

# Key Factors Associated with Oral Health-Related Quality of Life in Sri Lankan Adolescents: A Cross Sectional Study

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## Research article

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# Abstract

## Background

Oral Health Related Quality of Life (OHRQoL) measures have emerged as an important oral health outcome that is able to reveal the subjective burden of illness due to oral diseases. The association between socio-demographic and socio-economic factors, clinical dental conditions and OHRQoL indicators has been investigated in adolescents' cohorts across the world. The purpose of this study was to investigate key factors associated with oral health-related quality of life of Sri Lankan adolescents.

## Methods

A cross sectional study was conducted amongst a sample of 15-19 year-old secondary school students, Gampaha district, Sri Lanka. The data was collected using two self-administered questionnaires. A modified Sinhalese version of the Oral Impact on Daily Performance (OIDP) questionnaire that has been validated for Sri Lankan adolescents was administered. A second questionnaire collected information on socioeconomic characteristics, oral health care seeking and oral health behaviours. A clinical oral examination was performed on each participant. Oral health related quality of life was measured using OIDP domains and total OIDP scores. Multiple linear regression with stepwise selection was used to investigate the key factors associated with the OIDP additive score.

## Results

A total of 1,332 adolescents participated in the study. Negative quality of life impacts were more prevalent in the social and psychological domain of OIDP as compared with the functional domain. Total OIDP scores ranged from 0 to 36 with a mean of 3.16 (SD=4.71). The multivariate analysis revealed that decayed teeth, presence of anomaly, age, family income, health care seeking pattern and consumption pattern of soft drinks were all significantly associated with higher total OIDP scores, reflecting poorer oral health related quality of life. Frequency of daily tooth brushing was negatively associated with total OIDP scores.

## Conclusion

Various factors were associated with OHRQoL and could have implications for the improvement of OHRQoL among Sri Lankan adolescents.

## Introduction

Clinical parameters measuring oral health are usually objective, requiring a dental professional's judgment. Although these clinical measures indicate the presence and severity of an oral condition, they have limited capacity to assess the functional and psychological aspects of oral health in an individual [1–4]. Oral Health Related Quality of Life (OHRQoL) measures have emerged as an important oral health outcome that is able to reveal the subjective burden of illness due to oral diseases. Further, OHRQoL may

serve as criteria to identify priority groups for public health interventions and to establish as outcome measures for oral health promotion activities [5].

A number of questionnaires have been developed to measure socio dental indicators in a population, including the Oral Impact on Daily Performance (OIDP) tool [6]. The OIDP is conceptually based on the international Classification of impairments, disabilities and handicaps created by WHO in 1980 [7], later validated on a cohort of Sri Lankan Adolescents [8]. The association between socio-demographic and socio-economic factors, clinical dental conditions and OHRQoL indicators has been investigated in adolescents' cohorts across the world. It was evident that, poor OHRQoL in children and adolescents was associated with unfavourable socio-economic conditions and poor oral health [9, 10].

A recently published study on Brazilian adolescents aged 15–19 years, revealed that income inequality during childhood was associated with poor OHRQoL [11]. In addition, OHRQoL was negatively associated with poor individual socio-economic indicators, high number of untreated tooth decay and missing teeth and poor gingival status in same age cohort in Brazil [12]. Although dental caries was statistically significantly associated with children's oral health related quality of life, some studies reported equivocal findings [1, 4, 13, 14]. However, some reported significant methodological limitations on sampling, data collection and analysis in OHRQoL studies conducted among children [15–17].

The purpose of this study was to investigate key factors associated with oral health-related quality of life (OHRQoL) in a representative sample of adolescents, Gampaha district, Sri Lanka. The null hypothesis was that OHRQoL had no association with clinical oral conditions, oral health behaviours, health care utilization pattern and socio-demographic characteristics.

