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The Effect of Thumb Sucking Habit on Children's Dentomaxillofacial Development: A Systematic Review

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ABSTRACT

Oral bad habits are one of the major etiologic factors which will leads to malformation in dento- facial structures, teeth malposition, respiratory disorder, difficulty speaking, muscle imbalances, and face psychological problems. Thumb sucking is the most common oral bad habit in children that can be grouped under a list of habits known as non-nutritive sucking habits. The reported incidence of thumb sucking is between 13% and 100% in some societies. The oral habit may continue to 3–4 years and will stop automatically. If the habit continues whilst the permanent dentition is becoming established, a diverse variety of approaches include advice, removal of the comforting object, fitting an orthodontic appliance to interfere with the habit, or behavior modification techniques are needed. The aim of this study is to determine the effect of thumb sucking habit on children's dentomaxillofacial development. Data collection was carried out by searching the literature on the article search site, Pubmed, which was published from 2011 to 2020, the search was carried out in December 2020. The full-text articles in the remaining 46 articles were re-analyzed and excluded 36 articles and produced 10 articles which were then entered into the analysis. Based on this systematic literature review shows that thumb sucking can cause an impact on the muscles and facial development patterns in children, as well as impaired growth and development in the dentomaxillofacial.

Keywords: *Thumb Sucking; Children; Dentomaxillofacial*

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Introduction

A habit is a routine of behavior that is repeated regularly and tends to occur unconsciously, repetitive action that is being done automatically. Oral bad habits are one of the major etiologic factors which will leads to malformation in dento-facial structures, most frequent cause of these malformations mostly seen in the early childhood and mixed dentition stages.[1] Oral bad habits that are abnormal often associated with disorders of growth of the jaw, teeth malposition, respiratory disorder, difficulty speaking, muscle imbalances, and face psychological problems.[2] Thumb sucking is the most common oral bad habit in children that can be grouped under a list of habits known as non-nutritive sucking habits. The incidence of thumb sucking can be very variable depending on the geographic area. The reported incidence of thumb sucking is between 13% and 100% in some societies. The prevalence of this habit is decreased as age increases.[3] Thumb sucking is a common childhood habit or behavior that is considered normal up to the age of 3 to 4 years. Prevalence of thumb sucking habit was found to be 14% in six years-old children, and 6% in children 11 years old.[4] A Swedish study showed an 82% incidence of non-nutritive sucking behaviors during the first five months of life. Another study done in the U.S. showed a 73% incidence of non–nutritive sucking habits in children between 2 and 5 years. Studies have shown the presence of a digit or pacifier sucking habit in about 48% of children at 4 years of age and 12.1% in children older than 7 years. The habit persists in 1.9% of 12-year-old children.[5]

Most children leave this harmless habit before the age of two without any worries or interventions but the sucking habit in some children is so severe or repeated that it becomes a problem. Sucking a thumb is a natural reaction in children that may be beneficial or harmful. Sucking a thumb gives a sense of safety or joy to the infants; and helps them to better understand the world around themselves. On the other hand, thumbs that placed inside the mouth exert force on the tissues, thus creating physical changes as dentomaxillofacial abnormalities. Deleterious habitual patterns of muscle behaviour, often are associated with perverted or impeded osseous growth, tooth malposition, disturbed breathing habits, difficulties in speech, imbalance the facial musculature and psychological problems.[6] Thumb

sucking has 2 types: 1) Active: In this type, there is a heavy force by the muscles during the sucking and if this habit continues for a long period, the position of permanent teeth and the shape of mandible will be affected. 2) Passive: In this type, the child puts his/her finger in mouth, but because there is no force on teeth and mandible, so this habit is not associated with skeletal changes.[1]

The changes caused by thumb-sucking do not only occurred in the oral cavity. The dentomaxillofacial also can changes caused by direct pressure applied by the thumb. The risks associated with thumb sucking depend on the frequency and duration of the habit, the intensity of orofacial muscle contractions associated with the reduced intraoral pressure produced by sucking, and the position in which the fingers are placed in the mouth.[4] The changes occurred because the muscles tried to compensate for the force that was created during thumb-sucking. Thumb-sucking habit gives forces to the tissues of the oral cavity, creating an imbalance muscle tone, where the buccinator muscle will create a negative pressure on the jaw, thus the dental arches become narrower, causes constriction of skeletal structures, and abnormal facial growth. Thumbs also give pressure to the palate, so that the palate becomes deeper, and the pressure also moves the upper anterior teeth to labial and anterior teeth to lingual.[4,7]

