

# Prevalence of gestational diabetes mellitus in Colombia comparative study and systematic review

## Abstract

**Introduction:** Pregnant women with GDM gestational diabetes mellitus have a higher risk of having adverse maternal-infant outcomes.

**Objective:** To estimate the prevalence of GDM in Colombia according to the criteria of the International Association of Diabetes and Pregnancy Study Groups [IADPSG].

**Materials and methods:** A systematic review was carried out by searching the PubMed / Medline and Cochrane databases in English and Spanish. The quality assessment was done using the GRADE methodology. **Results:** A total of 7 articles with 37,795 Colombian participants were included in the systematic review. The prevalence of GDM in Colombia was 8.7%.

**Conclusion:** As far as we know, this systematic review is the first study to estimate the prevalence of GDM in women in Colombia according to criteria of the IADPSG. The results suggest a GDM prevalence in Colombia in the world average. Be careful with these results because there could be under-records.

**Keywords:** prevalence, gestational diabetes, Colombia, Latin America, systematic review, comparative study

Volume 12 Issue 2 - 2023

Antolín Maury,<sup>1</sup> Sara Concepción Maury Mena,<sup>2</sup> Juan Carlos Marín Escobar,<sup>3</sup> Vanessa Navarro Angarita,<sup>4</sup> Adolfo Ceballos Vélez,<sup>5</sup> Rosely Rojas Rizzo<sup>6</sup>

<sup>1</sup>Associate Senior Faculty Benjamin León - Miami-Dade College, School of Nursing, Miami, Florida, United States

<sup>2</sup>Psychologist, Specialist in Organizational Communication, Master in Research Methods in Education from the University of La Rioja in Madrid, Spain; Ph.D. in Educational Sciences, Research professor at the Faculty of Education of the American University Corporation, Barranquilla, Colombia

<sup>3</sup>Psychologist, Master in Social Projects, Ph.D. in Educational Sciences, Associate researcher Minciencias, Research Professor of the Educational and Social Synapsis Group, Simón Bolívar University of Barranquilla, Colombia, Professor and researcher of the Psychology Program, Faculty of Human and Social Sciences

<sup>4</sup>Degree in Early Childhood Education, Magister in Education from the Universidad del Norte. PhD in research, in Humanities, Art and Education from the Castilla La Mancha University (Spain), Dean of the Faculty of Educational Sciences of the American University Corporation, Barranquilla, Colombia.

<sup>5</sup>Director of the Bachelor's Program in Bilingual Education of the Faculty of Education and Director of the Language Center of the American University Corporation of Barranquilla, Colombia

<sup>6</sup>Environmental and Sanitary Engineer, Master in Human and Social Sciences, Second-year doctoral student in education. Research professor of the Bachelor's Program in Bilingual Education of the Faculty of Education of the Americana University Corporation of Barranquilla, Colombia

**Correspondence:** Sara Concepción Maury Mena, Psychologist, Specialist in Organizational Communication, Master in Research Methods in Education from the University of La Rioja in Madrid, Spain; Ph.D. in Educational Sciences. Research professor at the Faculty of Education of the American University Corporation, Barranquilla, Colombia, Tel 300 3243679, Email saramaury6@yahoo.com

**Received:** July 29, 2023 | **Published:** August 28, 2023

**Abbreviations:** ADA, American diabetes association; ALAD, Latin American diabetes association; GDM, gestational diabetes mellitus; DM2, type 2 diabetes mellitus; IADPSG, international association of diabetes and pregnancy study groups; IDF, international diabetes federation; WHO, world health organization; OGTT, oral glucose tolerance test; WDF, world diabetes foundation

## Introduction

Gestational diabetes mellitus (GDM) is defined as carbohydrate intolerance, resulting in hyperglycemia with onset or first detection during pregnancy and precisely induced by pregnancy.<sup>1</sup> The term is applied to any degree of intolerance to carbohydrates of variable intensity, beginning or first recognized during pregnancy, regardless of the need for insulin treatment, degree of metabolic disorder, or its persistence after the end of the pregnancy.<sup>2,3</sup> GDM carries seriously harmful consequences for both the woman and the fetus. Pregnant

women and postpartum women are prone to complications such as gestational hypertensive disease, polyhydramnios, premature rupture of fetal membranes, infection, and preterm labor; in severe cases, ketoacidosis can occur, and women in the postpartum period can develop type 2 diabetes mellitus in the short and long term. In addition, the fetus is prone to spontaneous abortion, malformations, and hypoxia; in severe cases, intrauterine death may occur. Hyperglycemia tends to cause fetal macrosomia; the chances of shoulder dystocia at birth are increased, and the newborn is prone to respiratory distress syndrome, hypoglycemia, and other complications after birth, including death in severe cases.<sup>4-6</sup> In the multicenter and multiethnic HAPO study,<sup>7</sup> conducted by the IADPSG in more than 25,000 pregnant women in 11 countries, including some developing countries, and lasting 7 years, it was shown that at 24-32 weeks of gestation, there is a higher blood glucose level in the 75-g oral glucose tolerance test (OGTT), indicating a greater risk of adverse pregnancy outcomes. In fact,

even with an increase of some blood glucose level, the risk of having an adverse outcome for both mother and baby is higher, while no significant thresholds were observed for most comorbidities.<sup>3,6</sup>

