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Elementary school staff knowledge about dental injuries

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Abstract – Elementary school staff can play a crucial role in managing traumatic dental injuries (TDIs) because they are often in proximity to children and are frequently called upon to assist with children's accidents. International studies reveal that elementary school personnel have little knowledge about emergency dental care and management. The purpose of this study was to assess the knowledge, practice and experience regarding TDIs among a sample of elementary school personnel in the USA. Assessment was performed using a demographic questionnaire and a newly developed TDI survey instrument. Results revealed a wide distribution of responses. Overall, dental trauma knowledge among this group was poor. The majority of respondents were not well-versed regarding TDIs, their management, the benefits of timely care or treatment costs. However, staff reported a keen interest in receiving more TDI information and training. TDI education and management are needed among all elementary school staff members to improve the prognosis of these accidents when they occur.

Traumatic dental injuries (TDIs) affect approximately one of five school-aged children (1–4) and most injuries occur either at home or at school (3–5). Parents, teachers, coaches and other non-dental professionals can play an important role in managing TDIs (6) and improving the prognosis. Yet, these adults generally have little knowledge about the proper management of these injuries (6–17). As a result, TDIs are frequently referred to physicians, dentists and hospital emergency departments without having had appropriate emergency management at the site of the accident (12, 18). The resulting complications can be costly and time-consuming (19–22) and many teeth are subsequently lost (22), often resulting from a delay in receiving care (12, 18).

Consequences of traumatic dental injuries

One-third of dental injuries have been shown to cause permanent sequelae to TDI victims (20). But, TDIs also have other ramifications that include children's hours lost from school and parents' hours lost from work (22), a consequence that disproportionately burden lower income, minority and non-insured children (20, 23). The cost and time needed to repair TDIs is high. For example, crown fractures may require as many as 16 dental visits (21) and replacing a tooth may cost several thousands of dollars (24). If a fractured or avulsed tooth is unsalvageable or the family cannot afford treatment, the tooth may be extracted, thereby affecting the child's dental development (25) and future prosthetic options. Early loss can have a psychosocial impact on children, as the child must deal with the consequences of missing a (usually, front) tooth (26). In summary, the time, cost and life-long consequences of TDI can be substantial (27).

School staff knowledge of TDIs

TDIs often occur at school or during after-school activities where supervising adults, such as school personnel, are often nearby or at the scene of the accident. Yet, international studies have revealed that school staff have little TDI knowledge (6–8, 11, 13–17, 28–33). However, no studies, to date, have confirmed this nationally in the USA.

Purpose

This study sought to fill this gap by evaluating elementary school staff regarding their knowledge of TDIs and related onsite emergency management. Specifically, we assessed among school staff in USA public elementary schools: (i) their knowledge of TDIs and related management and (ii) their TDI management practices and experience.

Material and methods

Overview of study design

This investigation was a census, cross-sectional survey of all the public elementary schools in the Orange County School District in North Carolina. An estimated 175 public elementary school teachers, teacher assistants (TA) and nurses for the grades 2–5 were recruited to

