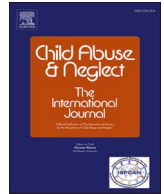




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Oral health history in children referred to a child advocacy center in Norway

Julie Toft^{a,*}, Arne Kristian Myhre^{b,c}, Yi-Qian Sun^{c,d}, Tiril Willumsen^a,
Anne Rønneberg^a

^a Department of Pediatric Dentistry and Behavioral Science, Institute of Clinical Dentistry, University of Oslo, Pb 1109 Blindern, 0317 Oslo, Norway

^b Department of Pediatrics and Youth Health, St. Olavs Hospital, Pb 3250 Torgarden, 7006 Trondheim, Norway

^c Department of Clinical and Molecular Medicine, NTNU, Norwegian University of Science and Technology, Erling Skjalgsons gate 1, 7491 Trondheim, Norway

^d Center for Oral Health Services and Research Mid-Norway (TkMidt), Miljøbygget, Professor Brochs gate 2, NO-7030 Trondheim, Norway

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ABSTRACT

Background: Some suspected child victims of physical or sexual abuse undergo dental forensic examinations at child advocacy centers (CACs) in Norway. Their oral health history has not previously been studied.

Objective: This study aimed to compare oral health history of CAC children to matched children. Additionally, the oral health history of children exposed to sexual abuse was compared to children exposed to physical abuse.

Participants and setting: The CAC cohort included 100 children, 3–16 years. The matched cohort, with no known history of abuse, included 63 children.

Methods: The retrospective study analyzed registered data in the children's dental records.

Results: CAC children were more likely than matched children to have caries experience in both primary and permanent teeth, with incidence rate ratio (IRR) 1.50 (95 % CI 1.01–2.25) and 1.92 (1.11–3.30). “Was Not Brought” to dental appointments was more than twice as likely, IRR 2.25 (1.31–3.86), in the CAC cohort. There were no significant differences in reports to the Child Protection Services or dental traumas. Suspected victims of sexual abuse had more caries, IRR 4.28 (2.36–7.77), and fillings, IRR 4.83 (2.55–9.16), in permanent teeth compared to suspected victims of physical abuse.

Conclusions: CAC children were more likely to have caries experience and not show up for dental appointments than the matched children. Sexual abuse suspected had four times more caries experience than physical abuse suspected. This study supports the need for addressing oral health in risk evaluations concerning child abuse, and provides valuable information to dental professionals and prosecuting authorities.

1. Introduction

The World Health Organization (WHO) have defined child abuse as all forms of physical, emotional and sexual abuse ([World Health](https://www.who.int)

* Corresponding author.

E-mail addresses: julie.toft@odont.uio.no, julto@tkmidt.no (J. Toft), arne.k.myhre@ntnu.no (A.K. Myhre), yiqsu@tkmidt.no (Y.-Q. Sun), tiril.willumsen@odont.uio.no (T. Willumsen), anne.ronneberg@odont.uio.no (A. Rønneberg).

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Organization et al., 1999). In Norway, a national survey including adolescents aged 12–16 years found that 6 % had experienced sexual abuse and 10 % had experienced repetitive physical abuse (Hafstad & Augusti, 2019). A majority of the adolescents who reported to have experienced one type of child abuse or neglect (CAN), had experienced other types as well. The same survey also found an association between the number of abusive experiences, and psychological and somatic health concerns in general. This is in accordance with the Adverse Childhood Experience (ACE) – study, which highlights the strong relationship between exposure to abuse and household dysfunction during childhood, and risk factors for several of the leading causes of early death in adults (Felitti et al., 1998). The consequences of child abuse and its adverse effects underline the need for prevention and early detection of children at risk (Petruccelli et al., 2019).

The UN Convention on the Rights of the Child enshrines children's right to be protected from all forms of abuse, neglect and violence (Convention on the Rights of the Child, 1989). In Norway, dental professionals are mandated by law to report suspicion of CAN to the Child Protection Services (CPS) (The Health Personnel Act, 1999, § 33). A great number of injuries and signs associated with CAN are found in the head and neck area (Cairns et al., 2005; da Fonseca et al., 1992; Valente et al., 2015), and several studies have found a relationship between CAN and poor oral health (Duda et al., 2017; Keene et al., 2015; Kvist et al., 2018). Only one in five Norwegian adolescents exposed to physical or sexual abuse, have been in contact with health and child protection professionals (Hafstad & Augusti, 2019). The Public Dental Health Service in Norway offers free comprehensive oral health care to all children aged 0–18 years, and most children are enrolled (Statistics Norway, n.d.). Consequently, dental professionals have a unique opportunity and responsibility to discover and follow up on early risk factors of CAN in collaboration with other authorities.