From this moment on, the IADPSG proposed new diagnostic criteria for GDM in 2010<sup>7</sup>: borderline fasting blood glucose levels, 1 and 2 h after oral glucose administration of 5.1, 10.0 and 8.5 mmol/L, respectively, per 75 g OGTT. If any of these three values reaches or exceeds the limit level, the patient must be diagnosed with GDM.<sup>3,6</sup> In 2011, the American Diabetes Association (ADA) recommended that the IADPSG criteria be adopted as GDM Diagnostic Criteria, and in August 2013, the World Health Organization (WHO)<sup>1</sup> used the results of the HAPO study as an important reference to develop new GDM diagnostic criteria. In 2015,<sup>8</sup> the Colombian Ministry of Health and Social Protection published for the first time the Clinical Practice Guideline for Gestational Diabetes, which determines those proposed by the IADPSG as detection and diagnostic criteria for GDM. However, until now there are very few studies dedicated to establishing the prevalence of this condition in Colombia, so the objective in this review was set to locate the studies carried out to date without limit of dates or languages to determine a prevalence in Colombia of gestational diabetes in a systematic way.

## Materials and methods

Systematic review and the comparative study followed PRISMA methodologies,<sup>9,10</sup> considering the checklist for systematic reviews and the GRADE Manual<sup>11</sup> to qualify the quality of the best available evidence. Search strategy: Pub Med/Medline and Cochrane databases were searched to find studies in English and Spanish up to October 15, 2020. Any study was considered relevant if it had been published before October 15, 2020. Keywords, medical subject titles (MeSH), and descriptors are presented in Table 1. Likewise, the authors of some studies were contacted when necessary to obtain additional information that was not available in the publications. A systematic search of the reviews and meta-analyses of the prevalence of GDM in the world was made to carry out the comparative study of the prevalence of GDM resulting in Colombia.

**Table 1** Database search strategy

Item	Descriptor	Studies found
1	Prevalence or incidence	
2	Gestational diabetes mellitus or GDM	
3	Epidemiology	
4	Colombia	
5	1 and 2 and 4	23
6	2 and 3 and 4	19
	<b>Total</b>	<b>42</b>

Note: Full electronic search strategy for Medline Limiters: until October 15, 2020, academic journals (peer-reviewed), English and Spanish language. Source: the authors, 2020.

**Inclusion / exclusion criteria:** All types of study with populations, samples, groups, and subgroups of pregnant women older than 14 years, with GDM, risk of GDM or previous GDM during their previous pregnancies were included; any criteria for detection and diagnosis of GDM; studies had to be published in English or Spanish by peer-reviewed journals. Systematic reviews and/or meta-analyses were also included. Studies with women with pre-existing type 1 or type 2 diabetes before pregnancy were excluded.

**Selection of studies:** Of the articles identified in the databases, duplicates were eliminated, the titles and abstracts were examined,

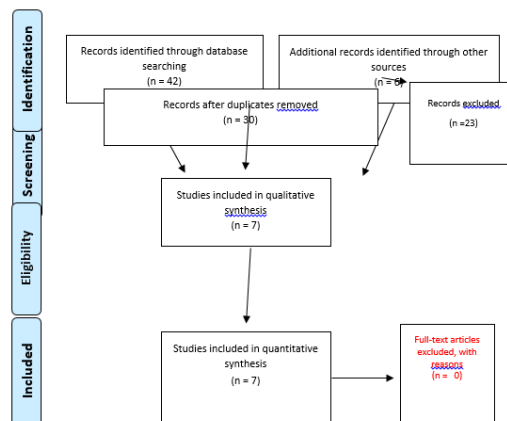
the articles in full text were evaluated with the inclusion and exclusion criteria and, finally, the studies that were going to be included in the systematic review were defined. All these steps were carried out by two reviewers independently, excluding the authors of this review since they were part of one of the studies included in the present study. Disagreements were resolved by discussion, and a third reviewer was consulted where necessary.

**Data extraction:** After baseline assessment, a standardized data collection form was used to extract study characteristics including article title, first author, study type, year, population (samples, groups, and subgroups), types of measurements, GDM diagnostic criteria. Data extraction was performed independently, and the results of the data extraction were compared between the two reviewers to ensure that there were no errors. Statistical summaries by outcomes were reported.

**Statistical analysis and quality assessment:** After extracting and characterizing the data from each study, a statistical analysis was carried out and the average prevalence of the studies found was obtained. The possibility of bias was assessed using the GRADE methodology. Subgroup analysis was used for geographic location, number of participants, GDM diagnostic criteria. Statistical significance was determined as  $P < 0.05$ . The I<sup>2</sup> was used to detect statistical heterogeneity, which ranged from 0 to 100% and was described as low (0 to 40%), moderate (30 to 60%), substantial (50 to 90%), and considerable (75 to 100%). The GRADE methodology was used to assess the quality of the studies. Two reviewers independently assessed study quality and discrepancies were resolved by discussion or intervention by a third reviewer. The quality of the studies included in the systematic reviews and meta-analyses was not re-evaluated if they were evaluated at the time with the GRADE methodology and the Colombian Guide for guide-making.