In the case of active thumb sucking habit, it is better for a child not to be blamed, teased, offended, humiliated and punished, because these methods will increase the anxiety and consequently, increase the incidence of the habit. The exact causes of thumb sucking are multifactorial, from non-pathological issues such as boredom, sleepy and hunger, to pathological causes, such as the child's inability to deal with and minimize stress. Behavioral and mood changes, reactions to family differences and lack of affection are important factors in sucking fingers in children.[6,8] However, if the habit continues whilst the permanent dentition is becoming established, a diverse variety of approaches include advice, removal of the comforting object, fitting an orthodontic appliance to interfere with the habit, or behavior modification techniques are needed. Some of these interventions are easier to apply than others and less disturbing for the child and their parents.[9] So the aim of this study is to determine the effect of thumb sucking habit on children's dentomaxillofacial development.

Methods

Data source

Data collection was carried out by searching the literature on the article search site, Pubmed, which was published from 2011 to 2020, the search was carried out in December 2020. The data search was carried out systematically using the keywords "*thumb sucking children*" and "*thumb sucking habit*".

Inclusion criteria

1. Articles published from 2011-2020
2. Articles in English
3. Scientific articles that have been published and are available online
4. Articles that examine the effect of thumb sucking habit in children's dentomaxillofacial development as a result of research

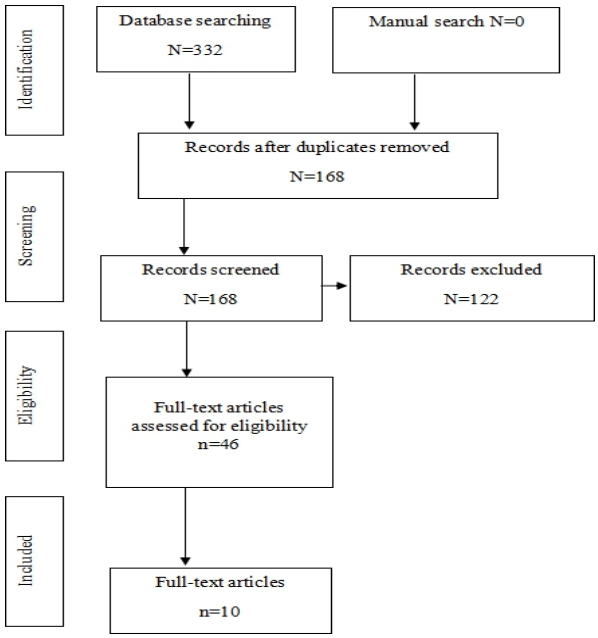
Exclusion criteria

5. Articles in Indonesian
6. Articles that cannot be accessed for free
7. Articles that do not discuss about the effect of thumb sucking habit in children's dentomaxillofacial development

Data collection

The data that will be used in this research is secondary data. The data is obtained from articles that are searched for in the article database which will then be reviewed according to the research criteria set by the researcher.

1. Procedure Systematic Review
2. Literature search was conducted on the online database PubMed. In addition, a search for the list of references to articles that fall into the inclusion criteria was also carried out to find out whether there were other related studies that were relevant to this research.
3. Keywords were determined in the literature search, namely "*thumb sucking children*" and "*thumb sucking habit*"
4. Eliminate duplicated literature
5. Articles are filtered on the basis of title, abstract, and keywords
6. Read complete or partial articles that have not been eliminated to determine whether the articles meet the eligibility criteria.
7. Data collection was done manually by creating a research matrix containing: author's name, year, title, result and conclusion.



8. Processing the data that has been obtained

Figure 1. A flow chart describing the search methodology and numbers of articles included/excluded at each stage

Result

After eliminating duplicated articles, the titles and abstracts of each article were analyzed across 168 articles resulting in 122 articles being excluded. The full-text articles in the remaining 46 articles were re-analyzed and excluded 36 articles and produced 10 articles which were then entered into the analysis.