Table 1. Demographics of study population from questionnaire

Question	Overall %	Overall *n*
What is your primary position in Orange County (OC) schools?		
Teachers	62	69
Teacher assistants	24	27
Nurse	6	7
Others	7	8
n	100	111
For what grades are you responsible?		
2	16	18
3	13	14
4	8	9
5	16	18
All	41	45
Did not report – no response	6	7
Your gender?		
Male	9	10
Female	91	101
n		111
Your age?		
Average		39.7
Standard deviation		10.2
n		102
Your level of completed education?		
High school	15	17
Associate's	10	11
Bachelor's	39	43
Master's	36	40
Bachelor's or higher	75	83
n	100	111
Are you currently BLS certified?		
Yes	26	29
No	69	76
Did not report	5	6
How many (no.) years at your profession?		
Average		13.0
Standard deviation		9.2
n		100
What is the maximum no. of students you are responsible for?		
Average		66.5
Standard deviation		215.3
n		105
Do you have children of your own?		
Yes	69	76
No	31	34
n		110
If yes, how many children do you have?		
Average		1.9
Standard deviation		0.80
Total no. of children by all respondents		76
What are the ages of your children?		
Average age		15.5
Standard deviation		7.96
Do your duties include recess supervision?		
Yes	71	79
No	23	26
n		105
Do your duties include lunch supervision?		
Yes	75	79
No	26	27
n		106
Do your duties include sports supervision?		
Yes	42	47
No	54	54
n		101
Have you personally experienced a TDI?		
Yes	24	26
No	76	82
n		108
Have you ever before received any advice re: TDIs?		
Yes	37	40
No	63	68
n		108
If yes, your primary source of TDI advice was:		
Family physician		5
Dentist		19
Dental hygienist		10
Dental office		10
Other health specialist		13
Friend		4
Child/adolescent		0
Teacher		1
Sports coach		5
Others		1
n		108
Do you feel adequately informed about TDIs?		
Yes	10	11
No	77	84
Don't know	13	14
n		109
Learning about TDIs is:		
Very important	57	61
Somewhat important	25	27
important	19	20
Not important	0	0
n		108
Learning about TDIs is:		
Very valuable	50	55
Somewhat valuable	14	16
Valuable	14	15
Not valuable	0	0
Did not report	23	25
n		111
Would you like to receive more information to manage TDIs properly?		
Yes	83	92
No	17	19
n		111
Would you like to receive more information to manage TDIs properly?		
Yes	79	80
No	19	21
n		101

participate. There were no exclusion criteria, other than the ability to understand and read English.

This study was reviewed and approved by the Biomedical Institutional Review Board at UNC – Chapel Hill. All eligible participants were required to review and give written informed consent to study participation and maintained their right to withdraw from the study at any juncture.

Assessment materials: demographic questionnaire and TDI survey

Our study employed a demographic questionnaire and a TDI survey. The demographic questionnaire included 14

questions about the participants as well as their attitudes, beliefs and experiences regarding TDIs. The TDI survey instrument contained questions with a response scale similar to the 5-Point Likert Scale (34). This survey evaluated the subjects' knowledge about crown fractures, avulsions and related management. We accepted the face validity of questions used in previous surveys and patterned our survey's questions after theirs (6, 14, 16, 17). After evaluation by a professional panel and revisions, we field-tested the questionnaire and survey among several lay individuals, dental students and dental trauma experts.

Survey reliability: Cronbach alpha test

We tested our new survey instrument for reliability by calculating Cronbach's alpha (35–37). Cronbach alpha (CA) is a statistical index associated with the variability because of the underlying characteristic being measured; it is considered a measure of internal reliability for new survey instruments. The CA value ranges from zero to one, and a measure ≥0.6 indicates acceptable reliability (37).

Data collection

We distributed the consent form and demographic questionnaire to all staff during August 2004; completion and submission of both confirmed their participation. In September 2004, participants were assembled at all seven respective schools to complete the TDI Survey. Participants were assigned confidential, unique identifiers that correlated to their school and their job description: teacher, teacher assistant or school nurse.

Statistical analysis

Data were obtained from the responses to the demographic questionnaires and entered for analysis using Microsoft Access (Microsoft Corporation, Redmond, WA, USA). Data analyses were performed by the Biometrics Laboratory in the UNC – CH School of Public Health.

Eleven items, as seen in the online survey, were used to determine our main variable of interest: the total TDI-knowledge score (TTKS) for each subject. To facilitate interpretation, the TTKS consisted of dichotomized responses to these 11 items regarding crown fractures and avulsion injuries. For a given survey item, participants were assigned one point for correct responses and no points for incorrect responses yielding a maximum TTKS of 11. Therefore, TTKS was computed through predetermined ('correct/acceptable') survey responses. Responses to the other survey items contributed to our findings as descriptive information, which is shared in the tables as well as in the results section.

Results

Study sample

Of the 175 potential participants, 135 subjects volunteered and 111 submitted all required components: the consent form, the demographic questionnaire and the survey. Participant demographics are further detailed in Table 1.

