

Dietary and Oral Hygiene Habits in Children with Type I Diabetes Mellitus Related to Dental Caries

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SUMMARY

The aims of the study were to evaluate differences in dietary, oral hygiene habits and social class in children with Type I diabetes mellitus (DM), compared to non-diabetics, and to investigate relationship between selected caries-risk factors and caries experience in diabetics. Material and methods: 70 children with Type I DM and 70 age- and sex-matched non-diabetic controls were included in the study. Metabolic control of diabetes was categorized into well- to moderately-controlled and poorly-controlled groups based on glycosylated haemoglobin HbA1c. The study was based on the data obtained from the questionnaire including information about dietary and oral hygiene habits, pattern of dental visits and social class. Results showed that the diabetic children had more frequent main meals and less snacking than their controls: the mean number of main meals/day was 4.33 (SD = 0.93) in the diabetics, and 2.53 (SD = 0.85) in the controls. Significantly less diabetics (43%) used sweet drinks than their controls (79%). There were no differences according to the frequency of toothbrushing as well as frequency of dental visits between the diabetics and controls, however, significantly more diabetics reported that they never used dental floss than non-diabetics. There were no significant differences in the diet, toothbrushing frequency between the diabetics with different metabolic control. Multiple logistic regression analysis showed that among caries risk associated variables only age of children (OR = 1.98; CI = 1.23-3.19) and level of metabolic control of diabetes (OR = 4.65; CI = 1.28-16.89) were statistically significantly associated with high caries experience in the diabetics. Conclusions: frequent consumption of sweet drinks and snacks can influence caries development in children. Amongst the diabetics, the differences in caries prevalence can be explained by combination of biological and behavioral factors rather than single dietary or oral hygiene elements.

Key words: diet, oral hygiene, caries, diabetes, children.

INTRODUCTION

Of the many factors contributing to development of dental caries, nutrition and diet plays an important role [1]. It is well known that frequent consumption of sugar-containing foods increases the risk of dental caries [2, 3].

However, the significant relationship between sugar intake and dental caries in modern society has been questioned [4]. Regular epidemiological monitoring of caries data in some countries showed that the caries prevalence in children continued to decrease, whereas sugar consumption increased (for the review see König KG, 2004) [5]. The decline in dental caries incidence has been attributed to increased exposure to fluoride and improved oral hygiene [6]. It has been shown that regular brushing with a fluoride toothpaste may have greater impact on caries in young

children than restricting sugary foods [7]. However, although fluoride has a dramatic effect on caries, it does not remove the major causing factor in caries development such as dietary sugars [1].

The relationship between dental caries and dietary factors is a question of particular interest in patients with diabetes mellitus. Due to disturbed glucose metabolism such patients are considered to be at higher risk of cariogenic challenge. Earlier it has been shown that diabetics had lower caries prevalence than their non-diabetic controls, due to their sucrose-restricted diet [8]. By contrast, more recent studies demonstrated no significant difference in caries prevalence in diabetic children compared with their healthy controls [9], or even higher caries levels in diabetics than in healthy population [10,11]. It was suggested that the modern management of diabetes with blood glucose monitoring and flexibility in insulin treatment allows a less restricted diet and reduces the significance of the dietary factors as the indicator for differences in caries development [12].

The aims of this study, based on the data obtained from questionnaires, were:

1. To describe and compare the dietary habits in the children with Type I diabetes mellitus, and their non-dia-

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betic controls.

2. To compare the dietary habits in diabetic children with different level of the metabolic control of diabetes.

3. To investigate the relationship of high caries experience in diabetics with the selected caries indicators such as dietary and oral hygiene habits.

MATERIAL AND METHODS

Study population

The study population consisted of 140 10-15 year-old children. The test group included 70 children (mean age 13.6; SD = 1.16) with Type I diabetes mellitus (DM) living in Kaunas city and the region. All diabetics were registered in the Lithuanian National Childhood Diabetes Register as having Type I DM and regularly attending the Department of Childhood Endocrinology at Kaunas University of Medicine for assessment of their metabolic control of diabetes based on the glycosylated haemoglobin HbA1c (analyzer DC-2000, Bayer, Germany) test. This test reflects the average of blood glucose balance over the past 2-3 months. According to the international guidelines for management of Type I DM in children and adolescents [13], the diabetic population was divided into two groups: well- to moderately-controlled (HbA1c \leq 8.9%) (n=39), and poorly-controlled (HbA1c \geq 9.0%) (n=31).