## Results

**Description of included studies:** The systematic search identified 42 articles from the initial selection, as shown in Figure 1. After eliminating duplicate articles of which there were 12, studies not relevant to the objective of the review were excluded and only one study was found in the PubMed/Medline and Cochrane databases that met the inclusion and exclusion criteria established in the methodology of this review, and 6 articles were found by hand search. The abstracts were reviewed, and the full texts were evaluated according to the inclusion criteria, from which it was decided to include all ( $n = 6$ ) of the studies resulting from the manual search plus the only product of the systematic review, for qualitative and quantitative analysis.



**Figure 1** PRISMA 2009 flow diagram.

**Characteristics of the included studies:** The characteristics of the included studies are described in Table 1. The 7 studies cover the period 1999-2017. The total population of the 7 studies was 38,231 women. Regarding the environment, the studies were carried out in 6 Colombian cities (of the 1118 cities in total, distributed in 32 departments). The two Medellín studies were carried out one 20 years

ago and the other 13 years ago. The rest of the studies occurred in the last decade. Most of the studies were cross-sectional (n=5), one was prospective cohort, and one was a case-control study. Regarding the mean age of the population studied, the studies reported a mean age of 28.92 years. One of the studies did not report the prevalence of GDM, but the risk factors for GDM Table 2.

**Table 2** Studies on the prevalence of gestational diabetes in Colombia (n=7)

Ítem	First author and year of publication	City and department of Colombia	Type of study	Study duration	Criterio DMG	Population, sample, subgroups	Median age in years	GDM prevalence	Others
1	Rincón Torres et al., <sup>12</sup>	Bucaramanga; (Santander)	Transversal study	2016-2017	O'Sullivan, NDDG y code 024,4 y 024,9* ICD, OMS, 1992	6395	29,5	3,50%	2016
						7034		4,10%	2017
2	Vergara Camargo et al., <sup>16</sup>	Zapatoca; (Santander)	Retrospective cohort study	2013-2017	2013 a 2016: criterio a dos pasos; 2016 a 2017: un paso IADPSG PTOG	269	31,5	4,46%	
3	Ruiz Hoyos et al., <sup>17</sup>	Armenia (Quindío)	Prospective cohort study	2015-2016	IADPSG PTOG	256	22,9	4,70%	
4	Tuesca Molina et al., <sup>18</sup>	Barranquilla_ (Atlántico)	Prospective cohort study	2012-2014	IADPSG PTOG	21169	Not reported	8,70%	
5	Burbano López et al., <sup>13</sup>	Manizales (Caldas)	Transversal study	2011-2012	O'Sullivan	1138	23,5	6,30%	
6	Campo Campo et al., <sup>14</sup>	Medellín (Antioquia)	Cases and controls study	2005-2007	O'Sullivan y ADA: Carpenter y Coustan, PTOG	244 cases y 423 controls	32	Not reported	
7	Cortés et al., <sup>15</sup>	Medellín I (Antioquia)	Prospective cohort study	1999-2000	ADA, Carpenter y Coustan, PTOG	1726	33,6	2,03%	
								O'Sullivan	1,43%
Prevalence of gestational diabetes in colombia as of October 2020 considering the 7 studies included								4,25%	
Prevalence of gestational diabetes in colombia as of October 2020 considering a single study (Tuesca Molina, 2019; Programa Vida Nueva, 2016)								8,70%	

Note: Own elaboration, 2020.

**GDM prevalence in Colombia:** A general prevalence was found among the 7 studies of 4.25%. However, and according to the worldwide debate, this result depends on the criteria applied in each study to measure gestational diabetes. Of the 7 studies considered in this review, 3 diagnosed GDM using the O'Sullivan criteria, which are currently discontinued due to the scientific evidence found in the last 10 to 15 years. The prevalence according to these 4 studies<sup>12-15</sup> reports two prevalences: one with Carpenter and Coustan criteria adopted by the ADA and another according to O'Sullivan criteria) with O'Sullivan criteria is 3.84%. And the other 3 studies with IADPSG (PTOG) criteria reported a prevalence of 4.97%<sup>15-18</sup> prevalence reported with Carpenter Coustan criteria adopted by the ADA.<sup>19</sup> However, the only study that declared and followed a precise methodology for the detection and diagnosis of GDM was that of Tuesca Molina et al.,<sup>18</sup> because it was based on the results of the Vida Nueva Program in agreement with the Mayor's Office of Barranquilla and the World Diabetes Foundation (WDF); study based on the GDM care guide of the program itself (2016) and on the Colombian Ministry of Health's GDM Guide,<sup>8</sup> which have clearly defined following the IADPSG criteria<sup>4,7,19</sup> to make the diagnosis of GDM. The IADPSG criterion consists of performing the one-step PTOG test from week 24 to 28. The criteria for diagnosing GDM before week 24 are: fasting blood glucose  $\geq 92$  and  $< 126$  mg/dl. Taking all the above into account, it could be said that the result of this study, due to the size of the population studied (21,169) and the methodology followed to make

the diagnosis, would be the most valid to consider the prevalence of GDM at 8.7% from 2012 to 2014 in the city of Barranquilla in Colombia Table 2.

