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Research Article

Assessment of orofacial functions in children using 'off track' mobile application: A cross-sectional study

Prajakta P Patwardhan* and Amar N Katre

Department of Pediatric and Preventive Dentistry, Dr GD Pol Foundation's YMT Dental College and Hospital, Navi Mumbai, Maharashtra, India

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***Corresponding author:** Dr. Prajakta P Patwardhan, Department of Pediatric and Preventive Dentistry, Dr GD Pol Foundation's YMT Dental College and Hospital, Navi Mumbai, Maharashtra, India, Tel: +91 8007595207; E-mail: pppatwardhan86@gmail.com

ORCiD: https://orcid.org/0009-0001-8293-0601

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Abstract

Introduction: Orofacial dysfunctions interfere with normal growth and development and may lead to multiple outcomes, including malocclusion. Assessment of Orofacial functions is thus critical in children.

Methods: 'Off Track', a mobile-based app was used for orofacial functional assessment. The domains assessed were breathing, swallowing, chewing, speech, sleep, and others. The dysfunctions in each domain and the 'Off Track' score distribution were represented as frequency with percentages. Fisher's exact test was used to detect the difference between the age groups. Unadjusted odds were estimated to assess the association between feeding history and breathing dysfunction, feeding history and sleep dysfunction, and breathing dysfunction and sleep dysfunction.

Result: The 'Off Track' scores 3, 4, 5, and 6 were recorded in 42.9%, 39.3%, 14.3% and 3.6% of the population, respectively. Most of the participants (89.29%) showed dysfunction in the breathing domain followed by swallowing (75%). The difference between the age groups was not significant ($p > 0.05$). Odd's ratios estimated for feeding history of the child and, mouth breathing and sleep dysfunction were not statistically significant.

Conclusion: Orofacial dysfunctions are widely prevalent in children and 'Off Track' may serve as a chairside user-friendly app-based screening tool to assess orofacial functions in children.

Abbreviations

OMD: Orofacial Myofunctional Disorder; KCPS: Karaduman Chewing Performance Scale; PEDI-EAT-10: Pediatric version of the Eating Assessment Tool; NOT-S: Nordic Orofacial Test Screening; MB: Mouth Breathing; SDB: Sleep Disordered Breathing

Introduction

Orofacial functions include many vital actions such as breathing, chewing, and swallowing, and they form the basis of social interaction in speech, emotional communication, and facial expressions [1]. Oral dysfunction can begin with the very first breath and with the very first feed [2]. It may also occur due to various genetic and congenital diseases, the existence of parafunctional habits, and/or as a result of trauma [3]. When oral dysfunction goes untreated, orofacial myofunctional disorders (OMD) can result. Orofacial myofunctional disorders include dysfunction of the lips, jaw, tongue, and/or oropharynx that interferes with normal growth and development or function of other oral structures, and the lack of intervention at critical periods may result in malocclusion and suboptimal facial development [4].

There is a close relationship between form and function. The development of malocclusion must be considered as a result of interactions among the genetically determined developmental

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factors and several external and internal environmental factors, including orofacial functions [5].

The impact of breathing, swallowing, chewing, normal resting position of musculature, and airway obstruction on the developing occlusion has been reported [4]. Hence early assessment of orofacial functions and dysfunctions is of paramount importance.

The use of electronic media is increasing day by day and there are several mobile-based applications being used as an aid in dental practice [6-10]. However, there is no mobile-based application available for assessment of orofacial functions to the best of our knowledge. A valid, reliable, economical, chairside, and easy-to-use tool for the orofacial functional assessment is thus needed. Thus, the aim of the study was to assess the orofacial functions in three to thirteen-year-old children using a mobile-based application – 'Off Track'.

Materials and methods

A cross-sectional study design was used. The study was carried out between the 7th and 14th of March, 2022 in the Department of Pediatric and Preventive Dentistry, YMT Dental College and Hospital, Navi Mumbai, India. As this was the first study using the app, no specific sample size was estimated. All children of three to thirteen years reporting to the outpatient department were screened. Children with any systemic disorders or craniofacial syndromes, children who were undergoing or had completed orthodontic treatment, children who did not cooperate with the examination and other procedures, and those whose parents refused to give consent were excluded from the study. The protocol was approved by the Institutional Review Board and Institutional Ethics Committee before the study commenced.

Informed consent was obtained from the parents or the guardians before the assessment. Basic demographic details (Name, age, gender, etc) along with the feeding history (Breastfeeding/bottle feeding/ both) of the children were recorded. Orofacial functions were assessed using 'Off Track'.