The control group of same size as the test group consisted of age- and sex-matched non-diabetic children without any reported systemic disease and medications from Kaunas city and the region.

Questionnaire

All study participants were asked to fill in a prepared questionnaire during their visit to dental clinic of Kaunas University of Medicine during the study period October-December, 2001.

The questionnaire comprised sections about social status, oral hygiene habits, frequency of dental visits, and dietary habits.

The social class of a child was evaluated based on mother's education level: uncompleted secondary school, comprehensive education, high school, university degree.

The questions about oral hygiene habits included:

frequency of toothbrushing, use of fluoride toothpaste, use of dental floss.

The questions about dietary habits included frequency of main meals, consumption of sweet snacks (chocolate, candy, cakes, biscuits); consumption and type of drinks (sucrose-free drinks such as tea or coffee, water, milk, and sweetened drinks such as sugar containing tea or coffee, lemonade, cola, fruit juices, sweet yogurts etc.); consumption and type of sweeteners such as sugar or sugar substitutes (sorbitol, xylitol, aspartame, cyclamate, saccharin).

Dental caries

The assessment of dental caries included non-cavitated and cavitated lesions of caries development. The mean DMFS in the diabetic children was 23.07 (SD = 14.38), and the mean DMFS in the non-diabetic controls was 27.64 (SD = 15.92), respectively. The mean DMFS in the well- to moderately-controlled diabetics was 19.51 (SD = 12.62), and the mean DMFS in the poorly-controlled diabetics was 27.39 (SD = 15.58), respectively.

Ethics

Informed consent was obtained from the parents of all study children and

the study protocol was approved by the Ethical Committee of Kaunas University of Medicine, Kaunas, Lithuania.

Statistical analysis

For statistical analysis, the data obtained from the questionnaire were categorized as follows:

1) Dietary habits:

- frequency of main meals: < 5 times/day; and ≥ 5 times/day;

- frequency of consumption of sweet snacks/drinks: more than once a day and once a day or less;

- frequency of fructose consumption: more than once a day and once a day or less.

2) Level of mother's education:

- low (uncompleted secondary school or comprehensive education);

- high (university degree, high school).

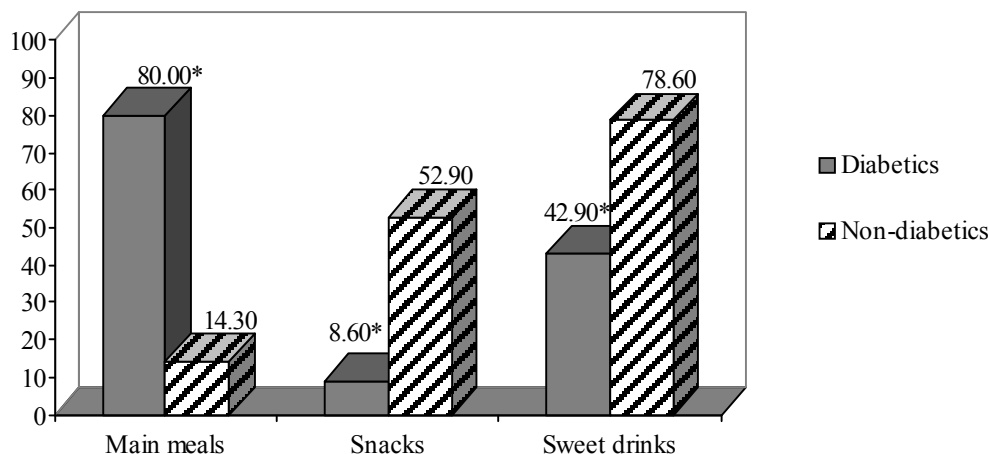


Fig. 1. Distribution of the children (%) according to frequency of main meals, sweet snacks and drinks

Table 1. Toothbrushing habits in the study groups.

Frequency of toothbrushing	Diabetics n = 70	Non-diabetics n = 70
Once a day or more	85.7%*	94.3%
2-5 times a week	12.9%	5.7%
Never brush	1.4%	0%

*p < 0.05 statistically significant association

Table 2. The multiple logistic regression analysis of the predictors of high caries experience (DMFS > 24) in diabetic children.

