the virus: Ensuring continuity of care for people with diabetes during COVID-19. Prim Care Diabetes [Internet]. 2021;15(1):16-7. https://doi.org/10.1016/j.pcd.2020.05.014

13. Barone MTU, Villarroel D, de Luca PV, Harnik SB, Lima BLS, Wieselberg RJP, et al. COVID-19 impact on people with diabetes in South and Central America (SACA region). Diabetes Res Clin Pract [Internet]. 2020;166:108301. https://doi.org/10.1016/j.diabres.2020.108301

14. Fondo Colombiano de Enfermedades de Alto Costo Cuenta de Alto Costo (CAC). Situación la enfermedad renal crónica, la hipertensión arterial y la diabetes mellitus en Colombia 2020 [Internet]. Bogotá D.C. 2021. Disponible en: https://cuentadealtocosto.org/erc/situacion-de-la-enfermedad-renal-cronica-la-hipertension-arterial-y-la-diabetes-mellitus-en-colombia-2020/

15. Arguello-Mondragón E, Acosta-Rivas S, Canencia MA, Nunez-Rodriguez E, Moya-Moya LM, Palencia-Sánchez F. Inequidad en la distribución del talento humano en salud: un análisis de los médicos especialistas y médicos generales por departamento en Colombia a partir del Registro Único Nacional del Talento Humano en Salud (ReTHUS) [Internet]. Disponible en: https://osf.io/vtpze/download/?format=pdf

16. Ministerio de Salud y Protección Social. Registro Especial de Prestadores de Servicios de Salud – REPS [Internet]. 2022. Disponible en: https://prestadores.minsalud.gov.co/habilitacion/

17. Agencia de Desarrollo Rural. Rural Statistical Bulletin [Internet]. 2018 Available from: http://www.centir.adr.gov.co/pdf/boletin.pdf

18. Harris D, Harvey DI, Leybourne SJ, Sakkas ND. Local asymptotic power of the Im-Pesaran-Shin panel unit root test and the impact of initial observations. Econ Theory (N Y) [Internet]. 2010;26(1):311-24. https://doi.org/10.1017/S0266466609090768

19. StataCorp. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC; 2019.

20. Feldman EL, Savelieff MG, Hayek SS, Pennathur S, Kretzler M, Pop-Busui R. COVID-19 and Diabetes: A Collision and Collusion of Two Diseases. Diabetes [Internet]. 2020;69(12):2549-65. https://doi.org/10.2337/dbi20-0032

21. White BM, Logan A, Magwood GS. Access to Diabetes Care for Populations Experiencing Homelessness: an Integrated Review. Curr Diab Rep [Internet]. 2016;16(11):112. https://doi.org/10.1007/s11892-016-0810-y

22. Lima EEC, Vilela EA, Peralta A, Rocha M, Queiroz BL, Gonzaga MR, et al. Investigating regional excess mortality during 2020 COVID-19 pandemic in selected Latin American countries. Genus [Internet]. 2021;77(1):30. https://doi.org/10.1186/s41118-021-00139-1

23. Mendivil CO, Gutiérrez-Romero SA, Peláez-Jaramillo MJ, Nieves-Barreto LD, Montaño-Rodríguez A, Betancourt-Villamizar E. Diabetes and associated dietary intake among urban adults: COPEN (Colombian Nutritional Profiles)-a cross-sectional study. BMJ Open [Interbet]. 2021;11(6):e042050. https://doi.org/10.1136/bmjopen-2020-042050

