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Knowledge of Dental Health and Oral Hygiene Practices of Taiwanese Visually Impaired and Sighted Students

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Abstract: This study investigated the dental health knowledge and oral hygiene practices of 95 students with visual impairments and 286 sighted students in Taiwan. It found that the students with visual impairments were less knowledgeable about dental health and less frequently completed oral hygiene practices than did the sighted students.

Knowledge of dental health is important, since it can promote the maintenance of oral health (Walsh, 1985). Several researchers (Anaise, 1979; Greeley, Goldstein, & Forrester, 1976; Mallatt & Palenik, 1990) have noted the need to provide more dental education and instruction for students with visual impairments. However, a thorough search of the dental literature on students with visual impairments (both those who are blind and those who have low vision) yielded little information on these students' knowledge of dental

health. Lebowitz (1974) and Ligh (1979) noted the absence of such information in the literature. Furthermore, no research in this regard has been conducted in Taiwan. Therefore, a study on dental health knowledge of students with visual impairments is needed. A better understanding of students' levels of knowledge may lead to the development of a comprehensive dental education program to teach good oral health practices and the maintenance of dental hygiene. Of all the oral hygiene practices, tooth brushing, brushing before going to bed, brushing and flossing daily, regular visits to dentists, and the frequency of consuming sugary foods and drinks have been discussed most often in the literature (Macgregor, Balding, & Regis, 1996; Mallatt & Palenik, 1990; Sauvetre et al., 1995; Van Nieuwenhuysen, Carvalho, & D'Hoore, 2002; Vazquez, Garcillan, Rioboo, & Bratos, 2002).

Oral hygiene practices

Tooth brushing is one of the most effective practices for removing dental deposits and preventing major dental and periodontal diseases (Sauvetre et al., 1995). Therefore, the frequency of daily tooth brushing has been proved to have a noted impact on the number of cavities a person has (Van Nieuwenhuysen et al., 2002). Persons who do not brush their teeth daily may also have more missing teeth (Lindemann, Zaschel-Grob, Opp, Lewis, & Lewis, 2001). Students with visual impairments may have difficulty brushing their

teeth because to do so appropriately, they need to place a toothbrush at the gum line (Hawkins et al., 2001), which can be challenging for them because of the uncertainty of visual clues to locate the gum line.

The habit of brushing one's teeth at bedtime has been continually emphasized by dental researchers (Macgregor et al., 1996; Sluder & Sluder, 1995; Van Nieuwenhuysen et al., 2002; Walsh, 1985). Macgregor et al. found that participants who brushed their teeth two or three times per day cleaned their teeth before bedtime. Another practice that is stressed in the dental literature is the combined effectiveness of brushing and flossing. This practice can efficiently clean the interproximal surfaces between teeth and prevent periodontal disease (Sluder & Sluder, 1995; Taani, 2002).

Still another way to ensure the early detection and prevention of dental diseases is to visit a dentist regularly. Van Nieuwenhuysen et al. (2002) noted that regular dental appointments were a significant factor in keeping children's teeth free from cavities, and Lindemann et al. (2001) found that those who kept regular dental appointments had fewer decayed teeth. Schembri and Fiske (2001) reported that 80% of the adults with visual impairments in their study did not realize the need to have regular dental visits to identify symptoms of oral pathology, such as bleeding, calculus, and shallow pocketing. Similarly, Nunn, Gordon, and Carmichael's (1993) study of the oral

hygiene of children with physical disabilities stated that only 18% of the participants had routine dental care. This pattern is similar to what we found in the study reported here.

The habit of consuming sugary foods and beverages has been cited as the major cause of cavities (Blinkhorn, Wainwright-Stringer, & Holloway, 2001; Moynihan, 2002; Nagel, 1987; Vazquez et al., 2002; Vignarajah, 1997). Therefore, sugary components should be restricted in the diet and should be provided only at mealtimes, both at school and at home (Blinkhorn et al., 2001).

As we mentioned earlier, it has been well documented that knowledge of dental health is associated with five key oral hygiene practices: the frequency of tooth brushing per day, teeth cleaning before going to bed, teeth cleaning with both a toothbrush and dental floss, regular dental visits, and the lower consumption of sugary food and beverages. Since few studies in Taiwan or other countries have addressed these issues for the dental health of children with visual impairments, we conducted a study to fill this information gap. We investigated the dental knowledge and oral hygiene practices of students with visual impairments who attended two residential schools for students with visual impairments and of sighted students in Tai-chung, Taiwan.

