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Where do children learn about pain? The role of caregiver responses to pre-schoolers' pain experience within natural settings

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Introduction

The preschool period is a critical stage of emotional and social development for young children (0-5 years), and socialisation methods are instrumental learning tools for the child's development during this stage [31]. Pain experiences are common during the preschool period, including minor medical procedures (e.g., immunisations) [67], **unintentional childhood injuries (e.g., (i.e., burns, shocks, poisoning)** [59], and 'everyday' incidents which lead to minor bumps, scrapes and cuts [16,43]. Consequently, the biopsychosocial model of pain, derived partly from social learning theory, is relevant to paediatric pain, as children's coping strategies may be inadequate [25], relying primarily on caregivers to interpret their distress [14,24,26]. Furthermore, childhood pain experiences are influenced both by who is present [16,20,43,48,63], and the responses exhibited by those present [2-5,35,51]. Social learning and imitation provide a valuable source of information, and children may learn how to respond to pain by observing others; e.g., watching their parents respond to pain [21,23]. However this developmental period presents a unique context for pain: children have less refined motor skills, the risk of everyday pains and injuries is high [see: 38,39,40], and the presence of caregivers provides opportunities to observe social influences during everyday painful moments. Given the frequency of minor pain events and their potential role in teaching children about pain management, the aims of this topical review are to (1) provide a critical reflection on the limited literature on "everyday" child pain experiences and the role of caregiver behaviour within natural contexts; and (2) set out a research agenda, calling for innovative, multi-method approaches to foster further research in this area.

Differences between clinical and “everyday” settings

One obstacle to researching everyday pains lies in demonstrating how they are distinct from *other* childhood pain experiences. Unintentional injuries often overlap with everyday pains: both are common within the family home, are spontaneous and difficult to anticipate, and often occur in proximity to caregivers. Parents respond similarly to both injuries and everyday pains in their toddlers, reporting few prevention strategies against common household accidents [12,18], and during everyday pain incidents, parents were observed to witness but rarely prevent incidents [43]. This is problematic as child factors during this developmental period (poor motor control, natural curiosity, temperament) are significant antecedents to injuries [41,60], while positive parenting moderates child injury risk [60]. These developmental factors are likely to also affect everyday pains [43]. The greatest distinction between injuries and everyday pains lies in the *threat* each poses to the child. Unintentional injuries are defined by the damage they cause [39], which in most cases, poses immediate danger to the child (e.g., poisoning). Conversely, everyday pains are fleeting, lasting mere seconds, and the lack of “*lasting tissue damage*” typically excludes them from injury research [39]. The most prevalent ‘everyday’ pains are bumps to the head or neck, which rarely leave physical wounds or require medical care [16], which also excludes everyday pain incidents from clinical research.

Unlike everyday pains, clinical settings do not represent a child’s typical environment: procedural pain occurs in unfamiliar environments, with unfamiliar medical staff present [55]. Even when parents are present, children respond differently to pain [27,34,42], and parental involvement is recommended as best practice during needle procedures [1,35,66] and other clinical procedures [4,53]. Parental protective behaviours (physical comfort, verbal reassurance) can amplify child distress [32], while coping-promoting behaviours (distraction, deep breathing) foster positive child pain outcomes [8,10,67] [For comprehensive reviews, see: 4,9,62]. However, it is important to acknowledge that clinical pain experiences differ from pain

experienced within natural settings: in the former, a level of pain is often expected (e.g., immunisations), which can be anticipated in advance, creating the potential for fear or anxiety to develop [36,56]. The preschool period of development is hallmarked by children bonding with their parents, and this attachment influences pain outcomes: children respond differently in familiar environments, feeling safe with parents present [15] but concealing distress when unfamiliar people are present [48]. Attachment influences procedural pain: secure attachment encourages greater child coping, self-efficacy, and positive parental behaviours [54,55], while children with insecure attachments display greater reactivity to both immunisations and minor pains, and poorer coping outcomes [29,54,65]. Equally, attachment may influence everyday pains: children with ambivalent or controlling attachments display more anger and take longer to calm following everyday pains than immunisations [65]. However, with little research on the role of attachment in everyday pains, we cannot further explore this at present.

