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An evaluation of Neuroprotective Developmental Care (NDC/Possums Programs) in the First 12 Months of Life

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Abstract

Background Transitioning to motherhood is an important life event. Stress often arises due to feeding concerns, infant crying, and sleep problems. Neuroprotective Developmental Care (NDC) also known as the Possums programs provides an evidence-based, consistent and holistic approach to maternal and infant wellbeing.

Objectives To understand maternal characteristics at point of services access and an exploratory evaluation of effectiveness of NDC/Possums services.

Methods All mothers accessing NDC/Possums services via clinical services or self-paced online modules were invited to participate in a baseline survey. Follow up occurred when infants were 6 and 12 months of age. Participants who completed the 6-month survey were compared against their own baseline surveys. Those who completed the survey at 12-months were compared against their own baseline surveys. A pseudo-control group who had completed the baseline survey with infants 12 months of age was also compared to those who had accessed NDC/Possums services prior to 12 months of age (termed 'intervention' group).

Results Crying time, mothers' perceptions of infant sleep problems, mothers' own sleep, mothers' Acceptance and Action Questionnaire (AAQ) scores and the mothers' Edinburgh Postnatal Depression Scale (EPDS) scores showed statistically significant improvements from baseline to 12-month old follow-up. Significant differences were also found between the pseudo-control group and 'intervention' groups.

Conclusions for Practice This results indicate that accessing NDC/Possums services is efficacious in addressing infant's crying, the mother's perceptions of their baby's sleep problems, the mother's own sleep satisfaction, the mother's experiential avoidance, and the mother's risk of postnatal depression. NDC is relevant to public health, clinical service delivery and education for health professionals.

Keywords Maternal health · Breastfeeding · Infant sleep · Crying · Postnatal depression · Evaluation · Pre-post survey

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Significance

Advice for parents regarding infant health, maternal health, feeding, infant crying, and sleep problems in the early months of life is often conflicting and confusing. Neuroprotective Developmental Care (NDC), also known as the Possums programs, provides an evidence-based, consistent and holistic approach to maternal and infant wellbeing. This preliminary, exploratory evaluation indicates there may be a genuine intervention effect of long term engagement with NDC/Possums services. These services could support more consistent evidence-based guidance for new parents of newborn babies. The NDC/Possums approach to maternal and infant care might be considered in public health, clinical service delivery and education for health professionals.

Introduction

The transition into motherhood is a vital period for both maternal and infant wellbeing, therefore deserving clear, consistent and quality support from health professionals (Froehlich, 2015). Yet mothers often report that health professionals offer conflicting advice, contributing to confusion, and undermining confidence (Schmied et al., 2011; Sherman et al., 2009). For example, traditional sleep advice focusses on the infant's sleep, even though it is maternal sleep efficiency that is related to postnatal depression (Dorheim et al., 2009; Whittingham & Douglas, 2016).

Consistent and quality advice is important because transitioning to motherhood is a profound and sometimes stressful life event (Andersson & Hildingsson, 2015). New mothers often express concerns about feeding (Froehlich et al., 2015; Hauck et al., 2002), crying and fussing (Leerkes & Qu, 2020) and sleep difficulties (Parade et al., 2019). These challenges are common and interrelated (Douglas, 2013) with one in five new parents reporting problem crying (Wake et al., 2007) and 20–30% of families in high-income countries experiencing sleep difficulties. During pregnancy and the postpartum period, depression affects 16% of women (Woolhouse et al., 2015) and has been associated with increased maternal and neonatal morbidity (Austin, Highet & the Expert Working Group, 2017) and mortality due to suicide in the first year postpartum (Queensland Maternal & Perinatal Quality Council, 2017).

Through ongoing clinical experience and critical review of research, the challenges of cry-fuss problems, breastfeeding, sleep and maternal mood were addressed in the development of an innovative model, Neuroprotective Developmental Care (NDC) also known as the Possums program. NDC/Possums provides a uniquely holistic approach which acknowledges the interrelatedness of infant feeding, sleep, cry-fuss behaviours, and maternal mood during the perinatal period. NDC/Possums (Ball et al., 2018; Douglas et al., 2013; Whittingham & Douglas, 2016), takes an evidence-based complex-intervention perspective. It supports 'responsive' parenting to promote neurohormonal parent-infant synchrony, healthy psychological attachment, and incorporates psychological strategies from Acceptance and Commitment Therapy (ACT) throughout (Hayes et al., 2003; Whittingham & Douglas, 2016). The Gestalt breastfeeding approach (Douglas & Geddes, 2018; Douglas & Keogh, 2017), is also embedded in NDC/Possums. In practice, assessment, planning and intervention are integrated across the five domains of infant health, mother's health, sleep, sensory experiences, and feeding (Ball et al., 2018; Whittingham & Douglas, 2016), with clients accessing aspects of NDC/Possums relevant to them. NDC/Possums services are accessible to families via individual health professional consultations where clinicians provide education as part of their sessions, group sessions, and self-paced use of online content. Core elements of NDC/Possums services, regardless of delivery format, are outlined in Table 1.

