Association of Adverse Childhood Experiences with Oral Health Status of children living in Rural Areas of Alexandria, Egypt: A household Survey

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Research Article

Keywords: Adverse childhood experiences, Oral health, Dental caries, Gingivitis, Rural population, Children, Egypt

Posted Date: May 23rd, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1670933/v1

Abstract

Background: Scarce research assessed the link between Adverse childhood experiences and oral health status of Egyptian children whose level of oral diseases and Adverse childhood experiences may be different from western countries and who have high level of caries. This study aims to investigate the association between ACE and the oral health status of children living in rural areas in Alexandria, Egypt.

Methods: A cross-sectional household survey was carried in North Western Delta, including 300 children 6-18 years old. Children were examined for dental caries and gingival condition then questioned about their oral hygiene habits and sugar consumption. Mothers/caregivers answered the adverse childhood experiences questionnaire. Three linear regression models were used to assess the relationship between dependent variables (primary caries experience, permanent caries experience, gingival score) and exposure (ACE) after adjusting for potential confounders. Furthermore, another 3 models were used to evaluate oral health behaviors (sugar consumption, plaque consumption, dental visits) effect on dependent variables.

Results: Most children were females (57.2%), mean age was 9.81, SD= 3.06. 68.6% children had caries experience in their primary teeth (mean ± SD dft= 3.03± 3.14) and 27.9% had caries experience in their permanent teeth (mean ± SD DMFT= 0.60 ± 1.16) with mean ± SD gingival index score 1.14± 0.37. The mean ± SD ACE score was 4.15 ± 1.91. When comparing adjusted R2 of ACE models and oral health behaviors models; dft model of both had an identical value of 0.44. However, adjusted R2 of ACE models (DMFT =0.20, and gingival score =0.03) were different than those in oral health behaviors models (DMFT =0.22, gingival score =0.45).

Conclusions: ACEs explained the same amount of variation in primary caries experience as sugar consumption, plaque accumulation and dental visits. Yet, it doesn't have the same effect on permanent caries experience or the gingival condition. Therefore, ACEs might have the same effect on primary dental caries as oral health behaviors. Further research is needed to evaluate if a dose-response relationship is present between ACEs, oral health and oral health behaviors as suggested by previous research.

Introduction

Dental caries is the most widespread chronic disease in children(1), yet it is preventable and has a significant effect on their overall quality of life and development (2). When left untreated, it leads to severe pain and prolonged infections. This can cause children to lose the ability to speak, chew, swallow, and sleep, eventually inducing behavioral problems, loss of self-esteem, learning difficulties and missed school days(3). Children with high levels of dental caries were found to be 1.7 times more likely to have poorer oral health- related quality of life than caries-free children(4). Unfortunately, these oral conditions are not taken seriously, and are often delayed or neglected as they are not life threating diseases(5). In 2014, the Egyptian Ministry of Health with World Health Organization, reported caries prevalence, among children of all ages, at 70% whereas gingival and periodontal prevalence was 80% (6). A study in 2019,

measured mean± SD dmft: 3.23±4.07 and DMFT: 1.04±1.56 among Egyptian children aged 3-18 years (7). This indicates high levels of dental caries, specifically in deciduous and mixed dentition of young Egyptian children. Mental health plays an important role in the oral health of individuals. Negative stressors interact with different areas in the brain resulting in disrupted development, adoption of risky behaviors and development of chronic diseases; hence, decline in the person's overall health. Stressors such as Adverse Childhood Experiences (ACE) affect individuals' well-being in their formative years and have inversely proportional relationship with the person's health(8). When children are victims of ACEs, they become at risk of developing chronic diseases and commonly report higher incidence of caries in primary and permanent teeth. Individuals with a history of neglect and abuse (physical, sexual and emotional) reported delaying dental visit, having more teeth extracted, and longer period since last dental cleaning (9). Bright et al (10) reported that 0-17 year-old American children, with more than one ACE, were more likely to have fair to poor oral condition and toothache. These findings suggest that ACEs may act as a risk indicator for dental caries and periodontal disease (9,10). However, among 6 to 16 years old Nigerian pupils, there was no association between dental caries, poor oral hygiene, oral disease complications and ACE (11). Nevertheless, little to scarce research assessed the link between ACE and oral health status of Egyptian children whose level of oral diseases and ACE may be different from western countries and who have high level of caries. The aim of this study was to investigate the association between ACE and the oral health status of children living in rural areas in Alexandria, Egypt. The null hypothesis was that no significant relationship would be observed between ACE and oral health status of those children.