When children and adolescents are suspected victims or witnesses of physical or sexual abuse, and the case is reported to law enforcement, they often undergo forensic interviews by specially trained police investigators at one of Norway's 11 child advocacy centers (CAC). The CACs, also referred to as “Barnahus” in the Nordic countries, are multidisciplinary centers where victims of physical or sexual abuse are supported during investigation and court proceedings (National Children's Advocacy Center, 2021; PROMISE Barnahus network, 2021). When police investigators find clinical forensic documentation and general health evaluation relevant, the children and adolescents are offered a medical examination by a child abuse pediatrician (Norwegian National Police Directorate et al., 2016). Since 2011, several CACs have additionally offered clinical dental forensic examinations, which are performed by specially trained dentists when either police investigators or child abuse pediatricians suspect head and neck injuries or oral findings relevant for the criminal case. Both information from the dental forensic examination and information previously registered in the public dental record is reported. To our knowledge, literature regarding the oral health history of children undergoing dental forensic examination is lacking. Both dentists and the prosecuting authorities at the CACs in Norway have expressed the need for more knowledge (Rønneberg et al., 2019). We therefore believe it is of importance to provide more information about the oral health history of children at the CACs in Norway.

The aim of this study was to increase knowledge regarding the history of oral health and injuries among suspected child victims of physical and sexual abuse.

The hypothesis was that children who underwent dental forensic examinations at a CAC in Norway, had experienced more oral health problems compared to a matched cohort of children with no known history of physical or sexual abuse. Additionally, we hypothesized that children exposed to sexual abuse had worse oral health compared to children exposed to physical abuse, based on literature on adults with a history of sexual abuse.

2. Methods

This study compared the history of oral health and injuries in a cohort of children investigated as victims of physical and sexual abuse at a CAC in Norway, with a matched cohort from the general population. The study was retrospective and we analyzed already registered data in the patient's dental records. We obtained the dental records for both cohorts from the public dental clinics in a chosen county where a CAC was situated. The specific county was chosen because it situates a CAC with well-established routines in referrals to dental forensic examinations.

2.1. Study population

The CAC cohort consisted of children who had undergone a dental forensic examination up to 10/01/2020. These children were identified from the public dental records by registrations from the CAC dentists. In cases with siblings, only the oldest was included. The reason for the criminal case investigation was described in the mandates from the prosecuting authorities, as well as from the children themselves. These descriptions had been stored in confidential folders in the children's public dental record system, only accessible for the CAC dentists. The prosecuting authorities defined the cases as either physical abuse, sexual abuse, or both, based on reported suspicion. These legal definitions were also used for further analysis in this study. All available patients were included, resulting in a CAC cohort of 100 children.

The matched cohort consisted of children acquired by contacting all the public dental clinics that the CAC children had attended before the criminal case investigations, 34 clinics in total. The public dental clinics were then asked to match patients based on sex, age and area of residence, and to obtain written consent from their caregivers to participate in the study. As a criterion of exclusion, children in the matched cohort could not have any previous documented contact with the CAC. For each child from the CAC cohort, we aimed to recruit one child to the matched cohort. However, only 63 children were included in the matched cohort due to missing response from seven clinics, lack of patients fulfilling the matching criteria in specific areas of residence or caregivers not willing to consent to participation.

The data collected from the dental records included all visits undergone at public dental clinics, by children from both the CAC and matched cohorts. Dental visits usually start at three years of age. Some children had their first visit at an older age, mostly due to families relocating from other counties or countries with different record systems. Results from the dental forensic examinations in the CAC cohort were excluded, since the dental forensic examinations are performed by specially trained dentists with a particular focus on findings related to maltreatment. We only looked at findings from the routine visits at the Public Dental Clinics, thus making the comparison between the cohorts as similar as possible. If dental records from after the child had undergone dental forensic examinations existed, these were not included, as interventions from the police or CPS might have affected the dental status.