'Off Track' is an android-based application consisting of 6 domains of orofacial functions. Each domain contains a set of questions with categorical outcomes. The domains assessed are breathing, swallowing, chewing, speech, sleep, and others (posture, history of oral habits, height and weight of the child, etc). Breathing is assessed as a binary categorical variable through three questions based on a three-point Likert rating scale. The responses of yes/sometimes are considered as breathing dysfunction. Swallowing is assessed as a binary categorical variable through three questions. A response of 'Yes' for questions 2 or 3 or a response of 'No' for question 1 is considered as swallowing dysfunction. Chewing is also assessed as a binary categorical variable through three questions. A response of 'No' for any one question is considered as chewing dysfunction. Speech is assessed as a binary categorical variable through two questions. A response of 'Yes' for question 2 or a response of 'No' for question 1 is considered as speech dysfunction. Sleep is also assessed as a binary categorical variable through six questions. Even a single affirmative answer is considered sleep dysfunction. The parameters/questions in the app were framed following a pilot expert validation.

All the parameters assessed are parent/ self-reported or investigator-assessed. Based on the information fed in the app, an 'Off Track' score ranging from 0-6 is calculated by the app. Higher scores indicate dysfunction in multiple domains. The app also gives general recommendations for orofacial functional improvement. (Details mentioned in Annexure 1).

The dysfunctions in each domain were represented as frequencies with percentages. The 'Off Track' score distribution was also represented as frequency with percentages. Fisher's exact test was used to detect the difference between the age groups. Unadjusted odds were estimated to assess the association between feeding history and breathing dysfunction, feeding history and sleep dysfunction, and breathing dysfunction and sleep dysfunction.

Results

28 children participated in the study. 9 (32.1%) children belonged to the age range of 3-6 years and 19 (67.9%) children were in the age range of > 6-13 years (Table 1). The mean age of the participants was 8.79 + 0.98 years. 53.6% were males and 46.4% were females. 21.4% had an abnormal birth history (caesarean section) and 28.6% of the children had a history of both bottle feeding and breastfeeding.

The 'Off Track' scores of the participants ranged from 3 to 6. The scores 3, 4, 5, and 6 were recorded in 42.9%, 39.3%, 14.3%, and 3.6% of children, respectively. None of the participants had 'Off Track' scores of 0, 1 or 2.

Table 2 depicts the age and gender-wise distribution of the dysfunction detected in each domain. Most of the participants (89.29%) showed dysfunction in the breathing domain followed by swallowing (75%), chewing (64.29%), and sleep (60.71%). The least dysfunction was recorded in the domain of speech (21.43%). When the breathing and swallowing domains were assessed according to age, no significant difference was found between the groups ($p > 0.05$).

The estimated odds of having breathing dysfunction and sleep dysfunction in participants with a history of bottle feeding were 0.77 (0.0605 to 10.0043) and 1.11 (0.2054 to 6.0093) respectively. The odds of having sleep dysfunction in participants with breathing dysfunction were 3.56 (0.2816 to 44.8860), none were statistically significant (Table 3).

Table 1: Age and gender-wise distribution of the sample population.

Age (years)	Boys (n = 15) (53.6%)	Girls (n = 13) (46.4%)
3 to 6	4 (14.28%)	5 (17.85%)
> 6 to 13	11 (39.28%)	8 (28.57%)

N = 28

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Table 2: Age and gender-wise distribution of orofacial dysfunctions.

Dysfunction	Age (years)	Boys	Girls	Total	
Breathing n1 = 25 (89.29%)	3 to 6	4 (16.00%)	5 (20.00%)	9 (36.00%)	x^2 = 1.591
	> 6 to 13	9 (36.00%)	7 (28.00%)	16 (64.00%)	
		x^2 = 0.231			
Swallowing n2 = 21 (75.00%)	3 to 6	3 (14.28%)	5 (23.80%)	8 (38.10%)	x^2 = 1.364
	> 6 to 13	8 (38.09%)	5 (23.80%)	13 (61.90%)	
		x^2 = 0.047			
Chewing n3 = 18 (64.29%)	3 to 6	3 (16.67%)	4 (22.22%)	7 (38.89%)	x^2 = 1.051
	> 6 to 13	6 (33.33%)	5 (23.80%)	11 (61.11%)	
		x^2 = 0.258			
Speech n4 = 6 (21.43%)	3 to 6	1 (16.67%)	2 (33.33%)	3 (50.00%)	x^2 = 1.116
	> 6 to 13	1 (16.67%)	2 (33.33%)	3 (50.00%)	
		x^2 = 1.257			
Sleep n5 = 17 (60.71%)	3 to 6	3 (17.65%)	4 (23.53%)	7 (41.18%)	x^2 = 1.619
	> 6 to 13	6 (35.29%)	4 (23.53%)	10 (58.82%)	
		x^2 = 0.007			

N = 28, $p > 0.05$

Table 3: Association of feeding history, mouth breathing and sleep dysfunction.

