

The effect of dental rehabilitation on the body weight of children with early childhood caries

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Abstract

Purpose: The purpose of this study was to determine the effect of comprehensive dental rehabilitation on the percentile weight and percentile growth velocity of children with early childhood caries (ECC).

Methods: The percentile weight categories of children with noncontributory medical histories and ECC were compared to caries free comparison patients, before and after comprehensive dental treatment under general anesthesia.

Results: Prior to dental rehabilitation, test subjects' percentile weight categories were significantly less than that of comparison counterparts ($P < 0.001$). Of the ECC patients, 13.7% weighed less than 80% of their ideal weight, thereby satisfying one of the criteria for the designation of failure to thrive, while none of the comparison patients did so ($P < 0.05$). Following therapeutic intervention, ECC children exhibited significantly increased growth velocities through the course of the follow-up period ($P < 0.001$), reflecting the phenomenon of catch up growth. The average length of follow-up for the test and comparison groups were 1.58 and 1.36 years, respectively. At the end of the follow-up period there were no longer any statistically significant differences noted in the percentile weight categories of the test and comparison groups.

Conclusion: Comprehensive dental rehabilitation resulted in catch-up growth, such that children with a history of nursing caries no longer differed in percentile weights from comparison patients. (*Pediatr Dent* 21:109-113, 1999)

Nursing caries is a form of rampant decay of the primary dentition distinguished by the specificity of tooth surfaces involved and the rapid progression of carious lesions on those surfaces that are considered, otherwise, to be at low risk to decay.¹ The interaction of host pathogenic oral microorganisms, fermentable carbohydrates, and susceptible tooth surfaces results in the carious lesions that characterize nursing caries. Additionally, inadequacy of the host's immunodefenses is suspected to play a role in the acquisition of carious lesions.²

Early childhood caries (ECC) is a term that has recently gained acceptance in describing the rampant caries observed

in some infants and children.³ Although there is some controversy regarding a clear association between feeding patterns and all early childhood caries, in many cases, ECC is thought to be initiated by the inappropriate use of a nursing bottle.⁴

Numerous studies have investigated the prevalence of nursing caries in children, using varying operational definitions related to caries in the maxillary anterior teeth. The results, both population and methodologically sensitive, reveal a wide range of prevalences.⁵⁻⁹ Recently, the prevalence of caries in 3- to 5-year-old US Head Start children has been reported to range as high as 90%.¹⁰ This finding corroborated the results of others that rampant caries is often encountered in socioeconomically deprived populations, often including racial and ethnic minorities.^{11, 12}

The costs of such rampant caries has recently been considered in terms that include both financial and quality-of-life factors. For those children whose extensive treatment needs require either sedation or general anesthesia, the total cost for care may reach as high as \$7,000.¹³ Only a small portion of the cost is directly attributable to the costs of the dental procedures.¹⁴ Additionally, children with ECC and otherwise noncontributory medical histories have been demonstrated to weigh less than age- and sex-matched caries-free children.¹⁵ The experience of that population indicated that advancing age in children with nursing caries was associated with decreasing age-adjusted weights. It was hypothesized that the high carbohydrate intake associated with nursing caries initially resulted in higher age-adjusted weights. However, as the caries process progressed, the onset of pain and infection altered eating and sleeping patterns, thereby causing a decrease in age-adjusted weight in older children.

Children with nursing caries have also been noted to be significantly more likely to weigh less than 80% of their age-adjusted ideal weight, thereby satisfying one of the criteria for failure to thrive (FTT).¹⁵ Recent case reports have suggested that children with nursing caries who weigh less than 80% of their age-adjusted ideal weight or are diagnosed with FTT may demonstrate significant weight gain following complete dental rehabilitation, and no longer complain of pain, or disturbed