**Criteria for diagnosing GDM in Colombia:** Different criteria were used to detect and diagnose GDM from O'Sullivan, NDDG, WHO, ADA, Carpenter and Coustan to those of the IADPSG.<sup>7</sup>

**Methodological quality of the included studies and GRADE evaluation:** Considering the criteria for evaluating the quality of the studies according to the GRADE methodology, as they are observational studies, their quality is low. And it was not possible to increase their quality, considering that they are studies that do not have a large magnitude of effect (except for the study carried out by the Vida Nueva Program between 2012 and 2014 and reported in the article by Tuesca Molina et al.,<sup>18</sup> and in the GDM Care Guide.<sup>8</sup> However, the study of the Vida Nueva Program does not report a prevalence adjusted for variables such as age, socioeconomic level, BMI of pregnant women, among others. Nor does it report the follow-up of the participants, therefore, it does not report how many were lost in the measurement process. In addition, confounding factors in the measurement to diagnose GDM are present in most of the few studies that have been carried out on the subject.

**Methodological quality of the included studies and GRADE evaluation:** Considering the criteria for evaluating the quality of

the studies according to the GRADE methodology, as they are observational studies, their quality is low. And it was not possible to increase their quality, considering that they are studies that do not have a large magnitude of effect (except for the study carried out by the Vida Nueva Program between 2012 and 2014 and reported in the article by Tuesca Molina et al.,<sup>18</sup> and in the GDM Care Guide.<sup>8</sup> However, the study of the Vida Nueva Program does not report a prevalence adjusted for variables such as age, socioeconomic level, BMI of pregnant women, among others. Nor does it report the follow-up of the participants, therefore, it does not report how many were lost in the measurement process. In addition, confounding factors in the measurement to diagnose GDM are present in most of the few studies that have been carried out on the subject.

**Comparison of the prevalence of GDM in Colombia with the rest of the world:** 10 systematic reviews and meta-analyses and 10 prevalence studies from various regions of the world were found

that show an overview of the prevalence of GDM based on scientific evidence. In addition, the estimated prevalence is reported by the International Diabetes Federation IDF for 2019.<sup>20</sup> The comparative study is shown in Table 3. In systematic reviews and meta-analyses on China, Asia, South and East Asia, India, and Iran,<sup>6,21-24</sup> a mean prevalence of 9 was reported, 72%; the IDF<sup>20</sup> reported for the South and East Asia region: 32.9 %. For Africa, 2 systematic reviews and meta-analyses were found,<sup>25-26</sup> with a mean prevalence of 13.81%; the IDF<sup>20</sup> reported 11.48% for this region. For Europe, 2 systematic reviews were found: for the Eastern Mediterranean of Europe,<sup>27</sup> which reported 11.70%, and that of Karacam,<sup>28</sup> which reported 7.7% for Turkey; the IDF<sup>20</sup> reported for this region: 19.49 %. For the Western Pacific, which includes Australia, the IDF<sup>20</sup> reported a 14.71% prevalence of GDM for the area; Chamberlain's systematic review<sup>29</sup> reported 5.7% for Australia with Aboriginal participants and Torres Strait Islander women.

**Table 3** Comparative study of the prevalence of GDM in the world and IDF report 2019

First author, year, included studies	Type of study	population, sample	age in years	diagnostic criteria	Prevalencia DMG, IDF, 2019	Prevalencia DMG	IC	Conclusions
Chenghan Gao, 2019, 25 studies	Systematic review and metanalysis	79064	28,49	IADPSG, 2010	32,9	14,80	95%: 12.8–16.7%	This systematic review is the first to estimate the combined prevalence of GDM among women in mainland China according to the International Association of Diabetes and Pregnancy Study Groups criteria. The results of our systematic review suggest a high prevalence of GDM in mainland China, indicating that this country might have the highest number of GDM patients worldwide.
Kai Wei Lee, 2018, 85 studies	Systematic review and metanalysis	2314763	Not reported	Diferentcriteria		11,50	95%: 10.9–12.1	A high prevalence of GDM was found among the Asian population. Asian women with common risk factors, especially those with a history of prior GDM, congenital anomalies, or macrosomia, should receive additional care from the physician as high-risk cases of GDM during pregnancy.

Table 3 Continued.....

First author, year, included studies	Type of study	population, sample	age in years	diagnostic criteria	Prevalencia DMG, IDF, 2019	Prevalencia DMG	IC	Conclusions
Cong Luat Nguyen, 2018, 48 studies	Systematic review and metanalysis	3594803	Not reported	Diferentcriteria		10,10	95%: 6.5%-15.7%	Prevalence of GDM in East and Southeast Asia was high and varied between and within countries. There is a need for international uniformity in screening strategies and diagnostic criteria for GDM.
Mehri Jafari-Shobeiri, 2015, 24 studies	Systematic review and metanalysis	26203	29,43	Diferentcriteria		3,41	—	Considering the high prevalence of postpartum diabetes and its related factors in Iran, strategic planning for disease prevention and reduction is inevitable.
Katherine T. Li, 2018, 64 studies	Systematic review and metanalysis	Not reported	Not reported	Diferentcriteria		8,80	95%: 15.5, 23.6	In India, GDM prevalence estimates vary substantially depending on diagnostic criteria. When evaluating the detection and diagnostic criteria for GDM, providers must consider the needs of their patients and correlate the detection criteria with pregnancy outcomes.
Akwilina W. Mwanri, 2015, 22 studies	Systematic review and metaregression	30216	30,53	Diferentcriteria	11,48	14,00	—	There are few studies on the prevalence and risk factors of GDM in sub-Saharan Africa and the heterogeneity is high. The prevalence was up to approximately 14% when high-risk women were studied. Preventive measures should be taken to reduce short- and long-term complications related to gestational diabetes in sub-Saharan Africa.

