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Self-reported TMD Symptoms, Oral Health and Quality of Life of Children in Kindergarten through Grade 5: Does Gender, Race, and Socio-economic Background Matter?

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Abstract

Background—The objectives were to determine the percentage of children in Kindergarten through Grade 5 who reported TMD symptoms, to assess whether gender, race, and socioeconomic background mattered, and to explore the relationships between TMD and children's oral health and oral health-related quality of life (OHRQoL).

Methods—Face-to-face interviews were conducted with 8,302 children in Kindergarten through Grade 5 (51% female/49% male; 53% African American/42% European American). Oral health screenings were conducted with 7,439 children.

Results—23.6% of the children reported pain when chewing tough food and 18.8% when opening their mouth wide; 23.2% reported to hear a sound (clicking) when opening their mouth wide. Female students were more likely than male students and African American children were more likely than European American children to report TMD symptoms. The prevalence of TMD symptoms was not correlated with whether the children had a need for oral health care services, or

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whether they had an abscess or carious teeth with pulpal involvement. They were significantly associated with children's OHRQoL.

Conclusions—Considerable percentages of 4–12 year old children reported TMD symptoms, with girls and African American children being more likely than their counterparts to be affected. Experiencing TMD symptoms is significantly associated with poorer OHRQoL.

Practical Implications—Dental practitioners need to be aware that substantial percentages of Kindergarten and elementary school age children experience TMD symptoms. Taking a dental history and conducting an oral exam should therefore include assessments of the signs and symptoms of TMD; treatment recommendations should be provided for affected children.

Keywords

Temporomandibular joint; Children Oral health; Gender; Socioeconomic factors; Quality of life; Oral health-related quality of life; Dental care for children

INTRODUCTION

Self-reported symptoms of temporomandibular joint disorder (TMD) include reports of problems related to the masticatory system such as pain when chewing tough food, limitations of mandibular movement, and joint sounds.¹ While adult dental patients' TMD issues have been widely discussed and analyzed since the earlier parts of the 20th century,^{2,3} fewer studies have been conducted about TMD among children and adolescents. However, research as early as 1995 showed that considerable percentages of children and adolescents do indeed experience symptoms of TMD.⁴ For example, studies with younger children showed that 16.5% of 3–5 year old children had one or more signs of TMD⁵ and that 17% of 4–6 year old children were affected by TMD.⁶ These percentages tended to be even higher in studies with older children. For example, Thilander et al.⁷ showed that 25% of the 5–17 year old children in their study had one or more signs of TMD, and Feteih found that 21.3% of their 12–16 year old subjects exhibited at least one sign of TMD.⁸ More recently, Franco et al.⁹ reported that 25.2% of 12–14 year old children in their study had TMD-related pain. While the reported prevalence of TMD in children ranges considerably between 7% in a study by List et al.¹⁰ in 1999 and 33% in a study by Moyaho-Bernal and colleagues in 2010¹¹ and 35% in research conducted by Vierola et al. in 2012¹², there is no doubt that TMD in children clearly deserves attention. One interesting question is whether certain subgroups of children differ in how likely they are to report TMD symptoms.

Among adult patients with TMD, there is clear evidence that female patients are more likely than male patients to report TMD symptoms^{13–18}. The evidence for a gender difference in the prevalence of TMD in children has been mixed. While some authors found that girls were more likely than boys to experience TMD^{4,5,8,19–25}, other studies found no gender differences^{26–31} or were inconclusive Kobayashi.³² It is therefore worthwhile to further explore the question whether girls and boys differ in the frequencies with which they report TMD symptoms.

A second, less well studied socio-demographic characteristic that was found to be a risk factor for TMD in adults was their ethnicity/race^{33,34}. For example, Slade and colleagues³⁴

found that Asian American subjects had lower TMD incidence and African American subjects had a greater incidence compared to European American subjects. Among children, Widmalm and colleagues^{4,26,35} found that African American children were more likely to report TMD-related pain compared to European American children. However, socio-economic differences might play a role when comparing the prevalence of TMD in black vs. white subjects.³⁶ Given that patients in all age groups in the U.S. are likely to experience more dental disease if they come from socio-economically disadvantaged backgrounds,³⁷ it might be interesting to explore whether these differences can also be found in regard to TMD symptoms. Already half a century ago, Franks³⁸ suggested to consider this relationship in adult patients and in 1995 Widmalm and colleagues⁴ proposed to consider socio-economic background as contributing factor to TMD in children. First empirical evidence that there might be a relationship between socio-economic status and the prevalence of TMD in adult patients was provided by Heloe et al.³⁹ Given these early considerations, it seems to be timely to explore the question whether such a relationship exists in children.