eating and sleeping habits.^{16, 17} The phenomenon of catch-up growth has been reported to occur in children whose growth had been slowed by illness or malnutrition.¹⁸ It has been reported that the rapid phase of growth can continue until the child has caught up to his pre-illness or normal growth curve. Incremental growth charts are used to indicate the velocity of growth during specified periods of time. By convention, growth velocity, a mathematically derived measurement, is expressed in terms of growth per 6-month period. Recently, in a study examining the effect of nutritional intervention in patients with FTT secondary to inadequate diets, improved weight-gain velocity rates were reflective of periods of catch-up growth.¹⁹ In the recent case reports, which included children with otherwise noncontributory medical histories, children whose age-adjusted weights were in the 3rd percentile or less experienced incremental growth velocities in excess of the 75th percentile following comprehensive dental rehabilitation, whereas their pre-illness growth velocities ranged from the 3rd to 50th percentile. These observations were consistent with the phenomenon of catch-up growth that is observed in nutritionally deprived children¹⁸ and in animal models.²⁰

The purpose of the present study was to investigate the effect of complete dental rehabilitation on the percentile weight and percentile growth velocity of children with nursing caries when compared to a caries-free population.

Methods

Children presenting for care at the advanced educational pediatric dental programs at the Children's National Medical Center in Washington, DC, and the Montefiore Medical Center in New York, were eligible for inclusion in this study. Children with nursing caries, as defined by the presence of at least three cariously affected maxillary primary teeth, including at least one pulpally involved tooth, were eligible for inclusion in the test group if they had an otherwise noncontributory medical history and had not previously received invasive dental treatment. Comparison subjects were obtained from the same low-socioeconomic-status clinical population and matched to the test subjects on the basis of age and gender. Eligibility in the comparison group was predicated upon a caries-free dentition as based upon clinical evaluation, no evidence of previous dental treatment, and a noncontributory medical history. Although patients in both groups and study sites were predominantly African-American, there was no attempt to additionally match patients on the basis of race. Additionally, in order to assess the impact of dental treatment, only those children with ECC who received all of their treatment at a single session were considered for follow-up study, in order to eliminate the potential confounders of prolonged or incomplete treatment protocols.

All patients were weighed in the same manner for both their initial and follow-up weights. At each of the two study sites the same medical-grade scales were used throughout the duration of the study. Weights were obtained in the same manner as for patients undergoing conscious sedation in that only shoes and over-clothing, such as sweaters, were removed. Weights were obtained by individuals trained in the use of medical scales, but who were not aware of the nature of the study.

The weights of children, coded on the basis of their medical record number, were then plotted on standard growth

charts. These were then converted into percentile categories ranging from 1 to 7. This range of categories represented the 5th and 95th percentiles, respectively. Both the plotting of weight and the conversion to percentile categories were performed independently by individuals trained in such methods. Inter-rater reliability was measured with the kappa statistic. In cases of discrepancy, a third individual was asked to assign a percentile conversion.

Follow-up eligibility required that comparison and test subjects remained free of any additional pulpal or extraction therapy throughout the course of the observation period. Additionally, in order to be included in the follow-up portion of this study, subjects were required to have their weights recorded no sooner than 6 months following baseline weight measurements.

Independent sample testing (Student's *t*-test) was performed on the age distribution of patients, their raw weights, and the length of follow-up. Nonparametric testing of before and after percentile weight categories were performed using the Mann-Whitney *U*-test. The presence of one criterion satisfying the designation of FTT, weight less than 80% of ideal weight, was assessed before and after dental rehabilitation using the chi-square test, with appropriate correction for continuity. Additionally, intragroup variations were assessed with the Wilcoxon's signed-rank test.

Results

Twenty-nine test subjects were enrolled at the Children's National Medical Center, while 22 were obtained from the patient population at Montefiore Medical Center. Likewise, 24 and 19 of the comparison group patients were enrolled at these sites, respectively. There were no statistically significant differences noted between patients from the two study sites with regard to any of the variables assessed.

Thirty-four percent of the test subjects ($N=150$) and 29% of the comparison patients ($N=150$) were available for follow-up evaluation and met all inclusionary criteria. There were no significant differences in the ability to follow patients on the basis of their group assignment. Follow-up lengths were 1.4 ± 0.5 and 1.6 ± 0.8 years for the comparison and test subjects, respectively. There was 100% agreement on assignment of percentile weight category for patients at baseline and follow-up weight measurements.