2.2. Measures

Our baseline variables were sex (defined as boy or girl), years of follow-up in the Public Dental Health Service, and if there was documented use of an interpreter. We presumed that children with the same years of follow-up, would have received the same dental monitoring. The interpreter variable was included since ethnicity can play a role in the dental status (Wigen & Wang, 2010), and the public dental records had no other information on ethnicity.

Reasons for criminal case investigation were classified as either suspicion of physical abuse, sexual abuse, a combination of physical and sexual abuse, or unknown. This was only documented in the CAC cohort.

Oral health variables were registered cumulative until the time of the CAC visit, like wise in the matched cohort. To explore the total burden of the children's oral history, both caries and possible treatments of the carious lesion with fillings or extractions were documented. The outcome variables are listed and described in Table 1.

2.3. Ethical considerations

The children in the CAC cohort are suspected victims of physical or sexual abuse. Often, the suspected perpetrator is one of the children's caregivers or close family and some of the children are removed from their families during the CAC assessment. Due to these circumstances, the Regional Ethics Committee (REC), case number 93690-2020, gave permission not to approach for informed consent to participate in the study. Regarding the matched cohort, informed consent from the caregivers was received. We kept the location of the CAC confidential, and did not name the county. All data collected was anonymized, and information about residency was deleted right after the matching. The Public Dental Health Service of the selected county permitted the collection of data. Since all information necessary was extracted from the dental records, police files did not have to be included.

2.4. Statistical analysis

Descriptive statistics were calculated for the total sample and stratified by CAC and matched groups for the following baseline variables: age, sex and interpreter. The relationship between CAC and the categorical dependent variables were analyzed using Fisher's Exact Test. A two-sided $p < 0.05$ was considered statistically significant. The relationship between CAC and the count dependent variables were evaluated using negative binomial regression. Negative binomial regression was used due to the lack of normal distribution and high number of zeroes in our dependent count variables (Hofstetter et al., 2016; McElduff et al., 2010). Crude and adjusted incidence rate ratio (IRR) with 95 % confidence intervals (CI) were estimated. The multivariable regression analysis was performed to control for the three potential confounding factors of age, sex and the use of an interpreter. All statistical analyses were

Table 1
Outcome variables.

<i>Caries and dental treatment (count variables)</i>	
Primary and permanent dentition	
Caries	Decayed surfaces extending into dentin
Fillings	Fillings registered each time a new filling was placed
Extractions	Only extractions due to caries included
<i>Variables related to dental visits (categorical and count variables)</i>	
Referral to a specialist in pediatric dentistry ^a	Registered if a referral was sent
Interrupted appointment(s) ^a	Behavior management problems or dental fear and anxiety leading to an interrupted appointment
Suspicion of CAN ^a	Reports sent to the CPS from the public dental clinic, suspecting CAN
Attendance ^b (Powell & Appleton, 2012)	
Was Not Brought	Missed appointment without notice or rescheduling
Did Not Attend	Missed appointment with notice and rescheduling
Dental trauma ^b	
Documented trauma	Documented right after the accident
Suspected trauma	Explained by patients or caregivers when found during routine examinations
General anesthesia ^b	Treatments carried out under general anesthesia
Sedation ^b	Treatments assisted by benzodiazepines or nitrous oxides

CPS - Child Protection Service, CAN - child abuse and neglect.

^a Categorical variable.

^b Count variable.

conducted using Statistical Package for the Social Sciences (SPSS) version 27.

3. Results

Baseline characteristics of the included children are listed in Table 2. Age ranged from 3 to 16 years and the mean age, mean years of follow-up and sex distribution did not significantly differ between the two cohorts. There were statistically more children in need of interpreters during one or more of their dental appointments in the CAC cohort (10 %), compared to none in the matched cohort (0 %), ($p = 0.007$).

In the CAC cohort, 23 (23 %) were suspected victims of sexual abuse, 59 (59 %) were suspected victims of physical abuse and 5 (5 %) were suspected victims of both. Thirteen percent lacked information on the cause of investigation in their dental records.

