

Research Article

Association between Oral Health Behaviors Mothers of Diabetic Children and Regular Dental attendance: A Model-guided Approach

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Abstract

Aim: The present study hypothesized that higher oral health behaviors (OHB) constructs of mothers of children with type 1 diabetes mellitus (T1DM) was associated with more regular dental attendance. Secondly, the study aimed to evaluate the association between children's mother OHB and their children oral health status (OHS). **Methodology:** A cross-sectional study conducted on 246 mothers with their children with T1DM. Analysis of Moment Structures (AMOS) software version 18 to construct a structural equation model (SEM) which was used to declare the direct association between OHB and OHS and the indirect association through regular dental attendance which considered a "mediator". To test the goodness-to-fit, the following indices references values were considered: (i) chi-squared test ($p > 0.05$), (ii) root mean square error of approximation (RMSEA < 0.06), (iii) comparative fit index (CFI > 0.95), and (iv) Tucker Lewis index (TLI > 0.95), and (v) normal fit index (NFI > 0.95) The level of significance was set to 5%. **Results:** The indicators values of model goodness-to-fit indicated that the model is adequately fit. The self-efficacy (SE) domain of OHB showed significant direct and indirect effect on children's OHS. Regular dental attendance had a significant direct effect on the children's caries experience and gingival status. **Conclusions:** Children's regular dental annual attendance showed direct and indirect association between maternal SE domain of OHB model and SES with OHS of their children with T1DM.

Keywords: oral health behaviors, type 1 diabetes mellitus, Analysis of Moment Structures

Introduction

The incidence of children with type-1 diabetes mellitus (T1DM) is continuously growing over the time in Egypt. Annually, eight new cases were reported per one hundred thousand (8/100,000) of children below age of under age of fifteen years (El-Ziny Salem et al., 2014). T1DM is a metabolic pancreatic beta-cells leading to abnormal increase in blood glucose level which exceeding the desired sugar threshold (Mauri-Obradors Estrugo-Devesa et al., 2017). The elevated glucose plateau has adverse influences on the body health generally (neuropathy, macro- and micro-angiopathy, and healing retardation) and oral health (OH) particularly. The severity of oral manifestations are directly proportionate to the prolonged hyperglycemia (Tandon Ali et al., 2012). There is nearly a relative consensus that, the incidence of impairment is obviously increased among children with T1DM (Miotti Ferro et al., 1985; Orbak Simsek et al., 2008). Other signs and symptoms are also reported with hyperglycemia such diminished salivary secretion, mouth burn and altered taste sensation (Mauri-Obradors

Estrugo-Devesa et al., 2017). Maintaining the OH in terms of caries and periodontal conditions of children with T1DM in an adequate state is a significant concern through adherence to rigorous preventive regime (tooth brushing, dental floss, fluoridated toothpaste and the utility of dental service) (Anagnostopoulos Buchanan et al., 2011).

The health believes play a crucial role in adopting positive OH promotion behaviors by children. Oral health behavior (OHB) conceptual model is based on a group of domains including perceived barriers, benefits, perceived severity, susceptibility and self-efficacy (Yekaninejad Eshraghian et al., 2012). In the current study, the regular attendance for oral/dental attendance (i.e. utility of dental services) of children with T1DM is the recommended action of their mothers who think that their children are susceptible to caries and periodontal diseases (perceived susceptibility), and ratify the adverse effects of the oral impairment (perceived severity) and perceive the benefits of regular dental appointments

(perceived benefits) over the dental expenses (perceived barriers). Finally the self-efficacy (SE) finalizes the OHB model and motivate diabetic children's' mothers to take an action (cue to action). Therefore, good SE is associated with better oral health status (OHS) (Adair Pine et al., 2004; Broadbent Thomson et al., 2006).

The present study hypothesized that higher OHB constructs of mothers of children with T1DM was associated with more regular dental attendance. Secondly, the study aimed to evaluate the association between children's mother OHB and their children OHS.

Material and methods

1. Study design and participant's selection

The study designed as a cross-sectional questionnaire conducted on the mothers of children with T1DM who attended the Endocrinology Outpatient Clinic, Pediatric Department, Faculty of Medicine, Faculty of Dentistry, Minia University from February January 2017 to March 2018. The included participant's number was 246 subjects after adding 10% to compensate the expected withdrawal. The sample size was calculated on the basis of estimated standard deviation (SD) of OHB scores of 36 subjects that were selected for a pilot study which was ± 0.45 . The degree of precision was set to 5%. The results of pilot study were not included in the final results data analysis.