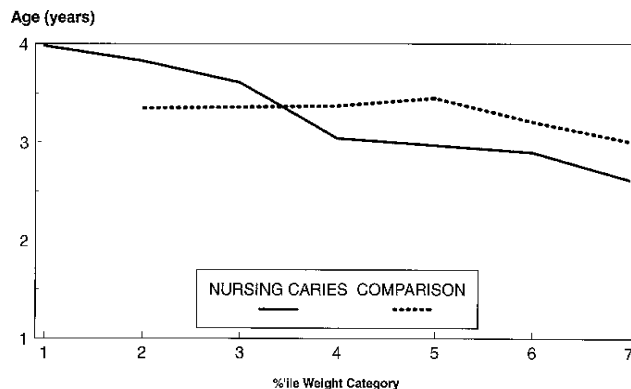


Fig 1. Age and percentile weight category

Table 1. Summary statistics

Category	Nursing caries	Comparison	Difference
Weight (baseline)	14.7±2.3 kg	16.9±2.9 kg	<i>P</i> <0.001
Age (baseline)	3.3±0.9 yrs	3.3±0.8 yrs	NS
Percentile weight (baseline)	3.6±1.8	5.4±1.3	<i>P</i> <0.001
Follow-up weight	19.2±4.4 kg	19.4±2.8 kg	NS
Follow-up age	4.8±0.9 yrs	4.6±0.6 yrs	NS
Follow-up percentile weight	4.6±1.4	5.1±1.1	NS
Percentile weight difference	0.9±1.2	-0.4±0.7	<i>P</i> <0.001
Follow-up length	1.6±0.8 yrs	1.4±0.5 yrs	NS
Growth velocity	1.5±0.6	1.0±0.7	<i>P</i> <0.001
Percentile growth velocity	5.0±1.4	3.4±1.5	<i>P</i> <0.001

Age and gender

Female subjects accounted for 47% of the comparison patients and 37% of the test patients (NS). Neither independent nor dependent variables exhibited statistically significant differences within the comparison and test groups when they were assessed on the basis of gender. Both male and female subjects exhibited the same pattern of differences when test and comparison groups were compared.

The age of both comparison and test patients at the initial weighing was 3.3±0.8 years and 3.3±0.9 years, respectively. The ages of comparison patients at the time of their follow-up was 4.6±0.6 years, while test subjects were 4.8±0.8 years. There were no significant differences of age at either the entry or the end point of the study.

Age and percentile weight

The relationship between age and percentile weight category is illustrated in Fig 1. For children with nursing caries, there is a strong inversely linear relationship. Younger children with nursing caries tend to be represented by the higher weight percentiles (*P*<0.03). However, by the age of 3, children with unrepaired nursing caries were most likely to be below the 50th percentile for age-adjusted weight. There was no such correlation among the comparison children.

The mean age of children with nursing caries who weighed less than 80% of their ideal weight was 4.0±1.3 years, while the mean age of the remaining children with ECC was 3.3±0.8.

Weight and percentile weight categories (Table 1)

The initial weight of comparison subjects was 16.9±2.9 kg, while test subjects weighed only 14.7±2.3 kg. The difference was statistically significant (*P*<0.001). The mean percentile weight categories at the initiation of the study were 5.4±1.3 and 3.6±1.8 for the comparison and test subjects, respectively (*P*<0.001). These mean percentile weight categories corresponded to between the 75th and 90th for comparison patients, while test subjects were represented between the 25th and 50th percentiles.

The follow-up weights for comparison patients was 19.4±2.8 kg, while test subjects weighed 19.2±4.4 kg. Their percentile weight categories at the conclusion of

the study period were 5.1±1.1 and 4.55±1.4 for comparison and test subjects, respectively. There were no statistically significant differences between the groups in these follow-up weight parameters.

