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Behavioral genetics and thumb sucking in adolescents

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Abstract

Thumb sucking is a common habit developed by children and begins as early as in utero. However, it becomes problematic when a child continues to suck their thumb past the age of 4 years, when their secondary dentition is developing and preparing to erupt. Prolonged thumb sucking into adolescence can have deleterious effects on dental and skeletal structures based on the duration and how frequent the child engages in this nonnutritive sucking habit. Thumb sucking can lead to various types of effects such as increased overjet, anterior open bite, posterior cross bite, maxillary arch constriction, high palatal vault, and Class II malocclusion. This paper presents a case study, which focuses on chronic thumb sucking in a family, the dental and skeletal changes that the family members experienced, and whether or not this prolonged behavior can be genetically influenced. Based on this case study and the field of behavioral genetics it is possible that there can be a genetic component to the duration of thumb sucking into adolescence.

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Introduction

Nonnutritive sucking is a very common habit that occurs in children and can persist through adolescence and sometimes even adulthood. Studies have suggested that 70-90% of children take part in some form of nonnutritive sucking in their lifetime [1]. Nonnutritive sucking can include thumb and finger sucking and pacifier use, with thumb sucking being the most prevalent. Evidence has shown that thumb sucking can start as early as 29 weeks of gestation. At birth, sucking is a natural reflex for newborns as it enables the child to breastfeed. However, it can be engrained in a habit that is very hard to break for some children. Most children stop sucking their thumbs by the age of 4, however some children continue to suck their thumbs into adolescence and sometimes even into adulthood.

Even though thumb sucking in infants and toddlers is normal, prolonged thumb sucking has been shown to have deleterious effects on the occlusion of children and adolescents. Primary, mixed, and secondary dentition can all be affected. The effects on the dentition and maxillofacial structures varies between individuals due to the frequency and duration of the thumb sucking in that individual.

Thumb sucking can be a result of environmental factors, but there has been some speculation that prolonged thumb sucking into adolescence may have some genetic influence. Behavioral genetics is a branch of genetics that focuses on how behavior and personality can be influenced by genes. This paper focuses on thumb sucking, the deleterious effects it can cause to the oral and maxillofacial structures, and how it may be associated with behavioral genetics.

Malocclusion

Chronic nonnutritive sucking, particularly thumb sucking can have some deleterious effects on the primary, mixed, and permanent dentitions. Studies have shown that in the primary dentition, nonnutritive sucking habits were associated with anterior open bite, increased overjet, and Class II canine and molar relationships [2]. Several studies have also shown that prolonged nonnutritive sucking can cause decreased maxillary arch width and an increased palatal depth. A cohort study conducted by Warren et al [2] consisted of sending questionnaires to mothers regarding whether or not their child took part in any nonnutritive sucking habit. Questionnaires were sent out at 3, 6, 9, 12, and 20 months

Figure 1. The figure shows a high maxillary vault on the palate of the proband, which is a common result of thumb sucking.

to assess nutritive and nonnutritive behaviors. Questionnaires were subsequently sent out at 24 months and then yearly thereafter. Study models of children 4-5 years of age were then studied to looks for any type of malocclusion. Children who continued their digit habits until 48 months of age or older presented with more constricted maxillary arch widths, increased maxillary arch depth, increased overjet, and anterior open bite compared to children with a shorter habit duration or those who had no habit at all.

Studies focusing on the mixed dentition are less common than the primary dentition because children should normally stop any form of nonnutritive sucking before the age of 4. However, the few studies that were conducted show that there is an increase in malocclusion in those who continue to suck their thumb into their mixed dentition stage. Common forms of malocclusion that are often seen in the mixed dentition stage include anterior open bite, posterior cross bite, bilateral class II molar relationship, and overjet >4 mm [3]. In a longitudinal study conducted by Warren et al. [3], dental examinations were conducted on 630 children, and 524 sufficient study models were obtained in order to evaluate the effects of chronic nonnutritive sucking habits on the mixed dentition. The children in the study were 7-11 years of age, with almost 90% of those children being 8 or 9 years old. Fifty-five percent of the children had some sort of malocclusion. The study showed that for anterior open bite and posterior cross bite, the prevalence increased significantly with a longer duration of digit sucking. In addition, there was a significant increase in the prevalence of a class II type malocclusion. The same dental and skeletal manifestations can then persist into the permanent dentition phase.

