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Eight-year outcome of implementation of abusive head trauma prevention

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ABSTRACT

Low incidence rates and economic recession have hampered interpretation of educational prevention efforts to reduce abusive head trauma (AHT). Our objective was to determine whether the British Columbia experience implementing a province-wide prevention program reduced AHT hospitalization rates. A 3-dose primary, universal education program (the *Period of PURPLE Crying*) was implemented through maternal and public health units and assessed by retrospective-prospective surveillance. With parents of all newborn infants born between January 2009 and December 2016 (n = 354,477), nurses discussed crying and shaking while delivering a booklet and DVD during maternity admission (dose 1). Public health nurses reinforced Talking Points by telephone and/or home visits post-discharge (dose 2) and community education was instituted annually (dose 3). During admission, program delivery occurred for 90% of mothers. Fathers were present 74.4% of the time. By 2–4 months, 70.9% of mothers and 50.5% of fathers watched the DVD and/or read the booklet. AHT admissions decreased for < 12-month-olds from 10.6 (95% CI: 8.3–13.5) to 7.1 (95% CI: 4.8–10.5) or, for < 24-month-olds, from 6.7 (95% CI: 5.4–8.3) to 4.4 (95% CI: 3.1–6.2) cases per 100,000 person-years. Relative risk of admission was 0.67 (95% CI: 0.42–1.07, P = 0.090) and 0.65 (95% CI: 0.43-0.99, P = 0.048) respectively. We conclude that the intervention was associated with a 35% reduction in infant AHT admissions that was significant for < 24-month-olds. The results are encouraging that, despite a low initial incidence and economic recession, reductions in AHT may be achievable with a system-wide implementation of a comprehensive parental education prevention program.

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1. Introduction

Abusive head trauma (AHT) [or shaken baby syndrome (SBS)] is a devastating form of infant abuse (Barr, 2012; Christian, Block, & Neglect, 2009) with significant mortality and morbidity (Duhaime, Christian, Moss, & Seidl, 1996; Keenan et al., 2003; Keenan, Hooper, Wetherington, Nocera, & Runyan, 2007; King, MacKay, & Sirnick, 2003), medical costs (Miller et al., 2017; Peterson et al., 2014), the destruction of families and society's failure to protect its most vulnerable citizens. Evaluation studies of the effectiveness of prevention efforts are mixed, and interpretation of these studies is challenging. Because crying is a significant trigger (Barr, Trent, & Cross, 2006; Barr, 2012; Lee, Barr, Catherine, & Wicks, 2007; Talvik, Alexander, & Talvik, 2008), prevention has targeted parents with education about crying and shaking. Randomized controlled trials (RCTs) of maternal education have demonstrated improved crying knowledge (Barr, Barr et al., 2009; Barr, Rivara et al., 2009; Bechtel et al., 2011; Fujiwara, Yamada et al., 2012), sharing of learned information with other caregivers (Barr, Barr et al., 2009; Barr, Rivara et al., 2009; Fujiwara, Yamada et al., 2012) and changed crying response behaviors (Barr, Barr et al., 2009; Fujiwara, Yamada et al., 2012). In observational studies, education of new mothers changed behaviors by reducing calls to a nurse advice line (Zolotor et al., 2015) and visits to emergency rooms for crying complaints (Barr, Rajabali, Aragon, Colbourne, & Brant, 2015). Economic influences may have confounded studies of the effectiveness of prevention through educating parents about crying and shaking. Early studies reported 47% and 78% reductions in AHT admissions pre- to post-implementation (Altman et al., 2011; Dias et al., 2005), but later studies reported an increase (Dias, Rottmund, & Cappos, 2017) or no reduction of cases (Zolotor et al., 2015). The later implementations coincided with the economic recession (December 2007—June 2009) associated elsewhere with substantial increases in AHT admissions (Berger et al., 2011; Huang et al., 2011; Klevens, Luo, Xu, Peterson, & Latzman, 2016; Wood et al., 2016; Xiang et al., 2013) that persisted post-recession (Wood et al., 2016), potentially confounding interpretation of the results.