## Methods

### Study setting, sample size and study design

We report on a cross sectional study conducted in the Gampaha district, Western Province of Sri Lanka. The study population was 15–19 year old adolescents who were attending secondary government schools in the district, encompassing a total of 377 functioning schools. The sample size for the study was calculated by using the formula  $n = z^2 p (1-p) / d^2$  [18] and minimum sample was found to be 384. Since the study was designed to have cluster sampling technique, sample was adjusted by including the designed effect of 2.9[19]. Hence the final sample size was calculated as 1337 with the inclusion of the 20% non-response rate. As this study involved secondary school children the minimum number of children was identified as 20, thus the number of children in a cluster or cluster size was decided as 20. Due to feasibility issues even though cluster size was determined as 20, two clusters were taken from one selected school. 67 clusters were selected using the multi stage cluster sampling technique with probability proportionate to size of grade, across grades 10, 11, 12 and 13. Clusters were selected according to the school sampling frame.

This study received the approval from the Ethics Review Committee of the Faculty of Medicine, University of Colombo, Sri Lanka (Ref No EC 15–171). Administrative clearance was obtained from the Educational and Health ministerial personnel. The objectives of the study and the data collection methods were explained to participants, along with their parents, with written consent obtained prior to commencement. The field team was formed by a dental surgeon who carried out an oral examination on all participants; a retired school dental therapist for recording clinical data; and an assistant. Data were collected from the adolescents' clinical oral examination as well as from two self-administered questionnaires: the OIDP to measure oral health related quality of life; and a second questionnaire developed for the study to collect information on socio economic characteristics and oral health care behaviours. Adolescents with dental problems were referred to the nearest government dental clinic where treatment was guaranteed.

## **Oral Impact on Daily Performance scale (OIDP scale)**

The OIDP index was initially developed by Adulyanon [6] and later modified and validated in a 220 sample of 15 to 19 year-aged cohort of Sri Lankan adolescents [20]. During cross-cultural adaptation few items were modified with the consensus of the members of the expert committee. In addition, scoring system was revised to report only the severity of the impact and period was shortened to three months. This was based on the results of the pre-testing of the modified OIDP scale among a sample of 15–19 year-aged adolescents and in agreement with the expert committee members.

An assessment of factorability found that all correlation coefficients were  $> 0.30$  with no item found to increase Cronbach's alpha when deleted. The KMO measure of sampling adequacy was 0.87 and Bartlett's test of Sphericity was significant ( $p < 0.001$ ), indicating that the data is suitable for factor analysis. Calculated Cronbach's alpha for the study was 0.88, indicating good internal consistency reliability of the scale. No correlation was negative indicating homogeneity among the items. Concurrent validity was assessed by testing modified OIDP scale against self-reported perceived oral treatment need and perceived oral health problems. The relationships were significant ( $p < 0.05$ ) indicating that the instrument could adequately discriminate between adolescents who had did not have perceived dental treatment needs and adolescents who had different perceptions of overall health problems.

It contains eight items distributed between two domains: functional; and social and psychological. The functional domain includes items assessing the impact of oral health on: chewing and enjoying foods; talking and pronouncing clearly; and cleaning teeth. The social and psychological domain includes items assessing the impact of oral health on: good sleep without disturbances; being able to smile without embarrassment; maintaining usual emotional state without being irritable; school and household activities; and enjoying time with friends. See the additional file 1 to 5 for more details.

Revised OIDP scores were recorded on a six-point likert scale to reflect how severe the impact of each event was over the past three months, ranging from 0 indicating no impact, to 5 indicating a very severe impact. The total OIDP scores for individual domains were calculated as a simple sum of the response code. The potential functional domain and social/psychological domain scores ranged from 0 to 15 and 0 to 25 respectively. Total OIDP scores could range from 0 to 40. Higher OIDP scores indicated poorer

OHRQoL. The primary outcome in this study was the total OIDP score. Domain specific scores were analysed as secondary outcomes.

## **Socioeconomic characteristics, oral health care seeking and oral health behaviour questionnaire**

An additional questionnaire was developed to collect information about adolescents' age, gender, family income (measured in Sri Lankan rupees and categorized in tertiles), oral hygiene habits (brushing frequency), consumption patterns of soft drinks, sugary items and fruits (categorized based on the frequency of consumption: occasional or regular); oral care seeking pattern (frequency of seeking care categorized according to the number of visits per year).