The changes in percentile weight categories were 0.9±1.2 and -0.4±0.7 for the test and comparison groups, respectively. The difference between the two groups was significant (*P*<0.001). Additionally, within groups, the test subjects exhibited a statistically significant increase in age-adjusted percentile weight category (*P*<0.01, Wilcoxon's signed-rank test), whereas the comparison group showed no statistically significant change in percentile weight category at the conclusion of this study.

Incremental growth velocity (Table 1)

At the end of the follow-up period the 6-month adjusted growth velocity for comparison and test subjects was 1.0±0.7 and 1.5±0.6, respectively (*P*<0.001). The mean percentile growth velocity categories were 3.4±1.5 and 5.0±1.4 for comparison and test subjects, corresponding to the 25-50th and 75th percentiles, respectively (*P*<0.001).

Presence of FTT criteria (Table 2)

None of the comparison subjects exhibited weights that were below the 3rd percentile. However, among the nursing caries patients, 14% weighed less than 80% of their ideal weight at baseline evaluation, thereby satisfying one criterion for FTT. This difference was significant (*P*<0.05). At the conclusion of the study none of the test subjects continued to satisfy this criterion.

Discussion

The potential impact of nursing caries on general health and development has only recently been reported. Systematic study of the weights of children with nursing caries has previously indicated that untreated nursing caries may have deleterious effects on weight gain. On a population basis, it had been observed that with advancing age, and presumably increasing severity of nursing caries, there was a deceleration of weight gain such that older children with nursing caries were more likely to be represented by lower-weight percentile categories.¹⁵ In that population of patients with noncontributory medical histories, untreated nursing caries may have been solely responsible for the extremely low weights exhibited by some children in the absence of any other identifiable causes. Such cases of FTT, where no etiology is readily identified, are often baffling and frustrating for both physicians and families.

Recent case reports, however, have further suggested that for children with FTT, restoration of oral health can lead to a

Table 2. Presence of failure-to-thrive weight criteria at initial examination

Weight less than 80% of Ideal?	Comparison Patients	Nursing Caries
Yes	0 (0.0%)	7 (14%)
No	43 (100.0%)	44 (86%)

P<0.03, chi-square=4.45, with Yates' correction for continuity.

more normal growth pattern, or a return to a previously established pattern. The impact of comprehensive dental rehabilitation in conjunction with other interventions was noted in patients with both organic and nonorganic FTT.¹⁶ However, perhaps more compelling, the impact of comprehensive dental rehabilitation, in the absence of other potentially confounding interventions, has been documented in case reports of children with contributory as well as noncontributory medical histories.¹⁷

The results of our study suggest that the impact of untreated nursing caries extends beyond reports of pain, sleepless nights, and infection. Although pain and infection may be the most readily noticed effects of nursing caries, rampant caries may also impact upon somatic growth and development. The catch-up growth observed in patients following comprehensive dental rehabilitation suggests that untreated nursing caries was responsible for the age-adjusted weight differences observed between the groups.

Following complete dental rehabilitation of children with ECC, there was no longer any difference in their age-adjusted weights when compared to comparison children. However, whereas comparison children continued to be above the median for their age-adjusted weight throughout the course of the study and maintained growth velocities between the 25th and 50th percentiles, children with comprehensive treatment of their rampant caries exhibited growth velocities in the 75th percentile at the end of the observation period, thereby propelling them from age-adjusted weights between the 25th and 50th percentiles to between the 50th and 75th percentiles. Both the increase in age-adjusted percentile weights and the age-adjusted growth velocity percentiles were significant. Furthermore, in the absence of any other interventions, none of the children with ECC who weighed less than 80% of their ideal weight continued to do so following comprehensive dental intervention. In the recently reported cases of children with FTT undergoing comprehensive dental rehabilitation, all exhibited growth velocities in the 75th percentile or greater following treatment.¹⁷ In the current cohort of children whose initial weights were less than 80% of their ideal weights, all exhibited growth velocities greater than the 75th percentile following dental rehabilitation, outpacing the growth velocities exhibited by the remaining children with nursing caries in the study.