**Appendix 1. Average rate of medical consultations per 100,000 inhabitants by year per state**

| State / Year | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|
| | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) |
| Antioquia | 5909.1 (62.5) | 3253.4 (485.1) | 5354.6 (550.0) | 8080.3 (65.2) | 8443 (267.0) | 8911.6 (1045.0) | 5177.3 (331.1) |
| Atlántico | 3997.8 (889.1) | 2568.4 (79.1) | 4814 (104.4) | 6081.5 (315.6) | 8239.3 (1376.0) | 7143.5 (1582.5) | 5665 (957.6) |
| Bogotá D.C | 3192.2 (582.2) | 2671.5 (5.6) | 3695.2 (418.8) | 5520.5 (264.4) | 6863 (415.5) | 9009.6 (2802.2) | 6266.1 (334.2) |
| Bolívar | 3280.8 (1323.3) | 1966.2 (329.6) | 3396.1 (340.1) | 4749.3 (1059.0) | 7538.5 (1226.6) | 7466.8 (2256.2) | 5901.4 (763.9) |
| Boyacá | 2165.4 (892.6) | 1185 (313.3) | 4037.8 (1943.3) | 4662.9 (1911.5) | 4230.0 (438.0) | 7209.8 (1122.6) | 4016.9 (866.9) |
| Caldas | 3661.9 (634.7) | 2597.4 (103.1) | 4536.1 (2547) | 5789.3 (1824.1) | 5137.7 (200.1) | 7839.5 (2499.3) | 4284.6 (719.8) |
| Caquetá | 2306.2 (142.4) | 1804.5 (178.7) | 3587.9 (3364.7) | 3636.9 (464.2) | 4381.3 (69.1) | 4982.4 (1655.3) | 4030.8 (587.5) |
| Cauca | 1785.1 (35.4) | 1252 (155.7) | 2594.7 (1659.8) | 3329 (222.6) | 4206.2 (369.6) | 6271.9 (1534.4) | 4646.2 (706.1) |
| Cesar | 1713.7 (179.8) | 1149.4 (104.4) | 2111.0 (495.0) | 3090.6 (264.2) | 5516.3 (492.6) | 4121.2 (565.3) | 3801.6 (234.9) |
| Córdoba | 3573.2 (837.9) | 7926.1 (161.8) | 8206.4 (809.8) | 9288.9 (266.7) | 6762.6 (470.1) | 6395.8 (834.6) | 5330.5 (710.7) |
| Cundinamarca | 2477.1 (756.9) | 3040.6 (1157.0) | 2870.4 (417.7) | 4112.7 (813.4) | 3735.8 (173.2) | 4428.4 (1836.1) | 3553.8 (30.0) |
| Chocó | 679.0 (248.7) | 488.4 (41.2) | 678.0 (61.6) | 1435.9 (169.4) | 1807.1 (1022.8) | 1427.9 (187.6) | 1483.5 (246.9) |
| Huila | 3734 (1398.8) | 3213.1 (90.7) | 6202.8 (3163.3) | 7483.2 (2538.7) | 9150.8 (2615.7) | 10405.1 (2376) | 7839.1 (965.6) |
| La Guajira | 1288.1 (222.1) | 986.8 (87.1) | 2054.3 (72.5) | 5361.9 (3458.0) | 3842.8 (200.7) | 3354.8 (481.2) | 6264.2 (143.8) |
| Magdalena | 1910.5 (734.7) | 1175 (179.1) | 2857.2 (22.6) | 5057.1 (485.3) | 5304.4 (388.6) | 5369.1 (1287.9) | 4473.1 (1229.6) |
| Meta | 2626.5 (1398.3) | 1095.6 (413.4) | 3315.1 (2180.4) | 3025 (1814.8) | 7787.5 (72.2) | 4426.3 (1447.3) | 4102.8 (443.9) |
| Nariño | 2858.7 (133.8) | 1891.8 (125.1) | 2570.3 (724.9) | 2896.1 (189.4) | 4183.9 (299.2) | 4654 (681.7) | 3295.1 (1272.3) |
| Norte de Santander | 2583.6 (762.1) | 1870.4 (164.2) | 3715.5 (1290.8) | 4585.9 (1919.7) | 5802.8 (1830.9) | 10286 (2073.4) | 8586.8 (507.4) |
| Quindío | 3494.9 (660.8) | 1919.8 (310.7) | 3570.6 (1610.8) | 5082 (768.8) | 7203.7 (769.8) | 8724.8 (1071.9) | 6268.6 (682.1) |
| Risaralda | 3563.5 (1160.4) | 2045.3 (539.6) | 3954.8 (1863.8) | 4882.2 (418.1) | 8257.6 (1296.2) | 10752.8 (2135.4) | 8232.0 (589.1) |
| Santander | 3458.2 (307.4) | 2923.6 (295.0) | 4985.7 (603.9) | 5882.8 (416.9) | 8109.2 (1681.9) | 11442 (873.1) | 6819.1 (193.9) |
| Sucre | 2357.6 (529.7) | 1286.8 (22.3) | 1668.7 (439.3) | 3160.5 (353.1) | 3510.2 (226.8) | 5947 (731.1) | 6330.0 (282.5) |
| Tolima | 2597.3 (1246.5) | 1530.6 (337.7) | 3603.7 (1649) | 4681.7 (2099.1) | 5134.9 (1519.0) | 11025.9 (2492.1) | 6900.2 (2653.2) |
| Valle del Cauca | 3578.6 (263.9) | 2501.5 (96.6) | 3767.6 (716.8) | 5254.5 (37.7) | 7370.2 (1773.5) | 10681.2 (1316.2) | 7153.4 (138.4) |
| Arauca | 1680.8 (567.4) | 437.5 (135.8) | 1583.6 (675.2) | 2157.9 (45.6) | 2884.2 (339.3) | 4403.5 (1599.0) | 2951.8 (516.8) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Casanare | 1758.8 (663.9) | 1345.9 (237.8) | 2055.5 (750.2) | 2258.8 (731) | 2736.4 (674.5) | 2671.6 (89.2) | 3400.0 (942.7) |
| Putumayo | 2130.5 (236.8) | 1302.3 (65.0) | 1616.1 (536.6) | 1959.5 (119.2) | 3037.7 (126.3) | 3158.6 (623.2) | 2926.5 (866.6) |
| San Andrés y Providencia | 1223.8 (222.2) | 515 (576.2) | 2948.2 (238.7) | 1675.1 (808.9) | 2430.3 (1594.6) | 2712.3 (791.6) | 1342.9 (169.5) |
| Amazonas | 536.0 (342.4) | 309.7 (62.3) | 732.3 (190.2) | 880 (356.4) | 1138.2 (207.3) | 1165.5 (73.4) | 929.6 (274.2) |
| Guainía | 392.7 (35.9) | 54.8 (77.5) | 48.6 (65.7) | 241.1 (58.8) | 1984.9 (122.9) | 2803.3 (1280.5) | 3559.8 (31.6) |
| Guaviare | 778.5 (241.4) | 160.5 (36.8) | 586.3 (409.3) | 425.9 (158.1) | 2694.9 (871.4) | 7394.7 (5188.0) | 3629.2 (470.7) |
| Vaupés | 10.6 (7.5) | 9.0 (1.8) | 54.0 (40.9) | 259.8 (176.8) | 1667.8 (912.0) | 1358.7 (988.4) | 647.3 (81.6) |
| Vichada | 166.3 (67.6) | 127.6 (62.0) | 380.3 (212.0) | 594.6 (224.3) | 1049.3 (83.8) | 764.9 (235.4) | 649.0 (345.0) |