The associations between the CAC children and caries, fillings and extractions before investigations of physical or sexual abuse are presented in Table 3. Compared with the matched cohort, the CAC children were more likely to have caries in both primary and permanent teeth, with IRR 1.50 (95 % CI 1.01–2.25) and 1.92 (1.11–3.30) respectively, when adjusted for potential confounding factors. It seems that the CAC children had more extractions in primary dentition and more fillings in permanent teeth. The differences, however, are not statistically significant. Results for the remaining outcome variables related to dental visits are presented in Table 4. The CAC children were more than twice as likely, IRR 2.25 (1.31–3.86), to have registered “Was Not Brought” to dental appointments at their public dental clinic. The other variables including dental traumas or reports to the CPS suspecting CAN did not significantly differ between the two groups.

Within the CAC cohort, the children who were suspected victims of sexual abuse alone or in combination with physical abuse (28 %) was compared with the children who were solely suspected victims of physical abuse (59 %), as reference group. Crude analysis of oral health variables found significantly different is presented in Table 5. The suspected victims of sexual abuse presented an increased risk of having caries and fillings in the permanent dentition four times as high as the children where physical abuse was suspected. Analyses with adjusted models were not possible to perform in the CAC cohort alone due to a small sample size.

4. Discussion

This study demonstrated that children who underwent dental forensic examinations at a child advocacy center (CAC) in Norway had experienced more caries in their primary and permanent teeth, compared to a matched cohort from the general population. These children were also more likely to have registered “Was Not Brought” to dental appointments at their local clinic. We found no difference in dental traumas or reports to the Child Protection Services (CPS) suspecting CAN between the two groups. In addition, there was a four times increased risk of caries and fillings in the permanent teeth of children who were later suspected victims of sexual abuse, when compared with suspected victims of physical abuse.

The results from this study are in accordance with studies who have explored oral health in children exposed to CAN (Duda et al., 2017; Keene et al., 2015; Kvist et al., 2018). Caries, both in primary and permanent dentition, is shown to be more prevalent among maltreated children. This current study focused on the oral health of children where physical abuse and sexual abuse were suspected, whereas most studies have included neglect or applied a less specific definition. Our results show that fillings in the primary teeth were not significantly different between the two cohorts, even with a higher rate of caries in the CAC cohort. Possible explanations could be a higher number of missed appointments without notice (Was Not Brought), or that the primary teeth had deeper carious lesions in the CAC cohort, leading to extractions rather than fillings.

To our knowledge, the difference in caries seen in children exposed to sexual abuse compared to physical abuse has not previously been studied. One study looked at children with a history of maltreatment, and found no significant difference in early childhood caries between the groups “physical/sexual abuse” and “neglect” (Valencia-Rojas et al., 2008). Our results indicate a four times increased risk of caries experience and fillings in the permanent dentition for children investigated as victims of sexual abuse, compared to physical abuse. Although caution is necessary when drawing conclusions from the CAC cohort alone due to a low sample size and wider confidence intervals, the observation is interesting. Among adults, survivors of sexual abuse in childhood have described serious oral

Table 2
Baseline characteristics of children overall and by CAC and matched cohorts.

	Total sample ($n = 163$)	CAC cohort ($n = 100$)	Matched cohort ($n = 63$)	p value ^b
Age	9.3 ± 3.6	9.4 ± 3.6	9.0 ± 3.5	0.45
Follow-up years	5.8 ± 3.4	5.7 ± 3.5	6.0 ± 3.4	0.62
Sex				0.68
Female	95 (58 %)	57 (57 %)	38 (60 %)	
Male	68 (42 %)	43 (43 %)	25 (40 %)	
Interpreter				0.007 ^a
Yes	10 (6 %)	10 (10 %)	0 (0 %)	
No	153 (94 %)	90 (90 %)	63 (100 %)	

CAC - child advocacy center.

Data are given as number of subjects (column percentage) or mean ± SD.

^a $p < 0.05$.

^b p values reported using student t -test for age and follow-up, Pearson chi-squared test for sex and Fisher's exact test for interpreter.

Table 3
The associations between the CAC cohort and variables related to caries.