Table 3 Continued....

First author, year, included studies	Type of study	population, sample	age in years	diagnostic criteria	Prevalencia DMG, IDF, 2019	Prevalencia DMG	IC	Conclusions
Achenef Asmamaw Muche, 2019, 23 studies	Systematic review and metanalysis	11902		New 2013 WHO or ADA or modified IADPSG diagnostic criteria		13,62	95%: 10.99, 16.23	The prevalence of GDM is high in Africa. Being overweight and/ or obese, having had a macrosomic baby, a family history of diabetes, a history of stillbirth, a history of abortion or miscarriage, chronic hypertension, and a history of previous GDM were factors associated with GDM. It is strongly recommended to prevent overweight and obesity, paying due attention to women who have high-risk cases of GDM during pregnancy to mitigate the burden.
Zekiye Karaçam, 2019, 41 studies	Systematic review and metanalysis	50767		Not reported	19,49	7.7	95%: 1.9- 27.9%	GDM prevalence in Turkey is remarkably high and the risk factors are similar to what has been reported in the current international literature. Continuing routine screening for GDM can help control the condition while ensuring that risk groups take special preventive measures and protecting maternal and child health.
Mahin Badakhsh, 2019, 33 studies	Systematic review and metanalysis	887166				11,70		Despite the great diversity of methods, the results of the present study indicate a high prevalence of GDM in the Eastern Mediterranean region, indicating a greater interest of policy makers in early detection and proper management.
Catherine Chamberlain, 2015, 23 studies	Systematic review and metanalysis	—	—	Diferentcriteria		5,74	95%: 4,78- 6.71	GDM prevalence among indigenous women varies markedly, probably due to variation in diagnostic and screening practices.

Table 3 Continued.....

First author, year, included studies	Type of study	population, sample	age in years	diagnostic criteria	Prevalencia DMG, IDF, 2019	Prevalencia DMG	IC	Conclusions
Carla L. DeSisto, 2014	Transversal study	23479	27,5	Diferentcriteria	24,88	9,20		Results indicate that the prevalence of GDM is as high as 9.2% and is more likely to be reported on the PRAMS questionnaire than on the birth certificate. We found no statistical differences in the prevalence of GDM between the 2 phases. Further studies are needed to understand discrepancies in GDM reporting by data source.
Sarah Stark Casagrande, 2018	Transversal study	8185				7,60		GDM prevalence in the US was 7.6%, and 19.7% of these women had a subsequent diagnosis of diabetes. Women with a history of GDM, a family history of diabetes, and obesity should be carefully monitored for dysglycemia.
Roseanne O. Yeung, 2017	Transversal study	498013				6,00		Compared with the general population, the prevalence of GDM is higher in Chinese Canadians and South Asians. Increasing maternal age is an important factor contributing to a higher prevalence of GDM in Chinese women. GDM rates were higher in both ethnic and general population women in BC compared with AB, suggesting that, in addition to differences in ethnic distribution, differences in diagnostic practices likely contribute to the observed geographic differences in GDM prevalence.
X.A. López-de la Peña, 1997		187		IADPSG, 2010	16,14%	6,90		GDM represents a serious public health problem. Appropriate screening, diagnosis, follow-up, and treatment should be implemented.

Table 3 Continued.....

First author, year, included studies	Type of study	population, sample	age in years	diagnostic criteria	Prevalencia DMG, IDF, 2019	Prevalencia DMG	IC	Conclusions
E. Meza, 1995	Transversal study	519		O'Sullivan & Mahan		11,00		A high prevalence of GD and an abnormal value was found during the OGTT in a Mexican population. Recommendations for GD screening should be consistently implemented in pregnant women of Mexican descent.
Gloria T. Larrabure-Torrealva, 2018	Transversal study	1300	28,86	IADPSG, 2010		16,00		GDM is highly prevalent and was associated with maternal obesity, a family history of diabetes, and antepartum depression in Peruvian women. Intervention programs aimed at the early diagnosis and management of gestational diabetes should take into account maternal obesity, a family history of diabetes, and antepartum depression.
Pamela Antoniazzi dos Santos, 2020	Transversal study	2313		IADPSG, 2010		5,40	95%: 4.56- 6.45	In this population, the prevalence of gestational diabetes mellitus was 5.4%. Age and overweight were predictors of gestational diabetes.
Silvia Gorban de Lapertosa, 2020	Cohort study			IADPSG, 2010 & ALAD		25% IADPSG, 9,8% ALAD criteria		A high metabolic risk population is identified using the ALAD criteria.
I. Mella, 1990	Retrospectiv cohort study	580 pregnant women and 100 controls				4,27		It was concluded that the frequency of gestational diabetes is significantly higher in pregnant women at risk of diabetes than in those who are not. In developing countries, it is recommended that screening for the disease be limited to pregnant women over 25 years of age, obese, and with a fasting blood glucose level greater than 4.4 mmol/l.



Table 3 Continued.....

