Zhou Z et al. (2024) IMPACT OF GESTATIONAL DIABETES HISTORY ON WOMEN'S SELF-RATED ORAL HEALTH: IMPLICATIONS FOR PHYSICAL WELLNESS AND SPORTS PARTICIPATION. vol. 24 (98.1) pp. 158-170
DOI: https://doi.org/10.15366/rimcafd2024.98.1.011

ORIGINAL

IMPACT OF GESTATIONAL DIABETES HISTORY ON WOMEN'S SELF-RATED ORAL HEALTH: IMPLICATIONS FOR PHYSICAL WELLNESS AND SPORTS PARTICIPATION

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Recibido 12 de abril de 2024 **Received** April 12, 2024
Aceptado 11 de diciembre de 2024 **Accepted** December 11, 2024

ABSTRACT

Aims: To evaluate the relationship between a history of gestational diabetes mellitus (GDM) and self-rated oral health (SROH) using data from the National Health and Nutrition Examination Survey (NHANES) and explore its implications for physical wellness and participation in sports and physical activity. **Methods:** Data from NHANES (2009–2014) were analyzed, including 4,767 women. GDM status was determined by responses to the question, "Have you ever had gestational diabetes?" SROH was assessed via self-report. Univariate and multivariate logistic regression models were used to evaluate the association between GDM and SROH, adjusting for confounders such as age, race, poverty income ratio, education, body mass index, hypertension, smoking, periodontal status, oral self-care, and history of periodontal treatment. **Results:** Among the 4,767 women analyzed, SROH was significantly associated with GDM status. After adjusting for confounders, a history of GDM was associated with poorer SROH (odds ratio 1.441, 95% confidence interval [CI] 1.151–1.803, P = 0.001; odds ratio 1.477, 95% CI 1.158–1.883, P = 0.002; and odds ratio 1.480, 95% CI 1.156–1.895, P = 0.002, respectively). Differences in periodontal status and oral health were observed between women with and without a history of GDM. **Conclusions:** Women with a history of GDM reported worse SROH compared to those without, even after controlling for confounding factors. Poor oral health may affect overall physical wellness, potentially impacting participation in sports and physical activity.

These findings highlight the importance of integrating oral health services into comprehensive wellness programs, particularly for women recovering from GDM, to enhance physical health and promote active lifestyles. Further research is needed to explore the long-term impact of oral health on functional performance and physical activity engagement.

KEYWORDS: Self-Rated Oral Health; National Health and Nutrition Examination Survey; Gestational Diabetes

1. INTRODUCTION

Gestational diabetes mellitus (GDM) is a common metabolic disorder during pregnancy, characterized by glucose intolerance that develops or is first recognized during gestation. While GDM typically resolves postpartum, its long-term health implications for women are significant, including an increased risk of type 2 diabetes, cardiovascular disease, and other chronic conditions. Additionally, emerging evidence suggests a link between GDM and poor oral health outcomes, such as periodontal disease, which can further influence overall physical wellness (Sert & Ozgu-Erdinc, 2021). Oral health is a critical yet often overlooked component of general health, impacting not only systemic conditions but also physical performance and quality of life. Self-rated oral health (SROH) is a subjective measure that reflects an individual's perception of their oral health status and has been shown to correlate with clinical indicators of oral health (Lende & Rijhsinghani, 2020). Poor SROH, particularly in women with a history of GDM, may exacerbate health challenges, leading to systemic inflammation and other complications that hinder physical activity and recovery. This is especially relevant for women aiming to maintain or regain physical fitness postpartum, as oral health issues can impact energy levels, systemic health, and participation in sports or exercise programs. The relationship between GDM and oral health underscores the need for integrative care approaches that address both systemic and oral health concerns (Li et al., 2020; Santos et al., 2020). Understanding this relationship can help develop targeted interventions to promote overall wellness and optimize physical activity engagement, particularly in populations at risk for long-term health complications (Turton & Africa, 2017). This study aims to evaluate the relationship between a history of GDM and SROH using data from the National Health and Nutrition Examination Survey (NHANES). By exploring this association, we seek to highlight the importance of oral health as a component of physical wellness and its potential impact on sports participation and recovery in women with a history of GDM. These findings will provide valuable insights into the role of comprehensive health management in enhancing physical performance and overall quality of life. Periodontal conditions tend to worsen during pregnancy, and periodontal disease is associated with a variety of systemic diseases, such as cardiovascular disease, stroke, diabetes, and adverse pregnancy results (Iheozor‐Ejiofor et al., 2017). Periodontal disease