The study focused on knowledge of dental health and

the foregoing five variables concerning oral health. In this context, we investigated whether there was a significant difference between the students with visual impairments and the sighted students with regard to (1) overall knowledge of dental health, (2) the average frequency of tooth brushing per day, (3) brushing teeth before going to bed, (4) the use of both a toothbrush and dental floss, (5) going for regular dental checkups, and (6) the habit of consuming sugary foods and beverages.

Methods

Participants

The participants were 95 students with visual impairments and 286 sighted students with no disabilities. The students with visual impairments were enrolled in two residential schools for students with visual impairments and had no other disabilities. The sighted participants with no disabilities were enrolled in public schools. The ages of the two groups ranged from 6 to 18 years; 46% were in elementary school (Grades 1 to 6), 28% were in middle school (Grades 7 to 9), and 26% were in high school (Grades 10 to 12). Table 1 presents the demographic characteristics of the participants.

The sighted students were randomly selected from one elementary school, one middle school, and one high school. To ensure that the geographic characteristics of

both groups were similar to each other, we chose the three public schools in the same school district and metropolitan area where the two schools for students with visual impairments are situated. The sighted students had lived in the metropolitan area throughout their lives. According to the school records of the students with visual impairments, 67% had attended the schools for students with visual impairments for at least six years; 91% had come from metropolitan areas, 8% had moved to the same metropolitan area where the schools are located from suburban areas, and 1% had moved from rural areas.

Instruments and variables

The self-report questionnaire included 50 items that were developed by the second author, who is a dentist in general practice with a teaching certificate in special education and five years' teaching experience in special education. The initial questionnaire was reviewed by three teachers of students with visual impairments. The revised version was pilot-tested by eight elementary students with visual impairments and five sighted middle school students without disabilities. Of the final 50 items, 12 were personal-background variables, 30 focused on knowledge of dental health, and 8 were related to oral hygiene practices. The eight oral hygiene items were categorized into five topics: the frequency of tooth brushing per day, the habit of brushing teeth at bedtime, the habit of both brushing and flossing, going for regular dental checkups, and the

habit of consuming sugary foods and beverages.

The questionnaire was administered to the participants with visual impairments in either Chinese large print or Chinese braille. The items were also modified to suit the Chinese reading level of elementary school students. For example, the word *interproximal* was changed to "the space between two teeth" in Chinese, and *periodontal* was replaced with "the soft muscular tissue that surrounds your teeth" in Chinese. A stability coefficient of 0.92 was revealed through a test-retest procedure, determined over a two-week period. A measure of internal consistency indicated a Cronbach's alpha of 0.90. Thus, we were assured that the results were stable and consistent.

The independent variables were the conditions of having sight or visual impairments. The dependent variables consisted of an overall knowledge of dental health and an understanding of five oral hygiene practices: the average frequency of tooth brushing per day, the habit of brushing teeth before bedtime, the habit of both brushing and flossing, going for regular dental checkups, and the habit of consuming fewer sugary foods and beverages.

Procedure and data analysis

The first author contacted two residential schools for students with visual impairments and three regular education public schools (one elementary, one middle,

and one high school) in the same metropolitan area. Consent forms were solicited and acquired from the participants' teachers and parents and from the participants. Both forms ensured the participants of anonymity and confidentiality. Two training sessions on testing procedures were held for the 10 teachers who helped administer the questionnaires. A chi-square test, contingency-table analysis, *t* -test, one-way analysis of variance (ANOVA), and Scheffe post hoc comparison were performed on the data using the SPSS computer program.

Results

Overall knowledge of dental health

Sighted students

The mean score for the sighted students on the knowledge test was 23.93 out of a total score of 30 (see Table 2). These students scored best on Item 10 (the knowledge that bleeding gums signifies periodontal disease), but scored low on Item 2 (the number of primary teeth). Specifically, 97% of the 286 sighted students knew that bleeding during tooth brushing indicates periodontal disease; however, only 52% knew the correct number of primary teeth (Item 2). Thus, almost half the sighted participants (48%) did not know the total number of primary teeth. In contrast, these students scored high on Item 14; that is, 97% knew that seeing a dentist instead of taking over-the-

counter medicine is necessary in case of a toothache (see Table 3).

Students with visual impairments

The mean score for the group with visual impairments was 22.40 (see Table 4), somewhat lower than the mean score of the sighted students. The students with visual impairments varied widely in their responses to the knowledge items. Only 54% knew that bleeding during tooth brushing indicates periodontal disease (Item 10); 97% knew that seeing a dentist instead of taking over-the-counter medicine is necessary for treating toothaches (Item 14); and only 41% knew that the most effective tool for cleaning an interproximal space is dental floss, rather than a toothbrush (Item 20). In addition, only 36% knew that the surface of a tooth is enamel, not dentin (Item 5), compared to 56% of the sighted students (see Table 3).