No research so far explored whether there is a relationship between poor oral health and TMD. This is not surprising because there is no reason to assume that TMD would be related to the presence of caries or periodontal disease. However, one could make an argument that pain caused by abscesses or caries with pulpal involvement might radiate and thus lead to higher reports of TMD symptoms. This question will also be explored in this study. While there is no empirical evidence so far supporting a relationship between poor oral health and TMD, two groups of authors explored whether children's experience of TMD symptoms would be related with a lower oral health-related quality of life overall. Both Jedel et al.⁴⁰ and Barbossa et al.¹⁹ found that children with TMD symptoms had a lower oral health-related quality of life than children with no TMD symptoms.

In summary, the objectives of this research were to determine the percentages of children in Kindergarten through Grade 5 who reported TMD symptoms and to assess whether male vs. female children, African American vs. European American children, and students in schools with lower vs. higher percentages of participants in the free school lunch program would be more likely to report TMD symptoms. In addition, the relationship between self-reports of TMD symptoms and experiencing other oral health problems, and between TMD symptoms and having a lower oral health-related quality of life were also explored.

METHODS

This study was approved both by the Institutional Review Board (IRB) for the Medical Sciences at the University of Michigan, Ann Arbor, MI., and the IRB of Mott's Children Health Center in Flint, MI.

Respondents

Data were collected from 8302 children in 35 different schools. On average, 339 children were enrolled in each school. Overall, 72% of the children returned a consent form signed by their parents and 56% were then screened and enrolled in the study. About half of the children were boys (N=4,099; 49%) vs. girls (N= 4,193; 51%). The majority were from

African American backgrounds (N=4,414; 53%), with 42% being from European American backgrounds (N=3,518). On average, 72% of the children in these 35 schools participated in the free school lunch program.⁴¹ Children from families with incomes at or below 130 percent of the federal poverty level are eligible for free meals and milk and can participate in this program.

Procedure

Before the start of the school year, the parents in the 35 participating schools received information about the study and a consent form together with the other forms they had to fill out. They were asked to return the forms by giving them to their child and their child then was asked in the school to hand in the forms. A total of 72% of the parents gave their written consent that their child could participate in the study. Over the course of two school years, the research team visited all 35 schools and conducted oral health screenings and face-to-face interviews with students who had received parental consent that they could participate in the study, were present on the day of the school visit, and gave their assent to participate.

The children's oral health was assessed during a screening exam conducted by one of 9 pediatric dentistry residents in Year 1 and by 10 different pediatric dentistry residents in Year 2. At the beginning of each year, the residents were calibrated in a three hour session to assure that they (a) were consistent in their screening exams, and (b) used the scoring system consistently. No actual clinical exams with children were conducted during these calibration sessions. Instead, dental photographs were used. At the end of the calibration sessions, 100% of the residents knew in which sequence to score the students' teeth and 90% or more gave correct answers concerning how they would record teeth that were either verbally described or depicted in dental photographs. At the end of the sessions, the participants were asked to describe situations in which they would feel uncertain which score to use and the only situations mentioned were fractures, fracture restoration and trauma/missing teeth. Further instruction was then provided concerning these situations.

When the dental team arrived at the school, they set up a portable dental chair in either the gym or an empty classroom in the schools. A dental assistant accompanied each dentist and used an Excel file on a laptop computer to record the dentist's findings. After the dental screening, the children were escorted to another part of the room and face-to-face interviews were conducted. The interviewers were two dental hygienists who were calibrated to conduct the interviews in the same manner. They used laptops to record the children's answers in an ACCESS file.