## **Clinical examination**

The children were examined in a classroom at the school lying on ordinary desk under natural light. The clinical examination was exclusively visual, with the help of a dental mirror, CPI probe and a millimetre ruler. Biosafety measures established by the World Health Organization (WHO) were strictly followed [21]. The WHO criteria for the diagnosis of Decayed, Missing and Filled teeth (DMFT) were applied. The DMFT was categorized into caries free (DMFT = 0), low severity (DMFT = 1–4) and high severity (DMFT > 4). Oral hygiene was assessed by Oral Hygiene Index-Simplified (OHI-S). Debris and calculus indices were calculated and there by OHI-S were calculated using the standard formula. OHI-S was categorized into good oral hygiene (OHI-S = 0) and poor oral hygiene (OHI-S > 0). Periodontal status was measured by assessing the bleeding status and pocket depth. The dental trauma data were analysed according to the presence of at least one kind of trauma or the absence of trauma. Dento-facial anomaly data were classified according to the need for professional intervention.

## **Quality control**

Quality control measures included a discussion of all possible classifications and criteria used in the study for the diagnosis of each oral health condition through an analysis of pictures of clinical cases for the disorders and diseases. An instruction manual for the field team was prepared and used during the training and throughout the data collection. Preceding the study, the inter examiner agreements were established. A specialist in community dentistry at Dental Institute, Colombo was considered as the gold standard and training involved 20 children of the same age and not belonging to the sample was performed to the test methodology. The inter examiner reliability was assessed using Kappa statistics. It showed a perfect agreement for both dental caries and bleeding. There was an 85.7% agreement for dental caries and 88.3% agreement for bleeding.

## **Data analysis**

Statistical analyses were carried out using the Statistical Package for Social Sciences (version 23). Total OIDP scores, the overall mean OIDP score and scores for the individual domains were analysed for difference between specific oral diseases and disorders, and adjusted for socio economic characteristics and oral health behaviours. After applying statistical and graphical tests for normality, it was observed

that distribution was positively skewed; hence non-parametric tests were used predominantly. Mann Whitney tests were used to compare the OIDP scores between different levels of dental caries, oral hygiene, trauma and malocclusion, with the level of significance was set to 5% ( $p < 0.05$ ). Spearman correlation was used to assess the correlation between the OIDP scores with the DMFT, OHI-S, debris and calculus indices.

Univariate and multivariate regression models were used to determine factors associated with total OIDP scores. The independent variables in these regressions included socio-economic characteristics (adolescents' age, gender, family income and mothers' education level), oral hygiene habits (daily brushing frequency), consumption patterns of soft drinks, sugary items and fruits and oral disease conditions (presence of dental trauma, anomaly, bleeding and pocketing and as well as number of decayed, filled and missing teeth due to caries and OHI-S index). A stepwise process was used in the multiple linear regression analysis. A stepwise selection is method basically follow the forward selection, however, at each step it checks to see whether variables can be eliminated from the model using a backward elimination process. [22]. The study conformed to the STROBE guidelines.

## Results

A total of 1,340 adolescents were approached to participate in the study. The final sample was 1,332 giving a participation rate of 99% (Table 1). All adolescents completed the questionnaire independently. No questions were excluded from the data analysis due to incompleteness of data. The mean age of the children was 16.5 years (SD = 1.25) and approximately 47% were boys. Maternal education varied from elementary level of schooling to university education, with 62.7% of mothers having a highest education level of elementary or middle level schooling. Income was relatively low with approximately 50% of families in the lowest income tertile. Dental caries was present in 47.6% of the sample and the mean DMFT was 1.14 (SD = 1.63).

Table 1  
Socio demographic and clinical characteristics of the sample of children (n = 1332)

Variables	N (%)
Gender	
Male	623(46.8)
Female	709(53.2)
Mother's education	
Elementary/middle school (up to O/L)	835(62.7)
High school (up to graduate)	497(37.3)
Family income	
1st tertile (= > Rs. 25,000.00)	662(49.7)
2nd tertile (< Rs. 25,000.00 to > 50,000.00)	494(37.1)
3rd tertile (= < Rs. 50,000.00)	176(13.2)
Oral health care seeking pattern	
Infrequent (never)	378(28.4)
Frequent (more than 1 visit per year)	954(71.6)
Frequency of daily tooth brushing	
Once	358(26.9)
Twice or more	974(73.1)
Consumption pattern of sugary items (candies/ sugary snacks)	
Occasional	394(29.6)
Regular	938(70.4)
Consumption pattern of soft drinks	
Occasional	853(64)
Regular	479(36)
Consumption pattern of fruits	
Occasional	653(49)
Regular	679(51)
Dental caries experience (DMFT)	