All seven nurses (100%) reported being certified in basic life support (BLS), while approximately one-quarter of the teachers and teacher assistants were – a large discrepancy. Further, only 29% of the nurses reported that they had been formally informed about TDIs. Again, this shows that not only the majority of our participants but also the majority of nurses have never received any formal education or training regarding TDIs – despite being in the child health care field. Lastly, all seven nurses (100%) wanted more information regarding TDIs, while 86% of nurses also desired more training regarding TDIs. This contrasts 83% and 71%, respectively, for the non-nurse participants: teachers and teacher assistants.

Survey reliability

The observed Cronbach's alpha was 0.8376 for the survey instrument.

TDI practice and experience

The results for TDI experience are presented in Table 2. When asked about approximately how many times in the past year each participant had personally witnessed a TDI among their children, neighborhood children or their students, 69% responded 'never'. When asked about approximately how many times in the past year children/students had asked for help with a chipped tooth, 64% responded 'never'. When asked about a knocked-out tooth, 80% responded 'never'. Further details can be found in Table 2.

Relative to the management of an avulsed tooth, our findings are presented in Table 3. When asked about their level of comfort to replant an avulsed tooth, 44% responded they would 'not do this' while 28% reported that they would 'not (be) comfortable' doing this. On the other hand, approximately 87% of respondents reported that they would be 'comfortable' or 'very comfortable' to 'save the 'knocked-out tooth' and take it to the dentist'.

Table 2. Participants' responses about TDI experience in the past year

Question	Never (%)	1–5 (%)	≥6 (%)	Others (%)	*n*	%
Number of TDIs witnessed	69	26	2	3	111	100
Number of consults regarding a broken/chipped tooth	64	30	4	3	111	100
Number of consults for help with a knocked-out tooth	80	14	3	3	111	100

Table 3. Participants' responses relative to avulsion

Choices	Would not do (%)	Not comfortable (%)	Undecided (%)	Comfortable (%)	Very comfortable (%)	No response (%)	*n*	%
Replant	44	28	15	7	5	0	111	100%
Save and take it to the dentist	1	2	10	37	50	1	111	100%

Findings for treatment costs

Participants' responses regarding treatment costs are illustrated in Table 4, and reveal a wide distribution of responses for both crown fracture as well as avulsion injuries.

Findings for storage media

The distribution of the participants' responses regarding the best (1st-ranked) storage media for an avulsed tooth is shown in Table 5. The results showed that 32% of the participants thought that Hank's Balanced Salt Solution (HBSS) (Gibco^{TM}; Invitrogen Co., Carlsbad, CA, USA) was the best storage media for an avulsed tooth while 29% thought that it is best to replant the tooth; 34% percent believed milk to be the best storage medium and 6% thought it to be water. Again, there was a wide distribution of responses across all media types.

TTKS results

The mean TTKS among the participants was 8.88 of a possible 11 points – approximately 80%. The median and mode of the TTKS was 9 with a range of 2–11 (SD ± 1.87). We examined the data in closer detail to separate the effect of training on TTKS by accounting for our participants' employment position in the school: teacher vs teacher assistant vs nurse. As shown in Table 6, all seven of the nurse participants attained a TTKS of either 9 or 11 (out of 11 possible); five nurses earned a perfect score: 11/11. This is notable because these seven nurses were the only participants who earned scores of 9 or above. In other words, all other participants' average TTKS was less than or equal to a TTKS of 7. In exact numbers, 100% of both the teachers and the teacher assistants received scores of 64% or less, while 100% of the nurses received scores of either 82% or 100%.

Table 4. Participants' responses regarding cost needed to treat a crown fracture or an avulsion injury. (a) In Orange County, a broken or chipped tooth generally costs about (blank) to repair…, (b) In Orange County, a knocked-out tooth generally costs about (blank) to repair…

(blank)	*n*	%
(a)		
<$400	27	24
$400–$1000	34	31
>$1000	7	6
Don't know	43	39
Total	111	100
(b)		
<$400	13	12
$400–$1000	41	37
>$1000	18	16
Don't know	39	35
Total	111	100

These are the data from questions 5 and 8 in the survey.