Materials

The interviewers used a survey that consisted of three sets of questions. First, information about the children's age, gender and grade level was recorded. Second, the children's oral-health related quality of life which was measured with the Michigan Oral Health-related Quality of Life Scale – Child Version (MOHRQoL-C).⁴² This scale consists of yes/no format questions which ask the child about oral health-related pain and functioning and how their oral health affects their psychological and social well-being. The final part of the survey consisted of three questions concerning symptoms of TMD. The child was asked to

report whether their face hurts when they chew on tough food, whether they hear a “noise” (clicking) when they open their mouth wide, and whether their face hurts when they open their mouth wide.

Statistical Analysis

The data were analyzed with SPSS (Version 21). Descriptive statistics such as frequency distributions, percentages, means, standard deviations and ranges were computed to provide an overview of the responses. Chi-square tests were used to compare the categorical responses of different groups of children and independent T-tests were used to compare the average number of TMD symptom-related responses. A $p < .05$ was assumed as the level of significance.

RESULTS

Table 1 provides an overview of the school and the student background characteristics. This table shows that 8,302 children in 35 schools participated in this study. The number of children enrolled in these schools ranged from 163–572 and the percentages of children whose parents had given written consent ranged from 42% –93%.

Overall, 23.6% of the children reported that their face hurts when they chew on tough food, 23.2% that they hear a noise (clicking) when they open their mouth wide, and 18.8% that their face hurts when they open their mouth wide. However, Figure 1 shows that there were significant differences in the percentages of children in different age groups who reported each of these three symptoms. While children in Grades 2 & 3 were most likely to report that their face hurts when they chew on tough food and that they hear a noise (clicking) when they open their mouth wide, the children in Kindergarten and Grade 1 were most likely to indicate that their face hurts them when they open their mouth wide.

While the age-related prevalence of the three symptoms was not consistent, Figure 2 shows that consistent gender differences were found. Higher percentages of girls reported that they had each of these three symptoms than boys. For example, while 25.9% of female students indicated that their face hurts when they chew on tough food, only 21.2% of the male students reported this symptom ($p < .001$), and while 20.4% of girls indicated that their face hurts when they open their mouth wide, only 17.1% of male students reported this symptom ($p < .001$).

The differences in the percentages of children from African American vs. European American backgrounds who reported TMD symptoms also differed consistently. The percentages of African American children who reported that their face hurts when they chew on tough food (28.1% vs. 18.4%; $p < .001$) and open their mouth wide (21.5% vs. 16.2%; $p < .001$), and that they hear a noise (clicking) when they open their mouth wide (25.4% vs. 20.6%; $p < .001$) were significantly higher than the percentages of children from European American backgrounds who indicated these symptoms (Figure 3).

In addition, the percentages of children reporting the three TMD symptoms who were enrolled in schools with less than 50% of the students participating in the free school lunch

program were compared with the percentages of children in schools with 50–75% and in schools with over 75% of students enrolled in this program. Figure 4 shows that children in schools with <50% of children in the free school lunch program were least likely to respond “yes” to the two questions “Does your face hurt when you chew on tough food?” and “Does your face hurt when you open your mouth wide?”. However, they were not the least likely group to respond affirmatively to the question “Do you hear a noise (clicking) when you open your mouth wide?”

In addition to exploring whether certain subgroups of children such as male vs. female children and children from African American vs. European American backgrounds differed in the prevalence of experiencing each of the three TMD symptoms separately, Table 2 considers if these different groups of children also differed in how likely they were to report none vs. 1 or 2 or all 3 of these TMD symptoms. While 4,848 children reported no TMD symptoms, 1,923 reported one symptom, 1,029 two symptoms, and 502 reported all three symptoms. Concerning differences in the percentages of reported symptoms by subgroups, this table shows that a higher percentage of male students did not report any TMD symptoms (61% vs. 56%) and that higher percentages of female students reported 2 symptoms (14% vs. 11%) or all 3 TMD symptoms (7% vs. 5%; $p<.001$) than male students. African American children had consistently higher percentages than European American children when reporting whether they had 1 or 2 or 3 TMD symptoms ($p<.001$). Children in schools with 50% or more free school lunch program participants were less likely to report no TMD symptoms and more likely to report 1 or 2 or all 3 symptoms than students in schools with less than 50% of children enrolled in this program ($p<.001$).