is considered a risk factor for adverse pregnancy results, including preeclampsia, premature delivery, low birth weight, and intrauterine growth restriction (Bobetsis et al., 2020; Boggess, 2020). Periodontal disease induces local and host immune responses and has been proven to play a potential role in the development of GDM. However, studies on the relationship between periodontitis and GDM show different or even opposing results (Abariga & Whitcomb, 2016). Poor self-rated oral health (SROH) is significantly associated with poor oral hygiene and periodontal health results (Kim, Sharma, & Callaghan, 2012). SROH differs significantly with respect to age, household income, education level, insurance type, smoking type, self-rated health, and dental caries index (Choi et al., 2022). Smokers are more likely to report poorer oral health than non-smokers (Csikar et al., 2013), and people of lower socio-economic status have poorer SROH and are less likely to purchase dental insurance and pay a visit to a dentist regularly (Teusner, Anikeeva, & Brennan, 2014). Aboriginal adults have worse oral and general health than non-Aboriginal adults (Parker et al., 2022). Previous studies have shown that individuals with impaired glucose tolerance have lower self-rated health than normoglycemic individuals (Han et al., 2023). Being underweight and obese is associated with worse SROH (Diurlin et al., 2020). The National Health and Nutrition Examination Survey (NHANES) is a population-based survey on the entire population of the United States. Therefore, we used data from the NHANES to investigate the relationship between a history of GDM and SROH. In this study, we analyzed the sociodemographic characteristics, periodontal status, and oral health care of the study subjects (Moon, Kwak, & Jang, 2017). We additionally evaluated the factors that affected SROH. After adjusting for known confounding factors, we used univariate and multivariate logistic regression analyses to better understand the association between GDM and periodontitis, which is important to guide oral healthcare measures during pregnancy and the postpartum period (Cui et al., 2022).

2. Material and Methods

We use NHANES data collected from 2009 to 2014, which contain cross-sectional sociodemographic, dietary, and medical data collected through questionnaires, standardized physical examinations, and laboratory tests. The NHANES is a population-based research program conducted by the National Center for Health Statistics (NCHS) to monitor the health and nutritional status of civilians and non-medical staff in the United States. Data collection and analysis were through a probabilistic design with multistage, complex clustering rather than from a simple random sample based on the United States population. The NHANES (http://www.cdc.gov/nchs/nhanes.htm), which adopts a cluster design that is complex, stratified, multistage, and probabilistic, selects a nationally representative sample from the non-hospitalized population to assess the health and nutritional status of the civilian noninstitutionalized population. The NCHS Research Ethics Review Board approved the trial

protocol of the NHANES, and all participants provided written informed consent. This study was a cross-sectional survey, and data from 2011 to 2014 (three 2-year survey periods: 2009–2010, 2011–2012, and 2013–2014) were analyzed. We investigated the relationship between a history of gestational diabetes and SROH. Our analytic cohort was restricted to women aged ≥20 years at the time of participation in the NHANES, who were not pregnant at the time of the survey. Women who did not have SROH or gestational diabetes questionnaire data were excluded. Finally, 4767 women were included in the survey.