Table 5. Opinion on storage media for an avulsed tooth

Choices	1st (%)	2nd (%)	3rd (%)	4th (%)	No response (%)	*n*
HBSS	32	32	25	12	1	111
Replant	29	10	18	44	1	111
Milk	34	34	27	9	0	111
Water	6	29	31	38	0	111
Total	100 (107)					

Summary of results

Generally, the participants had little knowledge about the proper management of TDIs, their associated costs and the proper storage media. However, nurses' knowledge regarding TDIs appeared much better than that compared with the teachers or the teacher assistants. Nevertheless, nearly all participants thought that this topic was important and reported their interest in receiving more information and/or training.

Discussion

Our new survey instrument was developed to assess knowledge regarding the proper management of TDIs among non-dental professionals. There are no reports in the USA literature of such instruments, and we felt it essential to test and report our survey instrument's reliability. Our Cronbach alpha proved this to be a reliable survey instrument. Accordingly, the instrument could be useful for further research to educate and test other populations.

Our findings are consistent with four other previously published studies in which elementary or primary school teachers reported that they received no advice regarding TDIs (6, 12–14). Sixty-one percentage of our participants reported having received no advice, similar to findings of 60% in Wales and England (14), 63% in Singapore (16), 88.5% in England (38) and 95.2% in China (17).

Compared with five other studies: 92% (6), 80% (15), 75% (14), 50% (30), a strikingly similar number of our

Table 6. TTKS distribution by subject's profession

TTKS (*n*)	1	2	3	4	5	6	7	9	11	Total (%)
Teacher	1	5	7	23	17	9	6			99
Teacher assistant		4	5	5	6	5	1			96
Nurse								2	5	100

participants, 72%, reported that they would 'not replant' an avulsed tooth. Over 80% of our participants expressed an interest in receiving more information on TDI management; this overwhelming interest among participants has also been shown in other studies (9, 14, 16). We can conclude that there is a generally consistent consensus among elementary school staff across developed countries.

As seen in Table 2, the majority of participants (69%) reported never personally having witnessed a dental injury, while 26% reported seeing anywhere from one to five TDIs. Our participants reported more experience with crown fractures (~36%) than with avulsed teeth (~20%), as would be expected (3, 25, 39, 40).

As seen in Table 3, a majority of our respondents either would not replant (44%) an avulsed tooth or would be uncomfortable (28%) doing so. Taken together then, approximately 72% of our sample would not immediately replant an avulsed tooth – the best possible management. Further, an additional 15% were undecided about what they would do. On the other hand, the majority, 87% of our respondents felt comfortable or very comfortable in saving the avulsed tooth and then seeking dental care. These findings emphasize that additional TDI education would be exceedingly beneficial for elementary school staff.

As seen in Table 5, our findings also illuminate the need for TDI education regarding storage media for avulsed teeth. Only 32% of our participants chose milk as the best (1st-ranked) storage media, a similar finding to a UK study where 46% of teachers chose milk (14). Other countries report similarly ill-informed teachers regarding incorrect transport and storage media methods (6, 16, 17). In Singapore, for instance, only 15% knew the ideal storage media (16) and in China only 9% chose milk as the best media for avulsion transport (17).

Indeed, replantation, HBSS or milk are the three best options for the management or transport of an avulsed tooth. However, only 29% of our respondents chose replantation as best while 32% of respondents chose HBSS and 34% chose milk, as seen in Table 5. Clearly, roughly one-third of our respondents chose each preferred option. But, choosing and actually doing are two different entities; one retrospective study found that among TDI patients none stored the avulsed tooth in a recommended transport medium while even fewer replanted the avulsed tooth (12).