2. Ethical standards

Before starting the study, informed consents were signed by all participants after through explanation of the study aim and procedures. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

3. Enrollment specifications

3.1 Inclusion standards

- Only mothers with children between 7- and 10-year-old
- Children were diagnosed as T1DM solely for a minimum of two years before starting the study

3.2 Exclusion standards

- Intellectual disabilities
- Sever behavior or emotional disturbances
- maxillofacial deformities or underwent orthodontic inference

4. Predictors and measures

The current study included demographic predictors (Gender and age of the mother and child). Socioeconomic data including (i) maternal schooling which classified according to the schooling years into (more than 12 years, 9 years, less than 9 years and illiterate) and (ii) average family income which dichotomized on the basis of poverty line in Egypt (1.99 USD per day which equivalent to 28.75 LE "current currency) (Mowafi Khadr et al., 2014). Oral health practice of the child and utility of dental service variables, OH practice evaluated via asking about (i) the frequency of daily tooth brushing which categorized into 4 subscales (never, once, twice and more than two times/day), (ii) the use of dental floss and (iii) fluoridated toothpaste and children responses were dichotomized into "Yes" or "No". The utility assessed through two questions (i) Did you visit the dentist in the last 12 months (Yes or No) responses and the reason the dental visit (Regular attendance or Treatment). OHS was evaluated in terms of caries experience using Decayed, Missing and Filled tooth (DMFT/dmft) scores and gingival condition using Gingival index (GI) (Carneiro Fraiz et al., 2015).

The OHB domains were assessed on a 5-point-likert scale ranging from score "1" denoted strongly disagree to score "5" which indicated strongly agree. The minimum score of OHB was "17" and the maximum score was "85". Higher scores indicated better OHB while the lower scores referred poor OHB. The details of each domain questions were illustrated in Appendix 1.

5. Examination and calibration

All children were examined at residency at the Paediatric and dental public health Department, Faculty of Dentistry, Minia University. Two expert Pediatric dentists for at least 5-year of experience were performed the examination and reported DMFT/dmft and GI scores. After tooth polishing and 5-seconds air-dryness, visual-tactile approach under the artificial light was

considered to detect the caries experience. DMFT/dmft scores were reported on the basis of the World Health Organization (WHO) criteria (Assaf Meneghim Mde et al., 2004; Silva Assaf et al., 2015). The gingival condition evaluated using the gingival index (GI) and criteria of Loe and Silness were adopted to calculate the GI scores (Loe & Silness 1963). After data collection, inter-observer reliability using Cronbach alpha were calculated.

6. Statistical analysis

Statistical Package for the Social Sciences (SPSS) version 16 was used for data processing. Descriptive statistics included frequency tables and mean (SD) were processed. Univariate analysis using Spearman's rank correlation coefficients (r_s) was used to detect the strength and linear association between variables. Analysis of Moment Structures (AMOS) software version 18 to construct a structural equation model (SEM) which was used to declare the direct association between OHB and OHS and the indirect association through regular dental attendance which considered a "mediator". To test the goodness-to-fit, the following indices references values were considered: (i) chi-squared test ($p > 0.05$), (ii) root mean square error of approximation (RMSEA < 0.06), (iii) comparative fit index (CFI > 0.95), and (iv) Tucker Lewis index (TLI > 0.95), and (v) normal fit index (NFI > 0.95) The level of significance was set to 5%.

Results

Out of examined 305 subjects, 59 were excluded (33 did not met eligibility specifica-

tions and 26 refused participation). The inter-observer caries experience and gingival condition was high ($\kappa = 0.88$ and 0.81 respectively). The prevalence of caries among children with T1DM was 32.1% for the permanent dentition and 44.3% for the primary dentition. The gingival condition was classified "fair" based on the average GI scores. The mean (SD) of the overall OHB was 60.7 ± 10.12 with the best perception of mothers was toward "Self-efficacy" domain. Other participants' data such as socioeconomic status (SES), children's oral health practices and were listed in table 1.

The linear correlation between OHB domains and different study predictors were summarized in table 2. OHS, regular oral attendance and oral health practices of the child showed moderate associations with the OHB total score. While, maternal level of education displayed a weak association.