Table 3 analyzes the relationships between two oral health indicators (presence/absence of abscess and of caries with pulpal involvement) and whether children needed/did not need oral health care and the likelihood to answer affirmatively to each of the three TMD symptoms respectively as well as the number of symptoms reported. The data showed that whether children had an abscess or pulpal involvement was not related with having/not having TMD symptoms nor were these two oral health indicators correlated with the number of TMD symptoms. Concerning the relationships between children’s need for dental treatment and the TMD data, the results showed that children with a treatment need were more likely to report that they heard a noise (clicking) when they opened their mouth wide compared to children with no treatment need (24% vs. 22%; $p<.05$).

Table 4 provides an overview of the percentages of children with no or 1 or 2 or 3 self-reported TMD symptoms who report impaired oral health-related quality of life (OHRQoL). The data show that children with three TMD symptoms consistently had the poorest OHRQoL and children with no TMD symptoms consistently had the best OHRQoL. For example, while 44% of children with three symptoms answered that their teeth hurt them at the time of the face-to-face interviews, only 29% children with two TMD symptoms, 18% of the children with one TMD symptom, and only 11% of children with no TMD symptom responded affirmatively to this question. In addition, when the average sum score of reported OHRQoL impairments for the four groups of children were compared, the data showed that the children with no TMD symptoms had an excellent OHRQoL (on a scale

from 0 = “optimal OHRQoL” to 13 = “worst OHRQoL”: Mean = 1.44), while the children with 3 self-reported TMD symptoms had the poorest OHRQoL (Mean = 4.84; $p < .001$).

DISCUSSION

The prevalence of self-reported TMD symptoms in this study ranged from 23.6% of children reporting that their face hurts when they chew on tough food to 18.8% who reported that their face hurts when they open their mouth wide. These percentages are between the prevalence data reported in prior research which ranged from only 7% among 12–18 year old children in a study by List et al.¹⁰ to 35% in a study by Vierola with children between 6 and 8 years.¹² Other authors found percentages of TMD symptoms and signs between 10% and 25% among the children in their studies.^{4–8,26,32} These percentages were closer to the percentages found in this study. This range of prevalence data raises the question whether children’s age might be an explanatory factor. The findings in this study showed that while the percentages of children with self-reported TMD symptoms differed for the three age groups considered (Group 1: children in Kindergarten and Grade 1/mostly 5–6 years of age; Group 2: in Grades 2 and 3/mostly 7–8 years of age; Group 3: in Grades 4 & 5/mostly 9 and 10 years of age) (see Figure 1), no consistent changes over time were noted. This finding is consistent with results reported by Emodi-Perlman et al. who also showed that in a 5 to 12 year old group of children age was not related with the prevalence of TMD symptoms.⁴³ However, some authors argue that TMD symptoms might increase with age among older children⁴⁴ and that this might be due to pubertal development and increased self-awareness among these older children.²¹ While future research should explore the way child developmental changes might affect the prevalence of TMD, overall there is consensus that TMD is a serious issue among children.

Concerning whether male vs. female children in Kindergarten through Grade 5 are more likely to self-report TMD symptoms, the findings in this study were consistent with findings in other studies that also showed that a higher percentage of girls than boys experienced TMD.^{4,5,8,19–25} However, the fact that some studies did not find gender differences in the prevalence of TMD symptoms deserves attention.^{26–31} It seems important to gain a better understanding of the reasons for these contradictory findings. For example, it should be ruled out that response biases - such as girls finding it more acceptable to report pain compared to boys - might explain these findings.

Future research is also needed to gain a better understanding why differences in the percentages of children from African American vs. European American backgrounds were found. Only research with children by Widmalm et al. found such differences.^{4,26,35} However, this could be due to the fact that race was not considered in nearly all of the reported studies concerning TMD in children. Research with adults showed some support for the hypothesis that African American adults might be more likely to experience TMD than European American adults.^{33,34} However, other authors argued that these racial differences might disappear if one would control for socio-economic differences.³⁶ This argument was not completely supported in this research. While children in schools with fewer than 50% of the children on free school lunches had consistently the lowest prevalence of TMD symptoms, the 50–75% vs. over 75% groups did not differ in a

consistent fashion. This finding could be due to the fact that socioeconomic status was indirectly determined by grouping the children dependent on the rate of free school lunch participants in this study. Future research should analyze the role of socio-economic background factors more precisely by including individual assessments of this variable in the design of the studies.