<b>Variables</b>	<b>N (%)</b>
Caries free (DMFT = 0)	697(52.3)
Low severity (DMFT >= 1 to <= 4)	568(42.6)
High severity (DMFT >= 5)	67(5)
Oral hygiene (OHI-S)	
Good (OHI-S = 0)	589(44.2)
Poor (OHI-S >= 1)	743(55.8)
Bleeding gums	
Absent	1073(80.6)
Present	259(19.6)
Tooth pocketing	
Absent	1310(98.3)
Present	22(1.7)
Dental trauma	
Absent	1305(98)
Present	27(2)
Dento facial anomaly	
Absent	1067(80.1)
Present	265(19.9)

Table 1

Table 2 displays the distribution of the responses to the OIDP according to each question. Negative impacts were more prevalent in the social & psychological domain relative to the functional domain. Items relating to enjoying time with friends, maintaining usual emotional state without being irritable and being able to smile without embarrassment were the most frequently reported impacts on the social & psychological domain. Chewing and enjoying foods was the most frequently reported impact on the functional domain.

Table 2  
Oral impact on daily performance scale responses (n = 1332)

<b>Impact</b>	<b>No / very little/little impact</b>	<b>Average impact</b>	<b>Severe/very severe impact</b>
	<b>N (%)</b>	<b>N (%)</b>	<b>N (%)</b>
<b>Social &amp; Psychological domain</b>			
Impact on good sleep without disturbances	1300(97.6)	20(1.5)	12(0.9)
Impact on being able to smile without embarrassment	1241(93.2)	53(4)	38(2.9)
Impacts on maintaining usual emotional state without being irritable	1238(92.9)	56(4.2)	38(2.9)
Impact on school and household activities	1306(98)	16(1.2)	10(0.8)
Impact on enjoying with friends	1166(87.5)	114(8.6)	52(3.9)
<b>Functional domain</b>			
Impact on chewing and enjoying foods	1276(95.8)	50(3.8)	6(0.5)
Impact on talking and pronouncing clearly	1299(97.5)	22(1.7)	11(0.8)
Impact on cleaning teeth	1304(97.9)	185(1.4)	10(0.8)

The OIDP scores ranged from 0 to 36 with a mean of 3.16 (SD = 4.71). When mean overall score was analysed, it was evident that health care seeking pattern, consumption pattern of sugary items and soft drinks, presence of dental trauma and presence of dento-facial anomaly had a statistically significant negative impact on OHRQoL (Table 3).

Table 3

Mean differences between selected oral clinical conditions and characteristics of oral behaviours for each domain and for overall OIDP (n = 1332)

	Functional domain	Social & psychological domain	Total OIDP
	Mean (SD)	Mean (SD)	Mean (SD)
Overall	0.87(1.72)	2.29(3.40)	3.16(4.71)
Oral health care seeking pattern			
Infrequent	0.68 (1.42)	1.95(3.18)	2.63(4.18)
Frequent (1 visit per year)	0.94(1.82)	2.43(3.48)	3.37(4.90)
<i>P</i> value*	0.011*	< 0.001*	< 0.001*
Frequency of daily tooth brushing			
Once	1.07(1.82)	2.55(3.89)	3.62(5.23)
Twice or more	0.79(1.63)	2.19(3.20)	2.99(4.50)
<i>P</i> value*	< 0.001*	0.229	0.49
Consumption pattern of sugary items (candies/ sugary snacks)			
Occasional	0.73(1.48)	1.90(2.80)	2.62(3.76)
Regular (daily)	0.93(1.81)	2.46(3.62)	3.38(5.04)
<i>P</i> value*	0.066	0.006*	0.008*
Consumption pattern of soft drinks			
Occasional	0.79(1.54)	2.00(2.90)	2.79(4.03)
Regular (daily)	1.00(1.99)	2.82(4.10)	3.82(5.68)
<i>P</i> value*	0.257	0.001*	0.004*
Consumption pattern of fruits			
Occasional	0.83(1.61)	2.30(3.33)	3.13(4.54)
Regular (daily)	0.91(1.81)	2.28(3.47)	3.19(4.87)
<i>P</i> value*	0.815	0.961	0.932
Bleeding gums			
* $p < 0.05$ ;			
Mann-Whitney test was used			