Methods

This study was carried out from May 2019 to February 2020 after obtaining the approval of the Research Ethics Committee, Faculty of Dentistry, Alexandria University (IRB 00010556 – IORG 0008839). Informed verbal consent was obtained from the parents/ caregivers of the participating children in presence of a witness; in accordance with the Helsinki ethical principles for medical research on human subjects. This was achieved after explaining the aim of the study and assuring them of data confidentiality and their right to withdraw any time. Sample size was estimated based on 95% confidence level , 80% study power, estimated odds ratio= 2 for impact of ACE score 1-3 compared to ACE score 0 on dental visits (12) and 26% of children in rural areas having a history of dental visits (13). The minimal required sample size was calculated (14) to be 294≈ 300. A household survey was carried out in rural Northwestern Delta, Alexandria, Egypt using a multistage stratified random sampling. In stage 1, the most densely populated administrative center was selected from 28 centers in the North Western Delta (15). In the second stage, villages were randomly selected in this center. In the third stage, eligible families were randomly selected from registries provided by local guides in these villages (16). In the last stage, the eldest child was recruited in each family(17). Children were included if they were residents of rural areas in Alexandria, aged between 6-18 years, free of mental or physical diseases and the parent/ caregiver was available and consented to participate. Clinical examination and interviewing of participants were conducted in their homes. Data were collected using a questionnaire; the first two sections were answered privately by

parents/ caregivers and the third section was answered by the child accompanied by a parent/ guardian. First, the demographic section assessed sex, age, and parental education. The second section included the validated ACE questionnaire (15) with 10- items assessing abuse (psychologically, physiologically and sexually), household dysfunction (parental separation, substance abuse, mental illness, incarceration, witnessing violence and death of loved ones) and unfair treatment. The responses were 'yes'/ 'no' and a total score was calculated by adding the items' points with possible score ranging from 0 to 10. The higher the score, the more life adversities the child has faced. We used a simplified version of this questionnaire (18) where the sexual abuse questions were removed and replaced by a question about child mistreatment, which was deemed more culturally appropriate for the study setting. The ACE questionnaire was translated to Arabic and back translated to English to ensure accuracy (19). The third section included the Arabic version of the World Health Organization (WHO) child questionnaire to assess oral health behaviors (20,21) including tooth brushing frequency, frequency of snacking on sugary foods, and dental visits in the last year. The questionnaires were pilot tested on ten mothers/ children in the first village visited and their data were excluded from the final analysis. After responding to the questionnaire, the children were examined under natural lighting without drying or magnification using the WHO criteria for caries diagnosis. Teeth were recorded as decayed if there was obvious cavitation, undermined enamel, soft floor or walls, or temporary fillings. DMFT (permanent dentition) and dft (mixed dentition) scores were calculated as the sum of decayed, missing due to caries and filled teeth (20). The gingival condition was assessed using the gingival index (GI) of Löe and Silness with scores ranging from 0=no inflammation, 1=mild redness and edema, 2=bleeding upon probing with inflammation to 3=spontaneous bleeding with severe inflammation (22). Oral hygiene was assessed using the plaque index (PlI) of Silness and Löe where score 0 indicates no plaque accumulation, score 1 indicates thin plaque adherent to tooth surface and only visible by probe, while score 2 indicates plaque accumulation on gingival margin visible by the naked eye and score 3 is abundant plaque on all gingival margin aspects(23). Both indices were applied on the same six index teeth (16/55,12/52,24/64,36/75,32/72,44/84) by measuring four surfaces (buccal, lingual, mesial, distal) of each tooth and the scores were averaged to give the tooth score. Teeth scores were divided by number of teeth examined to obtain the individual's score. Disposable mirrors and ball ended WHO probes #550B were used for clinical examination. Before the study, training and calibration of the examiner (HM) was done. Kappa score for intra-examiner reliability of caries examination was 0.94 indicating excellent agreement (24). An online platform (KoboToolbox)(25) was used to record data. Oral hygiene instructions were provided to the participants and toothbrushes and toothpaste were distributed after the examination and interview. Data collection was cut short due to the COVID-19 pandemic resulting in a sample of 229 participants and attempts to complete recruit were unsuccessful. The associations between the dependent variables (DMFT, dft, and GI) and the explanatory variables were assessed using linear regression analysis. Potential confounders (age, gender and mother's education) were adjusted for in all models. Model 1 included ACE as explanatory variable, Model 2 included oral health practices (dental visits, sugar consumption) and plaque index as explanatory variables. Regression coefficients (B), 95% confidence intervals (CI) and adjusted R2 were calculated. Significance was set at $P < 0.05$. Data were analyzed using IBM SPSS for Windows version 25(26).