Figure 1 illustrates path analysis. The indicators values of model goodness-to-fit were as follow: $\chi^2 = 8.65$ and $\chi^2/d.f.$ ratio = 1.97 ($p = 0.06$), RMSEA = 0.053, CFI = 0.97, NFI = 0.96 and TLI = 0.96. These values pointed out that the model is fit well. The frequency of regular dental appointment variance proportion (R^2) was 45% which can predict the children's OHS.

Table 3 shows the direct and indirect of OHB, regular dental visit, oral health practice and SES in relation to OHS. The SE domain of OHB showed significant direct and indirect effect on children's OHS. Regular dental attendance had a significant direct effect on the children's caries experience and gingival status

Table (1): Frequency and mean (SD) of socioeconomic, oral health practice, regular attendance, maternal dental attendance orientation and oral health status to oral health behaviour domains

Predictors	N(%)	Mean (SD)
Mother schooling		
>12 years	153(62.2)	
9 years	39(15.9)	-
<9years	54(22)	
Illiterate	0(0)	
Family income		
Extremely poor	20(8.1)	
Poor	24(9.8)	-
Intermediate	162(65.9)	
High	40(16.3)	
Tooth brushing frequency per day		
Never	41(16.7)	
Once	61(24.8)	-
Twice	122(49.6)	
>3 times	22(8.9)	
Dental floss use		
Yes	88(35.8)	-
No	158(64.2)	
Fluoridated mouth wash use		
Yes	51(20.7)	-
No	195(79.3)	
Regular annual professional attendance		
Yes	137(55.7)	-
No	109(44.3)	
DMFT score		
0	167(55.7)	1.01(0.66)
>0	79(44.3)	
dmft score		
0	137(67.9)	1.75(0.91)
>0	109(32.1)	
GI score		
Excellent	69(28)	1.48(0.75)
Good	76(30.9)	
Fair	79(32.1)	
Poor	22(8.9)	
Susceptibility	-	11.24(2.61)
Barriers	-	11.41(1.81)
Self-efficacy	-	13.60(2.68)
Benefits	-	11.61(1.87)
Severity	-	12.84(3.84)
Overall OHB	-	60.7(10.12)

Table (2): Spearman's rank correlation between of socioeconomic, oral health practice, regular attendance, maternal dental attendance and oral health status orientation to oral health behaviour domains

Predictors	Spearman's rank correlation (r_s)					
	Susceptibility	Barriers	Self-efficacy	Benefits	Severity	Overall OHB
Mother schooling	0.253**	0.335**	0.353**	0.406**	0.265**	0.370**
Family income	0.332**	0.396**	0.405**	0.413**	0.317**	0.446**
Tooth brushing	0.362**	0.457**	0.535**	0.454**	0.483**	0.575**
Dental floss	0.076	0.167**	0.210**	0.247**	0.135*	0.205**
Fluoridated mouth wash	0.432**	0.420**	0.515**	0.305**	0.356**	0.552**
Regular annual attendance	0.431**	0.543**	0.573**	0.580**	0.473**	0.532**
DMFT	0.443**	0.562**	0.600**	0.565	0.488**	0.597**
dmft	0.491**	0.512**	0.593**	0.533**	0.482**	0.534**
GI	0.550**	0.585**	0.625**	0.524**	0.512**	0.677**

* $p < 0.05$, ** $p < 0.01$

Table (3): Direct and indirect effects of OHB, regular dental visit, oral health practice and socioeconomic status in relation to OHS

Predictors	Direct effect				Indirect effect			
	Dmft β	GI β	DMFT β	Dental Visit β	Dmft β	GI β	DMFT β	Dental visit β
Susceptibility	-	0.003**	-	0.142	0.012	0.091	0.024	-
Barriers	-	-	-	0.274	0.022	0.036	0.031	-
Benefits	-	-	-	0.189	0.024	0.040	0.037	-
Self-efficacy	-	-	0.02**	0.037**	0.043*	0.070*	0.062*	-
Severity	-	-	-	0.621	0.088	0.0139	0.129	-
Dental visit	0.002**	0.003**	0.003**	-	-	-	-	-
OH practice	0.002**	0.002**	0.002**	0.251	0.091	0.141	0.133	-
SES	-	-	0.002**	0.004**	0.112**	0.181**	0.170**	-