Table 1. The characteristics of each article entered into a systematic review

No.	Author, Year	Title	Sample (n)	Conclusion
1	Tanny L, et al., 2020[10]	Characterisation of anterior open bite in primary school- aged children: a preliminary study with artificial neural network analysis	203	Thumb sucking, specifically for prolonged duration, increases the risk of development of anterior open bite (AOB). Cessation of thumb sucking habits should be encouraged at an early age to avoid the development of AOB.
2	Campos MP de MS, et al.,2018[11]	Influence of head and linear growth on the development of malocclusion at six years of age: a cohort study	290	This study suggest caution in associating factors related to sucking habits with malocclusion in children, and also provide food for thought regarding the treatment to be implemented. Growth assessment is extremely important to identify an individual's health status, and is an indispensable tool for the prevention and early intervention of occlusal anomalies.
3	Ling HTB, et al.,2018[12]	The association between nutritive, non-nutritive sucking habits and primary dental occlusion	1114	Children with more than one year of daily pacifier use and thumb/digit sucking have higher chances of developing abnormal dental relationships in the sagittal (i.e. Class II incisor and Class II canine relationships and increased overjet) and vertical (i.e. anterior open bite) dimensions, respectively.
4	Wagner Y, Heinrich-Weltzien R, 2015[13]	Occlusal characteristics in 3- year-old children result of a birth cohort study	377	Non-nutritive sucking habits were important risk factors for development of a malocclusion in the primary dentition
5	Moimaz SAS, et al.,2014[14]	Longitudinal study of habits leading to malocclusion development in childhood	40	Sucking habits and nocturnal mouth breathing were predisposing to malocclusion. Children with a finger sucking habit, as well as those with low rates of breastfeeding, were more susceptible to overjet and open bite. Children with a pacifier sucking habit was more susceptible to overjet, open bite and overbite. Posterior crossbite was associated with bottle fed children and nocturnal mouth breathers.
6	Ize-Iyamu IN, Isiekwe MC, 2012[15]	Prevalence and factors associated with anterior open bite in 2-5 years old children in Benin city, Nigeria	1031	The prevalence of AOB is this study appears to be similar to that in British children however; other races appear to have a higher prevalence rate than those reported from the above study. This study revealed that the most important aetiological factors are thumb finger and tongue thrusting but thumb sucking has been identified as the most important aetiological factor in the formation of an anterior open bite in pre-school children.
7	Pădure H, Negru AR, Stanciu D, 2012[16]	The Class II/1 anomaly of hereditary etiology vs. Thumb-sucking etiology	160	Both heredity and thumb-sucking are etiological factors occurring in patients who have the same features of II / 1 Angle anomaly, the frequency of this anomaly being present in almost one third of all cases in this study, which are consistent with international literature data. The predominant etiological factor is the hereditary one and the clinical features obvious for II / 1 Angle anomaly are present in the highest proportion within the thumb-sucking group, but no significant differences were observed between the groupsstudied according to the etiology.
8	Luzzi V, et al.,2011[17]	Malocclusions and non-nutritive sucking habits:apreliminary study		
9	De Vasconcelos FMN, et al.,2011[18]	Non-Nutritive Sucking Habits, Anterior Open Bite and Associated Factors in Brazilian Children Aged 30-59 Months	1308	The prevalence of non-nutritive sucking habits was high in this population. Gender, age and feeding type were associated factors for the occurrence of non-nutritive sucking habits. Anterior open bite was associated with feeding type and non-nutritive sucking habits.
10	Tanaka O, et al.,2016[19]	Breaking the Thumb Sucking Habit: When Compliance is Essential	2	The interception of themalocclusion at an early stage with the Haas-type fixed appliance was effective in RME and worked as an effective tool for stopping the thumb suckinghabit and normalization of overjet and overbite. However, there was the recurrence of the habit with the relapse of the anterior open bite (AOB), emphasizing the need of a multidisciplinary approach, consent, and cooperation as the keys to a good prognosis.

Discussion

The oral habit that has been developed since a baby is still in the mother's womb is the thumb sucking reflex. This is due to the developed neuromuscular functions. Distinct phases of psychological development include oral and anal phases seen in first 3 years of life. In oral phase, mouth is believed