Results

Table 1 shows that most children were females (57.2%) and mean age was 9.81 (SD 3.06), with almost half the mothers completed primary or middle school (46.7%). Also, 157 (68.6%) children had caries experience in primary teeth, mean ± SD dft= 3.03± 3.14, and 64 (27.9%) children had caries experience in permanent teeth, mean ± SD DMFT= 0.60 ± 1.16. The mean ± SD gingival and plaque scores were 1.14± 0.37 and 1.40± 0.57, respectively. Also, 10.5% of children brushed at least once daily, 95.2% had sugary snacks at least once a day and 46.3% reported visiting the dentist at least once last year. The mean ± SD ACE score was 4.15 ± 1.91, 63.3% had 4 or more ACE and 36.7% had <4 ACE.

Table 1: Demographic profile, oral health behaviors, oral health status and ACE of children participating in the study (n = 229)

Variable	-	N (%)
Age	Mean ± SD	9.81± 3.06
Gender N (%)	Female	131 (57.2%)
	Male	98 (42.8%)
Mother Education N (%)	No education	91 (39.7%)
	Completed primary or middle school	107 (46.7%)
	Completed high school or higher education	31 (13.5%)
caries experience in Permanent teeth (DMFT)	n (%)	64 (27.9%)
	Mean ± SD	0.60 ± 1.16
caries experience in Primary teeth (dft)	n (%)	157 (68.6%)
	Mean ± SD	3.03± 3.14
Gingival index	Mean ± SD	1.14± 0.37
Plaque index	Mean ± SD	1.40± 0.57
Tooth brushing (n%)	Less than once daily	205 (89.5%)
	At least once daily	24 (10.5%)
Sugar score (n%)	At least once daily	218 (95.2%)
	Less than once daily	11 (4.8%)
Dental visits last year (n%)	Less than once or never	123 (53.7%)
	At least once	106 (46.3%)
Adverse Childhood Experience	Mean ± SD	4.15 ± 1.91
	ACE score 0-3	84 (36.7%)
	ACE score ≥ 4	145 (63.3%)

Figure 1 shows that the most frequent ACEs were financial hardships (90.8%), witnessing violence (83.8%) and unfair treatment (60.3%)

Table 2 presents the factors associated with dft score. Model 1 shows that ACE was not significantly associated with dft score (B= 0.02, CI 95%= -0.15, 0.18). Model 2 shows that sugar score (B=0.63, 95%CI= -0.79, 0.73), dental visits (B=-0.53, 95%CI= -1.14, 0.08), and plaque index score (B=0.11, 95%CI= -0.43, 0.64) were not significantly associated with dft score. The adjusted R2 of model 1 and model 2 were the same = 0.44.