	Functional domain	Social & psychological domain	Total OIDP
	Mean (SD)	Mean (SD)	Mean (SD)
Absent	0.84(1.70)	2.32(3.42)	3.16(4.68)
Present	0.98(1.77)	2.18(3.35)	3.16(4.84)
<i>P</i> value*	0.120	0.958	0.765
Tooth pocketing			
Absent	0.86(1.71)	2.29(3.42)	3.16(4.72)
Present	1.14(1.98)	2.23(2.67)	3.36(4.42)
<i>P</i> value*	0.448	0.564	0.423
Dental trauma			
Absent	0.86(1.72)	2.27(3.40)	3.14(4.71)
Present	1.07(1.77)	3.22(3.66)	4.30(4.92)
<i>P</i> value*	0.386	0.052	0.037*
Dento facial anomaly			
Absent	0.77(1.62)	2.17(3.27)	2.95(4.51)
Present	1.26(2.01)	2.76(3.88)	4.02(5.39)
<i>P</i> value*	< 0.001*	0.006*	< 0.001*
* <i>p</i> < 0.05;			
Mann-Whitney test was used			

Table 3

Table 4 displays the correlations between selected oral health conditions between domain specific scores and with the total OIDP score. However, the DMFT index and number of decayed teeth had significant positive correlations with both domains as well as with the total OIDP score the strength of association is small (Table 4).

Table 4

Correlation between selected oral clinical conditions for each domain and for overall OIDP (n = 1332)

	<b>Functional domain</b>	<b>Social &amp; psychological domain</b>	<b>Total OIDP</b>
	<b>Spearman r</b>	<b>Spearman r</b>	<b>Spearman r</b>
DMFT index	0.108*	0.133*	0.14*
Number of decayed teeth	0.121*	0.121*	0.13*
Number of filled teeth due to caries	0.041	0.066*	0.068*
Number of missing teeth due to caries	0.017	0.037	0.035
OHI-S index	0.001	0.019	0.012
Debris index (DI)	0.001	0.036	0.029
Calculus index (CI)	0.030	-0.003	0.000

\*correlations significant at the 0.05 level

Spearman correlation test were used

Table 5. outlines the results of the univariate and the multivariate analyses of the association between total OIDP scores and exploratory variables. The residuals in the multivariate analysis were normally distributed and there was no evidence of heteroscedasticity. Evidence of outliers was assessed by Cook's distance score and a score less than one was considered appropriate. Multicollinearity was assessed using Variance Inflation Factor (VIF), which should be less than four. The maximum value of the Cook's distance was 0.117 and the VIF score was around one. The multivariate analysis revealed that higher OIDP scores were positively associated with two oral conditions, namely number of decayed teeth and presence of anomaly, as well as age, family income, health care seeking pattern and consumption pattern of soft drinks. Conversely, the frequency of daily tooth brushing showed a significant negative association with total OIDP scores.

Table 5

Unadjusted and adjusted  $\beta$  coefficients of the association between total OIDP scores and exploratory variables; linear regression analysis (n = 1332)

Variable	Unadjusted			Adjusted		
	$\beta$ coefficient	95% CI	p	$\beta$ coefficient	95% CI	P
Gender						
Female	1					
Male	0.358	-0.149 to 0.866	0.166			
Age	0.409	0.207 to 0.610	< 0.001*	0.338	0.135 to0.540	< 0.001*
Mother's education						
Elementary/middle school (up to O/L)	1					
High school (up to graduate)	-0.392	-0.915 to 0.132	0.142			
Family income						
1st tertile (= > Rs. 25,000.00)	0.714	0.208 to1.219	0.006*	0.662	0.164 to1.160	0.009*
2nd tertile (< Rs. 25,000.00 to > 50,000.00)	-0.539	-1.063 to -0.016	0.044*			
3rd tertile (= < Rs. 50,000.00)	-0.458	-1.206 to 0.290	0.230			
Oral health care seeking pattern						
Infrequent	1			1		
Frequent	0.736	0.175 to1.296	0.010*	0.745	0.190 to 1.300	0.009*
Frequency of daily tooth brushing						
Once	1			1		
* $p < 0.05$						