β : Beta coefficient, * $p < 0.05$; ** $p < 0.01$

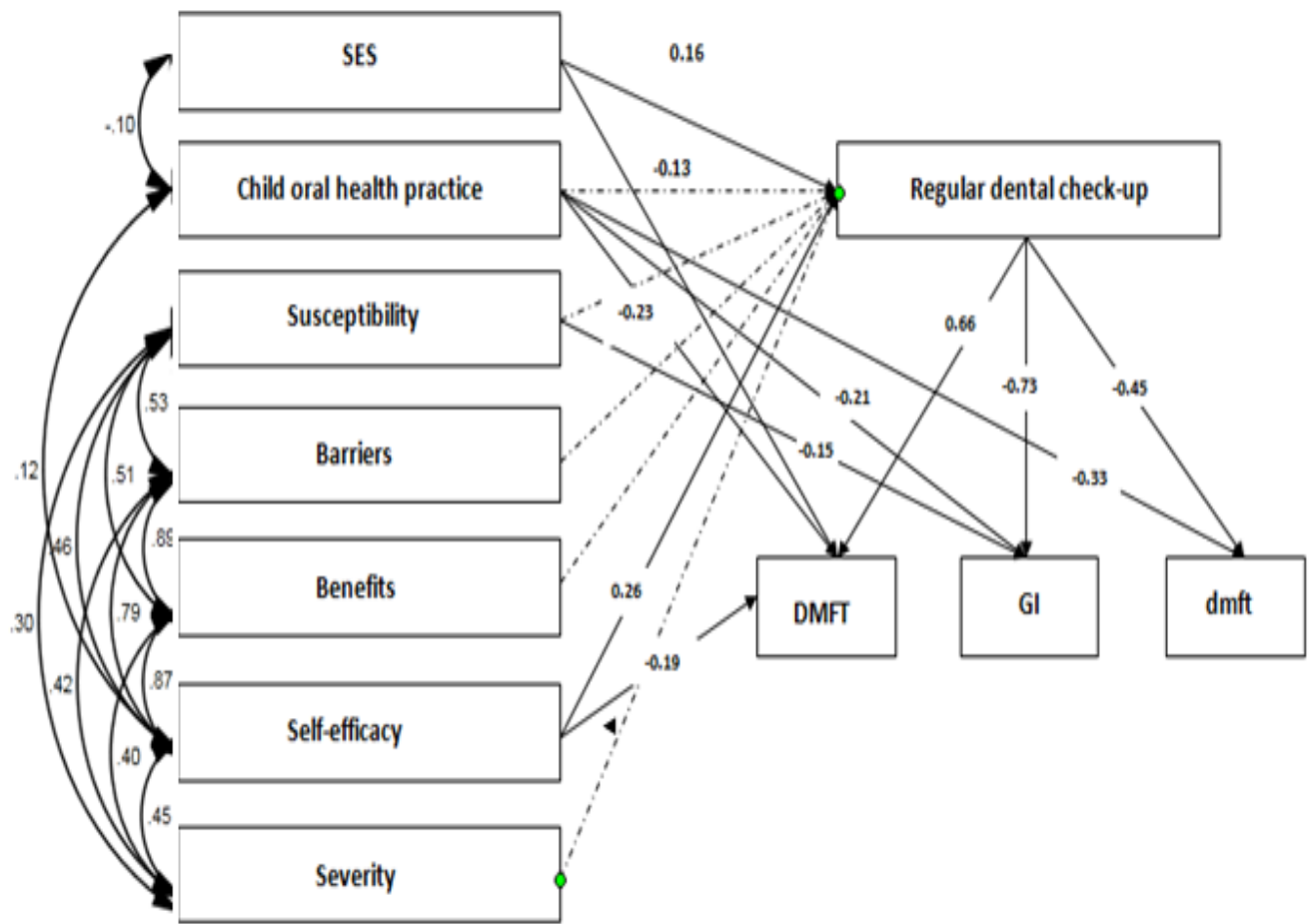


Figure 1. Path model considering regular dental attendance mediating socioeconomic status, oral health practices and OHB domains with oral health status in terms of DMFT, GI and dmft. The dashed lines indicated a non significant association. All solid lines and covariance indicated significant correlations ($p < 0.01$), except for the benefits domain ($p < 0.05$)

