TRAJECTORIES OF SUGAR CONSUMPTION AND DENTAL CARIES IN EARLY CHILDHOOD

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1. INTRODUCTION

Early childhood caries (ECC) is defined as the presence of one or more decayed (cavitated or non-cavitated), missing (due to caries) or filled dental surfaces in primary teeth of children under six years old (DRURY et al. 1999). Dental caries is one of the most prevalent chronic diseases in early childhood worldwide (WHO 2019). ECC is an important public health problem due to its high prevalence and preventable condition (PERES et al. 2019). The consequences include pain (SO et al. 2017), abscess, fever (MANSOORI et al. 2019), malnutrition (SO et al. 2017), difficulty eating, sleeping, attending school, and playing, which can impair the quality of life of children (LI et al. 2015).

Dental caries is a demineralization of dental tissues from the fermentation of dietary carbohydrates by cariogenic microorganisms (TINANOFF et al. 2019). Several determinants influence the dental caries, such as fluoride exposure, oral health practices, eating behaviors, maternal and family characteristics, socioeconomic status, access and availability of oral health services, as well as political and cultural influences (COLAK et al. 2013). Sugar consumption is the determining factor for the occurrence of caries (PITTS et al. 2019; TINANOFF et al. 2019). Moreover, excessive sugar consumption is a risk factor for several chronic non-communicable diseases (PITTS et al. 2019; TINANOFF et al. 2019). Childhood is a period of establishing behaviors, and the behaviors learnt early in life can be lifelong. Therefore, establishing strategies aimed at reducing sugar consumption in early life can benefit the individual not only in childhood, but also throughout the entire life cycle (MOVASSAGH et al. 2017).

Therefore, this study aimed to verify the association between the trajectory of sugar consumption and dental caries in early childhood in the 2015 Pelotas Birth Cohort Study.

2. METHODS

This study uses data from the 2015 Pelotas Birth Cohort Study. All children born alive in hospitals in Pelotas and who had mothers who lived in the city's urban area were eligible to be included in the cohort. 5,598 children were born in Pelotas during 2015, 4,387 of them from mothers living in the urban area. Of these, 54 were stillborn, and the remaining 4,333 were the study's target population. 51 refusals

and seven deliveries were not captured by the study teams. Thus, the 2015 Birth Cohort included 4,275 (98.7% of the target population) children in the study. Of the children followed up at 48 months, 3654 (91.1%) underwent an oral health exam. Data collection included interviews with the mother or first caregiver and clinical oral health examination of the child.

The interview was performed by trained interviewers using standardized questionnaires in each of the follow-ups.

The oral health examination of children at 48 months was carried out by a team of 12 dentists previously trained and calibrated. The dental caries inter-examiner agreement measured using the weighted Kappa statistic was 0.91. The outcome of this study was ECC, assessed in the clinical examination. ECC was analyzed as two dichotomous outcomes (no versus yes): dental caries experience and cavitated dental caries.

The exposure variable, the trajectory of sugar consumption, was defined through group-based trajectory modelling (Nagin and Odgers 2010). The trajectory of sugar consumption was created from the consumption of sugar in the 3-, 12-, 24- and 48-months follow-ups. Children with valid answers in 3 or more follow-ups were included for the construction of trajectory of sugar consumption. The logit distribution was the model adopted in our analyses, considering the dichotomous distribution of the sugar consumption at each time point. A cubic model was used, which represents the highest polynomial order allowed with the Stata procedure 'TRAJ'. The choice of the number of trajectories that best describes the study population was made according to the best fit of the model and through subjective judgment based on the literature.

Possible confounders included: family income (collected in Brazilian currency and categorized in quintiles) in the perinatal period and at 12, 24, and 48 months; maternal education (collected in years and categorized in none, from 1 to 3; from 4 to 7; from 8 to 11; 12 and more) in the perinatal and 48 months; maternal age (collected in years and categorized in less than 20 years; 20 to 35 years and more than 35 years) in the perinatal; and whether the mother had received any oral health instruction from a health professional in the perinatal and 12, 24, and 48 months (no versus yes).

