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Orofacial Changes in the First Year of Life in Babies of Diabetic Mothers in Brazil

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Authors' contributions

This work was carried out in collaboration among all authors. Author SG designed the study, collect data and wrote the manuscript, author FGT designed the study, and wrote the manuscript, author VCB designed the study, and wrote the manuscript, Author DAD designed the study, collect data, and wrote the manuscript. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Aims: Gestational diabetes has a major impact on pregnant women and foetal development, including possible problems in the baby's orofacial and dental development. The objective of this study was to evaluate the oral conditions of babies born to mothers with diabetes, monitoring them monthly from birth to 12 months of age.

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Study Design: This was an observational, prospective, and longitudinal study.
Place and Duration of Study: The study was conducted from August 2022 to August 2023 at the Women's Health Reference Center, located in the municipality of Boa Vista, RR, Brazil.
Methodology: Data were collected from 60 babies who are part of the follow-up project in Brazil. The data included information on the socioeconomic profile of the families, prenatal history, the birth, any problems with the oral mucosa and dentition, and the oral health habits of the babies. After collecting data using a questionnaire, the oral cavity of the babies was examined on a stretcher specifically designed to accommodate them, mouth mirror and WHO probe.
Results: The results of the study revealed some orofacial and dental changes, such as candidiasis, Bohn's nodules and Epstein's pearls, in addition to problems of enamel hypoplasia and hypomineralization.
Conclusion: Dental approach integrated with a multidisciplinary team, emphasizing prevention, plays an important role in the healthy development of children born to mothers with gestational diabetes.

Keywords: Gestational diabetes; pediatric dentistry; epidemiology.

1. INTRODUCTION

Diabetes mellitus is defined as a state of constant hyperglycaemia characterized by an accumulation of glucose in the bloodstream. This condition is typified by the inability of insulin to function properly or the absence of insulin [1].

As indicated by the medical literature, the three most relevant types of diabetes are type I diabetes, which results from an autoimmune process that destroys pancreatic beta cells; type II diabetes, which is characterized by the loss of responsiveness to insulin secretion combined with resistance to insulin; and gestational diabetes mellitus (GDM), a transient condition which the hormones produced by the placenta that are associated with other hormones specific to pregnancy reduce the action of insulin, limiting the entry of glucose into cells [2].

GDM is considered the most frequent metabolic syndrome during pregnancy, and 1 out of 6 new-borns is affected by hyperglycaemia due to maternal diabetes. Given this high prevalence, it is essential to understand the impact of GDM on women during pregnancy and on foetal development. The consequences of GDM in the pregnant woman can include preeclampsia, eclampsia, or a caesarean delivery. Also, GDM can affect newborn health; previous reports indicate a 10% increase in newborn comorbidities related to mothers with GDM [2]. These complications include prematurity, macrosomia, hypoglycaemia, and respiratory distress, malformations, and some complications can be more severe, culminating in foetal mortality [3].

Studies and scientific investigations about the impact of GDM on the general health of pregnant women and foetal development have been well explored in the medical field [3,4]. However, in the dental field, research still does not address some knowledge gaps that recognize, understand and elucidate the repercussions on oral health in the offspring of diabetic mothers [5].

2. METHODOLOGY

The design of this study was observational and longitudinal.

The study was conducted from August 2022 to August 2023 at the Women's Health Reference Center (WHRC), located in the municipality of Boa Vista, RR, Brazil. after approval by the Research Ethics Committee of the School of Dentistry, São Leopoldo Mandic College, under opinion number 5.587.680 and Certificate of Presentation for Ethical Consideration 59072722.0.0000.5374, meeting the fundamental ethical and scientific requirements of Resolution 466/2012 of the National Health Council.

The WHRC is a reference centre in the care of pregnant women with pregnancies considered to be at high risk. Due to the high potential for preterm births, a program called “Follow-up” was created. The program meets the guidelines and objectives of Ordinance MEC-930/2012, which determines comprehensive and humanized care for severe or potentially severe new-borns and authorization for beds in neonatal units under the Unified Health System (SUS).

2.1 Study Population and Procedures

The sample was selected using convenience sampling, including all mothers with GDM during the study period. 60 children were follow-up, they were at the aged 0 to 12 months, both sexes were included in the study, whose mothers were registered and attended at the WHRC /SESAN/RR and signed the Free and Informed Consent Form (FICT) and who did not express negative attitudes towards the execution of the research. All pregnant women were diagnosed with gestational diabetes mellitus (GDM) by the WHRC /SESAU/RR.

Children of indigenous ethnicity were excluded from the study due to the need for special authorization.

Initially, a structured questionnaire about the sociodemographic profile adapted from a previous study [6] was directed to the mothers through a personal interview to ensure that all questions were answered. Information on prenatal care was collected from the medical records available at WHRC.

The exams were performed in a dental environment especially created for the “Follow up” program, with intervals of 30 days until the child reached 12 months of age. They were conducted by tactile-visual inspection using a wooden spatula, sterile tongue depressors and gauze pads [7].