Comparisons of the groups

Sighted versus visually impaired students. Regarding the overall knowledge of oral hygiene by the sighted and visually impaired groups, the sighted group surpassed the one with visual impairments on the overall scores on knowledge of dental health. The difference between the two groups was significant ($p < .001$; see Table 4).

The mean score for the sighted group was 23.93,

compared to 22.40 for the group with visual impairments (see Table 4). Table 3 indicates the proportion of participants who gave the correct answer to each item on knowledge of dental health. For the difference between the groups with and without visual impairments, 11 items were found to be significant on the chi-square test: Items 4, 5, 7, 8, 9, 10, 17, 19, 20, 28, and 30. That is, a marked statistical difference was found between the following aspects of the dental knowledge of the two groups: (1) tooth anatomy, the purpose of teeth in digestion, and tooth brushing; (2) understanding the important roles of primary teeth and the necessity of brushing teeth after eating; (3) an awareness that bleeding gums are an early sign of periodontal diseases; and (4) the function of flossing. Table 3 also indicates that the group with visual impairments outperformed the sighted group on 7 of the 30 items: Items 1, 3, 9, 11, 13, 14, and 29. This finding suggests that the participants with visual impairments were more knowledgeable than their sighted peers about the function of teeth, the number of permanent teeth, the effects of periodontal diseases, the situations that could prevent permanent teeth from emerging, when to see a dentist, and the need for regular checkups. However, among these seven test items, no statistical significance was observed except for Item 9 ($p < .00$) about the impact of poor teeth cleaning. On the remaining 23 items, the proportions of correct answers of the sighted group surpassed those of the group with visual impairments.

The sighted participants versus the students with low vision and the students with total blindness. The one-way ANOVA revealed that the sighted group surpassed the group with low vision and the one with total blindness on overall knowledge of dental health. The mean score of the sighted group was 23.93, compared to 22.45 for the group with total blindness and 22.08 for the group with low vision (see Table 2). The one-way ANOVA also indicated a significant difference in the main effects among the three groups ($F = 8.970$, $p < .01$; see Table 5). Therefore, the Scheffe post hoc comparison was conducted, and the results indicated a significant difference between the sighted group and the one with total blindness (see Table 5). Furthermore, the mean difference between the sighted group and the group with low vision was greater than the mean difference between the sighted group and the one with total blindness. However, no significant difference between the sighted group and the group with low vision was found using the Scheffe method, perhaps because the sample of participants with low vision was too small for there to be a considerable difference in the statistics. The fact that the students with low vision scored less well than did those who were totally blind on overall knowledge of dental health indicates that students with low vision, like those who were totally blind, have a great need to be educated about oral health and teeth-cleaning techniques.

Oral hygiene practices

The sighted versus the visually impaired groups

For a comparison of the oral hygiene practices of the sighted and the visually impaired groups, the results of the *t*-test and chi-square test (see Table 6) indicated salient differences on the following three items: the practice of brushing teeth before going to bed, using both a toothbrush and dental floss, and having regular checkups. No significant differences were found on the average frequency of tooth brushing per day and the habit of consuming sugary foods and beverages.

Average frequency of tooth brushing per day. The mean number of daily tooth brushings for the sighted group was 2.29, compared to 2.20 for the group with visual impairments; however, the *t*-test indicated no significant difference in the average frequency of tooth brushings per day between the two groups (see Table 6, Item 1).

Tooth brushing at bedtime. Of the sighted group, 88% of the participants brushed their teeth before going to bed, compared to 65% of the participants with visual impairments. The chi-square results showed that there was a significant difference between the two groups ($p < .001$; see Table 6, Item 2).

Using both a toothbrush and dental floss. The results indicated that 40% of the sighted participants used both devices for teeth cleaning, but only 20% of the participants with visual impairments did so. The chi-

square statistics showed an extremely significant difference between the two groups (see Table 6, Item 3).

Regular dental checkups. The sighted group outperformed the group with visual impairments on going for regular dental checkups. The chi-square results in Table 6 (Item 4) show that 42% of the sighted students, but only 27% of the students with visual impairments, had regular dental checkups. The difference between the two groups was highly significant ($p < .05$).