	Mouth breathing	Sleep dysfunction
Bottle feeding*	OR = 0.7778	OR = 1.11
Breastfeeding only	(0.0605 to 10.0043)	(0.2054 to 6.0093)
	OR = 3.56 (0.2816 to 44.8860)	

* History of both bottle and breastfeeding

Discussion

It may be possible to ensure early detection of any problem in the stomatognathic system by using reliable and valid screening of the orofacial functions in children. Children with neurological or anatomical problems have been assessed for orofacial functions in the past [11-13]. However, data on healthy children is lacking, hence, this study on three to thirteen-year-old children using a chairside tool - The 'Off Track' app. Children in the age group of 3-13 years were selected and analysed under 2 subgroups viz. 3-6 and > 6-13. This division was done according to the dentition present i.e., primary and mixed dentition, respectively.

There are various studies reported in the literature for the assessment of orofacial functions. Authors have used simple orofacial examination, appropriate tests (Mirror test/ water retention test) [5], or different tools like the Karaduman Chewing Performance Scale (KCPS), Pediatric version of the Eating Assessment Tool (PEDI-EAT-10), Nordic Orofacial Test Screening (NOT-S) protocol for the assessment [3]. However, there is no single tool that provides a comprehensive assessment of all the orofacial functions. 'Off Track' is a promising and easy-to-use chairside tool providing the overall assessment of the orofacial functions.

Breathing is a critical function of the human body. Mouth Breathing (MB) is a form of breathing that replaces nasal breathing and the aetiology is complex. Due to its various deleterious effects, mouth breathing has been a concern for healthcare professionals in various areas. Children with MB show skeletal as well as dental deformities such as backward and downward rotation of the maxilla and mandible, steep occlusal plane, and labially inclined upper anterior teeth [14]. Hence, assessment of breathing is crucial. The mirror test and the water retention test are among the breathing tests most cited in the literature [15]. The off Track app uses the water retention test along with the parent-reported indicators of mouth breathing. We found that the breathing domain showed the most dysfunction among all the domains. The prevalence of mouth breathing in children is highly variable ranging from 11% - 56% [16-19]. Adenotonsillar hypertrophy is the most common cause of mouth breathing in children [20] and children in the age group of 2 to 10 years are most commonly affected [21]. Mouth breathing can also result from nasal obstruction because of nasal inflammation in children. In the past few years, environmental degradation and air pollution have led to an increased prevalence of respiratory allergic diseases, and hence allergic rhinitis-related nasal obstruction has become more common [22], which may also lead to compensatory mouth breathing.

The swallowing domain was the second most common domain to show dysfunction. Atypical swallowing develops as a compensatory movement pattern when normal movement is inhibited and this tongue thrust swallow involves excessive perioral effort and the tongue exerts forward and/or lateral pressure into the teeth [4]. The off Track app uses the actual observation of lip movements while swallowing for assessment of the swallowing domain. It has been reported in the literature that atypical swallowing starts as a compensation mechanism for a pre-existing malocclusion (e.g., open-bite, spacing in the dentition, etc). [23]. Also, patients who present with malocclusions like posterior crossbite have an increased prevalence of atypical swallowing [5].

Odd's ratios estimated for feeding history of the child and, mouth breathing and sleep dysfunction were not statistically significant. According to a recent systematic review, breastfeeding is a protective factor against the development of mouth breathing (OR = 0.62; 95% CI: 0.41-0.93) and the likelihood of developing mouth breathing is 41% and 34% lower among children that were breastfed for more than 12 and more than 24 months, respectively [24]. A study done by Talib, et al. in 2017 [25] reports that breastfeeding has a protective effect on sleep-disordered breathing (SDB) while non-nutritive sucking has no effect on SDB. In our study, the population was either breastfed or had a combined history of bottle and breastfeeding. None of the children had a history of purely bottle feeding. This, along with the limited sample size may be the reason for our observations.

Age had no significant impact on any of the assessed orofacial functions. Most of the children were in the age range of > 6-13 years which may possibly have contributed to the same.

In our study, none of the participants had 'Off Track' scores of 0, 1 or 2. Our study was performed on the patients reporting for treatments with existing dental problems possibly affecting more than one functional domain.

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The 'Off Track' app has some inherent limitations. The sixth domain in the assessment collects information regarding unrelated parameters like posture, oral habits, height and weight of the children, and others, and a score is calculated, however, the impact of each of these parameters is not assessed. The recall bias encountered while questioning the parents regarding the history cannot be overlooked. Additionally, owing to this being a pilot study, a definite sample size estimation, calibration of the operator, etc. was beyond the scope of this research. We carried out expert validation of the questions framed in the app, however, content validity and criteria validity have yet to be evaluated. Additionally, agreement with specific functional parameters (Eg. PSG for determining sleep disturbances) was not a part of this pilot study.

Conclusion

The 'Off Track' app may serve as a simple, chairside screening tool to assess orofacial functions in children, with certain improvements. Future studies with adequate sample size may help substantiate our claims.

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Ethics approval

Institutional Review Board and Ethics Committee,

Dr. G.D. Pol Foundation's YMT Dental College and Hospital, Navi Mumbai, India.

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