Predictor	Odds ratio	95% CI	p-value
Age	1.98	1.23-3.19	0.005
Mother's education level	0.35	0.08-1.40	0.137
Level of metabolic control	4.65	1.28-16.89	0.020
Frequency of main meals consumption	1.84	0.38-9.06	0.450
Frequency of sweet drinks consumption	0.28	0.07-1.10	0.067
Frequency of fructose consumption	2.17	0.54-8.76	0.278

p ≤ 0.05 statistically significant association

3) Oral hygiene habits:

- frequency of tooth brushing: once a day or more and less than once a day.

Differences between the study groups were assessed by Student's t test. Frequencies were compared by using chi-square test for cross-tables. The relationship of caries-risk variables and the high caries experience (defined as belonging to the upper part from the midpoint of the distribution of DMFS; >24) in the diabetics was assessed by multiple logistic regression analysis. The explanatory variables such age, mother's education, level metabolic control of diabetes (HbA1c ≥ 9), frequency of consumption of main meals, frequency of consumption of snacks, frequency of consumption of sweet drinks, frequency of fructose consumption, frequency toothbrushing were entered in the multiple logistic regression model when it showed statistically significant associations with the outcome variable. The age was considered as continuous variable.

The 95% confidence intervals (95% CI) and odds ratios (OR) were calculated. P-value < 0.05 was considered as being statistically significant. The data were analyzed using an SPSS (version 12.1) statistical program package.

RESULTS

Social class

The diabetic and non-diabetic children were found similar with regard to the level of their mother's education, as reported from the questionnaire.

Low level of mother's education was indicated by 46% of the diabetics, and by 56 % of the non-diabetics, and high level of mother's education was reported by 54 % of the diabetics and by 44% of the controls.

Dietary habits

Analysis of the dietary habits of the study population showed that statistically significantly more diabetic children reported more frequent main meals (≥ 5 times per day) than their non-diabetic controls (Figure 1). The mean number of main meals per day was 4.33 (SD = 0.93) in the diabetics and 2.53 (SD = 0.85) in the control children, re-

spectively (p < 0.01). More non-diabetics were used to snacking between-meals (more than once a day) compared with the diabetics (Figure 1).

There were no significant differences according to the frequency of main meals and snacks between the groups of well- to- moderately-controlled and poorly-controlled diabetics. The mean number of main meals per day was 4.33 (SD = 0.98) in well- to- moderately-controlled and 4.32 (SD = 0.87) in poorly-controlled diabetics, respectively.

All non-diabetic children reported that they used table sugar, most of them (81 %) used it more than once a day. Among the diabetic children, 59% used fructose and 42% of those indicated using fructose more than once a day. Of the diabetic population 41% used artificial non-fermentable sweeteners (aspartame, saccharin, cyclamate and etc.) irregularly. Ten percent of the diabetics never used any sugar substitutes. Nobody indicated using sugar substitutes such as xylitol or sorbitol.

No significant difference was found with regard to consumption of fructose in the groups with different metabolic control (56% of well- to- moderately-controlled, and 48% of poorly-controlled diabetics). Use of sweet drinks was more frequently reported among the non-diabetics than non-diabetics: 79% and 43%, respectively, used sweet drinks more than once a day (Figure 1). No statistically significant difference in frequency of using sweet drinks was found in the reports of diabetic children with different metabolic control: 36% of well- to- moderately-controlled diabetics and 52% of poorly-controlled, respectively.

Oral hygiene habits

Analysis of the questionnaire reports about oral hygiene habits showed that virtually all study children (99.3%) reported using fluoridated toothpastes. The majority of the study participants brushed their teeth once a day or more often: 86% diabetics and 94% non-diabetics, respectively (Table 2). Two thirds of the diabetic children reported that they had never used dental floss, compared to 86% non-diabetics (p < 0.05). Both study groups were similar with regard to frequency of dental visits, the mean dental visits per year being 1.41 (SD = 1.27) in diabetics, and 1.65

(SD = 1.55) in the non-diabetics, respectively.