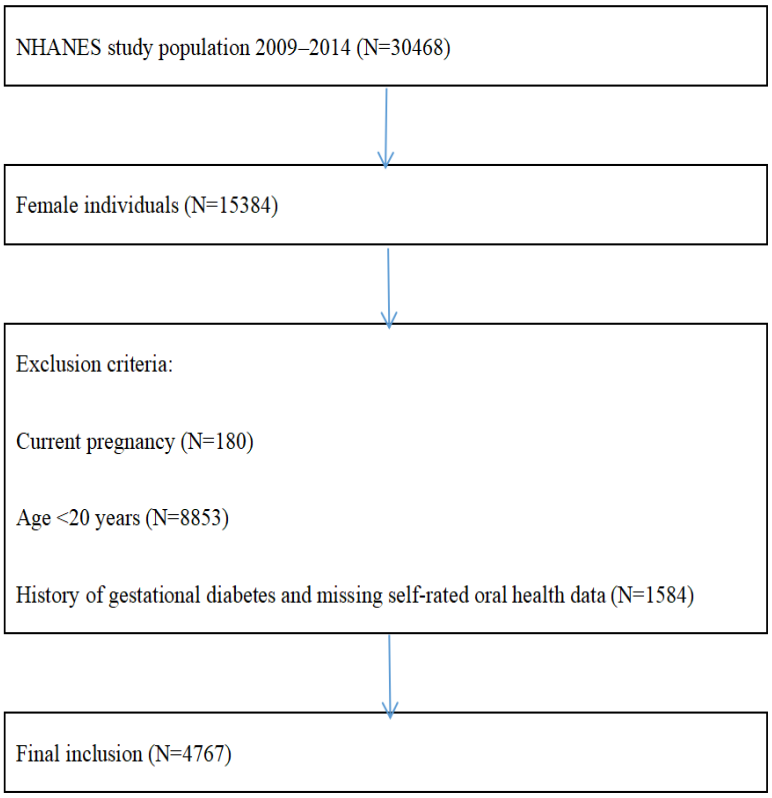

Figure 1: Flow chart of study subject exclusion and inclusion

2.1 History of Gestational Diabetes

This was the independent variable in this study. Gestational diabetes was defined as a definite diagnosis of the same by a doctor or other health professionals during pregnancy, excluding pregestational diabetes.

2.2 Self-Rated Oral Health

For the outcome variable in this study, an oral health questionnaire with intraoral assessment by a dental hygienist was used to provide data on oral health of United States civilians collected during NHANES 2009–2014 (Dye et al., 2019; Dye et al., 2014). Self-rated oral health was categorized as very good/very good/good and fair/poor.

2.3 Periodontal Status

Periodontitis was diagnosed using the criteria given by the Centers for Disease Control and Prevention and American Academy of Periodontology and divided into three categories: (1) mild periodontitis: attachment loss (AL) ≥3 mm at the interproximal site of ≥2 non-single teeth and periodontal probing depth (PD) ≥4 mm at the interproximal site of ≥2 non-single teeth or PD ≥5 mm at ≥1 interproximal site; (2) moderate periodontitis: AL ≥4 mm at the interproximal site of ≥2 non-single teeth or PD ≥5 mm at the interproximal site of ≥2 non-single teeth; and (3) severe periodontitis: AL ≥6 mm at the interproximal site of ≥2 non-single teeth, and PD ≥5 mm at ≥ 1 interproximal site (Page & Eke, 2007). In this study, subjects were divided into those with moderate/severe periodontitis and those with mild/no periodontitis.

2.4 Lifestyle and Socio-Economic Variables

These include age, race/ethnicity (Mexican, other Hispanic, Non-Hispanic White, Non-Hispanic Black, and others), education (<12 years, 12 years, or >12 years of education), smoking (at least 100 cigarettes in a lifetime defined as smoking), body mass index (BMI; <25, 25–30, ≥30 kg/m²), hypertension (defined as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg and averaged over three valid measurements), and the ratio of household income to poverty (PIR, reflecting the ratio of household income relative to the poverty line).

2.5 Statistical Analyses

In this study, SPSS26.0 was applied for data analysis. Quantitative data conforming to the normal distribution were expressed as means±standard deviations, and qualitative data were expressed as rates or constituent ratios. If the quantitative data conformed to the normal distribution, variance analysis was used. If the quantitative data did not conform to the normal distribution, the rank sum test was used.