Stata 15.0 was used for data analysis. Descriptive analyzes were performed using relative and absolute frequencies. The associations between the trajectory of sugar consumption and dental caries were analyzed using bivariate analysis, through chi-square test. Poisson regression with robust variance was used, estimating prevalence ratios and their 95% confidence intervals, adjusting for confounding factors.

3. RESULTS AND DISCUSSION

In 2015, 4,275 children born in hospitals in the city of Pelotas-RS-Brazil were evaluated. Of the 4,010 children interviewed at 48 months, 3,654 (91.1%) children participated in the oral health survey at 48 months. For this study, all analyzes were performed among complete cases, therefore, our final sample consisted of 2,806 children with data for all variables of interest. In the analyzed sample, 1,012 children (36.1%; 95%CI 34.3-37.8) experienced caries, and 723 (25.8%; 95%CI 24.2-27.4) had cavitated lesions. The group-based trajectory analysis identified four distinct trajectories of sugar consumption: trajectory 1 (Sugar consumption always low) comprised 22.1% of the sample; trajectory 2 (Sugar consumption always intermediate) accounted for 44.0%; trajectory 3 (Sugar growing consumption) represented a consumption that started low and increased significantly as the child got older and comprising 27.6% of the total sample; and trajectory 4 (Sugar

consumption always high) represented a consumption that was consistently high during the first 4 years of life. It represented 6.3% of the sample. At age 48 months, both trajectories 3 and 4 had a similar probability of sugar consumption. The BIC value associated with this analysis was −8829.15.

An association between the trajectory of sugar consumption and dental caries at 48 months was identified. A higher prevalence of caries experience (47.5%) and cavitated caries (37.3%) was observed in the groups that presented always high sugar consumption.

Experience of caries was 1.44 (1.24-1.67 95%CI) times higher in the group with increasing sugar consumption, compared to the group with always low consumption, in the adjusted analysis. The prevalence of cavitated caries was 1.48 (1.22-1.79 95%CI) times higher in the group with increasing sugar consumption compared to the reference group, also in the adjusted analysis.

The early consumption of sugar has an impact on the future occurrence of caries through the growth of cariogenic bacteria and by modulating the individual's future food preferences (Chaffee et al. 2015; Ventura and Worobey 2013; Feldens et al. 2021). Therefore, it is important to establish strategies to reduce sugar consumption and ECC in childhood (Movassagh et al. 2017). For instance, the application of fluorides for ECC risk groups, referring children with high sugar consumption to the nutritionist and developing motivational interviews with families whose children face increased risk for ECC (Chi and Scott 2019) are individual-level strategies that can be applied during dental appointments by oral health professionals. Other strategies that can contribute to reducing the burden of ECC and other non-communicable diseases include promoting preventive guidance during prenatal care, immediate postnatal care (Feldens et al. 2021) and in the first year of life by health professionals or community health agents (Pitts et al. 2019).

On a macro level, the global increase in sugar consumption poses a threat to oral health and requires policy solutions (Hagenaars et al. 2021). Among these strategies, the taxation of products containing sugar has been advocated to reduce chronic diseases, including dental caries (Jevdjevic et al. 2019). There is ample evidence that sugary beverage taxes can efficiently mitigate sugar consumption (Hagenaars et al. 2021). Oral health professionals may contribute towards decreasing sugar consumption at both individual and societal levels. In the clinical setting, they can help identify and resolve high sugar consumption in pediatric patients while also advocating for broader approaches, including taxes, warning labels, and policy changes that can help reduce added sugar intake, prevent cavities, and improve health outcomes in vulnerable child populations (Chi and Scott 2019).

4. CONCLUSIONS

We conclude that there is an association between the trajectory of sugar consumption and dental caries at 48 months, with children with always high sugar consumption presenting the highest prevalence of dental caries. The study findings reinforce the need to adopt effective strategies to delay the supply of sugar in early life, such as taxing products containing sugar, government incentives for the purchase of fruits and vegetables, and promoting preventive by health professionals.

5. REFERENCES

Chaffee BW, Feldens CA, Rodrigues PH, Vítolo MR. Feeding practices in infancy associated with caries incidence in early childhood. **Community Dent Oral Epidemiol,** v.43, n.4, p.338-348, 2015.