The habit of consuming sugary foods and beverages. Concerning the habit of consuming sugary foods and beverages, the statistics indicated no significant differences between the sighted group and the group with visual impairments (see Table 6, Item 5). Table 6 shows that 31.8% of the sighted participants and 31.6% of those with visual impairments said that they frequently had sugary foods and beverages and that 48.6% of the sighted students and 44.2% of those with visual impairments said that they "sometimes" consumed such products. Taking the percentages for the two categories ("frequently" and "sometimes") into account, a high percentage of sugar consumption was observed for both groups.

Discussion

Overall Knowledge of Dental Health

The first research question compared the two groups' overall knowledge of dental health on the basis of the 30 knowledge items. The data indicated significant differences between the two groups. This finding reflects the groups' dissimilar levels of dental health education. In other words, the sighted students had a more thorough knowledge of dental health than did the students with visual impairments because of better dental health education. This finding is in line with Anaise's (1979) research, which indicated that Israeli students with visual impairments had a higher need for dental health education than did their sighted counterparts.

Specifically, with regard to the significant difference exhibited for Items 8, 17, and 19, regarding the purpose of teeth in digestion and knowledge of tooth brushing, the chi-square results indicated that the group with visual impairments had more misconceptions about dental health. In addition, statistically significant differences were also found between the two groups for Items 7, 28, and 30, concerning cavities in the primary teeth and brushing teeth after eating. This finding suggests that the participants with visual impairments did not have a clear awareness of oral hygiene. The significant differences for Items 4 and 5 indicate that the participants with visual impairments were unclear about the anatomy of teeth (that is, the roots, enamel, and dentin). The statistical difference for Item 10 indicates the visually impaired students' poor

knowledge that bleeding gums are an early symptom of periodontal disease. It should be noted that this early warning sign of peridontal disease may be difficult for students with visual impairments to detect, since the visual channel is one of the only ways to identify the condition. Furthermore, the salient difference for Item 20 suggests that the visually impaired students did not know the function of flossing in teeth cleaning.

It is interesting that on the cognitive level of overall knowledge of dental health, no statistical significance was observed for Items 24, 26, and 29, which concerned the practices of both brushing and flossing, brushing before bedtime, and regular dental checkups (see Table 3). However, on the practice level of these items, statistical significance was found (see Table 6). It could be that the students with visual impairments cognitively understood the importance of these three items but did not practice them. It is not clear whether this phenomenon is the result of such problems as manual dexterity, limited visual ability, problems in orientation and mobility, or the lack of oral health education.

Oral hygiene practices of the two groups

Frequency of tooth brushing per day

The second research question was asked to determine if there was a significant difference in the average frequency of tooth brushing per day between the

sighted students and those who were visually impaired. In this case, no statistical significance was observed between the two groups. The finding that less than 40% of the participants with visual impairments brushed their teeth twice a day (see Table 6, Item 1) indicates that students with visual impairments need a comprehensive oral hygiene education program, although it was encouraging that the percentage of daily tooth brushing was higher than what was found in Schembri and Fiske's study (2001) of elderly persons with visual impairments.

Tooth brushing at bedtime

For the third research question, on the habit of brushing teeth before going to bed, a significant difference was found between the two groups—more sighted students than visually impaired students brushed their teeth at bedtime. This finding was in disagreement with the finding by Macgregor et al. (1996) that less than one third of their sighted adolescent participants brushed their teeth before going to bed. A search of a dental research database indicated that no findings were available regarding this practice for people with visual impairments.

The use of both a toothbrush and dental floss

The fourth research question addressed the habit of using both a toothbrush and dental floss for teeth cleaning. Few participants in either group were in the

habit of using both tools for teeth cleaning. Although the participants in both groups shared a similar level of awareness about the benefits of using both a toothbrush and dental floss, they did not seem to have this practice. Thus, more effort is needed to encourage and reinforce the daily use of dental floss.

A statistical significance was observed between the two groups with respect to the facility of sight and dental health knowledge. Despite the finding that the percentage of the sighted participants who used both tools was double that of those with visual impairments, the low percentage rate of using both a toothbrush and dental floss in both groups indicates the need to teach appropriate brushing and flossing methods to all children, especially since both groups of participants lacked knowledge of the most effective way to clean teeth: using both a toothbrush and dental floss. As we previously mentioned, neither tool can be skipped for the effective maintenance of oral health.

Regular dental checkups

The fifth research question probed the regularity of the participants' dental checkups. The calculation of the statistical significance of the results indicated that the sighted group outperformed the group with visual impairments in terms of going for regular dental checkups. In other words, the group with visual impairments had regular dental care less frequently. This finding corresponds to that of Van

Nieuwenhuysen et al. (2002), who reported fewer regular dental appointments by nonprivileged children without disabilities. For the participants with visual impairments in the current study, their lack of regular dental checkups may be due to their living situation. Since the children stay at their residential schools during the entire school year, their appointments may need to be with dentists near their schools for regular dental appointments to be feasible.