Delay in intervention, however, appears to have a tangible and adverse impact upon growth. Age and percentile weight category were inversely related in a significant manner in children with untreated nursing caries, whereas the comparison group did not exhibit such a relationship. Children with nursing caries tend to be represented in the higher weight categories when they are younger than age 3, perhaps due to the readily available and ever-present source of substrate. However, as they aged, they were increasingly likely to exhibit the deceleration of growth velocity that would move them to a lower percentile weight category. Conceivably, the child's reactions to early pathological pulpal stimuli may not be recognized by caretakers as being noxious in nature. This early stage of the continuum from decalcification to abscess formation may initially result in more subtle alterations of eating and sleeping patterns. Perhaps parental recognition of these alterations comes at a relatively late stage of the continuum, the stage that is ultimately characterized by significantly altered feed-

ing and sleeping patterns which may subsequently effect growth and development.

Whether late diagnosis, intentionally deferred care, or lack of access to care are responsible for delaying treatment, repeated anecdotal experiences indicate that the triad of pain, inability to eat, and disturbed sleep patterns are very often a part of the initial presentation to the dental care provider. Equally compelling are the repeated experiences following dental rehabilitation that often involve improved sleeping and eating patterns, together with relief of acute and chronic pain.

It is recognized that the health of individuals with specific medically compromising conditions, such as congenital heart disease or immunodeficiency states, is placed at risk when advanced carious lesions are present. However, little consideration is given to the impact of dental caries on the otherwise healthy individual. In addition to the obvious issues regarding a deteriorating quality of life, characterized by pain and the inability to eat or sleep, rampant dental caries in the child patient has been demonstrated to adversely effect growth. The impact of chronic disease on growth in children has been well established. It appears that the chronicity of nursing caries may have the same influence on a child's ability to sustain normal growth patterns, and may, therefore, impact general health and well being.

Although pediatric dentists continue to strive to prevent the onset of ECC in the individual as well as in susceptible populations, oral health is often considered outside the realm of general health. Such distinction between oral and general health is often reflected in the reluctance of third-party payors to reimburse expenses associated with the delivery of dental services in the operating room environment, due to "lack of medical necessity". Infant oral health protocols, such as espoused by Goepferd,^{21, 22} are designed to promote prevention of oral disease and promote health. In addition, infant oral health protocols provide the opportunity for early diagnosis and the institution of effective and minimally invasive treatment measures. However, barriers to the successful implementation and utilization of such programs exist. The ultimate cost of such barriers may be measured in financial terms, as resource-intensive efforts to protect the developing child's psyche²³ must subsequently be instituted to restore a clinical profile that has progressed to that of rampant decay. Additionally, and perhaps more importantly, those costs can be measured in terms of the general health that is compromised in the constellation of events that includes pain, loss of appetite, and interrupted sleep, and concludes with decelerated weight growth velocity.

Conclusions

1. Children with nursing caries weighed significantly less than comparison children and were represented by significantly lower percentile weight categories before dental intervention.
2. Children with nursing caries and otherwise noncontributory medical histories were significantly more likely to satisfy one of the criteria for FTT.
3. The effects of untreated nursing caries on the percentile weights of children is progressive.
4. Completion of comprehensive dental rehabilitation resulted in the phenomenon of catch-up growth such that children with a past history of nursing caries no longer differed in percentile weight from comparison subjects.

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ABSTRACT OF THE SCIENTIFIC LITERATURE



DENTO-MAXILLOFACIAL SEQUELAE IN A CHILD WITH RHABDOMYOSARCOMA

This case report presented a current literature review on rhabdomyosarcoma and current treatment modalities. The article presents a case that shows the importance of a dental consult and treatment prior to initiating chemo-radiation therapy. And demonstrates the avoidable adverse sequelae when the patient's oral health is ignored. This is a well-documented, nicely illustrated case report with a very good literature review. **MGP**

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