Both the examiner and the interviewee strictly followed all biosafety standards, using disposable caps, gloves and masks. The data collected during the clinical evaluation of each infant were recorded on standardized forms. To evaluate the caries experience, the International Caries Detection System (ICDAS) was used according to Pitts et al. (2013), and to evaluate developmental disorders of dental enamel, the DDE index was used, as recommended by the Fédération Dentaire Internationale, Oral Health Commission [6].

3. RESULTS AND DISCUSSION

Sixty children born to diabetic mothers included in the follow-up project who met the inclusion criteria were examined. The following variables were analysed as independent and dependent variables: sex (Fig. 1), maternal and paternal education (Table 1), family income (Fig. 2), maternal disease prior to pregnancy (Fig. 3), and family hereditary disease (Fig. 4). Also, the relation between mother’s age, and weight and height at birth were reported (Table 2).

Maternal and paternal education were equivalent for primary and secondary education, but paternal education was higher for higher education. The population had a family income between 1 and 3 minimum wages. The age range was 0 to 12 months, 63.3% of the children were male and 54.16% female, and 73.0% of the parents were married or living in a stable relationship. None of the parents were consanguineous. Regarding family income, 46.7% of the parents received only 1 minimum wage. The minimum wage in force at the time of the study corresponded to R$ 1,212.00.

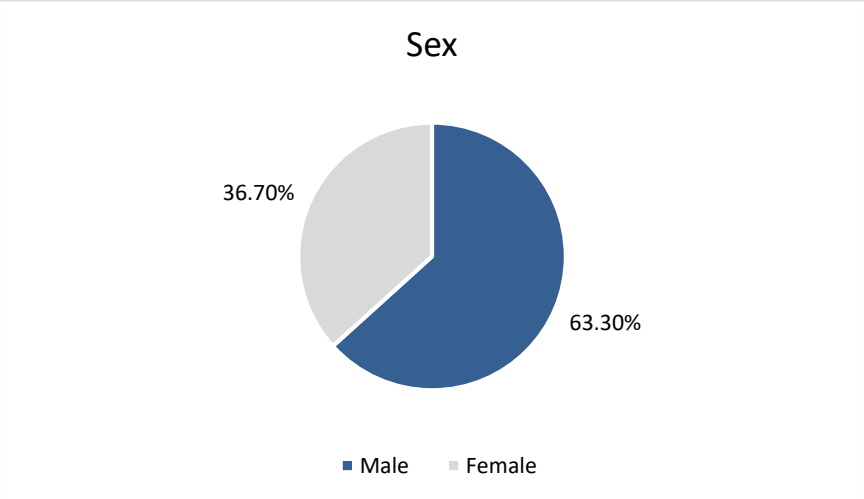

Fig. 1. Descriptive analysis of the sample profile (n=60)

Table 1. Maternal and paternal education levels represented as percentages

Level of Education	Maternal Education	Paternal Education
Incomplete elementary education	1.7%	1.7%
Completed elementary school	10.0%	3.3%
Incomplete high school	8.3%	6.7%
Completed high school	36.7%	10.0%
Incomplete higher education	8.3%	40.0%
Completed higher education	35.0%	6.7%
No education	0%	31.7%