Chi DL, Scott JM. Added Sugar and Dental Caries in Children: A Scientific Update and Future Steps. **Dent Clin North Am**, v.63, n.1, p.17-33, 2019.
Colak H, Dülgergil CT, Dalli M, Hamidi MM. Early childhood caries update: A review of causes, diagnoses, and treatments. **J Nat Sci Biol Med**, v.4, n.1, p.29-38, 2013.
Drury TF, Horowitz AM, Ismail AI, Maertens MP, Rozier RG, Selwitz RH. Diagnosing and reporting early childhood caries for research purposes. A report of a workshop sponsored by the National Institute of Dental and Craniofacial Research, the Health Resources and Services Administration, and the Health Care Financing Administration. **J Public Health Dent**, v.59, n.3, p.192-197, 1999.
Feldens CA, Vítolo MR, Maciel RR, Baratto PS, Rodrigues PH, Kramer PF. Exploring the risk factors for early-life sugar consumption: A birth cohort study. **Int J Paediatr Dent**, v.31, n.2, p.223-230, 2021.
Hagenaars LL, Jeurissen PPT, Klazinga NS, Listl S, Jevdjevic M. Effectiveness and Policy Determinants of Sugar-Sweetened Beverage Taxes. **J Dent Res**, 220345211014463, 2021.
Jevdjevic, M, Trescher AL, Rovers M, Listl S. The caries-related cost and effects of a tax on sugar-sweetened beverages. **Public Health**, v.169, p.125-132, 2019.
Li MY, Zhi QH, Zhou Y, Qiu RM, Lin HC. Impact of early childhood caries on oral health-related quality of life of preschool children. **Eur J Paediatr Dent**, v.16, n.1, p.65-72, 2015.
Mansoori S, Mehta A, Ansari MI. Factors associated with Oral Health Related Quality of Life of children with severe -Early Childhood Caries. **J Oral Biol Craniofac Res**, v.9,n.3, p.222-225, 2019.
Movassagh EZ, Baxter-Jones ADG, Kontulainen S, Whiting SJ, Vatanparast H. Tracking Dietary Patterns over 20 Years from Childhood through Adolescence into Young Adulthood: The Saskatchewan Pediatric Bone Mineral Accrual Study. **Nutrients**, v.9, n.9, p.1-14, 2017.
Nagin DS, Odgers CL. Group-based trajectory modeling in clinical research. **Annu Rev Clin Psychol**, v.6, p.109-138, 2010.
Peres MA, Macpherson LMD, Weyant RJ, Daly B, Venturelli R, Mathur MR, Listl S, Celeste RK, Guarnizo-Herreño CC, Kearns et al. Oral diseases: a global public health challenge. **Lancet**, v.394, n.10194, p.249-260, 2019.
Pitts NB, Baez RJ, Diaz-Guillory C, Donly KJ, Feldens CA, McGrath C, Phantumvanit P, Seow WK, Sharkov N, Songpaisan Y, Tinanoff N, Twetman S. Early Childhood Caries: IAPD Bangkok Declaration. **J Dent Child (Chic)**, v.86, n.2, p.72, 2019.
So M, Ellenikiotis YA, Husby HM, Paz CL, Seymour B, Sokal-Gutierrez K. Early Childhood Dental Caries, Mouth Pain, and Malnutrition in the Ecuadorian Amazon Region. **Int J Environ Res Public Health**, v.14, n.5, 2017.
Tinanoff N, Baez RJ, Guillory CD, Donly KJ, Feldens CA, McGrath C, Phantumvanit P, Pitts NB, Seow WK, Sharkov N, Songpaisan Y, Twetman S. Early childhood caries epidemiology, aetiology, risk assessment, societal burden, management, education, and policy: Global perspective. **Int J Paediatr Dent**, v.29, n.3, p.238-248, 2019.
Ventura AK, Worobey J. Early influences on the development of food preferences. **Curr Biol**, v.23, n.9, p.401-408, 2013.
WHO. World Health Organization. 2019. Ending childhood dental caries: WHO implementation manual.