Appendix 1

Domain	Strongly disagree	Disagree	Neutral	Agree	Strongly disagree
Susceptibility 1. The chance of my child to get cavities and/or gingivitis is higher than his/her peers without T1DM because no regular oral attendance per year 2. Within the next year, my child will get cavities or gum disease because no regular oral attendance per year 3. My child has a high chance to get tooth decay because no regular oral attendance per year					
Barriers 1. I feel that regular oral attendance per year will not improve my child's oral health 2. I feel that regular oral attendance per year is expensive 3. I feel that dentist will not adequately explain preventive measure to my child					
Self-efficacy 1. I am confident that I can provide a regular oral attendance per year for my child at least once every year 2. I am confident that I can provide a regular oral attendance per year for my child even if I am busy 3. I am confident that I can provide a regular oral attendance per year for my child, if there is a good reason for doing so 4. I am confident that I can provide a regular oral attendance per year for my child whatever the obstacles					
Benefits 1. Regular oral attendance per year helps my child to prevent tooth decay 2. Regular oral attendance per year helps my child to prevent gum bleeding 3. Regular oral attendance per year helps to make my child feel better					
Severity 1. Tooth decay can may my child looks bad 2. Dental problems can be more serious if not regularly attendance my child teeth 3. The consequences of tooth decay can be adverse if I am not regularly checked-up my child teeth 4. The gingival problems can cause other systemic problems (e.g . cardiovascular,etc)					

Discussion

The present study tried to provide to some extent a comprehensive thorough view of the association between oral health status of children with their mother's OHB and one independent predictor (frequency regular dental professional examination per year) was picked up to the assess its direct and indirect effect on the children's OHS. Therefore, SEM is the suitable approach to exhibit the complex interrelation between variables and it offers the opportunity to test more than one proposal simultaneously (Kueh Morris et al., 2015).

The findings of this study suggested that SE perception was the only maternal OHB domain that significantly affected the frequency of regular dental visit which acted as a mediator between SE and OHS. In addition, SE also showed a direct effect on DMFT scores. Maternal SE was significantly correlated with the child's adopted oral hygiene practices. This was in line with the published findings of former studies. For instance, an international survey included 17 countries concluded that children adhered to more tooth brushing practice were belonged to families with high SE (Adair Pine et al., 2004). Another study conducted on 377 Australian elementary schools revealed that parent's SE scores was in direct relation with the frequency of tooth brushing of their children (de Silva-Sanigorski Ashbolt et al., 2013). However, there is a debate regarding the position of SE in the cause-effect chain. In other words, there is no agreement whether SE precedes a certain behavior or it is a sequela of such behavior (Hawkins 1992). Another view opposed Hawkin's hypothesis and suggested that OHB is a result of SE (Kakudate Morita et al., 2010).

The regular dental visit mediated the effect of SES on children's OHS. Low SES might be diminishing the access to dental service. Moreover, SES was directly associated with tooth brushing frequency which confirmed by the results of the current study. This was in agreement with Paula et al, findings who reported less use of dental auxiliaries (e.g. flossing and risings) among Brazilian schoolchildren descended from families with low education level (Paula Ambrosano et al., 2015). Another data extracted from published

article by Park et al, confirmed the low SES (education and income) as a risk indicators of OHB (Park Han et al., 2016).

The children's oral health practices such as frequency of tooth brushing, dental floss and mouth wash use has a non-significant association with regular dental attendance. Meanwhile, the oral health practices have a direct and significant effect on children's OHS. Inadequate children' oral health practices were associated with poor OHS in terms of gingivitis and caries. Children with T1DM especially those with uncontrolled hyperglycemia have general systemic inflammatory mediators including the periodontal ligament with subsequent chronic inflammatory responses. Therefore, proper oral health practices were remarkably contributed in prevention of chronic inflammation caused by diabetes (Lalla Cheng et al., 2006).

Caries experience in the current study (DMFT and dmft) was less than that recorded for children with T1DM in former studies (Oulis Tsinidou et al., 2012; Dye Thornton-Evans et al., 2015). The differences in the caries experience results among studies might be attributed to several factors such as the miscellaneous study designs including eligibility specifications, participant's cultural backgrounds and baseline characteristics and metabolic status and treatment.

Study strength and limitations

The study has a number of strong aspects, the chief powerful point was the use of comprehensive model which has the advantage of declaring multiple and complex interrelations. The second positive point was the priority of this study in figuring out the concept of OHB with its different domains among mothers of children with T1DM. The principle negative point was the use of cross-sectional design in conducting this investigation. In cross-sectional design the cause and outcome are found in the same time which is not sufficient to declare the causality. Also this design measure the association between dynamic variables at one point of time which make measuring of the actual effect difficult.

Conclusions

From the findings of the current study, it can be concluded that children's regular dental annual attendance mediate the association between maternal SE domain of OHB model and SES with OHS of their children with T1DM. Furthermore, it has a direct effect on the children with T1DM caries experience and gingival condition.

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