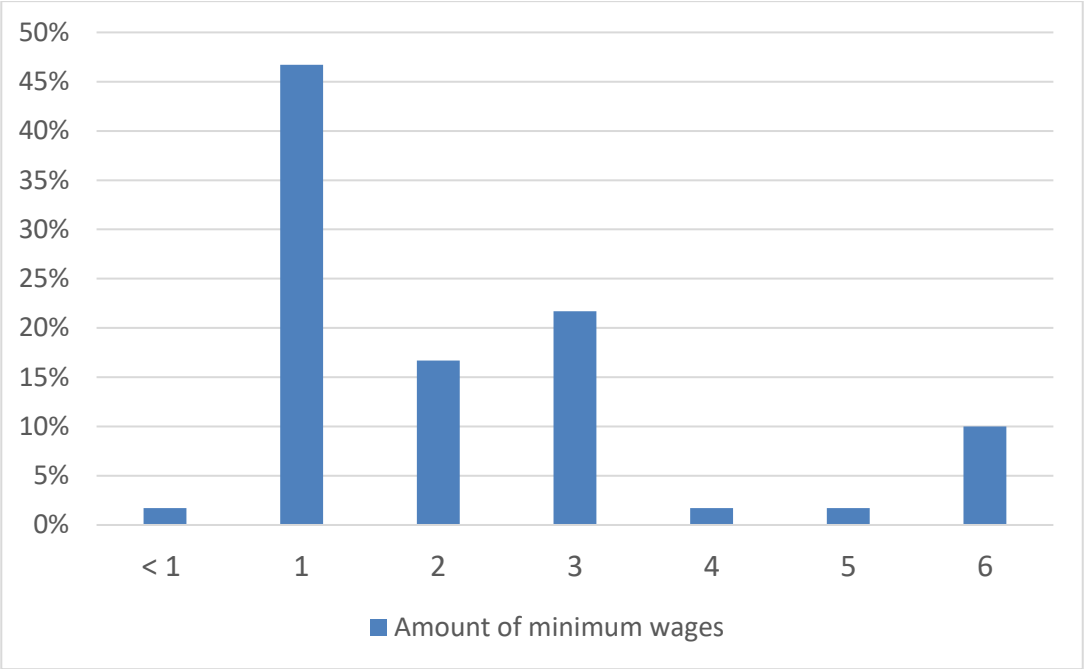

Fig. 2. Family income

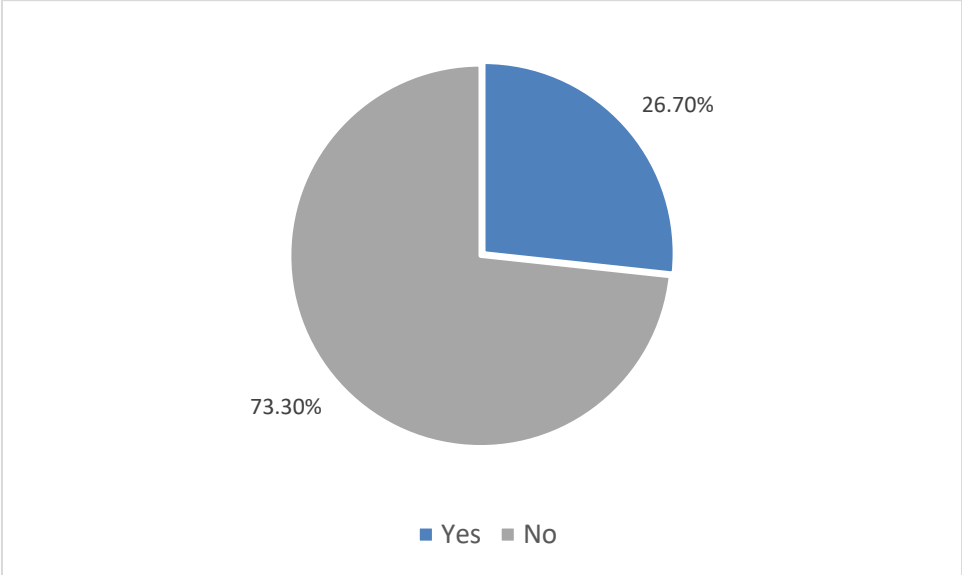

Fig. 3. Maternal disease prior to pregnancy

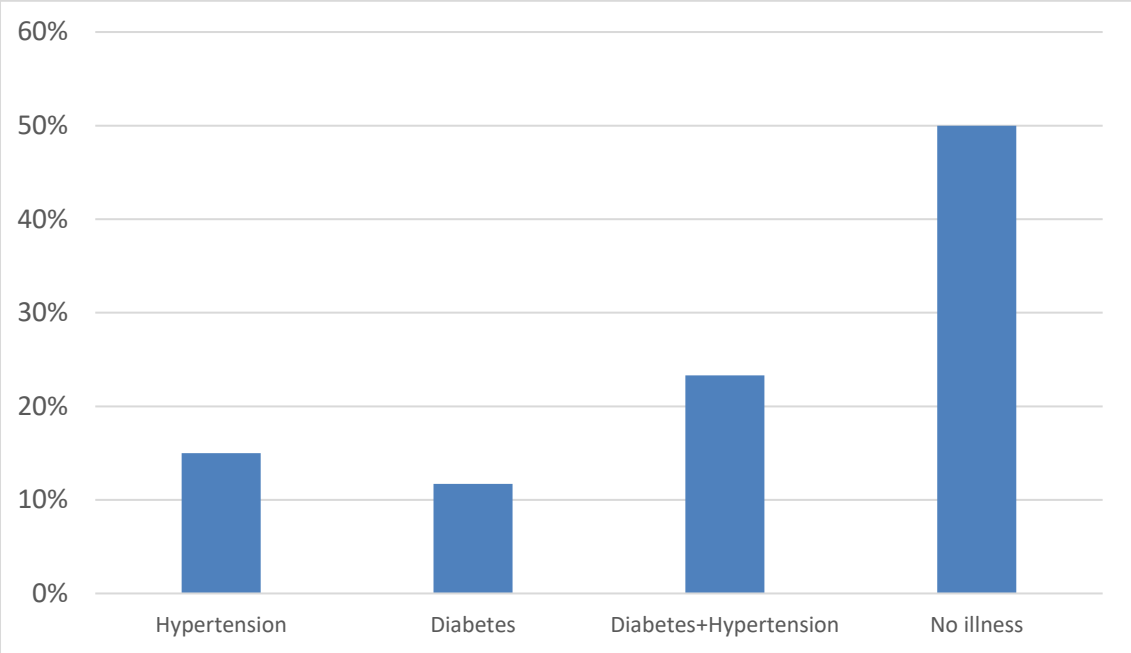

Fig. 4. Hereditary diseases in the family

Table 2. Descriptive analysis of the follow-up profile of mothers and children during the birth period (n=60)

Variables	%
Gestational Age	
Less than 30	5.0
31-36	55.0
37-39	36.7
Above 40	3.3
Weight at birth	
< 1,999 kg	30.0
2–3 kg	45.0
3,001–4 kg	25.0
Height at birth	
< than 40 cm	8.3
between 41 e 45	30.0
Between 46 a 50	43.3
Above 51	18.3

In the report of maternal education, 48.0% of the mothers had between 8 and 11 years of formal education, and 50.0% of the fathers had between 8 and 11 years of formal education.