Variable	Unadjusted			Adjusted		
	$\beta$ coefficient	95% CI	p	$\beta$ coefficient	95% CI	P
Twice or more	-0.634	-1.205 to -0.064	0.029*	-0.599	-1.16 to -0.037	0.037*
Consumption pattern of sugary items (candies/ sugary snacks)						
Occasional	1					
Regular	0.763	0.209 to 1.317	0.007*			
Consumption pattern of soft drinks						
Occasional	1			1		
Regular	1.026	0.501 to 1.551	< 0.001*	0.902	0.382 to 1.423	0.001*
Consumption pattern of fruits						
Occasional	1					
Regular	0.060	-0.447 to 0.567	0.817			
Bleeding gums						
Absent	1					
Present	0.004	-0.637 to 0.644	0.991			
Tooth pocketing						
Absent	1					
Present	0.208	-1.780 to 2.196	0.838			
Dental trauma						
Absent	1					

\* $p < 0.05$

Variable	Unadjusted			Adjusted		
	$\beta$ coefficient	95% CI	p	$\beta$ coefficient	95% CI	P
Present	1.161	-0.637 to 2.958	0.205			
Dento facial anomaly						
Absent	1			1		
Present	1.073	0.441 to1.705	0.001*	0.995	0.374 to1.616	0.002*
Number of decayed teeth	0.465	0.248 to0.681	< 0.001*	0.327	0.109 to0.546	0.003*
Number of filled teeth due to caries	0.294	0.005 to 0.584	0.046			
Number of missing teeth due to caries	0.657	-0.003 to 1.317	0.051			
OHI-S index	0.091	-0.264 to 0.447	0.615			
* $p < 0.05$						

## Discussion

This study identified seven key factors that were associated with OHRQoL in a sample of Sri Lankan adolescents. To our knowledge, this is the first study to report on domain specific OIDP scores in Sri Lankan adolescents after the recent validation of the tool in this cohort.

The importance of OHRQoL is particularly relevant for adolescents. There is evidence that juveniles are more sensitive to a variety of impacts, such as appearance, relative to older age groups. These impacts will affect their quality of life and may influence their social skills and education [23, 24]. This is supported by our findings that social and psychological impacts; such as enjoying time with friends and smiling without embarrassment, were more prevalent than those observed in studies reporting on adults and elderly [25].

Our data were strongly skewed towards the “no impact” or “very little/little impact” end of the scale, with more than 85% of the study population reporting never experienced an oral impact during past three months giving a strong floor effect. This is similar to findings in previous studies among children in Brazil [15, 26]. This OIDP distribution of scores is characteristic of a population based study and indicative of

adolescents having genuinely low levels of impacts, but may be due the instrument not being sensitive to identify the impacts that are experienced in the particular cultural context. Direct comparisons with the published literature across different countries must be interpreted with caution as the nature and the magnitude of impacts may vary among the populations with different cultural backgrounds [27–29]. The prevalence of oral impacts experienced during the previous three months by the study population was less than those reported in some previous studies [30, 31], with values slightly lower than those reported in other young Asian populations [29, 32, 33].

Frequency of daily tooth brushing appeared to have a significant association with the functional domain, whereas number of filled teeth, consumption of sugary items and soft drinks showed a significant association with the social and psychological domain. Oral health care seeking pattern, number of decayed teeth and presence of dento facial anomaly were significantly associated with both domains. These findings were similar to that found in published literature on Brazilian children [15, 26].