to be oroerotic zone and the child has tendency to place his finger or any object into the oral cavity.[19] The oral habit may continue to 3–4 years and will stop automatically.[4,20] The thumb sucking habit in children can be influenced by various factors. Ling HTB et al., study shows that pure breastfeeding for more than 6 months is inversely associated with daily pacifier use and daily pacifier use is positively associated with daily thumb sucking. Children with more than one year of daily pacifier use and thumb sucking have higher chances of developing abnormal dental relationships in the sagittal (i.e. Class II incisor and Class II canine relationships and increased overjet) and vertical (i.e. anterior open bite) dimensions, respectively.[12] Padure H, et al study also shows that the clinical features obvious for II/I Angle anomaly are present in the highest proportion within the thumb-sucking group.[16] The higher incidence of increased overjet may be due to proclination of the maxillary incisors and forward displacement of the maxillary base as a result of the pressure of the thumb. The overjet may also be worsened by retroclination of the lower incisors due to the lever action of the thumb. The increase in Class II canine relationships may be due to the forward displacement of the anterior maxillary base.[12,21] Oral habits may affect masticatory functions, respiration, speech and esthetics. Several studies have also stated that oral habits including thumb sucking can cause an impact on the muscles and facial development patterns in children, as well as impaired growth and development in the dentomaxillofacial. Growth and development of the face is a complex phenomenon, an interrelation between genetics and environment, a tremendous transformation from childhood to adulthood, a process that continues throughout life. Tanny L, et al study shows that thumb sucking, specifically for prolonged duration, increases the risk of development of anterior open bite (AOB).[10] This is in agreement with De Vasconcelos FMN, et al[18], Moimaz SAS, et al[14], and Ize-Iyamu IN, Isiekwe MC[15] who also researched thumb sucking, that thumb sucking has been identified as the most important aetiological factor in the formation of an anterior open bite in children. Thumb sucking associated with an increased overjet and decreased overbite.[13,22–24] According to the Luzzi V, et al., study, that there was no difference in the type of non-nutritive sucking habit in children who presented an anterior open bite, while there was a higher prevalence rate of children with a posterior crossbite who had sucked the pacifier and of children with increased overjet who had sucked their finger or thumb. The association between the anomalies in the sagittal, frontal and transverse plane and the non- nutritive sucking habits when the spoiled habit continues over 6 hours a day.[17] A persistent period of oral habits could have implications in the genesis of this malocclusion during growth, being the functional stress factors among the primary causes of disturbed development of dentition.[25–28] At the time of sucking the thumb, pressure changes occur in the cavum oris. The combination of pressure directly from the thumb and change patterns of pressure cheeks and lips. Cheek pressure on the mouth corner is the highest pressure, the pressure of cheek muscle to the posterior teeth of upper jaw increased due to the contraction of buccinators muscles during sucking at the same time so it makes maxilla into shaped V. The orbicularis muscle contraction and buccinators continually separate causes leading to make collapse maxillary arch so it occurs crossbite, i.e. a disorder in which the superior teeth on the buccal side go deeper into than the inferior teeth. It can also change the ratio between the top and bottom anterior face height. As a result, the anterior teeth position is much more advanced than the lower teeth and going on an open bite.[29–31]

The effect on the development of the dentofacial structures with the persistence of these habits depend on the: 1) The frequency of the habit, 2) Duration of the habit, 3) Intensity of the sucking, 4) Relationship of the dental arches, 5) Childs physical health, 6) Direction and nature of force excreted by the digit.[32] Continuous presence of thumb or finger in the oral cavity can exert sufficient pressure to deform the maxillary arch or palate or both. There is a strong agreement that the digit sucking habits that persist while permanent teeth erupt can have detrimental effects on the dentofacial development.[32,33] Posterior cross bite may be results from thumb sucking habit practice if the habit continues after the age of 36 months.[34,35,36] Campos et al.,[11] suggest caution in associating factors related to sucking habits with malocclusion in children, and also provide food for thought regarding the treatment to be implemented. Growth assessment is extremely important to identify an individual's health status and is an indispensable tool for the prevention and early intervention of occlusal anomalies. Sucking habits developed from the use of pacifiers and bottle-feeding may interfere in facial development. Thumb sucking is classified into 4 types (Subtelny;s classification): 1) Type A-(50%) of children place the entire thumb or digit inside the oral cavity witha pad of the thumb is a place such that is pressing the palate. Anterior teeth of the maxillary and mandibular region are in contact; 2) Type B-(25%) of children place the whole thumb inside the mouth but it is not in contact with the vault of the palate. Only anterior teeth mandibular and maxillary region are in contact; 3) Type C- (18%) of children place thumb just beyond its first joint, there is no mandibular contact thumb is in contact with maxillary incisor; 4) Type D-(6%) of children doesn't fully place thumb inside the mouth, only thumbnail is in approximate contact with mandibular incisors.[37,38]