First author, year, included studies	Type of study	population, sample	age in years	diagnostic criteria	Prevalencia DMG, IDF, 2019	Prevalencia DMG	IC	Conclusions
Laura Andrea Huidobro, 2004	Retrospectiv cohort study	234	28,6	ADA, 1990		11,20		GDM and obesity are highly prevalent in Chilean pregnant women. BMI, family history of type 2 DM, and age have been shown to be independent risk factors for this condition. On the other hand, DG is associated with a higher risk of cesarean section and greater complications for the newborn.

Note: Own elaboration, 2020.

For North America and the Caribbean, 2 cross-sectional studies from the United States<sup>30-31</sup> and the cross-sectional study of Asian citizens in Canada reported a mean of 7.6%; the IDF<sup>20</sup> reported 24.88% for this region. No systematic reviews or meta-analyses on the prevalence of GDM in South and Central America were found. A study was found in Aguascalientes (Mexico) from 1997,<sup>32</sup> which reported a prevalence of GDM of 6.9%. A recently produced cross-sectional study in Lima (Peru)<sup>33</sup> that reported with IADPSG criteria in 1300 participants with a mean age of 28.86, a prevalence of GDM of 16%. A cross-sectional study from Brazil<sup>34</sup> was found with a prevalence of 5.40%. A cohort study was found in Argentina<sup>35</sup> that applied the criteria of both the IADPSG= 25% prevalence of GDM and the ALAD and established a different prevalence = 9.8%. Two studies from Chile were found,<sup>36-37</sup> whose results are outdated. The prevalence of GDM reported by the IDF<sup>20</sup> for South and Central America is 16.14%: this figure was obtained from the 13.5% prevalence of hyperglycemia in pregnancy for South and Central America<sup>20</sup> (p. 53), of which the IDF considers 83.6% to be represented by the DMG.

## Discussion

This systematic review is the first to be carried out in Colombia on this subject, it included more than 38,000 participants from 6 cities in the country, showing a prevalence of GDM of 8.7% if only the study carried out by the Vida Nueva Program in Barranquilla is considered, which used IADPSG criteria; in the other 4 articles the prevalence varies according to the detection and diagnostic criteria used. In addition, there are 2 of the 7 articles included (Medellín 1 and 2)<sup>14-15</sup> that were written more than 15 years ago, for which reason their results were not considered.

Prevalence of 8.7% is almost half of that estimated by the IDF<sup>20</sup> for the Central and South American region. It is not about underreporting because screening was universal from 2012 to 2014. This prevalence for Colombia is lower than that of developed countries such as the United States, Canada, and China, and that of developing countries in Africa and Asia. It is not possible to establish whether this prevalence has decreased or increased because no other reference studies were found. Although the 2012-2014 Vida Nueva Program study was assumed as prevalence, it did not include multivariate and subgroup analyzes that reported adjusted prevalence according to factors such as age, socioeconomic level, educational level, BMI, and

other risk factors. Regarding the criteria for diagnosing GDM, it is known that the Colombian Gestational Diabetes Guide<sup>8</sup> proposes the IADPSG criteria; therefore, future studies on the prevalence of GDM in Colombia should follow this recommendation to have a single criterion that serves as a comparative basis.

However, it is suggested that studies report glucose test results so that whatever criteria are used to detect and diagnose GDM, the reference data is clear and accurate and can be converted based on the criteria used. as recommended by the IADPSG.<sup>7</sup> Comparative study of these results with systematic reviews and meta-analyses from various regions of the world and with the IDF estimates of GDM<sup>20</sup> for these regions, show that in general the prevalence of GDM estimated by the IDF is higher than those found in the scientific evidence reviewed. And it is more than double (16.14%) for Central and South America than the prevalence found in Colombia (8.7%). If the data reported in this review are considered, it could be said that Colombia is in the world average for GDM, considering that Africa has the highest prevalence of GDM (13.81%), and Australia the lowest (5.74%). If the IDF estimates are considered,<sup>20</sup> Asia would have the highest GDM prevalence (32.9%) and Africa the lowest (11.48%) and the prevalence resulting from this review (8.7%) would be the lowest GDM prevalence of all world regions. We do not have clear reasons for the differences between the IDF estimates<sup>20</sup> and the average prevalence reported in the reviewed scientific evidence, and we recommend considering the result of Colombia comparing it with the results of the scientific evidence until further studies are carried out and higher quality than those carried out so far in Colombia and South America.

## Conclusion

This systematic review highlights the need for additional high-quality research on the prevalence of GDM in Colombia. Such research is needed to inform the development of evidence-based guidelines that will help clinicians care for women with DIP and depression. It is strongly recommended to carry out high-quality studies in all the cities of the country following the methodology for detection and diagnosis of GDM contemplated in the National Ministry of Health Guide on this condition,<sup>8</sup> because it is necessary to determine the real prevalence of GDM in Colombia, which will serve as a reference point to measure the impacts of intervention programs

and promotion and prevention of this condition. For now, there is only one benchmark, which is the 2012-2014 results of the Vida Nueva Program in agreement with the Mayor's Office of Barranquilla and the World Diabetes Foundation, which have been doing work that covers the last decade (2010-2020).