The chi-square test was used for qualitative data. Binary logistic regression was used to analyze the relationship between a history of GDM and SROH: (1) univariate logistic regression and (2) multivariate logistic regression: model 1, adjusted for age and ethnicity; model 2, adjusted for age, ethnicity, PIR, education, smoking, and BMI; and model 3, adjusted for age, ethnicity, PIR, education, smoking, BMI, periodontitis, and oral health care. Two-sided P-values <0.05 were considered statistically significant.

3. Results

The general characteristics of the study participants are depicted in Table 1. Overall, 389 women had GDM, had a lower average age when getting

the disease, had a lower level of education and income, and had a higher prevalence of smoking and obesity. No significant difference in the prevalence of hypertension between women with and without GDM was found. The proportion of patients with moderate/severe periodontitis (52.7%) was higher than that of the controls (51.0), and the difference was not significant (P=0.516).

Table 1(a): Characteristics of the study population according to GDM history

VARIABLES	GDM HISTORY	NO GDM HISTORY	P-VALUE
N	389	4378	
AGE (YEARS)	46.5±11.0	55.2±14.5	<0.001
PIR	2.4±1.6	2.5±1.6	0.546
BMI (KG/M^2)			<0.001
<25	255 (67.1%)	3230 (75.1%)	
25～	39 (10.3%)	430 (10.0%)	
30～	86 (22.6%)	639 (14.9%)	
HYPERTENSION			0.003
YES	50 (13.4%)	825 (19.9%)	
NO	322 (86.6%)	3322 (80.1%)	
ETHNICITY/RACE			<0.001
MEXICAN-AMERICAN	75 (19.6%)	566 (13.1%)	
OTHER HISPANIC	43 (11.2%)	475 (11.0%)	
NON-HISPANIC WHITES	134 (35.0%)	1922 (44.4%)	
NON-HISPANIC BLACKS	72 (18.8%)	949 (21.9%)	
OTHER RACES	59 (15.4%)	416 (9.6%)	
EDUCATION LEVEL			0.300
<12 YEARS	92 (24.0%)	1118 (25.9%)	
12 YEARS	76 (19.8%)	954 (22.1%)	
>12 YEARS	215 (56.1%)	2248 (52.0%)	
SMOKING			0.506
YES	141 (36.8%)	1668 (38.5%)	
NO	242 (63.2%)	2660 (61.5%)	
PERIODONTITIS (GUM DISORDER)			0.516
MODERATE/SEVERE PERIODONTITIS	205 (52.7%)	2232 (51.0%)	
MILD/NO PERIODONTITIS	184 (47.3%)	2146 (49.0%)	
FLOSSING/ADJACENT SURFACE CLEANING TOOLS			0.028
YES	284 (74.2%)	2943 (68.7%)	
NO	99 (25.8%)	1339 (31.3%)	
USE OF MOUTHWASH			0.615
YES	218 (56.9%)	2494 (58.2%)	
NO	165 (43.1%)	1788 (41.8%)	

Table 1(b): Characteristics of the study population according to GDM history

VARIABLES	GDM HISTORY	NO GDM HISTORY	P-VALUE
HISTORY OF PERIODONTAL TREATMENT			0.348
YES	51 (20.3%)	643 (22.9%)	
NO	200 (79.7%)	2164 (77.1%)	
SROH			<0.001
EXCELLENT/VERY GOOD/GOOD	226 (59.0%)	2964 (69.2%)	
FAIR/POOR	157 (41.0%)	1320 (30.8%)	

GDM Gestational diabetes mellitus, PIR the ratio of household income to poverty, BMI body mass index, SROH self-rated oral health.

A lower proportion of participants with previous GDM had a better oral self-assessment (7.1%) than controls (10.6%). Those with lower education and smokers had poorer oral self-assessment, and those with better oral self-assessment had lower BMI and higher income poverty. In addition, those who used an adjacent surface cleaning tool had better oral self-assessment, while those who used mouthwash had poorer oral self-assessment. Among those with better oral self-assessment, 43.2% had moderate/moderate periodontitis, which was lower than the 61.7% of those with poor oral self-assessment, and all differences were significant (P<0.01).