Behavioral Genetics

It has been speculated that human behavior and personality are influenced by our genetic makeup. The study of behavioral genetics has been a topic of interest among many researchers. In the case of thumb sucking, genes can be influencing the behavior of children and can cause some children to suck their thumbs for a prolonged period of time. Children usually suck their thumbs when they are bored, stressed, anxious, or nervous. According to Lubitz [4], children suck their thumbs due to developmental problems and environmental disturbances and that thumb sucking is a way of relaxation for many children. Our genetic composition can make some people more susceptible to these emotions than others and can lead to differences in behavior.

Children usually stop sucking their thumbs by the age of 4 years. However, a child can continue to suck their thumbs into adolescence. Adolescence is a developmental period that marks many changes in physical growth, maturation, and psychological development [5]. The children who do suck their thumbs past the age of 4 years usually stop sucking their thumbs during adolescence. Rarely, do people suck their thumbs into adulthood. It is possible that people stop sucking their thumbs during adolescence because they are transitioning into being their own person. It is possible that behavioral genetics is causing a switch in the decision-making process in those individuals. A study by Dick et al [5] focuses on adolescents and how their genes can affect their behavior and decision making processes. They looked at literature related to alcohol use in adolescents and then concluded that there is a genetic association with their decision-making process. They believe during that period in their lives, adolescents are becoming their own person and are more likely to experiment with different things like alcohol use and cigarette use. This study isn't related to thumb sucking, but it can be used to show that adolescence is a very dynamic period where individuals are trying to become their own person and change their behaviors. That could be a possible explanation why people who suck

Figure 2. The two pictures above show a good example of a posterior cross bite on the aunt's left side.

(a) (b)

Figure 3. Examples of occlusion. (a) The picture above shows an Angle's Class II malocclusion. In this picture you can notice that the right canines are lined up with each other. (b) This picture shows a constricted and high palatal vault.

their thumbs for a prolonged period of time discontinue sucking their thumb during adolescence.

Most of the studies that looked at behavior and genetics consisted of twin study models. These models allowed researchers to determine whether genetics is responsible for the behavior or if it is mainly the environment that is influencing the behavior. In these studies, if dizygotic twin behavior is very similar to monozygotic twin behavior, their environment could play a larger role in the development of that particular behavior [5]. On the other hand, if a behavior is seen more in monozygotic twins than dizygotic twins, genetics is the most likely explanation since they have the same DNA. A Japanese Twin study by Ooki et al [6] evaluated the association of genetics with thumb sucking and nail biting in monozygotic and dizygotic twins. The results of this study have shown a greater prevalence of thumb sucking in monozygotic twins than dizygotic twins, suggesting that there is most likely a genetic component to thumb sucking.

Case Study

A family where chronic thumb sucking was common was studied to show if there is a genetic component for thumb sucking in families. Chronic thumb sucking in this study was defined by an individual sucking their past the age of 4 years old. The study was performed by interviewing the family members that were chronic thumb suckers and observing their dentition and skeletal orientation. The family members were asked what age did they discontinue sucking their thumb, whether or not they had undergone orthodontic therapy, and what made them discontinue this habit. In addition, the dental and skeletal relationship was observed to determine whether they had any sort of malocclusion.

The family members who chronically sucked their thumb included the proband in the third generation, a paternal aunt in the second generation, and a paternal first cousin in the third generation. Only females were shown to suck their thumb for a prolonged period of time. Two of the three relatives presented with signs of malocclusion or changes to their skeletal structures.

The proband is a 23 year-old Caucasian female. She discontinued sucking her thumb at the age of 12 years. The patient currently presents with a Class I occlusion and straight profile. The proband's occlusion is normal and ideal. However, the proband had undergone orthodontic treatment at the age of 13 years to correct her crowding. Before orthodontic treatment, the proband had increased maxillary overjet. The proband currently has a very high palatal vault, which is a common finding in individuals with a chronic history of thumb sucking (Figure 1). Force of the thumb onto the palate during growth and development causes the maxillary vault to increase in depth. The proband stopped sucking her thumb at the age of 12 years due to peer acceptance. She was going into middle school and did not want anyone to see her and make fun of her. Also, she was planned to start orthodontic treatment in the next year.