Fig. 5 shows the descriptive analysis between the independent variables with preterm birth (between 31 and 36 weeks) and use of oxygen (56.7%). Another factor observed was jaundice at birth (48.3%), which is predictable in a mother with gestational diabetes mellitus.

Figs. 6 and 7 show the presence of both physiological and pathological changes in the mucosa, oral candidiasis in 5.4% of the babies, and Epstein's pearls and Bhon's nodules in 4.2%, in addition to changes in enamel quality with hypocalcification (1.8%) and enamel changes such as hypocalcification, hypoplasia and ectopic eruption. Caries were not detect in any of the children during the follow-up period.

Changes in orofacial clefts were absent in 98.3% of patients, as shown in Fig. 8. Regarding the onset of eruption, we can observe in graph 3 that tooth eruption began around the 8th month of life.

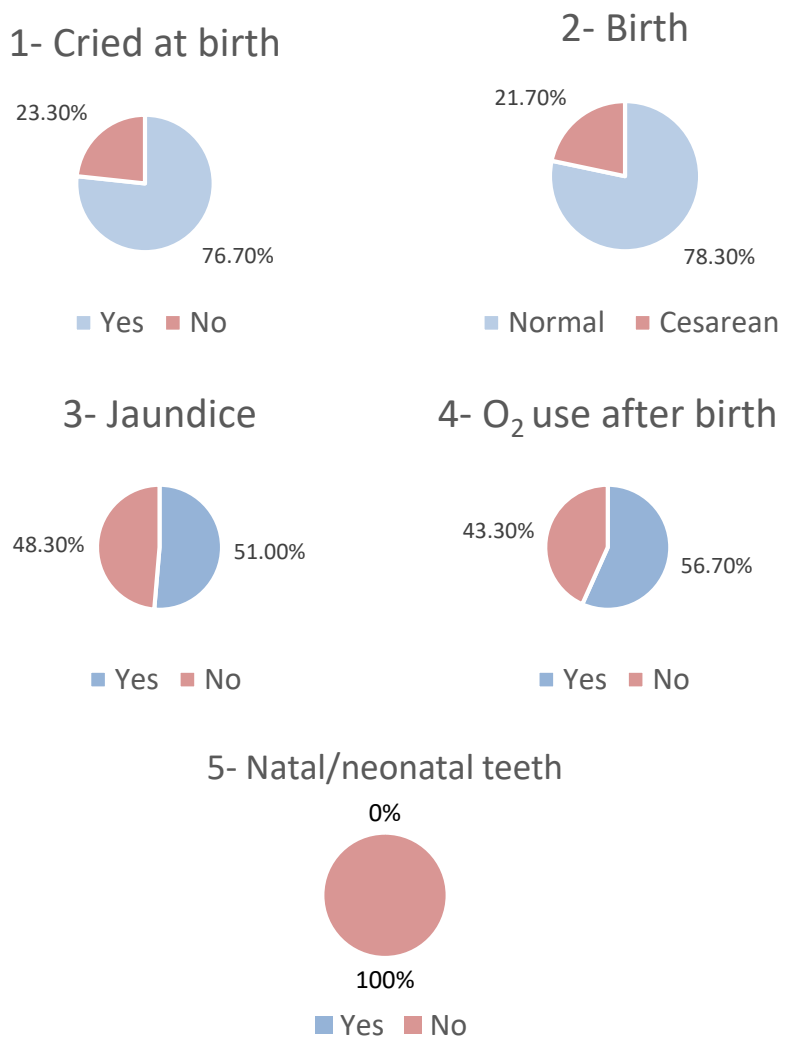

Fig. 5. Descriptive analysis between independent variables

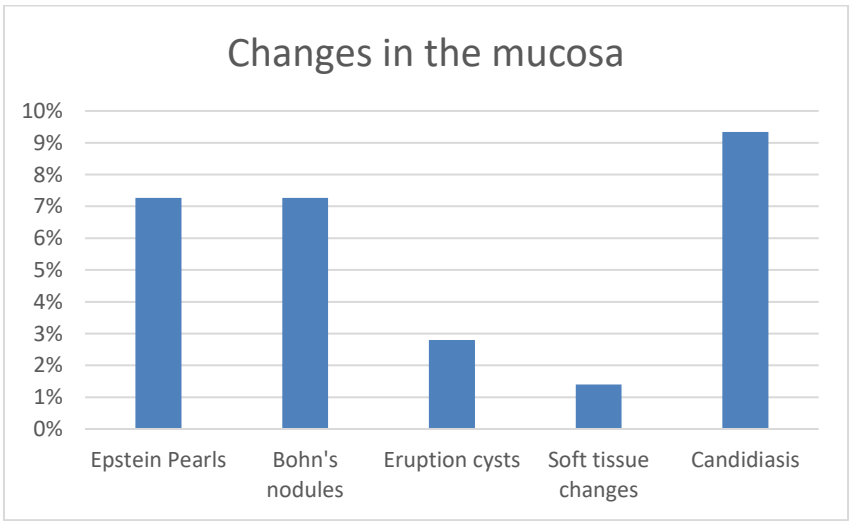

Fig. 6. Distribution of changes in the mucosa of new-borns, 2022 (n=60)