Table 2(a): Characteristics of the study population according to self-rated oral health

VARIABLES	SROH (EXCELLENT/VERY GOOD/GOOD)	SROH (FAIR/POOR)	P-VALUE
N	3190	1477	
BMI (KG/M^2)	29.3±7.0	31.2±7.7	<0.001
AGE (YEARS)	55.0±14.8	53.0±13.5	<0.001
PIR	2.8±1.6	1.9±1.4	<0.001
GDM			<0.001
1	226 (7.1%)	157 (10.6%)	
2	2964 (92.9%)	1320 (89.4%)	
BMI (KG/M^2)			0.002
<25	2352 (75.2%)	1036 (71.3%)	
25～	320 (10.2%)	147 (10.1%)	
30～	455 (14.6%)	270 (18.6%)	
HYPERTENSION			0.998
YES	584 (19.3%)	271 (19.3%)	
NO	2439 (80.7%)	1132 (80.7%)	
ETHNICITY/RACE			<0.001
MEXICAN-AMERICAN	302 (9.6%)	318 (21.7%)	
OTHER HISPANIC	336 (10.7%)	172 (11.7%)	
NON-HISPANIC WHITES	1542 (49.0%)	469 (32.0%)	

Table 2(b): Characteristics of the study population according to self-rated oral health

VARIABLES	SROH (EXCELLENT/VERY GOOD/GOOD)	SROH (FAIR/POOR)	P-VALUE
NON-HISPANIC BLACKS	621 (19.7%)	384 (26.2%)	
OTHER RACES	345 (11.0%)	122 (8.3%)	
EDUCATION LEVEL			<0.001
<12 YEARS	628 (20.0%)	532 (36.3%)	
12 YEARS	663 (21.1%)	348 (23.8%)	
12+ YEARS	1849 (58.9%)	584 (39.9%)	
SMOKING			<0.001
YES	1115 (35.4%)	650 (44.4%)	
NO	2031 (64.6%)	815 (55.6%)	
PERIODONTITIS (GUM DISORDER)			<0.001
MODERATE/SEVERE PERIODONTITIS	566 (38.3%)	1812 (56.8%)	
MILD/NO PERIODONTITIS	911 (61.7%)	1378 (43.2%)	
FLOSSING/ADJACENT SURFACE CLEANING TOOLS			<0.001
YES	2315 (72.7%)	909 (61.6%)	
NO	870 (27.3%)	567 (38.4%)	
USE OF MOUTHWASH			<0.001
YES	1792 (56.3%)	918 (62.2%)	
NO	1393 (43.7%)	558 (37.8%)	
HISTORY OF PERIODONTAL TREATMENT			0.740
YES	449 (22.9%)	232 (22.3%)	
NO	1515 (77.1%)	807 (77.7%)	

GDM Gestational diabetes mellitus, PIR the ratio of household income to poverty, BMI body mass index, SROH self-rated oral health.

4. Discussion

To the best of our knowledge, this is the first study to explore the relationship between a history of GDM and SROH. In a nationally representative sample of women, women with a history of gestational diabetes exhibited more severe periodontal disease than those without a history of gestational diabetes, consistent with the findings of the NHANES III (Novak et al., 2006). We found poorer SROH in women who had gestational diabetes. This was also true for the clinical and demographic outcomes in those with a history of GDM in our study, and these contributing factors were associated with SROH. Numerous epidemiological studies have shown a link between oral health and adverse pregnancy results, mainly consisting of two pathogenic