The proband's paternal aunt is a 57 year-old Caucasian female. She stopped sucking her thumb at the age of 15 years. The

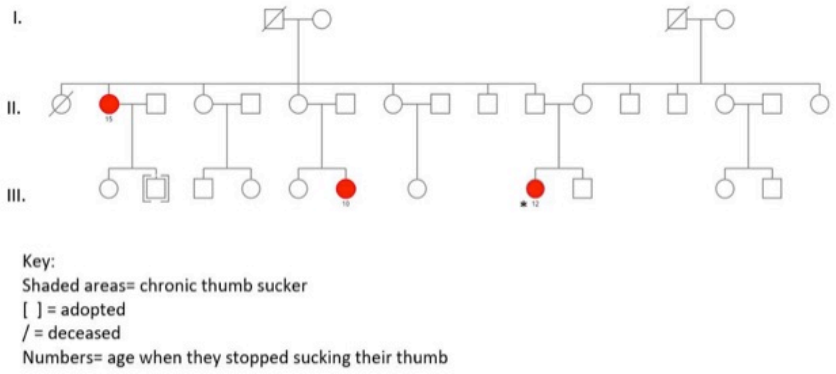

Figure 4: Pedigree of a family showing the individuals who have sucked their thumb past the age of 4 years old. The numbers under the affected individual represent the age at which they stopped sucking their thumb.

subject presents with a unilateral posterior cross bite on her left side with her mandibular premolars and molars positioned in front of her maxillary premolars and molars (Figure 2). The subject also presents with a very constricted and high maxillary palatal vault. In addition, the subject presents with an Angle's class II malocclusion, with her mandible being slightly retrognathic (Figure 3). The class II malocclusion is apparent when you observe the position of her canines as seen in the pictures below. Her canines line up instead of her mandibular canine being slightly ahead of the maxillary canine as seen in an ideal Class I occlusion. The subject never received any orthodontic treatment to correct her malocclusion. She discontinued sucking her thumb at the age of 15 because she didn't want people to make fun of her. She was able to break this long-term habit with the use of a palatal appliance.

The next subject in the study is the proband's first cousin, a 17 year-old Caucasian female. She stopped sucking her thumb at the age of 10 years. She presents with no forms of dental and skeletal malocclusion. She had never had an orthodontic treatment performed on her. This is most likely because she did not suck her thumb as long as the other subjects in the study. The subject stated that she stopped sucking her thumb for social acceptance and so people would not make fun of her.

By looking at the pedigree on the next page and seeing that three people on one side of the family all sucked their thumbs into adolescence, there can be possible genetic component to this distribution of traits in a family (Figure 4). The field of genetics that is most probable for influencing this behavior is behavioral genetics. There is very little research on chronic thumb sucking and behavioral genetics. However, it can be a possible explanation for the prevalence of this habit in families. The most likely mode of inheritance for this trait is a multifactorial mode of inheritance where both genes and environment play a role. The genes involved are most likely genes that affect our personality and decision making. Children often suck their thumbs in the presence of stress, anxiety, and nervousness. It is possible that the subjects in the study had an increased level of stress which could be influenced by genetics. The family members who had this habit all stopped sucking their thumbs during adolescence. Adolescence is a transitional period where children are starting to make their own decisions and trying to become more independent. In all three cases, the subjects wanted to stop sucking their thumbs for peer acceptance. Perhaps, behavioral genes are affecting the decision making process, and that is why the family members discontinued sucking their thumbs during adolescence.

Conclusion

Nonnutritive sucking is a common phenomenon that occurs in young children, but when the habit becomes engrained, the individual can continue to suck their thumb into adolescence and sometimes even into adulthood. There are many deleterious effects that can result from the forces that are applied by the thumb onto the oral structures. The duration and frequency of the sucking influences how severe these effects can be on the dental and skeletal structures. Thumb sucking is a very difficult topic to study. Very little research has been performed on whether or not there is genetic component to chronic thumb sucking. However, there is some speculation that there can

be a behavioral genetic component related to prolonged nonnutritive sucking. Often children who suck their thumbs are nervous, anxious, or bored. Studies have shown that there are some behavioral genes that could be influencing those emotions and subsequent behaviors. The case study presented in this paper, shows that thumb sucking can possibly have a genetic component. Three individuals on one side of a family all sucked their thumb into adolescence. Adolescence is a transitional period with many developmental changes that often affect the individual's personality, emotions, and decision making. It is believed that genes can affect all of these changes throughout adolescence. It can be hypothesized that the behavioral genes play a role in the prolonged habit of thumb sucking and then the subsequent discontinuation of the habit in adolescence. However, it is still uncertain whether this is true and more research needs to be conducted to obtain more information on this possible association.

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