Table 2: Factors associated with dft score (n=229)

Variable		Model 1 B (CI 95%)	Model 2 B (CI 95%)
ACE score		0.02 (-0.15, 0.18)	-
Sugar score	At least once daily	-	0.63(-0.79, 0.73)
	Less than once daily	-	Reference
Dentist visits last year	Less than once or never	-	-0.53 (-1.14, 0.08)
	At least once	-	Reference
Plaque index score		-	0.11 (-0.43, 0.64)
Adjusted R2		0.44	0.44

Model 1: Including ACE adjusting for age, gender and mother education

Model 2: Including (dental visits, sugar consumption) and plaque index adjusted for age, gender and mother education

Table 3 shows that the association of ACE with DMFT was not statistically significant (B= -0.02, CI 95%=-0.10, 0.05). In model2, consuming sugar at least once daily was not statistically significant (B=-0.27, CI 95%= -0.90,1.23) and neither were dental visits in the past year (B= -0.32, 95%CI= -0.59, -0.06) or plaque scores (B= 0.14, 95%CI=-0.10, 0.37). The adjusted R2 of model 1 and model 2 were very close (R2= 0.20 and 0.22 respectively).

Table 3 Factors associated with DMFT score (n=229)

Variable		Model 1 B (CI 95%)	Model 2 B (CI 95%)
ACE score		-0.02 (-0.10, 0.05)	-
Sugar score	At least once daily	-	-0.27(-0.90, 1.23)
	Less than once daily	-	Reference
Dentist visits last year	Less than once or never	-	-0.32 (-0.59, -0.06)
	At least once	-	Reference
Plaque index score		-	0.14(-0.10, 0.37)
Adjusted R2		0.20	0.22

Model 1: Including ACE adjusting for age, gender and mother education

Model 2: Including (dental visits, sugar consumption) and plaque index adjusted for age, gender and mother education

Table 4 presents the association between ACE, oral health practices and gingival score. In Model 1, ACE was not significantly associated with the gingival index score (B= 0.12, CI 95%= -0.01, 0.04). In Model 2, consuming sugar more than once daily and plaque index had a negative association with gingival score (B=0.23, CI 95%=0.06, 0.40 and B=0.42, CI 95%= 0.036,0.049) The adjusted R2 of model 1 and 2 were 0.03 and 0.5.

Table 4 Factors associated with Gingival score (n=229)

Variable		Model 1 B (CI 95%)	Model 2 B (CI 95%)
ACE score		0.12 (-0.01, 0.04)	-
Sugar score	At least once daily	-	0.23(0.06, 0.40)
	Less than once daily	-	Reference
Dentist visits last year	Less than once or never	-	0.04(-0.03, 0.11)
	At least once	-	Reference
Plaque index score		-	0.42(0.36, 0.49)
Adjusted R2		0.03	0.45

Model 1: Including ACE adjusting for age, gender and mother education

Model 2: Including (dental visits, sugar consumption) and plaque index adjusted for age, gender and mother education

Discussion

The effect of Adverse childhood experiences has been related to childhood obesity, poor health outcomes, development of chronic diseases and engagement in health-risk behaviors(27–29).

This study investigated frequency of oral diseases (primary and permanent dental caries, gingival condition, plaque accumulation) in children, the frequency of adverse childhood experiences for children and the association between exposure to ACEs and outcome variables; dft, DMFT and gingival scores. Findings have shown that the larger part of study participants experienced primary caries while only a quarter of them had permanent caries experience. Moreover, plaque accumulation and gingival scores were of a moderate degree. Almost all of the children consumed sugary snacks more than once daily and reported brushing their teeth less than once daily. Majority of children had high ACE score; more than two thirds of the current study participants had a score of 4 or more ACEs. Previous literature reporting similar ACE scores puts children at risk of increase in dental caries and poor oral hygiene (30, 31); however this study's results are in disagreement with them since ACE was not significantly associated with any of outcome variables.