Social influences in “everyday” pain contexts

Socioemotional regulation is developed through interactions with caregivers during the preschool period [15]. Acute, everyday incidents occur more frequently than other pains for young children, and represent key opportunities to regulate emotions and learn appropriate responding; as such, they may signify the “*foundations of all pain management behaviour*” [11]. Though the evidence of caregiver influences over clinical pain experiences is well-established, similar evidence to indicate caregiver influences during naturalistic pain events appears scarce. Of five identified studies, most utilised behavioural observations of children in day-care environments and recorded staff, child, and/or peer responses [16,19,63]; one study observed parent-child responses within a play activity centre [43]; while another explored parent-child responses to pain events within the family home [48] (see Table 1).

[INSERT TABLE 1 AROUND HERE]

Few age differences were identified: Children engaged in fewer help-seeking behaviours as they aged [16], child age was correlated with displays of anger in developmentally-delayed children [19], and parents picked up older toddlers most frequently [43]. Sex differences were observed in both children and caregivers: boys and girls were equally likely to experience pain events, but girls exhibited more visible distress than boys and received more physical comfort from caregivers [16], while boys expressed more anger following pain events than girls [63]. Girls played alone more often, and exhibited higher personal control prior to pain events than boys [48]. Boys exhibited fewer protective behaviours (i.e., holding/favouring the injured area) [43], with the exception of developmentally-delayed boys [19]. **None of the studies specified the sex of the attending caregiver, creating a gap in our understanding of how male caregivers respond to child pain compared to female caregivers.**

Caregiver responses depended on their relationship to the child: day-care staff dealt with everyday pain incidents in a neutral manner [16], while parents were less neutral and often responded to their child's pain with protective behaviours (physical comfort; verbal reassurance) rather than coping-promoting behaviours (distraction; offering toys) [43,48]. To an extent, children influenced the attention they received from caregivers: stronger facial cues and visible distress attracted caregiver intervention more often [63], while children gave lower pain ratings when asked by an unfamiliar researcher instead of their parents, to discourage intervention [48]. Individual child characteristics, such as temperament, predicted the emotional and behavioural responses they received from caregivers [43].

While each study measured child and caregiver responses these were reported individually, reducing the ability to demonstrate bidirectional or reciprocal influences between them. During the preschool period, social learning is key to how children acquire and shape skills, and in particular, parents can model appropriate behaviours for their child [23]. Parental responses to their child's pain may be particularly important at this stage, when their influence on their child is strongest [43,48]. There is extensive evidence demonstrating that child responses during minor clinical procedures are modifiable by the reactions of their parent; yet similar, consistent, and strong evidence on social learning within the context of everyday pain experiences is lacking. As these constitute the most common types of pain for young children, it is prudent to explore everyday pain experiences and expand our understanding of how and where children learn to cope with pain.

An agenda for future research

Questions to be answered

While advances are being made in our understanding of paediatric pain, much remains unclear. **Where do children learn to manage pain? Parent socialisation methods model appropriate child behaviours, and there is ample evidence from clinical research that parents can influence their child's response to pain. However, this evidence is still limited within 'everyday' environments such as home or day-care, as only two studies to-date observed parental behaviours in everyday environments (rather than day-care staff). 'Everyday' pain events occur frequently, with familiar people in familiar environments, making them almost totally opposite to clinical pain experiences. Given the extant differences between these settings, pain experiences in both settings are likely quite distinct, and we must consider that we do not currently have the "full picture" of where and how children conceptualise pain.**

Reminiscing about events enhances socioemotional and cognitive development, by imparting empathy and improving memory and language [57], and parents are key in modulating how children reflect on past pain experiences and setting the framework for coping with future pain [17,44,46]. For instance, following minor surgeries, parents effectively shaped their child's memory of pain, using emotion-centric prompts to positively influence recall, or pain-centric prompts to negatively influence recall [45,47]. Furthermore, parents utilised different elaboration strategies when prompting their child about *painful* versus *sad* events, socialising their children to regard pain as distinct from other forms of distress [50]. Naturally, parents may also be able to guide their child to reminisce differently about everyday pains. However, comparisons of child responses in different pain situations (e.g., clinics versus home or day-care) have not been conducted. Future research directly comparing parent-child responses during both acute clinical and everyday pains is needed to determine whether responses differ in each context.