This paper describes the eight-year outcome of AHT admissions in British Columbia (BC) following implementation of a primary, universal prevention program, the *Period of PURPLE Crying* (www.dontshake.org/purplecrying: National Center on Shaken Baby Syndrome [NCSBS], Farmington, UT). The intervention included three "doses:" education of parents of all newborns during maternity admission or home births; post-partum reinforcement of Talking Points by public health nurses (PHNs); and an annual public education campaign. The intervention had two aims: (1) improving understanding of early increased crying by parents, and (2) reducing AHT incidence. Aim 1 was evaluated by measuring visits for crying complaints to the BC Children's Hospital (BCCH) emergency previously reported (Barr et al., 2015). Aim 2 is being evaluated by retrospective-prospective surveillance of AHT hospital admissions.

Implementation began in January 2008. At that time, AHT incidence in the USA and Britain clustered around 30 per 100,000 person-years for < 12-month-olds (Barlow & Minns, 2000; Ellingson, Leventhal, & Weiss, 2008; Fujiwara, Barr, Brant, Rajabali, & Pike, 2012; Keenan et al., 2003). Subsequently, Fujiwara, Barr et al. (2012) and others in Canada (Bennett et al., 2011)—consistent with reports in New Zealand (Kelly & Farrant, 2008) and Britain (Hobbs, Childs, Wynne, Livingston, & Seal, 2005)—reported incidences around 15 per 100,000 person-years. In BC, there were an estimated 10 admissions per 100,000 person-years using the same data and methodology (unpublished). With that incidence, assuming a 14-year baseline and a birthrate of 45,000/year in BC, power to detect a 50% reduction as previously reported by Dias et al. (2005) required 9 years and detecting a statistically significant 30% reduction was not possible. Consequently, achieving statistically significant reductions with highly variable but low annual incidences approached infeasibility. Nevertheless, because of mixed and potentially confounded reports on prevention effectiveness, we elected to report our experience after 8 years of follow-up.

2. Patients and methods

2.1. Intervention

The *Period of PURPLE Crying* program development began in 2002. The strategic approach and materials centered on parental interest in their infants' normal development, especially crying, and the dangers of shaking when frustrated with crying. It utilized 40 years of empirical evidence supporting a developmental interpretation of early increased crying (Barr, 2000, 2012; Brazelton, 1962; St.James-Roberts et al., 1991) and clinical and epidemiological evidence that crying was the most common stimulus for AHT (Barr et al., 2006; Brewster, Nelson, & Hymel, 1998; Kempe, 1971; Lee et al., 2007; Reijneveld, van der Wal, Brugman, Sing, & Verloove-Vanhorick, 2004; Talvik et al., 2008). AHT was conceptualized as a failure of normal, common, iterative infant-caregiver interactions, rather than only of abnormal behavior, at-risk caregivers or their interaction (Barr, 2012; Jenny, 2008).

Dose 1 included scripted interactions between a maternity nurse (or midwife) and mother with father present if possible, protocolized use of the 10-page educational booklet where the nurses reviewed the booklet as the stimulus for the discussion, viewing an educational film on a DVD when possible, emphasis on key program messages (Talking Points: see Fig. 1), and providing the materials to the parents to take home with them. In 2012, another film (*Crying, Soothing and Coping*) was added to the DVD emphasizing parental coping when soothing failed. Unique to the *PURPLE* program, parents received their own booklet and DVD (available in 10 languages) to share with fathers and other caregivers, and review later when crying increases (Barr, 2000; Brazelton, 1962). Two features emphasized non-maternal caregivers. First, because fathers are the most common perpetrators (Barr, 2012; Starling, Holden, & Jenny, 1995), nurses were encouraged to teach with fathers present. Second, Talking Point #4 emphasized sharing information with anyone caring for the infant (e.g. grandparents, sitters).

In Dose 2, to assure consistent and accurate messaging from multiple sources (Willinger, Ko, Hoffman, Kessler, & Corwin, 2000), the Talking Points were reinforced within 2 weeks during routine post-natal telephone contact or, occasionally, during home visits