Results showed that there was no statistically significant association between exposure to ACE and dft score. Yet, ACEs affected the variation present in dft score same as the combination of daily sugar consumption, dental visits in the past year and plaque accumulation as shown by their equal values of adjusted R2 (0.44). This emphasizes that the importance of ACEs is similar to that of oral health-related behaviors in relation to caries experience in primary teeth. This weakly corresponds with previous cross-sectional research that highlight an association between ACEs and tooth decay. (8, 10, 29, 31–34). It also showed no significant association with DMFT score and gingival score. These findings are consistent with Folayan et al (11) who clinically examined Nigerian children, in schools, from ages 6–16, and revealed that less than 4% of the sample developed caries and had dental complications. Furthermore, this was the only study with similar sample selection and examination methodology that showed no association between tooth decay and ACE which; supports the current findings. No statistically significant association was observed between ACEs' exposure and gingival score, where adjusted R2 is 0.03.This is maybe attributed to the fact that gingivitis is a generally reversible condition that constantly changes over short periods of time(35). This study had some limitations. First, data collection was interrupted due to the COVID-19 outbreak and the remaining part of the sample could not be recruited. Second, house surveys allowed friendly neighbors or extended family to observe and eavesdrop on examiners even behind closed doors; this limited the number of unbiased available houses at each block. Third, social desirability can cause participants to answer questions about mental illness, domestic violence, drug and alcohol abuse in a biased manner; since these self-reports of certain health attributes and behaviors are

often stigmatized (36). Hence, the amount of ACEs affecting these children might have been underestimated and is actually of more impact. Furthermore, the nature of data collection of ACEs was very delicate and using an observational study was the suitable choice at the time, however, it merely unsurfaced the need for further research by using cohort studies to identify exact cause-effect association; while also, including participants from urban areas. Additionally, Egypt is a collectivist society which emphasizes the needs and goals of the group over those of the individual. This may alter a person's perception of hardships and adversities (37–39). There is a possibility that Egyptian children might tolerate ACEs more than children in other cultures since these experiences are shared by all of them and are viewed as normal. Nevertheless, the current study showed that ACE may be important traditional indicators of oral health in children.

Conclusion

It is evident that dental caries experience remains an issue that widely effects Egyptian children. The current study suggests that ACEs might have the same effect on primary dental caries as oral health behaviors. Furthermore, this proposes that further research is needed to illuminate the hidden effects of the accumulation of these proximal variables. On the other hand, the effects of these experiences can be alter or reduced if sufficient support is received by the exposed individual; therefore it is recommended that upcoming dental professionals are educated on the matter enough to provide the preventive and corrective treatment that exposed communities need. Future studies, would explain if there is a dose-response relationship between ACEs, oral health and oral health behaviors as it is suggested by previous research.

Abbreviations

ACEs: Adverse Childhood Experiences;

WHO: World Health Organization;

DMFT: Decayed, missing due to caries and filled permanent teeth;

dft: Decayed and filled primary teeth;

SD: Standard Deviation;

B: Unstandardized Regression Coefficient;

CI: Confidence Interval

Declarations

Ethics approval and consent to participate

Prior to the commencement of the study, ethical approval was obtained from the Research Ethics Committee at the Faculty of Dentistry, Alexandria University, Egypt (IRB 00010556 – IORG 0008839). Informed verbal consent of the parent in the presence of a witness was used due to the high illiteracy levels in this rural setting. This consent was in accordance with the Helsinki ethical principles for medical research on human subjects.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

None

Funding

There was no funding to support this research.

Authors' contributions

HHM conceptualized the study, collected data, developed and implemented the statistical analysis plan and prepared the manuscript draft. AAM and WEA helped in designing the study methods and contributed to the review and finalization of the manuscript. All authors read and approved the final manuscript.

Acknowledgments

The authors would like to express their deepest appreciation to Prof. Maha El- Tantawi for her fine contribution to this study. The authors would also like to thank the dental public health research team, Faculty of Dentistry, Alexandria University, for their help in data collection and great support in achieving this work.