According to the records of the two schools for students with visual impairments, one school scheduled yearly dental cleaning and checkups for its students, but no dentists came to the school on a regular basis. The other school had a dentist come in twice a week to help its students with reported dental problems, but did not schedule yearly checkups. Thus, regular dental checkups are not arranged unless parents schedule them. It would be a great service to the students with visual impairments if both residential schools could schedule yearly dental checkups for their students.

The habit of consuming sugary foods and beverages

The sixth research question involved the consumption of sugary foods and beverages. Statistically, no significant difference between the sighted and the visually impaired groups was found. Moreover, when we combined the percentages for the two categories ("frequently" and "sometimes"), a high percentage of

sugar consumption was observed for both groups. This result agrees with that by Vigild, Petersen, and Hadi (1999), who reported a high consumption of sugar-containing products in their 500 young adolescent Kuwaiti participants. As a result of their finding, these researchers suggested the need to establish oral health care programs in secondary schools in their country. Similarly, the result of the current study indicates a need for more dietary instruction in schools to enhance students' oral health care. As Moynihan (2002) noted, students need to learn to reduce their intake of sugary foods and beverages to increase their dental health.

Conclusion

In summary, this study revealed that these Taiwanese students with visual impairments had less overall knowledge of dental health than did their sighted peers and hence practiced oral hygiene less habitually. In particular, fewer students with visual impairments brushed their teeth at bedtime and had regular dental visits than did their sighted counterparts. Since of all the topics studied, both groups were the least educated about using both a toothbrush and dental floss, this practice should be a priority in dental education programs for all students. One possible program may include educators working with dentists on oral health issues. In cooperation with dental health providers, educators could discuss the benefits of having regular dental checkups and of reducing the intake of sugary foods and beverages in health classes. Providers of

residential care in schools for students who are visually impaired could help students improve their oral hygiene practices by adding the practice of brushing teeth at bedtime and using both a toothbrush and dental floss in students' daily routines. An alternative to a dental education program may be to have students visit a dental clinic and interview dental practitioners on oral hygiene practices.

The students with visual impairments lacked knowledge of the early detection of oral disease, such as gum disease, which is easily detected visually when gums bleed. Therefore, it is important for these students to improve their knowledge of dental health and establish oral hygiene practices so as to reduce the prevalence of dental and periodontal pathology in the population with visual impairments.

The comparison of the findings of this study with those of previous research was limited because there have been few studies of dental knowledge by people with visual impairments. Little past research has focused on the oral hygiene practices of the population with visual impairments. Therefore, future studies are needed in this area. Future research could compare students' dental records with their self-reported answers regarding their oral health status. Furthermore, researchers could make greater efforts to examine the oral health status of children with visual impairments in the future to ensure the quality of life of this population. Good dental care helps in socializing,

improves health, and heightens confidence, which are important for all people (Fiske, Gelbier, & Watson, 1990), but perhaps even more so for people who are visually impaired.

A limitation of this study is that it was not feasible to include all the students in Taiwan with visual impairments in this research because of a restricted amount of funding. Another drawback is related to the oral health status of these students, which could have been inspected at the same time to gain a clearer understanding of the relationship between the students' dental knowledge and their oral health status. Next, the generalizability of the findings may be diminished by the broad variance between the number of sighted participants and those with visual impairments. The 95 participants with visual impairments were the number available when the dental health questionnaires were conducted. Another caution is that chi-square statistics become sensitive when large samples are used, and so the results must be carefully interpreted.

In addition, it was difficult to match both groups for age, grade, and gender because of some culturally specific factors. For example, in Taiwan, students whose only disability is visual impairment are educated mainly in inclusive settings near their homes. Of the total of 1,698 students with visual impairments as their only disability in Taiwan (from elementary to senior high school), only 371 (22%) attend schools for students who are visually impaired (Ministry of

Education, 2003). This fact severely limited the scope of our study. Another cultural impact that limited the gender balance of our study was that parents tend to prefer that their daughters live with them and go to school in their immediate neighborhood, rather than let them leave home for residential schooling. Thus, we had more boys than girls with visual impairments in our study These two aspects reduced the number of potential students to be matched for age, grade, and gender and caused the number of sighted participants to be larger than the number of participants with visual impairments. Given the limitations just delineated, this study was devised to help draw the attention of educators to issues of dental health for students with visual impairments. We especially hope to increase awareness of the need for effective dental education programs for these students, not only in Taiwan, but in communities around the world.

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