While there is no reason to assume that TMD would be related to the presence of caries or periodontal disease, one could make an argument that pain caused by abscesses or caries with pulpal involvement might radiate and thus lead to higher reports of TMD symptoms. However, this expected relationship was not found in this study. In addition, there was only one significant relationship between having vs. not having a need for dental treatment and reporting a TMD symptom. While this relationship was significant, one might argue that the difference was not highly clinically relevant (22% vs. 24%; $p < .05$). One could therefore conclude that there is no relationship between oral disease and TMD in children.

However, the connections between TMD symptoms and children's oral health-related quality of life were strong. Children without any TMD symptoms had excellent OHRQoL, while children reporting 3 symptoms had the worst OHRQoL. These findings are consistent with recent findings by Barbosa et al. and Jedel et al.^{19,40}

This study had three major limitations. First, TMD was only assessed with self-reported interview questions and not in a clinical exam. Not using the diagnostic criteria for temporomandibular disorders (DC/TMD)⁴⁴ for this research study is clearly a limitation because it makes it difficult to compare these findings with the results in the existing TMD literature. However, other researchers collected both clinical exam and survey questionnaire data and found a rather impressive level of consistency between the two sets of data.^{8,10,19,24,28,45}

The second limitation was the fact that socio-economic background was only assessed on a group level by considering the percentages of free school lunches in each of the 35 schools. More precise individual assessments would definitely have contributed to a more accurate assessment of the role of children's socio-economic background for their reported TMD symptoms. In addition, it would have been helpful to include the assessment of etiologic factors such as trauma, oral habits, and stressors which would have helped with a discussion of etiology.

Finally, it would have been valuable to also ask the children whether their face hurts at rest and to determine if there were earaches, headaches and neck pain since these often overlap with TMD pain. This information could have been valuable when considering that interprofessional collaborations with pediatricians might be helpful when providing care for these children.

In conclusion, these data clearly showed that significant percentages of Kindergarten through Grade 5 elementary school students report TMD symptoms related to the masticatory system such as pain when chewing tough food, limitations of mandibular movement such as when opening wide, and joint sounds. While the data concerning age differences were not conclusive, consistent findings related to the role of gender and race

and preliminary indications for the role of socio-economic factors were found. Girls were more likely to report TMD symptoms than boys and children from African American backgrounds were more likely than children from European American background to report TMD symptoms. However, while children in schools with <50% of the students enrolled in the free lunch program were consistently least likely to report TMD symptoms, the relationships were not as straightforward for the students in schools with 50–75% vs. >75% of the students enrolled in this program.

In addition, no relationships between TMD prevalence and the presence/absence of abscesses and caries with pulpal involvement were found. However, the presence of TMD symptoms is strongly related with poorer OHRQoL.

There are three sets of practical implications of these findings for dental and dental hygiene educators, for practicing clinicians and for researchers. First, dental and dental hygiene education and continuing education for dental care providers has to incorporate education about how to diagnose TMD in children and adolescents and how to provide treatment recommendations (see also Greene et al.⁴⁷; Tegelberg et al.^{48,49}). Second, clinicians need to include questions about TMD in their medical/dental history forms and be skilled in conducting clinical exams for diagnosing TMD in children. Once a child is diagnosed, it is crucial that practitioners are aware which treatment recommendations need to be provided. Third, given the prevalence of TMD among children and the degree to which TMD affects children's well-being and quality of life, research needs to focus on gaining a better understanding of how to prevent TMD and how to provide optimal treatment when they are diagnosed with TMD.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Figure 2.

Figure 3.

Figure 4.