mechanisms: direct invasion of the feto-placental unit by oral microorganisms or their components and the influence of inflammatory mediators produced in the oral cavity on the feto-placental unit (Xu & Han, 2022). Some evidence from observational studies suggests that periodontal interventions may reduce adverse pregnancy outcomes (Iheozor‐Ejiofor et al., 2017). We found that SROH was worse in those with a history of gestational diabetes. Based on our findings, we propose several possible hypotheses. First, gestational diabetes is likely to progress to type 2 diabetes (Vounzoulaki et al., 2020), and the relationship between diabetes and oral health has been identified (Kudiyirickal & Pappachan, 2015). Second, pregnant women with GDM are older, less educated, of lower socioeconomic status, have a high percentage of overweight/obesity, and have poorer periodontal status during pregnancy (Anwar et al., 2016; Damante et al., 2022). As a result, oral health awareness is lower and there is also an inability to pay related costs. Changes in sex hormone and blood glucose levels during pregnancy can also lead to oral microbial imbalance, and oral flora during pregnancy appears to be influenced by oral and systemic conditions (e.g. gestational diabetes, pre-eclampsia, among others) (Jang et al., 2021). The detection rate and number of oral bacteria in pregnant women with GDM are higher than those in pregnant women without diabetes during the second trimester (Yao et al., 2019). There are significant differences in salivary and dental plaque flora in patients with GDM (Li et al., 2021). Periodontitis and gestational diabetes may have separate effects on the oral microbiota (Zhang et al., 2021). Oral health is closely linked to general health, which can seriously affect a person's quality of life (Spanemberg et al., 2019). A cross-sectional study of SROH in people with diabetes found that those with older age, lower monthly income, obesity, periodontal disease, very poor/poor/fair self-rated health, and public oral health insurance had a higher probability of caries (Gomez-Aguilar et al., 2020). Another study demonstrated the validity and diagnostic accuracy of SROH data compared with clinical assessment data (Farmer et al., 2017). Therefore, poor SROH is significantly associated with poor oral hygiene and periodontal status, which can help identify unmet periodontal treatment needs and can help guide oral health care programs for pregnant women. Periodontal health promotion strategies should be directed at this group to reduce future periodontal burdens. The strengths of this study include the national representativeness and large sample size of the NHANES data; however, our study also has some limitations. First, this study was cross-sectional and therefore limited our ability to assess causality. Second, other confounding factors (e.g., current blood glucose levels, dietary habits, and other adverse pregnancy histories) were not included in our analysis and were not controlled for in our analysis. Finally, bias was also an issue that we cannot address. This study failed to further elucidate the main mechanism of gestational diabetes and periodontal disease, as well as the association between gestational diabetes and periodontal disease, and still needs further study.

5. Conclusions

This study highlights a significant relationship between a history of gestational diabetes mellitus (GDM) and self-rated oral health (SROH), emphasizing that women with previous GDM are more likely to report poorer oral health compared to those without such a history. Even after adjusting for various confounding factors such as socioeconomic status, body mass index, hypertension, and periodontal health indicators, the association remains robust. These findings underline the long-term impact of GDM on oral health and its broader implications for systemic health and physical well-being. Poor oral health in women with a history of GDM may contribute to systemic inflammation and metabolic dysregulation, compounding the challenges of postpartum recovery and increasing the risk of chronic diseases. From a sports and physical activity perspective, these health issues can significantly impede a woman's ability to engage in physical exercise, which is crucial for maintaining fitness, managing weight, and reducing the risk of type 2 diabetes and cardiovascular diseases. Oral health, therefore, plays a pivotal role in supporting physical wellness and should be integrated into comprehensive health and fitness strategies, particularly for women recovering from GDM. This study also underscores the need for enhanced oral health services and preventive care in women with a history of GDM. Regular dental check-ups, personalized oral hygiene education, and early interventions for periodontal issues can help mitigate the long-term effects of GDM on oral health. Moreover, integrating oral health assessments into postpartum care protocols could foster better health outcomes, enabling women to achieve their physical performance goals and engage actively in sports and other physical activities. Future research should explore the direct impact of improved oral health on physical activity levels and sports participation in this population. Longitudinal studies are also necessary to investigate the long-term benefits of targeted oral health interventions in reducing systemic complications and enhancing overall quality of life. By bridging the gap between oral health and sports medicine, these efforts can contribute to holistic healthcare models that prioritize physical, oral, and systemic wellness for women recovering from GDM.

Funding

This work was supported by research grants from the Stomatology Hospital of Chongqing Medical University.

REFERENCES

Abariga, S. A., & Whitcomb, B. W. (2016). Periodontitis and gestational diabetes mellitus: a systematic review and meta-analysis of observational studies. *BMC pregnancy and childbirth*, *16*, 1-13.