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Figures

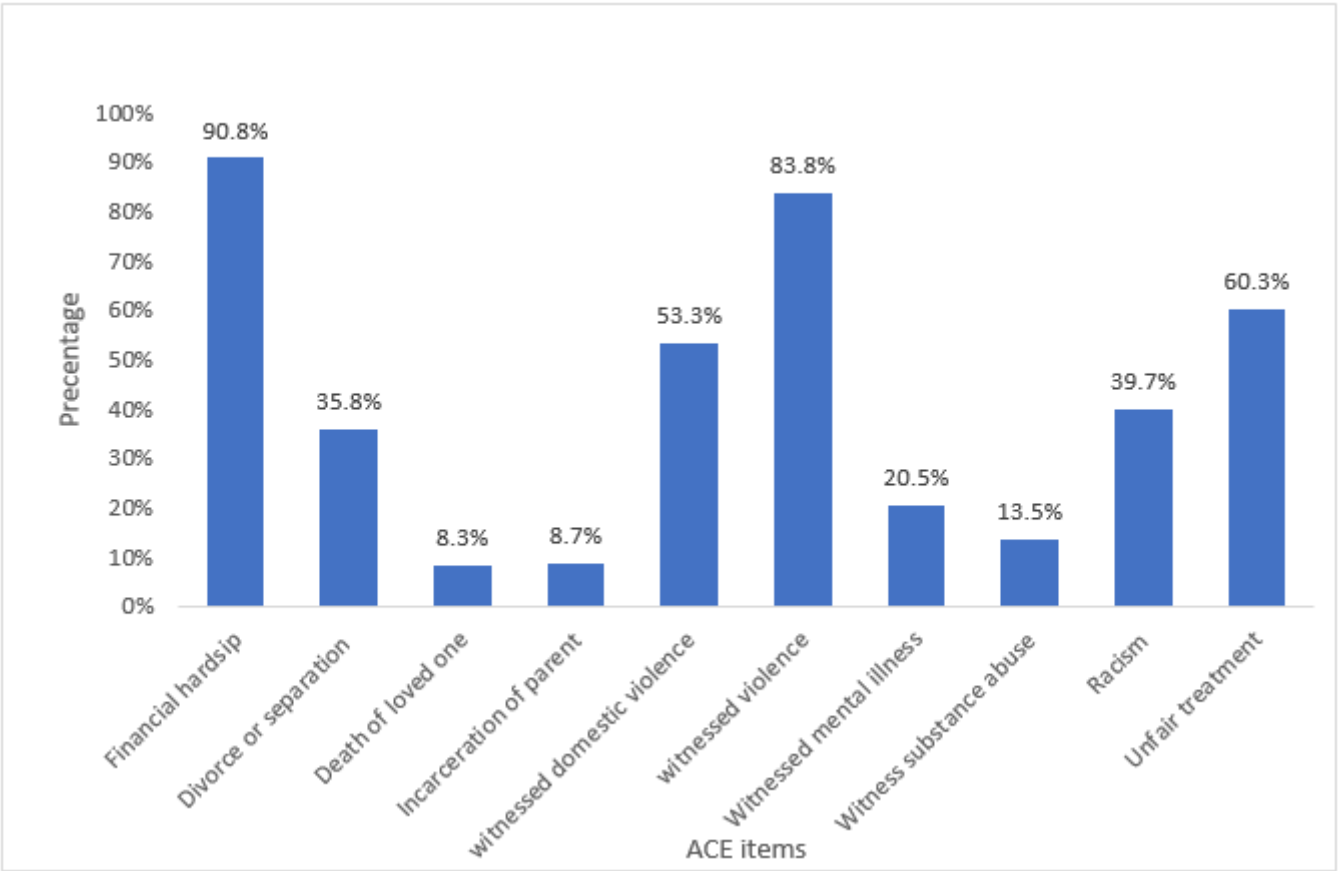

Figure 1

Percentage of Adverse Childhood Experiences reported by children participating in study (n=229)