Table 1

Overview of the children's background characteristics

School characteristics	N or Mean	% or SD/Range
# children in study	N 8,302	100%
# of schools	N 35	100%
# enrolled students/school	Mean 339	111.9 163 – 572
% consent forms returned	Mean 72%	11.757 42 – 93%
% screened of all students enrolled	Mean 56%	18 23 – 98%
% economically disadvantaged ¹	Mean 72%	16.187 32 – 98%
Student characteristics		N/%
Grade:	N	
- K	1366	17%
- 1	1724	22%
- 2	1418	18%
- 3	1213	15%
- 4	1206	15%
- 5	1032	13%
Gender:	N	
- female	4193	51%
- male	4099	49%
Age	Mean 7.66	1.871 4 – 12
Ethnicity:	N	
- Hispanic	281	3%
Race:	N	
- African American	4414	53%
- European American	3518	42%
- other	370	4%

Table 2
Percentages of self-reported TMD symptoms among different subgroups of children

Background characteristics	No TMD Symptoms N=4,848	1 TMD Symptom N=1,923	2 TMD Symptoms N=1,029	3 TMD Symptoms N=502	P
Grade:					
- Kindergarten & Grade 1	60%	21%	11%	8%	<.001
- Grade 2 & 3	55%	24%	14%	6%	
- Grade 4 & 5	51%	24%	12%	4%	
Gender:					
- Male	61%	23%	11%	5%	<.001
- Female	56%	23%	14%	7%	
Ethnicity/Race:					
- African American	54%	24%	15%	7%	<.001
- European American	64%	22%	9%	5%	
Socio-economic background:					
- <50%	63%	22%	10%	5%	<.001
- 50-75%	60%	24%	11%	6%	
- >75%	56%	24%	14%	6%	

Table 3

Oral health indicators and self-reported TMD symptoms

Self-reported TMD symptom:	Abscess		Pulpal Involvement		Tx need	
	Yes	No	Yes	No	Yes	No
Does it hurt when you chew on tough food?	25%	23%	25%	23%	25%	23%
Do you hear a noise when you open your mouth wide?	23%	20%	22%	23%	24%	22%*
Does it hurt when you open your mouth wide?	21%	19%	19%	21%	20%	19%
Number of TMD symptoms						
# self-reported symptoms:						
0 (N=4,346)	2.5%	97.5%	8.7%	91.3%	52.0%	48.0%
1 (N=1,712)	3.2%	96.8%	8.8%	91.2%	53.6%	46.4%
2 (N=919)	2.3%	97.7%	9.5%	90.5%	54.4%	45.6%
3 (N=462)	3.0%	97.0%	8.6%	91.4%	54.1%	45.9%

Table 4

Oral health-related quality of life of children who report no, 1, 2 or 3 symptoms of TMD

Oral health-related quality of life questions	No TMD Symptoms N=4,848	1 TMD Symptom N=1,923	2 TMD Symptoms N=1,029	3 TMD Symptoms N=502	p
a. Do your teeth hurt you now? % Yes	11%	18%	29%	44%	<.001
b. Do your teeth hurt when you eat hot or cold food? % Yes	27%	40%	56%	66%	<.001
c. Do your teeth hurt when you eat sweet food? % Yes	17%	28%	37%	50%	<.001
d. Do your teeth hurt when you chew or bite? % Yes	22%	36%	50%	70%	<.001
e. Does a tooth ache wake you up at night? % Yes	14%	24%	38%	56%	<.001
f. Does a tooth ache stop you from playing? % Yes	10%	19%	32%	45%	<.001
g. Does a tooth hurt in school? % Yes	15%	25%	42%	53%	<.001
h. Does a tooth ache keep you home from school? % Yes	7%	12%	21%	36%	<.001
i. Does a tooth ache keep you from learning in school? % Yes	5%	8%	15%	25%	<.001
j. Does a tooth ache keep you from paying attention in school? % Yes	5%	10%	18%	28%	<.001
k. Do you have a nice smile? % No	6%	8%	6%	8%	.003
l. Are you happy with your teeth? % No	5%	6%	9%	8%	<.001
Oral health-related sum score: Mean (SD) ^l	1.44 (1.81)	2.33 (2.24)	3.50 (2.51)	4.84 (2.85)	<.001

^l The oral health-related quality of life sum score was computed by adding 1 point for a “yes” response to items a-j and one point for a “no” response to items k and l. The scores ranged from 0 = best OHRQoL to 13 = worst OHRQoL.