	CAC cohort (range)	Matched cohort (range)	Crude model		Adjusted model ^b	
			IRR (95 % CI)	p value	IRR (95 % CI)	p value
Primary dentition	n = 95	n = 63				
Caries	0–39	0–16	1.97 (1.35–2.90)	<0.001 ^a	1.50 (1.01–2.25)	0.05 ^a
Fillings	0–14	0–10	1.02 (0.65–1.61)	0.92	0.78 (0.48–1.28)	0.33
Extractions	0–6	0–8	1.99 (1.06–3.75)	0.03 ^a	1.96 (0.96–3.99)	0.06
Permanent dentition	n = 79	n = 46				
Caries	0–78	0–7	2.98 (1.82–4.87)	<0.001 ^a	1.92 (1.11–3.30)	0.02 ^a
Fillings	0–54	0–7	2.42 (1.43–4.09)	0.001 ^a	1.67 (0.92–2.99)	0.09
Extractions ^c	0–2	0	–	–	–	–

CAC - child advocacy center, IRR - Incident Rate Ratio, CI - Confidence Interval.

^a p < 0.05.

^b Adjusted for age, sex and use of interpreter.

^c No valid results due to fewer cases of outcome.

Table 4
The associations between CAC and variables related to dental visits.

	CAC cohort ^b n = 100	Matched cohort ^b n = 63	Crude model		Adjusted model ^d	
			IRR (95 % CI)	p value	IRR (95%CI)	p value
Referral to a specialist in pediatric dentistry	3 (3 %)	0 (0 %)	–	0.28 ^c	–	–
Interrupted appointments	16 (16 %)	4 (6.3 %)	–	0.09 ^c	–	–
Suspicion of CAN	3 (3 %)	0 (0 %)	–	0.28 ^c	–	–
Attendance						
Was Not Brought	0–9	0–7	2.59 (1.55–4.32)	<0.001 ^a	2.25 (1.31–3.86)	0.003 ^a
Did Not Attend	0–9	0–7	0.79 (0.52–1.20)	0.27	0.75 (0.49–1.15)	0.19
Trauma						
Documented trauma	0–7	0–7	0.79 (0.47–1.33)	0.37	0.79 (0.46–1.35)	0.39
Suspected trauma	0–6	0–4	1.54 (0.67–3.56)	0.31	1.50 (0.64–3.53)	0.35
General anesthesia	0–2	0–1	3.15 (0.36–27.60)	0.30	2.84 (0.30–26.55)	0.36
Sedation	0–4	0–7	0.58 (0.25–1.36)	0.21	0.46 (0.18–1.16)	0.10

CAC - child advocacy center, CAN - child abuse and neglect, IRR - incident rate ratio, CI - confidence interval.

^a p < 0.05.

^b Data are given as number of subjects (column percentage) or range.

^c Only the p value was calculated with Fisher's Exact Test.

^d Adjusted for age, sex and use of interpreter.

Table 5
The relationship of sexual abuse and the outcome variables found significantly different, compared to physical abuse.

	Physical abuse (range) n = 46	Sexual abuse (range) n = 22	IRR (95 % CI)	p value
Permanent dentition				
Caries	0–19	0–78	4.28 (2.36–7.77)	<0.001 ^a
Fillings	0–14	0–54	4.83 (2.55–9.16)	0.003 ^a

IRR - incident rate ratio, CI - confidence interval.

^a p < 0.05.

health symptoms and traumatic reactions triggered both by dental self-care and dental treatment (Søftestad et al., 2020). These adults described reactions triggered by objects or fluids filling the mouth, complicating oral hygiene, which might be a possible explanation for the decreased oral health in the suspected victims of sexual abuse in our CAC cohort.

A somewhat surprising finding was the lack of significant difference between the two cohorts regarding dental practitioners suspicion of CAN reported to the CPS. This differs from a study that looked at the oral health of children investigated by the CPS in Sweden, which found a higher probability of dental professionals reporting suspicion of CAN in the CPS children (Kvist et al., 2018). One of the major differences between the Swedish study and our study is that a majority of the children in the Swedish study were under investigation due to suspicion of neglect, whereas this study only included children who were suspected victims of physical or sexual abuse. When dental professionals report their concerns to the CPS, most of the cases are due to parental deficiencies and suspected neglect (Brattabø et al., 2018; Kvist et al., 2017).