No difference between the groups of diabetics with different metabolic control was found with regard to toothbrushing frequency (87% of well-to moderately controlled and 86% of poorly-controlled reported brushing their teeth at least once a day) (Table 1).

Associations between high caries experience and the selected caries determinants

Multiple logistic regression analysis carried out on potential caries risk associated variables in turn, demonstrated that only age of children (OR = 1.98; CI = 1.23-3.19), level of metabolic control of diabetes (OR = 4.65; CI = 1.28-16.89) were statistically significantly associated with high caries experience (DMFS > 24) in the diabetic children (Table 2). Neither frequency of main meals or sweet drinks, social class (based on the level of mother's education), or frequency of fructose consumption were significantly associated with high caries experience in diabetics. No association in the univariate analysis was found between frequency of snacks as well as frequency of toothbrushing and high caries experience. Thus, these variables were not included in final model.

DISCUSSION

Analysis of the questionnaire data did not reveal major differences in the reports of this study population as concerns their dietary and oral hygiene habits as well as their social status. However, we found that pattern of food consumption slightly differed between diabetic and non-diabetic children. The diabetics had more main meals per day, and less snacking, while the non-diabetic children were characterized by more frequent use of sweet snacks. The number of recommended meals per day for diabetic children is related to insulin dosage, therefore, careful meal planning is important [14]. Nevertheless, it is difficult to judge how relevant the difference between meals and snacks is, because an overall food composition may be rather similar. It has been demonstrated before that the starch-rich diet, and frequent meals as well as longer eating time in diabetic children was associated with similar caries prevalence in diabetics compared to healthy population [15].

Several studies identified that the frequent sugar consumption was associated with caries development in children [2, 16]. Sugary foods and drinks between-meals are considered to be particularly harmful and should be avoided. According to the modern dietary advices the soft drinks and other sugar containing sweets should be replaced with those containing non-cariogenic sweeteners [17, 18]. However, our data showed that low-cariogenic sweeteners such sorbitol, xylitol, mannitol were not popu-

lar in diabetics as well as in non-diabetic children. More than half of diabetic children reported that they used fructose instead of sucrose, however this product has as high cariogenic potential as any other fermentable carbohydrates [1].

Our logistic regression analysis did not reveal a significant association between consumption of sweet snacks or drinks and high caries experience in diabetics. However, it showed that metabolic control of diabetes was significantly related with high caries levels in the diabetics. Such a finding correlates with the results of some other studies on caries development in diabetic population [19, 20]. It was shown that diabetic children with less good metabolic control of diabetes may exhibit uncontrolled caries development in relation with biological and behavioral factors [12]. Poor metabolic balance of diabetes is associated with caries-risk factors such as decreased salivary secretion, elevated glucose concentrations in saliva and pronounced yeasts growth [20-22]. Thus, chronic hyperglycemia can cause shifts in the composition and ecology of saliva by increasing the risk for the development of a cariogenic environment in the oral cavity. In addition, poor controlled diabetics were shown to have lower attention to their oral health [23].

In our study we found no differences according to oral hygiene habits in diabetic children with different metabolic control as well as in the non-diabetics. Most of the study children reported that they brushed their teeth daily (once a day or more), however we did find the correlation between toothbrushing frequency and caries in these children. Considering the fact that these data are based on self-reported information rather than on objective clinical examination, they cannot be used for making definitive conclusions.

CONCLUSIONS

The results of this study suggest that certain dietary factors, such as frequent consumption of sweet snacks and drinks may have an impact on caries development in children. Furthermore, a combination of multiple biological as well as behavioral factors, rather than single elements of individual diet or oral hygiene, seems to determine differences in caries prevalence in a diabetic population.

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REFERENCES

1. Moynihan P, Lingström, Rugg-Gunn AJ, Birkhed D. The role of dietary control. In: Fejerskov O, Kidd E, ed. Dental caries. The disease and its clinical management. 1st ed. Copenhagen: Blackwell Munksgaard; 2003. p. 224-44.
2. Ruottinen S, Karjalainen S, Pienihakkinen K, Lagstrom H, Niinikoski H, Salminen M, et al. Sucrose intake since infancy and dental health in 10-year-old children. Caries Res 2004; 38(2):142-8.
3. Holbrook WP, Amadottir IB, Takazoe I, Birkhed D, Frostell G. Longitudinal study of caries, cariogenic bacteria, and diet in children just before and after starting school. Eur J Oral Sci 1995; 103(1): 42-5.
4. Burt P, Pai S. Sugar consumption and caries risk: a systemic review. J Dent Educ 2001; 65(10):1017-23.