To examine avulsion storage media choices further and this discrepancy between choosing and doing, we evaluated the respondents who ranked correctly the action/media from best to worst: replant, then HBSS, then milk and then water. Of the 111 respondents, only 11% got this order completely correct, as seen in Table 7. Additional analyses revealed that if the participants chose replantation or HBSS as the first or second best action/media, with the consideration that many are not comfortable to replant the avulsed tooth, still, only 3% chose replantation or HBSS as first or second best. Therefore, an overwhelming 87% got the entire or partial order of acceptable actions/storage media to manage an avulsed tooth incorrect. In other words, only 13% evaluated this question regarding action/storage media for the management of an avulsed tooth correctly. These findings suggest that the combination of answers was scattered and varied, and most likely intuitive or educational guessing occurred rather than informative responses. Intuitive guessing has been previously suggested in the literature (6) when employing questionnaires regarding this topic – a possible limitation of our study as well. In summary, our participants were not well-informed about storage media for either an avulsion or crown fracture injury.

Table 7. Rankings' distribution of storage media/action for an avulsed tooth

Rankings	*n*	%
Replant 1st, HBSS 2nd, milk 3rd, water 4th (correct order)	12	11
Replant or HBSS 1st or 2nd (the two first best choices)	3	3
Any other order	96	87
Total	111	100%

Our findings also revealed a wide distribution of responses about TDI direct costs. We selected a figure of < $400 as the average cost for a crown fracture injury repair but only 24% of our respondents chose this figure. An avulsion injury can cost over $1000 to repair yet only 16% of our respondents chose this. In general, our participants were not well-informed about the treatment expenses for TDIs and our participants greatly underestimated the costs to repair these injuries. We believe if school staff were better informed about TDI costs, then they may be more likely to give more attention to this subject matter.

TTKS

Our main outcome variable was the TTKS. Our findings confirm knowledge among our USA school staff participants was inadequate, a finding that corroborates international studies that have examined similar subjects (6, 11, 13, 14, 16, 17), as well as other lay subjects (7, 8, 15, 28–33). Our findings support the pressing need of TDI education for school staff who often supervise children under scenarios where TDIs are likely to occur. In real numbers, our findings suggest that if 100 school children were to suffer an avulsion in the school environment, all would likely lose the tooth because of TDI mismanagement.

This low average TTKS of 8.88/11 is significant because of its translated clinical importance and detrimental effects related to TDI mismanagement. It is important to remember that the seven nurses greatly increased this average score. Hence, considering that all the nurses scored 9 or above, if the nurses' scores had not been considered, the average TTKS of teachers and TA would have been even lower than 8.88. This finding reinforces the need for both teachers and TAs to be well educated in this area; otherwise, continued mismanagement efforts will see no change to the prognosis of these injuries. Presently, the data suggest that all teachers and TAs would greatly contribute to mismanagement of these injuries, while only the nurses conveyed the

potential to correctly manage TDIs. Our findings are clear: school staff members need more education regarding TDIs and our data confirm that school staff would be eager and receptive to this educational information.

Limitations and strengths

Our study was cross-sectional in nature and consisted of seven schools in one county school district. Moreover, our participants' responses regarding TTKS were self-reported; hence, caution with generalizations must be considered. Nevertheless, our response rate of 82% (111/135) was excellent. These USA findings corroborate those reported from other developed counties and the incidence of TDIs among our subjects (24%) concurs with that of published reports (~20%) – factors that add validity to our data.

Conclusions

Many studies encourage education of proper dental trauma management (3, 6–11, 13–18, 26, 28–33, 41–49) and it is widely recognized that timely, correct management in the early stages of TDI, as well as prompt treatment, provide for the best prognosis of a traumatized tooth. Our findings emphasize that educational programs and training are needed to enhance proper management of TDIs experienced by USA elementary school children. Accordingly, we encourage partnerships that will achieve these educational outcomes and future efforts should be directed toward such endeavors.

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Appendix 1: TTKS Survey Questions

2) Please indicate your level of agreement with each of the following statements:
(Check the appropriate box for each statement.)

Which of the following do you consider a dental injury?	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	No opinion
a) A broken/chipped tooth	❑1	❑2	❑3	❑4	❑5	❑6
A tooth that has…						
b) … moved from its original position	❑1	❑2	❑3	❑4	❑5	❑6
c) … been knocked out of the mouth	❑1	❑2	❑3	❑4	❑5	❑6

For the following questions, the scenario is as follows:

During a Physical Education lesson, Sally is hit in the face with a softball. Her upper front tooth is broken (see Figure 1 below), and there is bleeding coming from the inside of the tooth – from the tooth's fracture site. Sally is otherwise unhurt, and she did not lose consciousness.