**Limitations and strengths:** Included studies are observational studies that, from the quality assessment of the GRADE studies, start from a low quality of evidence due to the biases that characterize them (selection bias, information bias, recall bias, attrition bias). Another limitation is that these were studies on hospital data and were not multicenter and multilevel studies that showed an overview of GDM in Colombia. On the other hand, the populations of pregnant women were of urban origin, and it is necessary to refer to the rural areas of the country, where there could be a greater number of GDM cases, probably related to the socioeconomic level, and the socio-educational level, which in international evidence is associated with risk factors such as obesity. Another limitation is the size of the samples of the included studies, which ranged from 250 to 21,200; therefore, the results of a combined prevalence could suffer great variability.

## Contribution of the authors

Conceptualization and design: A.M., S.C.M.M., J.C.M.E., A.C.M.B., J.C.M.R., M.C.P.M. Methodology: A.M., S.C.M.M., J.C.M.E. Data Acquisition and Software: A.C.M.E.; Analysis and interpretation of data: A.M., S.C.M.M., J.C.M.E. Principal Investigator: A.M., S.C.M.M. Research: A.M., S.C.M.M., J.C.M.E., A.C.M.B., J.C.M.R., M.C.P.M. Manuscript writing: A.M., S.C.M.M., J.C.M.E. Preparation of original draft: A.M., S.C.M.M., J.C.M.E. A.C.M.B. Drafting, review and editing of the manuscript: A.M., S.C.M.M., J.C.M.E., A.C.M.B. Visualization: A.M., S.C.M.M. Supervision: A.M., S.C.M.M., J.C.M.E.

## Acknowledgments

The authors wish to thank the New Life Generation Project: WDF 15-955 Project, Barranquilla, Colombia and the Simón Bolívar University of Barranquilla, Colombia.

## Conflict of interest

None.

## Financing sources

self-financed.

## References

- Organización Mundial de la Salud OMS. *Informe Mundial sobre la Diabetes*. 2016.
- Metzger BE. Summary and recommendations of the Third International Workshop-Conference on Gestational Diabetes Mellitus. *Diabetes*. 1991;40(Suppl 2):197-201.
- Mendoza Charris H, Armenta Ferreira J, Díaz Bernier A. *Detección y manejo de la diabetes gestacional*. Guía de atención. World Diabetes Foundation, Alcaldía de Barranquilla y Fundación Vida Nueva. Barranquilla, Ed. Mejoras, marzo. 2016.
- HAPO Study Cooperative Research Group, Metzger BE, Lowe LP, et al. Hyperglycemia, and adverse pregnancy outcomes. *N Engl J Med*. 2008;358(19):1991-2002.
- Metzger BE, Persson B, Lowe LP, et al. Hyperglycemia and adverse pregnancy outcome study: neonatal glycaemia. *Pediatrics*. 2010;126(6):e1545-1552.
- Gao C, Sun X, Lu L, et al. Prevalence of gestational diabetes mellitus in mainland China: A systematic review and meta-analysis. *Journal of diabetes investigation*. 2019;10(1):154-162.
- Coustan DR, Lowe LP, Metzger BE, et al. The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study: paving the way for new diagnostic criteria for gestational diabetes mellitus. *Am J Obstet Gynecol*. 2010;202(6):654.e1-6.
- Alejandro Gaviria Uribe, Fernando Ruiz Gómez, Carmen Eugenia Dávila Guerrero, et al. *Guía de práctica clínica para el diagnóstico, tratamiento y seguimiento de la diabetes gestacional*. Sistema General de Seguridad Social en Salud, Colombia. 2015.
- Urrutia G, Bonfill J. Declaración PRISMA: una propuesta para mejorar la publicación de revisiones sistemáticas y metaanálisis. *Med Clin (Barc)*. 2010;135(11):507-511.
- Moher D, Liberati A, Tetzlaff J, et al. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med*. 2009;6(7):e1000097.
- Schumemann H, Brożek J, Guyatt G, et al. *GRADE Handbook*. Grading of Recommendations Assessment, Development and Evaluation, Grade Working Group. 2013.
- Rincón Torres D, Villamizar Maldonado K. *Incidencia de diabetes gestacional en Bucaramanga durante los años 2016 y 2017*. Bucaramanga: Universidad de Santander. 2018.
- Burbano López RM, Castaño Castrillón JJ, González Castellanos L, et al. Frecuencia de diabetes mellitus gestacional y factores de riesgo en gestantes atendidas en clínicas de ASSBASALUD ESE, Manizales (Colombia), 2011-2012: estudio de corte transversal. *Revista Colombiana de Obstetricia y Ginecología*. 2014;65(4):338-345.
- Campo Campo MN, Posada Estrada G, Betancur Bermúdez LC, et al. Factores de riesgo para diabetes gestacional en población obstétrica en tres instituciones de Medellín, Colombia. Estudio de casos y controles. *Revista Colombiana de Obstetricia y Ginecología*. 2012;63(2):114-118.
- Cortés H, Ocampo I, Villegas A. Prevalencia de diabetes mellitus gestacional en una población de Medellín de 1999-2000: valor predictivo positivo de la prueba de tamiz y comparación de los criterios de la NDGG y la ADA. *Revista Colombiana de Obstetricia y Ginecología*. 2002;53(1):81-85.
- Vergara Camargo JL. Prevalencia de diabetes gestacional en el Hospital Gestionar Bienestar, Zapatoca, Santander, 2013-2017. *Revistas Médicas UIS*. 2018;31(2):17-23.
- Ruiz Hoyos BM, Londoño Franco AL, Ramírez Aristizábal RA. Prevalencia de diabetes mellitus gestacional por curva de tolerancia a la glucosa en las semanas 24 a 28. Cohorte prospectiva en Armenia, Colombia, 2015-2016. *Revista Colombiana de Obstetricia y Ginecología*. 2018;69(2):108-116.
- Tuesca Molina R, Acosta Vergara T, Domínguez Lozano B, et al. Diabetes gestacional: implementación de una guía para su detección en la atención primaria de salud. *Rev Med Chil*. 2019;147(2):190-198.
- American Diabetes Association ADA. Standards of Medical Care in Diabetes-2020 Abridged for Primary Care Providers. *Diabetes Care*. 2020;38(1):10-38.
- International Diabetes Federation IDF*. Atlas de la Diabetes de la FID. 9<sup>th</sup> edn. 2019.
- Lee KW, Ching SM, Ramachandran V, et al. Prevalence, and risk factors of gestational diabetes mellitus in Asia: a systematic review and meta-analysis. *BMC Pregnancy Childbirth*. 2018;18(1):494.
- Nguyen CL, Pham NM, Binns CW, et al. Prevalence of Gestational Diabetes Mellitus in Eastern and Southeastern Asia: A Systematic Review and Meta-Analysis. *J Diabetes Res*. 2018;2018:6536974.