Anwar, N., Zaman, N., Nimmi, N., Chowdhury, T., & Khan, M. (2016). Factors

Associated with Periodontal Disease in Pregnant Diabetic Women. *Mymensingh Medical Journal: MMJ*, *25*(2), 289-295.

Bobetsis, Y. A., Graziani, F., Gürsoy, M., & Madianos, P. N. (2020). Periodontal disease and adverse pregnancy outcomes. *Periodontology 2000*, *83*(1), 154-174.

Boggess, K. A. (2020). Choosing the left fork: Steven Offenbacher and understanding maternal periodontal disease and adverse pregnancy outcomes. *Journal of Periodontology*, *91*, S40-S44.

Choi, J.-A., Mun, S.-J., Chung, W.-G., & Han, S.-Y. (2022). Differences in Determinants Influencing Self-Rated Oral Health in Korean and American Adults. *International journal of environmental research and public health*, *19*(6), 3618.

Csikar, J., Wyborn, C., Dyer, T., Godson, J., & Marshman, Z. (2013). The self-reported oral health status and dental attendance of smokers and non-smokers. *Comm Dent Health*, *30*, 26-29.

Cui, Y., Marshall, A., Tsaih, S.-W., & Palatnik, A. (2022). Impact of prior gestational diabetes on long-term type 2 diabetes complications. *Journal of Diabetes and its Complications*, *36*(9), 108282.

Damante, C. A., Foratori Junior, G. A., Cunha, P. d. O., Negrato, C. A., Sales-Peres, S. H. C., Zangrando, M. S. R., & Sant'Ana, A. C. P. (2022). Association among gestational diabetes mellitus, periodontitis and prematurity: a cross-sectional study. *Archives of Endocrinology and Metabolism*, *66*, 58-67.

Diurlin, S., Eriksson, M. C., Daka, B., Lindblad, U., & Hellgren, M. (2020). Men with impaired glucose tolerance have lower self-rated health than men with impaired fasting glucose. *Primary Care Diabetes*, *14*(1), 40-46.

Dye, B. A., Afful, J., Thornton-Evans, G., & Iafolla, T. (2019). Overview and quality assurance for the oral health component of the National Health and Nutrition Examination Survey (NHANES), 2011–2014. *BMC Oral Health*, *19*(1), 1-11.

Dye, B. A., Li, X., Lewis, B. G., Iafolla, T., Beltran-Aguilar, E. D., & Eke, P. I. (2014). Overview and quality assurance for the oral health component of the National Health and Nutrition Examination Survey (NHANES), 2009-2010. *Journal of Public Health Dentistry*, *74*(3), 248-256.

Farmer, J., Ramraj, C., Azarpazhooh, A., Dempster, L., Ravaghi, V., & Quiñonez, C. (2017). Comparing self-reported and clinically diagnosed unmet dental treatment needs using a nationally representative survey. *Journal of Public Health Dentistry*, *77*(4), 295-301.

Gomez-Aguilar, B., Jiménez-Garcia, R., Palomar-Gallego, M. A., Hernández-Barrera, V., Carabantes-Alarcón, D., & López-de Andres, A. (2020). Oral health status among Spanish adults with diabetes: National Health Survey, 2017. *Primary Care Diabetes*, *14*(5), 552-557.

Han, A. R., Shin, M. H., Yang, J. h., Choi, C. K., Koh, J. T., & Kim, O. S. (2023). Body mass index and self-rated oral health in Korean adults in 2017.

Gerodontology, *40*(2), 183-191.

Iheozor-Ejiofor, Z., Middleton, P., Esposito, M., & Glenny, A. M. (2017). Treating periodontal disease for preventing adverse birth outcomes in pregnant women. *Cochrane database of systematic reviews*(6).

Jang, H., Patoine, A., Wu, T. T., Castillo, D. A., & Xiao, J. (2021). Oral microflora and pregnancy: A systematic review and meta-analysis. *Scientific Reports*, *11*(1), 16870.