Furthermore, research on parent-child influences in everyday settings could explore interactions based on parental sex and cultural values. Experimental literature has demonstrated that mothers and fathers respond differently to their child's pain [22,58], and as social interactions differ between sexes, pain experiences are likely also sex-dependent [37]. **However, none of the presented studies specified the sex of the attending caregiver**, while more widely, the majority of pain studies featuring parent-child pairs obtain data from only the child's mother, and paediatric research in all settings has reported significant challenges in recruiting fathers into study samples [33,52]. As everyday pain events are frequent experiences, and one or both parents are present for at least some events, it is prudent to explore potential sex differences during everyday pain responses and how children interpret differing parental responses concurrently; thus, future studies should continue attempting to recruit fathers.

To an extent, the lack of paternal involvement may result from *cultural values*, which govern how parents interact with their children. Only one study to-date examined cultural values in caregiver responses to child pain [30]. In both “individualistic” (Canada; Iceland) and “collectivistic” cultures (Thailand), almost 80% of caregiving duties fell to female family members (mothers, grandmothers, etc). Cultural norms dictated the involvement of male caregivers: in the Thai sample, fathers and grandfathers assumed 25% of caregiving duties, compared to just 14% of the Canadian (and 19% of the Icelandic) samples [30]. This also highlights a considerable limitation of the studies on everyday pains: all were conducted in Western cultures. Future studies might consider exploring everyday pains in families from other cultural contexts.

Finally, parental traits such as catastrophizing may influence their behaviour towards their child’s pain, thereby influencing the child’s own response to pain [6,7]. To-date, the impact of parental traits on their responses to everyday pains remains largely unknown. Further research is needed to understand whether some parental traits may be more (or less) likely to produce adaptive pain coping skills in children across different environments, and whether educational interventions for parents could be beneficial.

Methodological improvements

Before we can determine how everyday pains contribute to children’s knowledge of pain, we must address methodological challenges to effectively capture children’s daily pain experiences. The still-developing cognitive abilities of young children require adaptations: an inability to use numerical reasoning or interpret pain may render rating scales or diagnostic interviews unsuitable [61]. Measures must be matched to the child’s understanding; e.g., asking binary questions such as “Do you feel sore?” [13], or telling stories with pictures of pain [64].

It is notable that only one of the presented studies asked the child to report their own pain [48], and all of the studies utilised the same few measures for observation: the *Dalhousie Everyday Pain Scale* [DEPS; 16] and the *Faces Pain Scale-Revised* [FPS-R; 28]. As the assessment of parental responses to their child's pain often involves hypothetical situations, rather than actual experiences or behaviours [49], Noel and colleagues adapted the Dalhousie Everyday Pain Scale with an objective measure to capture genuine parent behaviours [43]. The continued refinement of suitable measures could stimulate research in this area, as would the introduction of methodologies from other paediatric fields. Given the overlap between childhood injuries and everyday pains, injury research methodologies may be suitable for exploring how parents and children manage everyday pains. For example, diaries allow parents to track unintentional injuries within the home over extended periods [39,40], and similar methods could prove viable when tracking everyday pains.

A significant limitation of the presented studies is that they primarily described caregiver *responses* to a child's everyday pains, but none highlighted caregiver *influences* over child responses (despite this being a well-established phenomenon within clinical settings, which might be applicable elsewhere). Audio-visual recording is commonly used in venepuncture procedures but could similarly enable the capture of parent-child reciprocal influences during everyday pain situations, in both an objective and real-time manner. Two everyday pain studies attempted to use audio-visual recording for this purpose, though not without difficulties: the first study recorded at a play activity centre; however, the footage was deemed too poor quality for coding purposes, and data was not reported [43]. The second study recorded in family homes: the footage was of high-quality, and data was reported; however, parents considered the recording equipment somewhat "intrusive", which impacted natural behaviour [48]. Instead, parents suggested that portable video-cameras, or the recording of specific events or spaces (e.g., outside free play, play dates, or playground visits) could

preserve natural behaviour[48]. Audio-visual observations could also explore how child pain responses are shaped longitudinally throughout this developmental period, and explore how motor and cognitive improvements advance a child's understanding and interpretation of pain [43,58]. Equally, innovative, multi-method approaches (e.g., diaries, electronic momentary assessment, and qualitative reflective interviews) could significantly advance our knowledge regarding children's everyday pain experiences.