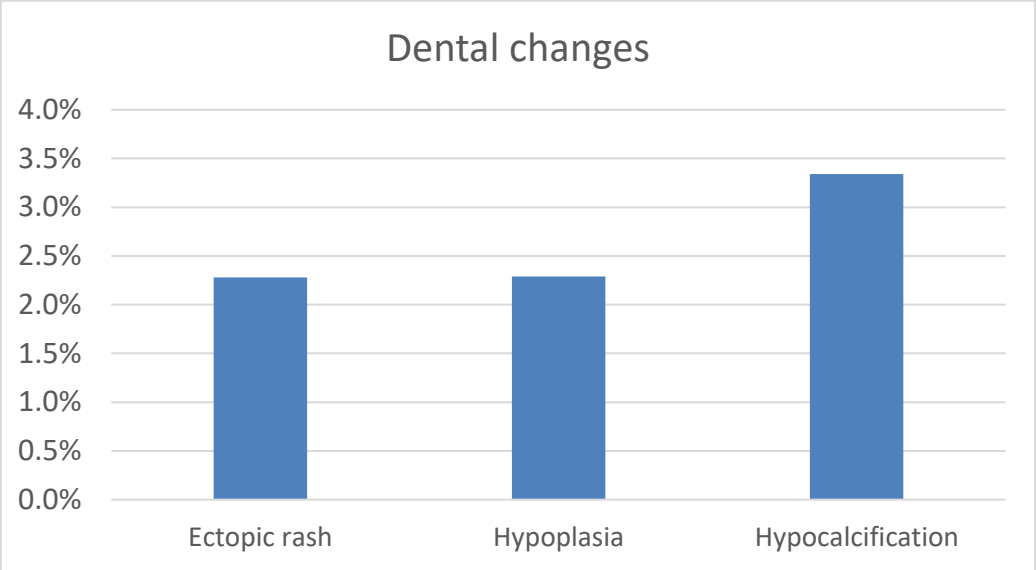

Fig. 7. Distribution of the dental changes of new-borns, 2022 (n=60)

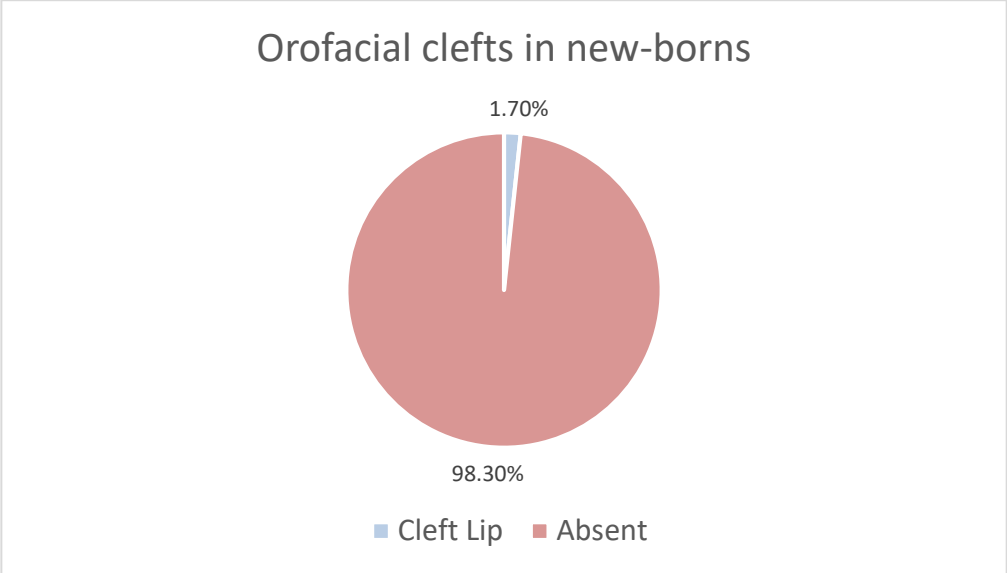

Fig. 8. Distribution of orofacial clefts in new-borns, 2022 (n=60)

Fig. 9 shows that in the vast majority of children, the first deciduous tooth to erupt was the lower central incisor, the first period of eruption for all infants was in the 6th month, and the second period was in the 8th month.

The transformations in maternal metabolism that occur during pregnancy are essential to ensuring and meeting the demands of the mother-foetus binomial [8,9]. However, pregnant women who develop a certain degree of insulin resistance, whether due to the action of anti-insulin placental hormones or other factors, may be susceptible to risks to the health and well-being of the newborn [10].

The negative outcomes of GDM on the general health of pregnant women and new-borns are well understood in the field of medicine, which studies the maternal-foetal bond and symbiotic relationship. In contrast, the impact on the oral health of the new-born has not been fully investigated [11]. This fact makes the scope of the present study justifiable and justified.