Empowerment of caregivers underpins all NDC/Possums services, whether they are accessed in individual or group clinical services or via online content. Empowerment is achieved by supporting caregivers to understand their infants' communication based on evidence-based information and then make their own decisions about how to respond to infant cues based on that understanding in combination with their unique infant's needs, their own family context and their values. Table 2 provides an overview of how NDC/Possums services support families to understand and respond to infant communication.

This exploratory study aims to (1) investigate experiences and characteristics of mothers with infants accessing NDC/Possums services via face-to-face and online interventions through a private, not-for-profit clinic based in Brisbane Australia at point of access, and (2) to assess the effectiveness of NDC/Possums services at two time points, when the infants were 6 and 12 months of age.

Methods

Design

This exploratory evaluation used a prospective single group pre/post survey design to compare baseline data to outcomes when the infant was 6 and 12 months of age. Additionally,

Table 1 Core elements of NDC/Possums services

Family concern	Core elements of neuroprotective developmental care services	Described in references
All concerns	All NDC/Possums services: • Educate about infant communication or cues, and evidence-based ways of responding (see Table 2) • Invite caregivers to test and experiment with strategies • Encourage caregivers to find workable solutions for their own family (given social context, time demands, individual family members' unique needs, and family values) • Incorporate multiple evidence-based concepts across the five domains of sleep, feeding, sensory nourishment, infant health (e.g. gut, reflux, 'wind') and parent mental health	Whittingham and Douglas, (2016) Ball et al. (2018)
Crying and fussing	• Educate about normal infant crying behaviour and developmental changes across the first year of life into toddlerhood • Understand sympathetic nervous system and hypothalamaic-adrenal–pituitary axis arousal and hyperarousal using language of 'dialing up', 'dialing down,' and 'conditioned dialing up' • Educate about the two tools for dialing down/downregulation of the sympathetic nervous system: • feeds and • sensory nourishment (diverse experiences throughout the day) • When reflux, tongue-tie or allergy are of concern to caregivers: • inform parents about signs and symptoms • offer evidence-based medical advice, and • if these explanations are ruled out, information for caregivers that offers alternative explanations for infant crying/fussing • Maternal mental health focus with encouragement of care for self in conjunction with care for infant • Maternal mental health focus using Acceptance Commitment Therapy approach when thinking about challenges faced • Consideration of key strategies in five domains to understand infant communication and address underlying causes of crying/fussing (sleep, feeding, sensory nourishment, infant health and mother's health): 'NDC five-domain approach to infant crying'	Douglas and Hiscock (2010) Douglas et al. (2011) Douglas and Hill (2010) Douglas et al. (2012) Douglas and Hill (2013) Douglas et al. (2013)
Breastfeeding	Gestalt breastfeeding including: • Fit-and-hold based on gestalt biomechanical model (increased intra-oral volume of breast tissue enhances efficiency of feed and decreases pain) • Positional stability for infant considering mothers' and infants' alignment for fit-and-hold • Eliminating conflicting intra-oral vectors of force ('breast tissue drag') reduces maternal breast and nipple pain and enhances efficiency of feeds • Offering feeds flexibly and frequently throughout the day for a range of reasons including infant nutrition, responsiveness to infant/maternal-infant connection, and allowing infant to dial down at the breast • Mindfulness before and during feeds to support mothers' awareness of fit-and-hold, co-regulation during feeding, as well as to support maternal mental health • Maternal mental health focus with encouragement of care for self in conjunction with breastfeeding • Maternal mental health focus using Acceptance Commitment Therapy strategies when thinking about feeding challenges (e.g. values clarification, cognitive defusion, mindfulness, self-compassion) • Consideration of interactions between five domains to understand infant communication and underlying causes of feeding challenges (sleep, feeding, sensory nourishment, infant health and mother's health)	Douglas and Keogh (2017) Douglas and Geddes (2018)

Table 1 (continued)