23. Li KT, Naik S, Alexander M, et al. Screening and diagnosis of gestational diabetes in India: a systematic review and meta-analysis. *Acta Diabetol.* 2018;55(6):613–625.
24. Jafari Shobeiri M, Ghojzadeh M, Azami Aghdash S, et al. Prevalence and Risk Factors of Gestational Diabetes in Iran: A Systematic Review and Meta-Analysis. *Iran J Public Health.* 2015;44(8):1036–1044.
25. Mwanri AW, Kinabo J, Ramaiya K, et al. Gestational diabetes mellitus in sub-Saharan Africa: systematic review and metaregression on prevalence and risk factors. *Trop Med Int Health.* 2015;20(8):983–1002.
26. Muche AA, Olayemi OO, Gete YK. Prevalence and determinants of gestational diabetes mellitus in Africa based on the updated international diagnostic criteria: a systematic review and meta-analysis. *Arch Public Health.* 2019;77:36.
27. Badakhsh M, Daneshi F, Abavisani M, et al. Prevalence of gestational diabetes mellitus in Eastern Mediterranean region: a systematic review and meta-analysis. *Endocrine.* 2019;65(3):505–514.
28. Karaçam Z, Çelîk D. The prevalence and risk factors of gestational diabetes mellitus in Turkey: a systematic review and meta-analysis. *J Matern Fetal Neonatal Med.* 2021;34(8):1331–1341.
29. Chamberlain C, Joshy G, Li H, et al. The prevalence of gestational diabetes mellitus among Aboriginal and Torres Strait Islander women in Australia: a systematic review and meta-analysis. *Diabetes Metab Res Rev.* 2015;31(3):234–247.
30. DeSisto CL, Kim SY, Sharma AJ. Prevalence estimates of gestational diabetes mellitus in the United States, Pregnancy Risk Assessment Monitoring System (PRAMS), 2007-2010. *Preventing chronic disease.* 2014 19;11:E104.
31. Casagrande SS, Linder B, Cowie CC. Prevalence of gestational diabetes and subsequent Type 2 diabetes among U.S. women. *Diabetes Res Clin Pract.* 2018;141:200–208.
32. López de la Peña XA, Cajero Avelar JJ, De León Romo LF. Prevalence of gestational diabetes in a group of women receiving treatment at the Mexican Institute of Social Security in Aguascalientes, Mexico. *Arch Med Res.* 1997;28(2):281–284.
33. Larrabure Torrealva GT, Martínez S, Luque Fernández MA, et al. Prevalence and risk factors of gestational diabetes mellitus: findings from a universal screening feasibility program in Lima, Peru. *BMC Pregnancy Childbirth.* 2018;18(1):303.
34. Santos Pamela Antoniazzi dos, Madi José Mauro, Silva Emerson Rodrigues da, et al. Gestational Diabetes in the Population Served by Brazilian Public Health Care. Prevalence and Risk Factors. *Revista Brasileira de Ginecologia e Obstetricia.* 2020;42(1):12–18.
35. Silvia Gorban de Lapertosa, Stella Sucani, Susana Salzberg, et al. Prevalence of gestational diabetes mellitus in Argentina according to the Latin American Diabetes Association (ALAD) and International Association of Diabetes and Pregnancy Study Groups (IADPSG) diagnostic criteria and the associated maternal-neonatal complications. *Health Care for Women International.* 2021;42(4-6):636–656.
36. Mella I, López G, Durruty P, et al. *Frecuencia de diabetes gestacional en embarazadas en riesgo diabético de Santiago, Chile.* Institutional Repository for Information Sharing. Pan American Health Organization (PAHO). 1990.
37. Huidobro A, Fulford A, Carrasco PE. Incidencia de diabetes gestacional y su relación con obesidad en embarazadas chilenas. *Rev Med Chile.* 2004;132:931–938.