3) Please check the appropriate box for each statement below about when a child comes to <u>you</u> for help and has broken/chipped their tooth, such as the one shown in Figure 1.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	No opinion
a) I think that broken/chipped teeth can be saved	❑1	❑2	❑3	❑4	❑5	❑6
b) I would look for the broken/chipped tooth piece	❑1	❑2	❑3	❑4	❑5	❑6

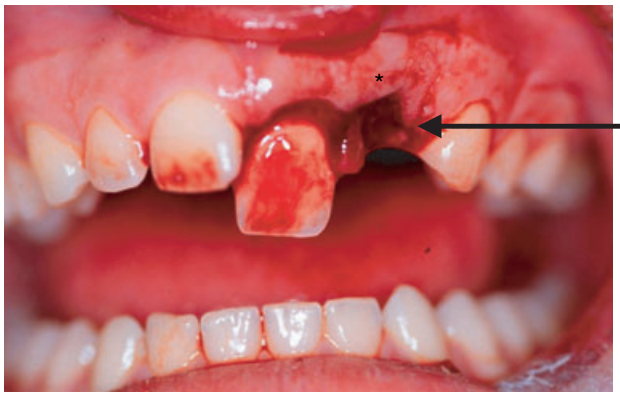
For a broken/chipped tooth, I believe	Never	Within 1 week…	By the next day…	Immediately (ASAP)	Don't know
c) … the child should get treatment…..	❑1	❑2	❑3	❑4	❑5

4) You've called the child's caregivers and they have just arrived. However, they are unsure about what to do next. They ask you for your advice. What would you advise them to do next?

***Next* to be done, I would advise them…**	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	No opinion
a) … to go to their dentist	❑1	❑2	❑3	❑4	❑5	❑6

For the following questions, the scenario is as follows:

During recess, Timmy is hit in the mouth by another student in a game of tag. His upper front tooth is missing – it has been knocked out – and there is blood in his mouth. Timmy is otherwise unhurt, and he did not lose consciousness.



***The permanent tooth has just been knocked out in the accident.**

6) Please check the appropriate box for each statement below about when a child comes to you for help and has knocked out their tooth, such as the one shown in Figure 2.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	No opinion
a) I think knocked-out teeth can be saved	❑1	❑2	❑3	❑4	❑5	❑6
b) I would look for the knocked-out tooth	❑1	❑2	❑3	❑4	❑5	❑6

For a knocked-out tooth, I believe…	Never	Within 1 week…	By the next day…	Immediately (ASAP)	Don't know
c) … the child should get treatment…..	❑1	❑2	❑3	❑4	❑5

7) You've called the child's caregivers and they have just arrived. However, they are unsure about what to do next. They ask you for your advice. What would you advise them to do next?

***Next* to be done, I would advise…**	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	No opinion
a) …them to go to their dentist	❑1	❑2	❑3	❑4	❑5	❑6

Appendix 2: Other Survey Questions

1a. Approximately how many times have you personally witnessed any dental injury among your children, neighborhood children, or your own students?

1b. Approximately how many times have your children, neighborhood children, or your own students come to you for help with a broken/chipped tooth?

1c. Approximately how many times have your children, neighborhood children, or your own students come to you for help with a knocked-out tooth?

7d. If the knocked-out tooth were found, I would feel comfortable about actually putting the tooth back into its socket?

7e. If the knocked-out tooth were found, I would feel comfortable about actually saving the tooth and taking it to the dentist?

9) Next to each statement below, please rank what you believe is the best immediate management for a knocked-out tooth: best #1 to worst #4.

	Best #1 – Worst #4	Rank Order ▼
a)	Placing a knocked-out tooth in specialized storage liquid	
b)	Placing the knocked-out tooth back into its socket	
c)	Placing a knocked-out tooth in milk	
d)	Placing a knocked-out tooth in water	

A = Specialized storage media (such as HBSS)
B = Replantation of the tooth
C = Milk
D = Water