The main reason for Norwegian dental professionals to report suspected CAN is severe caries and recurring missed appointments (Brattabø et al., 2018). Severe caries without explanations in the medical history or improvement after hygiene instructions by dental professionals is classified as dental neglect in the National guidelines for the Public Dental Health Service in Norway (Norwegian

Directorate of Health, 2022). The guidelines also recommend that if a number of missed appointments have occurred, combined with other concerns regarding the child, a report to the CPS should be sent. With several “Was Not Brought”, caregivers fail to provide health care for their children. We found that the children in the CAC cohort had significantly more caries and “Was Not Brought” documented in their public dental records than the matched cohort, but this seemed not to affect the public dental practitioners reporting practice. A recent scoping review on child maltreatment and oral health (Bradbury-Jones et al., 2021) concluded that there are discrepancies between the knowledge of dental practitioners and their aptitude in identifying and reporting child protection concerns. This is supported by a former Norwegian study, where one of three dentists had chosen not to send a report to CPS despite suspicion of CAN (Rønneberg et al., 2019). Our findings emphasize the importance of encouraging dental professionals to report their concerns regarding CAN.

Dental trauma is considered an important finding in a dental forensic examination for suspicion of physical abuse (da Fonseca et al., 1992). Interestingly, our results showed no significant difference in the amount of documented or suspected traumas in the public dental records between the two cohorts. A study from Southern Brazil (Silva-Júnior et al., 2019) demonstrated a significant increase of dental trauma when maltreated children were compared to a control group. In our study, only traumas before physical or sexual abuse investigations at a CAC were included. This could be a possible explanation for our results. We also had to exclude documented findings of the oral mucosa from our study, as descriptions of either healthy, unhealthy or damaged oral mucosa were sparsely documented in the public dental records. Possible findings in the oral mucosa due to trauma could consequently have been missed. This demonstrates a potential for improvement in the standard examinations and documentation by dental professionals, as the oral mucosa is an important factor in the general oral health that can show signs of disease and injury.

When a case is investigated at a CAC in Norway, it is common practice that all siblings in a family are assessed. Since we chose to include only one child from each family in our CAC cohort, the oral health of large families did not affect our outcomes. The mean age, sex and reason for investigation at CAC in our study population corresponded with the yearly reports from the CACs in Norway (Norwegian National Police Directorate, 2020). By documenting caries as surfaces affected and not teeth affected, we could get more detailed data on the extent of the carious lesions. We chose not to use the Decayed Missing and Filled (DMF) index for dental health (Shulman & Cappelli, 2008), as we included children with different dental ages and wanted information from teeth and dental treatment from the children's first dental visit up until now. As children are mostly referred to dental forensic examinations based on the case type, and not on observations of the oral health, it is likely that the results from our study can be applied to CAC children in general.

Due to the high number of dental clinics involved in gathering consents, we depended on many dental professionals to find matching children. Although our CAC cohort size was comparable to similar research, a limitation to this study is that our matched cohort was smaller. This gave us a smaller sample size than desired, and our cohorts were not perfectly matched on sex, age and area of residence. We therefore controlled for sex and age, in addition to interpreter, as there could be differences in the subgroups of primary and permanent teeth. When assessing our analysis, the majority of the confidence intervals still show an acceptable power. For some outcome variables, however, we did not have sufficient power for which the calculated estimates are presented with wider confidence intervals. Although we controlled for sex and age in the adjusted analysis, area of residence or other measures that could indicate socio-economic status were not possible to control for with the available data. All the included dental records were filled out by different dental professionals. However, since there are expected to be equal variations in the two cohorts, it is not likely to introduce bias to our results.

In 2020, >5000 children underwent forensic interviews at the CACs in Norway and 432 children underwent dental forensic examinations (Norwegian National Police Directorate, 2020). It is important to emphasize that our CAC cohort includes children with suspicion of physical or sexual abuse, and we have no information regarding the outcomes of the police investigations.

This is the first study looking at the oral health history of children who undergo dental forensic examinations at CACs in Norway. The results will hopefully provide valuable information, identify risk factors and support dental professionals when reporting suspicion of physical or sexual abuse. It can provide a better foundation for inter-professional cooperation and contribute to provide early help for children at risk.

In conclusion, children from the child advocacy center (CAC) had experienced caries and “Was Not Brought” more often than the matched cohort. Children who were suspected victims of sexual abuse had experienced more caries and fillings in their permanent teeth when compared to suspected victims of physical abuse. It was not found any difference in dental reports to the Child Protection Services (CPS) among CAC and matched children. This shows that observing oral health risk factors and reporting suspicion of violence or sexual abuse should receive more focus in dentistry.

Declaration of competing interest

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