In general, the orofacial alterations observed in the study population did not represent a notable difference when compared to other studies [5,12–15]. Thus, candidiasis, Bohn's nodules, Epstein pearls and developmental enamel

disorders were the alterations scored and are frequently recorded in new-borns not necessarily generated from mothers diagnosed with GDM [16–18]. The presence of oral candidiasis can be considered low. This condition is attributed to the immunological immaturity of the new-born, with a gestational age lower than 32 weeks as a risk factor, a condition present in this study, and to some extent, GDM can modulate the new-born's immune system, making it more susceptible to infection by Candida albicans [16–18].

The literature shows an association between Bohn's nodules and Epstein's pearls with prematurity, justifying their presence due to the limitation of the full development of the new-born, for not having completed the full gestational period. The results of this study show a negligible number of these changes; however, because they are physiological and transient, they may have been under diagnosed [19,20].

Despite finding only one child with cleft lip, studies suggest an association between GDM and cleft lip, considering that hyperglycaemia and macrosomia at birth can lead to this anomaly [21–23].

Among the data recorded, it is important to note the normality in the sequence and chronology of tooth eruption of the evaluated new-borns, given that the peak of onset of tooth eruption occurred between the sixth and eighth months of life, which is similar to other results in similar studies [5,24]. Although there were children whose deciduous teeth did not erupt in the first year of life, it is possible to suggest that prematurity and low weight did not interfere with the process of tooth eruption, considering that most new-borns in this study had a gestational period of 31 to 36 weeks.

The presence of an eruption cyst or haematoma was noted; however, this is a relatively common event and is usually associated with the process of tooth eruption, without maintaining a causal relationship with GDM. On the other hand, it may be compatible with prematurity [25].

Regarding enamel development disorders, hypocalcification and hypoplasia were observed, though at a markedly low frequency. Enamel hypoplasia is characterized by inadequate formation of the organic matrix of enamel, resulting from changes in ameloblasts, while hypocalcifications are marked by factors that interfere with the stage of calcification of the teeth in conditions of immaturity of organs such as the liver and kidneys, which do not metabolize calcium [26].

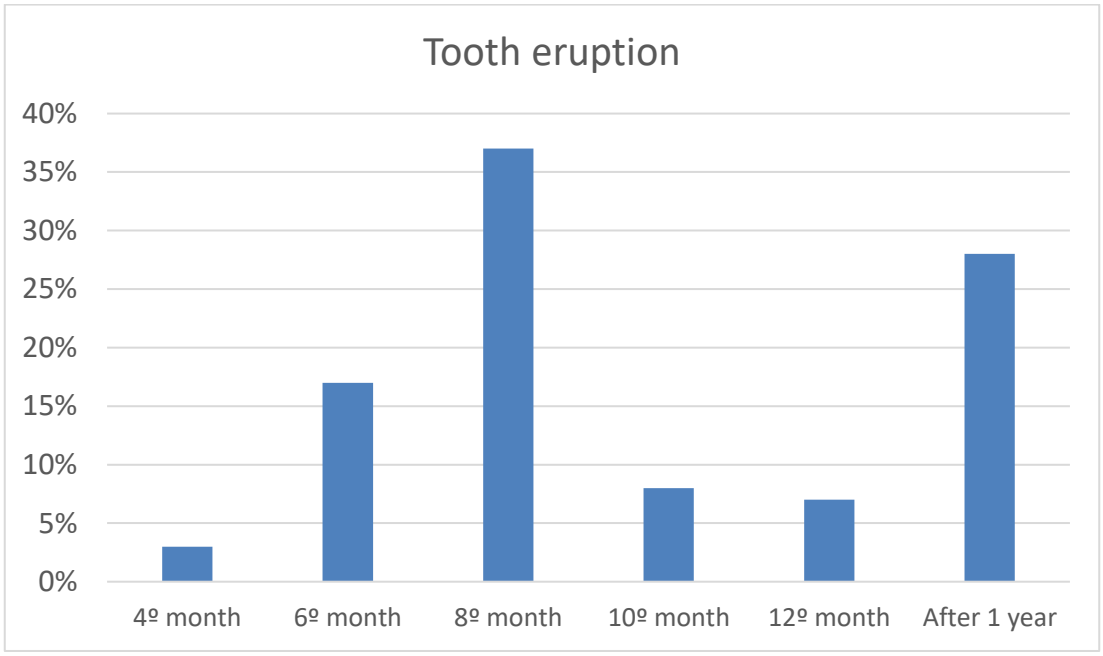

Fig. 9. Distribution of infant tooth eruption, 2022 (n=60)

The causal relationship between GDM and defects in dentition cannot yet be confirmed, nor is the mechanism that may interfere in the development of DED identified. In any case, it is recognized that premature new-borns have disturbances in calcium metabolism due to their own physiological conditions, as well as due to complications of the pregnant woman [27,28].

The results of the present study showed no caries lesions in the study population, although visible plaque was observed. A recent study investigated the influence of GDM on the colonization of the oral microbiota of neonates when compared to mothers without GDM. Although there were no significant differences in the metrics of bacterial diversity between the two groups, maternal GDM was associated with different colonization of the oral microbiota in neonates [29].

The absence of caries may be related to the fact that these mothers and children participated in the multiprofessional educational and preventive program, especially the follow-up project. Added to this is the fact that the teeth present in the oral cavity of the evaluated population were not subjected to a high frequency of cariogenic challenges, considering that they erupted around the sixth to eighth month and were evaluated up to twelve months. These results are consistent with those of other studies [30,31].