Kim, S. Y., Sharma, A. J., & Callaghan, W. M. (2012). Gestational diabetes and childhood obesity: what is the link? *Current opinion in obstetrics & gynecology*, *24*(6), 376.

Kudiyirickal, M. G., & Pappachan, J. M. (2015). Diabetes mellitus and oral health. *Endocrine*, *49*(1), 27-34.

Lende, M., & Rijhsinghani, A. (2020). Gestational diabetes: overview with emphasis on medical management. *International journal of environmental research and public health*, *17*(24), 9573.

Li, F., Hu, Y., Zeng, J., Zheng, L., Ye, P., Wei, D., & Chen, D. (2020). Analysis of risk factors related to gestational diabetes mellitus. *Taiwanese Journal of Obstetrics and Gynecology*, *59*(5), 718-722.

Li, X., Zheng, J., Ma, X., Zhang, B., Zhang, J., Wang, W., Sun, C., Wang, Y., Zheng, J., & Chen, H. (2021). The oral microbiome of pregnant women facilitates gestational diabetes discrimination. *Journal of Genetics and Genomics*, *48*(1), 32-39.

Moon, J. H., Kwak, S. H., & Jang, H. C. (2017). Prevention of type 2 diabetes mellitus in women with previous gestational diabetes mellitus. *The Korean journal of internal medicine*, *32*(1), 26.

Novak, K. F., Taylor, G. W., Dawson, D. R., II, J. E. F., & Novak, M. J. (2006). Periodontitis and gestational diabetes mellitus: exploring the link in NHANES III. *Journal of Public Health Dentistry*, *66*(3), 163-168.

Page, R. C., & Eke, P. I. (2007). Case definitions for use in population-based surveillance of periodontitis. *Journal of Periodontology*, *78*, 1387-1399.

Parker, E., Mejia, G., Spencer, A., Roberts-Thomson, K., Haag, D., & Jamieson, L. (2022). Self-rated oral and general health among Aboriginal adults in regional South Australia. *Australian Dental Journal*, *67*(2), 132-137.

Santos, P. A. d., Madi, J. M., Silva, E. R. d., Vergani, D. d. O. P., Araújo, B. F. d., & Garcia, R. M. R. (2020). Gestational diabetes in the population served by Brazilian Public Health Care. Prevalence and risk factors. *Revista Brasileira de Ginecologia e Obstetrícia*, *42*, 12-18.

Sert, U. Y., & Ozgu-Erdinc, A. S. (2021). Gestational diabetes mellitus screening and diagnosis. *Diabetes: from Research to Clinical Practice: Volume 4*, 231-255.

Spanemberg, J., Cardoso, J., Slob, E., & López-López, J. (2019). Quality of life related to oral health and its impact in adults. *Journal of stomatology, oral and maxillofacial surgery*, *120*(3), 234-239.

Teusner, D. N., Anikeeva, O., & Brennan, D. S. (2014). Self-rated dental health

and dental insurance: modification by household income. *Health and quality of life outcomes*, *12*, 1-8.

Turton, M., & Africa, C. W. (2017). Further evidence for periodontal disease as a risk indicator for adverse pregnancy outcomes. *International dental journal*, *67*(3), 148-156.

Vounzoulaki, E., Khunti, K., Abner, S. C., Tan, B. K., Davies, M. J., & Gillies, C. L. (2020). Progression to type 2 diabetes in women with a known history of gestational diabetes: systematic review and meta-analysis. *bmj*, *369*.

Xu, B., & Han, Y. W. (2022). Oral bacteria, oral health, and adverse pregnancy outcomes. *Periodontology 2000*, *89*(1), 181-189.

Yao, H., Xu, D., Zhu, Z., & Wang, G. (2019). Gestational diabetes mellitus increases the detection rate and the number of oral bacteria in pregnant women. *Medicine*, *98*(11).

Zhang, X., Wang, P., Ma, L., Guo, R., Zhang, Y., Wang, P., Zhao, J., & Liu, J. (2021). Differences in the oral and intestinal microbiotas in pregnant women varying in periodontitis and gestational diabetes mellitus conditions. *Journal of Oral Microbiology*, *13*(1), 1883382.