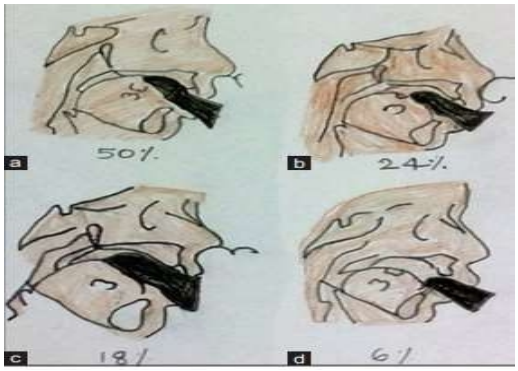


Figure 2. Subtelny's classification[37,38]

Dentofacial effects can be seen on maxilla, mandible and on inter-arch relationship.[39,40] Prolong thumb sucking can cause damage to facial and dental structure, effects on inter-arch relationship, lip incompetence, associated orofacial muscle contractions, effects on mandible and

maxillary.[19,38] Maxillary changes due to a long time sucking habit are overjet of the maxilla, increased maxillary arch length, reduced width of palatal arch, increased angle of sella-nasion-point A. Effects on the mandible include proclination of the mandibular incisors, increased distance in intermolar region and reduced angle of sella-nasion-point B. Other dental deformity includes increased overjet, reduced overbite, and crossbite in posterior tooth region. Digit deformity can be caused in chronic sucking patients.[37,38,41–43] Abnormal pressure habits changes the alveolar bone and regulate teeth because the bone-building cells on the receiving end of pressure or stimulus cannot differentiate whether that pressure or stimulus is intentional or unintentional. The face, with its cartilaginous bone, yields easily to stimulus and pressure, especially during growth spurts, and presents the most complicated growth problem in the entire skeleton. Since the greatest growth changes in the head are being made by the facial structures, it logically can be assumed, therefore, that all abnormal pressures should be kept from this most vulnerable target, the face.[43] The proposed results of maxillary expansion and stopping thumb sucking habit were fully achieved with the functional reestablishment of the occlusion. According to the Tanaka O et al., study, that Haas-type fixed appliance was effective and worked as an effective tool for stopping the thumb sucking habit and normalization of overjet and overbite.[9,44] However, management of thumb sucking can be done by:

a) Preventive therapy (Hughes): Feed the child enough in a natural way such that his feeding needs are fulfilled

b) Psychological therapy: This habit usually acquires by those children who lack parental care, love and proper care. Hence dentists and parents need to carefully handle the situation with proper understanding and without shaming and punishment. Positive reinforcement or positive reward system should be used to modify behavior.

c) Reminder Therapy: They are of two types chemical and mechanical. Chemical therapy includes the use of bitter-tasting or bad odor chemicals such as quinine, asafetida, castor oil, red pepper in volatile liquid, commercially available femite (Denatonium benzoate) in thumb. Mechanical therapy includes mechanical restrains applied to hand, wrist, thumb to quit habit examples of mechanical restrainers are thermoplastic thumb post, ace bandage system, use of long sleeves nightgown, three-alarm system introduced by Northan and Gellin. According to them when the child putsa finger in mouth and feels the tape its first alarm when a child feels the pin which is tied with a bandage in the elbow is second alarm lastly when bandage gets tightened serves as a third alarm.[45,46]

d) Appliance Therapy: They are of two types. 1) Removable Appliance: Palatal crib, oral screen, hay rakes.[47,48,49] 2) Fixed Appliance: Quad helix, bluegrass appliance, modified bluegrass appliance.[19,37,38,41–43]

The identification and assessment of an abnormal habits andits immediate and long term effect on the craniofacial complex and dentition,should be made as early as possible to minimize the potential deleterious effect on dentomaxillofacial or dentofacial complex.[50,51,52,53,54,55]

Conclusion

Thumb sucking can cause an impact on the muscles and facial development patterns in children, as well as impaired growth and development in the dentomaxillofacial. Prolonged thumb sucking habit are characterized by anterior open bites, labial inclination of the maxillary incisors, an increase in over jet, and spacing of the maxillary incisors. Other maxillary changes include an increase in arch depth, anterior displacement of the maxilla, high palatal vaults, and narrowing of the inter-canine and inter-molar arch widths. It can also change the ratio between the top and bottom anterior face height. Class II canine and molar relationships and posterior cross bites have been observed in thumb-sucking individuals.

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