5. König KG. Clinical manifestations and treatment of caries from 1953 to global changes in the 20th century. *Caries Res* 2004; 38(3):168-72.
6. Sanders TAB. Diet and general health: dietary counselling. *Caries Res* 2004; 38(Suppl 1): 3-8.
7. Gibson S, Williams S. Dental caries in pre-school children: associations with social class, toothbrushing habits and consumption of sugars and sugar-containing foods. *Caries Res* 1999; 33: 101-13.
8. Matsson L, Koch G. Caries frequency in children with controlled diabetes. *Scand J Dent Res* 1975; 83(6): 327-32.
9. Edblad E, Lundin SÅ, Sjödin B, Åman J. Caries and salivary status in young adults with type 1 diabetes. *Swed Dent J* 2001; 25(2):53-60.
10. Jones RB, McCallum RM, Kay EJ, Kirkin V, McDonald P. Oral health and oral health behaviour in a population of diabetic outpatient clinic attenders. *Community Dent Oral Epidemiol* 1992; 20(4):204-7.
11. Lopez ME, Colloca ME, Paez RG, Schallmach JN, Koss MA, Chervonagura A. Salivary characteristics of diabetic children. *Braz Dent J* 2003; 14(1):26-31.
12. Twetman S, Johansson I., Birkhed D, Nederfors T. Caries incidence in young type 1 diabetes mellitus patients in relation to metabolic control and caries-associated risk factors. *Caries Res* 2002; 36(1): 31-5.
13. International Society for Pediatric and Adolescent Diabetes. Consensus guidelines 2000. ISPAD consensus guidelines for the management of Type 1 diabetes mellitus in children and adolescents. Zeist: Medforum; 2000.
14. Alemzadeh R, Wyatt DT. Diabetes mellitus. In: Behrman RE, Kliegman RM, Jenson HB, ed. *Nelson textbook of pediatrics*. 17th ed. Philadelphia: Saunders; 2004. p.1960-63.
15. Sarnat H, Eliaz R, Feiman G, Flexer Z, Karp M, Laron Z. Carbohydrate consumption and oral status of diabetic and nondiabetic young adolescents. *Clin Prev Dent* 1985; 7(4): 20-3.
16. Paunio P, Rautava P, Helenius H, Alanen P, Sillanpää M. The Finnish Family Competence Study: The relationship between caries, dental health habits and general health in 3-year-old Finnish children. *Caries Res* 1993; 27(2):154-60.
17. Makinen KK, Makinen PL, Pape HR Jr, Peldyak J, Hujoel P, Isotupa KP, et al. Conclusion and review of the Michigan Xylitol Programme (1986-1995) for the prevention of dental caries. *Int Dent J* 1996; 46(1): 22-34.
18. Das S, Das AK, Murphy RA, Warty S. Cariostatic effect of aspartame in rats. *Caries Res* 1997; 31(1): 78-83.
19. Canaperi P, Zerman N, Cavalleri G. Lack of correlation between salivary *Streptococcus mutans* and lactobacilli counts and caries in IDDM children. *Minerva Stomatol* 1994; 43(11): 501-5.
20. Karjalainen KM, Knuutila ML, Kaar ML. Relationship between caries and level of metabolic balance in children and adolescents with insulin-dependent diabetes mellitus. *Caries Res* 1997; 31(1): 13-8.
21. Karjalainen KM, Knuutila MLE, Käär ML. Salivary factors in children and adolescents with insulin-dependent diabetes mellitus. *Pediatr Dent* 1996; 18(4): 306-11.
22. Reuterving CO, Reuterving G, Hägg E, Ericson T. Salivary flow rate and salivary glucose concentration in patients with diabetes mellitus: Influence of severity of diabetes. *Diabete Metab* 1987; 13(4):457-62.
23. Syrjälä A-MH, Knecht MC, Knuutila, MLE. Dental self-efficacy as a determinant to oral health behaviour, oral hygiene and HbA1c level among diabetic patients. *J Clin Periodontol* 1999; 26(9): 616-21.

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