The strength of the socioeconomic profile and the level of family education have been frequently addressed in health studies. In line with this statement, income and education seem to qualify the acquisition of knowledge and improve the quality of life of people. However, in this study, these factors did not present a significant result, contrary to other studies [32,33].

It should be emphasized that to date, a significant number of bibliographic productions specific to oral changes in children descended from mothers with GDM have not been found, weakening the comparison of results with other studies with similar designs. Indeed, it can be considered a limitation of the study, and despite being a longitudinal study, the sample evaluated was relatively small, decreasing the power of the analysis and conclusion of the outcomes observed.

In addition, sample selection bias should not be disregarded, given that in studies conducted in clinical settings, research subjects presumably have more access to information.

However, the novelty of the study overcomes these limitations and establishes a methodological design for future investigations and comparisons. In addition, the study contributes to and highlights the need for the construction of planning of public health policies, with emphasis on the health promotion of pregnant women, particularly those diagnosed with GDM and its consequences for the offspring.

4. CONCLUSION

The results of the study indicated orofacial changes such as candidiasis, Bohn's nodules and Epstein's pearls, in addition to changes in dental structures, especially enamel hypoplasia and hypocalcification.

Although the observed changes were not of great magnitude, it is important to emphasize that the health education of pregnant women with GDM is a responsibility to be exercised continuously and systematically by a multiprofessional team, in which dentistry needs to be involved, envisioning the promotion of oral health of pregnant women and new-borns, bringing healthy habits to the whole family.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

CONSENT

As per international standards, parental written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The study was conducted at the Women's Health Reference Center, after approval by the Research Ethics Committee of the School of Dentistry, São Leopoldo Mandic College, under resolution number 5.587.680 and CAAE 59072722.0.0000.5374, meeting the fundamental ethical and scientific requirements of Resolution 466/2012 of the National Health Council

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Barros B da S, Nepomuceno B de S, Santana LB, Sá MCLO de, Vieira MEVA, Bendel MF, et al. A importância do pré-natal na prevenção de complicações materno-fetais do diabetes mellitus gestacional. Revista Eletrônica Acervo Científico. 2021, May 30;27:e7588.
2. Boe B, Barbour LA, Allshouse AA, Heyborne KD. Universal early pregnancy glycosylated hemoglobin A1c as an adjunct to Carpenter-Coustan screening: an observational cohort study. Am J Obstet Gynecol MFM. 2019;1(1):24-32. DOI:10.1016/j.ajogmf.2019.02.003
3. American diabetes association. Introduction: Standards of Medical Care in Diabetes—2022. Diabetes Care. 2022, Jan 1;45:S1–2.
4. Zhang C, Catalano P. Screening for gestational diabetes. JAMA. 2021, Aug 10;326(6):487.
5. Pascon T, Barbosa AMP, Cordeiro RCL, Bussaneli DG, Prudencio CB, Nunes SK, et al. Prenatal exposure to gestational diabetes mellitus increases developmental defects in the enamel of offspring. Plos One. 2019, Feb 27;14(2):e0211771.
6. D Agostino ES, Primo Chagas JRL, Frederico de Almeida T, de Sousa Cabra MBB, Teixeira Cangussu MC, Pereira Vianna MI. Developmental enamel defects and other oral problems in children with microcephaly associate with fetal exposure to zika virus (ZIKV). International Journal of Pregnancy & Child Birth. 2020, Jun 17;6(3):67–74.
7. Fédération Dentaire Internationale. A review of the developmental defects of enamel index (DDE Index). Commission on Oral Health, Research & Epidemiology. Report of an FDI Working Group. Int Dent J. 1992;42(6):411–6.
8. Pitts N, Ekstrand K. International Caries Detection and Assessment System (ICDAS) and its International Caries Classification and Management System (ICCMS) - methods for staging of the caries process and enabling dentists to manage caries. Community Dent Oral Epidemiol. 2013 Feb;41(1):e41–52.
9. Mockridge A, Maclennan K. Physiology of pregnancy. Anaesthesia & Intensive Care Medicine. 2019, Jul;20(7):397–401.
10. Benton M, Davies M, Ismail K, Lenzi J. Gestational diabetes mellitus and its impact on the mother-infant relationship: A cohort study in the postnatal period. Prev Med Rep. 2023, Aug 1;34:102270.
11. Chen G, Chen J, Yan Z, Li Z, Yu M, Guo W, et al. Maternal diabetes modulates dental epithelial stem cells proliferation and self-renewal in offspring through apurinic/apyrimidinicendonuclease 1-mediated DNA methylation. Sci Rep. 2017, Jan 17;7:40762.
12. Cruz P, Bendo C, Bouzada MF, Machado MP, Martins C. Oral mucosal lesions in newborns: Relationship with prematurity, low birth weight, and associated factors. J Clin Neonatol. 2021;10(3):170–7.
13. Vargas-Ferreira F, Peres MA, Dumith SC, Thomson WM, Demarco FF. Association of pre- peri- and postnatal factors with developmental defects of enamel in school children. Journal of Clinical Pediatric Dentistry. 2018, Jan 1;42(2):125–34.
14. Carvalho P de, Arima L, Abanto J, Bönecker M. Maternal-child health indicators associated with developmental defects of enamel in primary dentition. Pediatr Dent. 2022;44(6):425–33.
15. Tolomeu JSO, Soares MEC, Mourão PS, Ramos-Jorge ML. Is gestational diabetes mellitus associated with developmental defects of enamel in children? A systematic review with meta-analysis. Arch Oral Biol. 2022, Sep;141:105488.
16. Tinoco-Araujo JE, Araújo DFG, Barbosa PG, Santos PS da S, Medeiros AMC de. Candidíase invasiva e alterações bucais em recém-nascidos prematuros. Einstein (São Paulo). 2013, Mar;11(1):71–5.
17. Yanai S, Tokuhara D, Tachibana D, Saito M, Sakashita Y, Shintaku H, et al. Diabetic pregnancy activates the innate immune response through TLR5 or TLR1/2 on neonatal monocyte. J Reprod Immunol. 2016, Sep;117:17–23.
18. Cook A, Ferreras-Antolin L, Adhisivam B, Ballot D, Berkley JA, Bernaschi P, et al. Neonatal invasive candidiasis in low-and middle-income countries: Data from the NeoOBS study. Med Mycol. 2023, Mar 1;61(3):1–11.
19. Perez-Aguirre B, Soto-Barreras U, Loyola-Rodriguez JP, Reyes-Macias JF, Santos-Diaz MA, Loyola-Leyva A, et al. Oral findings and its association with prenatal and perinatal factors in newborns. Korean J Pediatr. 2018, Sep 15;61(9):279–84.
20. Patel C, Fernandes S, Bafna Y, Patel D, Parmar D, Patel D. Prevalence of