Conclusion

During the preschool developmental period, parents are instrumental in modelling appropriate pain responding through social learning and modulating their child's response to pain. While the literature on parental influences during clinical pain experiences has greatly improved our understanding of social factors in paediatric pain, several avenues of research remain largely unexplored. Specifically, the small number of studies which explored everyday pains spanned a wide time-period, with almost two decades between the most recent studies. In this same time-period, our understanding of parental influences during clinical pain experiences has advanced significantly, but this evidence does not readily apply to everyday pain experiences. An increased focus should be placed on understanding where children learn about pain, and how caregivers respond to common pain incidents in their natural environment. Methodological improvements to facilitate such endeavours will complement existing clinical findings and enrich the field of paediatric pain management.

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Authors	Setting	Observation type	Measures used	N (Male; Female)	Age range (Months)	# total pain events	Outcomes
O'Sullivan et al., 2019	Family home	In-person coding Audio-video recording	DEPS FPS-R	13 6 M 7 F	37 - 68	14	Pain events occurred at a mean rate of 0.39 per child per hour Pain events were more common when researchers were not present, compared to when researchers were observing the child within the family home Child pain responses lasted significantly longer with researchers in the home Child distress was significantly more intense when researchers were in the home
	Day care	In-person coding		32 17 M 15 F	38 - 63	44	Pain events were more common in day-care than at home (mean rate of 2.93 events per hour) Children in day-care displayed less distress and lower personal control than those observed at home. ----- Caregiver behaviour was similar in home and day-care (physical and/or verbal comfort). Adults favoured physical comfort if child distress was sobbing or exhibited prolonged distress (>8 seconds) Limited sex effects: girls had higher personal control and were more likely to be playing alone prior to incidents than boys, who were more likely to get hurt playing with others No significant age differences on any observed variables
Noel et al., 2018	Indoor play centre	In-person coding <i>(Audio-video coding used but not reported)</i>	DEPS-R FPS-R TTS	52 28 M 24 F	12 - 32	101	Pain events were more common with parents present, compared to previous studies involving pre-schoolers and day-care staff (1.02 events per hour) Parents most often used verbal (reassurance) and non-verbal (hugging, kissing, etc.) behaviours to soothe their child Boys were less likely to exhibit protective behaviours (e.g., holding the injured area) than girls Older toddlers were more likely to be picked up and soothed by parents
Gilbert-McLeod et al., 2000	Day care	In-person coding	DEPS IBES	60 36 M 24 F	24 - 60	<i>Not stated</i>	Pain events occurred at a mean rate of 0.22 per hour for non-delayed children, and 0.25 for delayed children (<i>no difference</i>) Developmentally-delayed children were less likely to display reactions to pain, and less likely to engage in help-seeking or to display social responses than children without developmental delays

							Sex difference (only in developmentally-delayed group): boys more likely to use self-protective behaviours than girls Age difference (only in developmentally-delayed group): correlational relationship between age and use of anger following pain incident
von Baeyer et al., 1998	Day care	In-person coding	DEPS FPS	50 28 M 22 F	37 - 68	51	Pain events occurred at a mean rate of 0.41 per child per hour Children receiving attention from day-care staff exhibited more visible distress (based on facial coding). Physical comfort and first aid were offered most frequently by adult caregivers Significant sex difference only for expression of anger (more common in boys); sex differences did not affect the type of response to their pain, nor influence the cause/source of the pain incident; non-significant trend for girls to display more distress than boys No significant age differences on any observed variables
Fearon et al., 1996	Day care	In-person coding	DEPS	56 31 M 25 F	28 - 81	300	Pain events occurred approximately every 3 hours (0.33 per child per hour) Children experiencing more pain events showed longer-lasting and more intense distress Day-care staff did not respond to majority of incidents. If responding, behaviours included verbal and physical comfort Sex differences in both child and adult response: girls showed higher distress than boys; received more physical comforting from day-care staff. Girls were more vocal about distress than boys. Age difference in social response only: children were less likely to exhibit help-seeking behaviours as they got older (3yrs vs 4, 5, and 6yrs). No significant relationship between age and other observed variables.

Abbreviations: *N* = number in sample; *M* = Male; *F* = Female; *DEPS* = Dalhousie Everyday Pain Scale; *DEPS-R* = Revised Dalhousie Everyday Pain Scale; *FPS/FPS-R* = Faces Pain Scale/Faces Pain Scale-Revised; *IBES* = Illness Behaviour Encouragement Scale; *TTS* = Toddler Temperament Scale

Table 1 – Overview of the currently-published literature on “everyday” pain events (from 1996 to 2019)