Locker suggested that the relationship between oral disease and quality of life outcome in Canadian children is mediated by personal and environmental variables [34]. He reported that children from low income families had higher impacts on quality of life than children from high income families, signifying poorer OHRQoL. Further, family income remained a predictor of OHRQoL scores after adjusting for the effects of other explanatory variables. This is supported by our findings which revealed, even after adjustment in the multivariate analysis, a highly significant association found between the lowest family income tertile and OHRQoL. Similar findings have been reported in other studies among children in Brazil and India [26, 35, 36]. It is therefore important to assess socio economic conditions in general when dealing with OHRQoL, even among school children who are eligible for free hospital dental services in Sri Lanka.

Our findings revealed a positive significant association between oral health care seeking pattern and OHRQoL after adjustment for confounding. This may be due to the care seeking homogeneity of the population studied which outweighs the influence of the other explanatory factors. However, it could be reflecting a factor such as dental care personnel's influence on improving oral health or motivation to use care as routine care rather than for treatment. Further, our findings suggested a significant negative association between frequency of daily tooth brushing and total OIDP score after the adjustment revealing that adolescents' brushing behaviour had a significant predictive power whereby those who brush their teeth less frequently are more likely to experience negative impacts. Similar observations have been reported in school children in Italy and New Zealand [25, 29]. The only demographic determinant that increased the overall impact score in our study was age. This may be explained in part by the fact that intensity of the oral disease progresses with the children's age. However, the relationship between other sociodemographic characteristics and OHRQoL is unclear [37].

Our results indicated that regular intake of soft drinks has a strong significant positive correlation with OIDP score after adjusting for other factors. The most significant risk factor for developing dental caries and enamel erosion is the local action of the diet on teeth. Previous studies have recommended to reduce the

frequency of consumption of foods containing free sugars to four times a day and to limit the total amount of free sugars consumed [38] .

Recent studies have revealed that malocclusion plays an important role in social interactions and psychological well-being in adolescents [15, 35, 39] and it has been suggested that there is a significant impact of malocclusion on the OHRQoL of young children. Our findings confirm this and show a strong significant positive association between anomaly and the OIDP score after adjustment for other factors. Our results were also consistent with previous studies that have found the presence of decayed teeth has a measurable effect on OHRQoL among adolescents [26, 35]. Decayed teeth, whether treated or untreated, may make the children feel a lower level of oral well-being [38].

A key strength of this study was the use of an OHRQoL tool that has been validated in this population cohort. Further, our data was from a relatively large sample that can be considered representative of adolescents in Gampaha district, Sri Lanka.

A limitation of our study is its cross sectional nature. It is known that cross sectional studies may be constrained in relation to hypothesis testing since the data on risk factors and outcomes are assessed at the same time [40]. Nonetheless, our findings are broadly consistent with the published literature. The use of self-report data on socio-economic characteristics and oral health care behaviours may have introduced response bias that we were not able to account for. The results may not be generalizable to the broader Sri Lankan population, as population characteristics and service availability varies across the country. Future studies could be used to assess the impacts of oral diseases and socio-economic factors on oral health-related quality of life in other districts, and ideally with longitudinal studies.

## Conclusions

This study suggests that socio demographic factors including age and family income have a strong influence when determining OHRQoL in Sri Lankan adolescents. However, other factors including number of decayed teeth and presence of anomaly, and as well as health care seeking pattern, frequency of daily tooth brushing and consumption pattern of soft drinks, remained significantly associated with OHRQoL even after socio-economic characteristics were adjusted for.

## Abbreviations

OHRQoL

Oral health Related Quality of Life; OIDP:Oral Impact on Daily Performance; HRQoL:Health Related Quality of Life

## Declarations

**Ethics approval and consent to participate**

The study is accordance with Helsinki Declaration. The study protocol has been approved by Ethics Committee of Medical Faculty, Colombo, Sri Lanka (Ref No EC 15-171). Written informed consent for the participation for the study were obtained by the parent or guardian (children under 16 years old) and students above the 16 years old, given their written informed consent to participate for the study.

### **Consent for publication**

Not applicable

### **Availability of data and materials**

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

### **Competing interests**

The authors declare that they have no competing interests.

### **Funding**

There is no funding to the report.

### **Author's contributions**

UA: Research idea, study design, statistical analysis & drafting the manuscript, PJ & IR: Study design, data analysis/interpretation, supervision & mentorship, HC, SS, & SK: Data interpretation, technical supervision, all authors read and approved the final manuscript.

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