developmental anomalies among infants 0-12 months in Mehsana district, north Gujarat, India. Int J Community Med Public Health. 2022, Nov 28;9(12):4595.
21. Kozma A. Gestational diabetes mellitus and the development of cleft lip / palate in newborns. Acta Endocrinologica (Bucharest). 2019;15(1):118–22.
22. Yang GR, Dye TD, Li D. Effects of pre-gestational diabetes mellitus and gestational diabetes mellitus on macrosomia and birth defects in Upstate New York. Diabetes Res Clin Pract. 2019, Sep;155:107811.
23. Kantar RS, Hamdan US, Muller JN, Hemal K, Younan RA, Haddad M, et al. Global prevalence and burden of orofacial clefts: A systematic analysis for the global burden of disease study 2019. Journal of Craniofacial Surgery. 2023, Aug 15;Aug(15). DOI:10.1097/SCS.0000000000009591.
24. Salami A, El Karim I, Lundy F, Loney T, Donaldson M, O'Neill C. An exploratory study of maternal diabetes and offspring use of dental services—Northern Ireland national cohort study. BDJ Open. 2023, Apr 10;9(1):14.
25. Yoshida E, Goto K, Matsuoka D, Miyai Y, Asaumi H, Tabata K, et al. Eruption cyst caused by congenital tooth in low birth weight infant. Pediatric Dental Journal. 2023, Jul;(14):1–4.
26. Reed SG, Miller CS, Wagner CL, Hollis BW, Lawson AB. Toward preventing enamel hypoplasia: Modeling maternal and neonatal biomarkers of human calcium homeostasis. Caries Res. 2020;54(1):55–67.
27. Collignon AM, Vergnes JN, Germa A, Azogui S, Breinig S, Hollande C, et al. Factors and mechanisms involved in acquired developmental defects of enamel: A scoping review. Front Pediatr. 2022, Feb 24;10:836708.
28. Miyamoto A, Minagawa K, Nohno K, Kaneko N, Ichikawa Y, Hoshino T, et al. Prevalence and cause of enamel hypoplasia in primary teeth among 1-year-old japanese children. Open Dent J. 2023, Mar 31;17(1).
29. Song Q, Xiao B, Huang H, Ma L, Zhang J V., Zhu Y. Influences of gestational diabetes mellitus on the oral microbiota in offspring from birth to 1 month old. BMC Pregnancy Child Birth. 2022, Dec 6;22(1):289.
30. Leal SC. Is there an association between maternal factors and the development of early childhood caries? Evid Based Dent. 2023, Mar 8;24(1):35–6.
31. Anchidic M, Nicoleta Savin C, Tatarciuc M, Bejan O, Maria Butnaru O, Cenusa C, et al. Early caries in children: Etiology, diagnosis and treatmente. A narrative review. Romanian Journal of Oral Rehabilitation. 2023;15(1):170–8.
32. Sow M, Raynault MF, De Spiegelaere M. Associations between socioeconomic status and pregnancy outcomes: A greater magnitude of inequalities in perinatal health in Montreal than in Brussels. BMC Public Health. 2022, Dec 25;22(1):829.
33. Roustaei Z, Anttonen S, Räisänen S, Gissler M, Heinonen S. Socioeconomic status, maternal risk factors, and gestational diabetes mellitus across reproductive years: A Finnish register-based study. BMJ Open Diabetes Res Care. 2023, Aug 16;11(4):e003278.

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