Family concern	Core elements of neuroprotective developmental care services	Described in references
Bottle feeding	Gestalt approach to bottle feeding including: • Use of paced bottle-feeding • Positional stability for infant considering mothers' and infants' alignment for bottle feed • Offering feeds flexibly and frequently throughout the day for a range of reasons including infant nutrition, responsiveness to infant/maternal-infant connection, and allowing infant to dial down at the breast • Maternal mental health focus with encouragement of care for self in conjunction with feeding infant • Maternal mental health focus using Acceptance Commitment Therapy approach when thinking about feeding challenges (e.g. values clarification, cognitive defusion, mindfulness, self-compassion) • Consideration of interactions between five domains to understand infant communication and underlying causes of feeding challenges (sleep, feeding, sensory nourishment, infant health and mother's health	Douglas and Keogh (2017) Douglas and Geddes (2018)
Sleep	• Information regarding two biological sleep regulators: sleep pressure (sleep–wake homeostat) and the circadian clock • Information about strategies which enhance maternal sleep efficiency (e.g. strategies for optimising safety if family bed-shares;) avoiding disruptive strategies such as burping babies after a feed, putting babies to bed awake and not asleep,) • Maternal mental health focus with encouragement of care for self in conjunction with caring for infant through the days and nights • Maternal mental health focus using Acceptance Commitment Therapy approach when thinking about feeding challenges • Consideration of interactions between five domains to understand infant communication and underlying causes of feeding challenges (sleep, feeding, sensory nourishment, infant health and mother's health)	Whittingham and Douglas (2016) Ball et al. (2018) Douglas (2018)

a pseudo-control group (not-randomized) of participants who completed the baseline survey when their baby was within the 12-month age range (11–13 months) and had not received any NDC/Possums services via the clinic or online at that point was compared with participants completing the 12-month old follow-up survey. Data collection occurred between August 2015 and November 2018 with a pause due to an email system error between July 2017 and March 2018. Any data that were missed in follow-up during the data-collection pause was treated the same as other missing data as the pause applied equally to all participants. Ethical clearance was obtained from The University of Queensland Behavioural and Social Sciences Ethical Review Committee (2015000296).

Procedure

All mothers accessing group or individual NDC/Possums services at the clinic and/or online modules via the clinic website were offered participation. Services accessed are depicted in Table 3. All services provided content according to the core elements outlined in Table 1 and supported parents to understand, interpret and respond to infant cues in the ways outlined in Table 2. Participants were informed that they were free to withdraw at any time during the study and their withdrawal would not affect their experience of clinical services. All participating mothers indicated their consent before participation in the baseline survey.

Participants were mothers with infants. The study focused on the experiences and perceptions of mothers only. If they consented to participate, they were then asked to complete the baseline survey immediately. They were also invited by automatic email to complete surveys when their infant was 6 months (5 to 7 months) and 12 months (11 to 13 months) of age. For families where the infant was already 6 months of age or older at the time of the baseline assessment, the baseline survey was completed and the 6 month assessment did not occur. The surveys were completed online using the program Qualtrics.

Participant information was provided at the clinic and baseline surveys were completed onsite at the clinic for consenting participants. At 6 and 12 months, participants were emailed a link to the surveys and completed them online, at a convenient time and location for the participant.

Prompts for participants to complete the surveys occurred by email only. No financial incentive for participation in the study was offered. Figure 1 displays the high rate of attrition in this unfunded study and shows a breakdown of how the numbers for participant groups was obtained.

Table 2 Neuroprotective Developmental Care (NDC)/Possums approach to interpreting and responding to infant communication

Infant cue/communication	NDC interpretations of infant cues/communication ("possibilities for the family to consider")	NDC approach to responding to infant cues/communication
Crying and fussing		
Crying	Poor satiety	• Understanding links between crying and hunger (learning about infant communication) • Recommendations for identifying and managing underlying breastfeeding problems—Gestalt breastfeeding to optimise milk transfer and satiety • Principles of frequent and flexible offers of feeds
Crying and fussing	Dialing up/sympathetic nervous system arousal and hyperarousal	• Reassurance through information provided and the way it is presented • Understanding 'the dial' (sympathetic nervous system arousal) • Consideration of the 5 domains of sleep, feeding, sensory nourishment, infant health and maternal health and relevant strategies to support dialing down for infant and mother
Grizzling and crying	Hunger for richer environmental stimulation or 'sensory nourishment'	• Use of two tools of satiety to downregulate infant: 1. milk 2. satiety of sensory nourishment
Back-arching with feeds	Postural instability	• How to achieve healthy spinal support and fit-and-hold for feeding • Use of two tools of satiety to downregulate infant: 1. milk 2. satiety of sensory nourishment
Writhing, grunting, grizzling when lying in cot	Early dialing up wanting physical contact with adult body/sensory nourishment	• Reassurance through information provided and the way it is presented • Explanations that caregivers can wait and see if baby will settle but may need to pick baby up/offer sensory nourishment
Breastfeeding		
Falls asleep at the breast	Normal biological process (↑parasympathetic nervous system response, ↑oxytocin, ↑cholecystokin)	• Healthy function of the biological sleep regulators ("sleep pressure" and "circadian clock")
Burping	Not necessary as infant relieves him or herself of air in any position; disrupts the powerful biological cue of sleepiness at end of feeds	• Parents educated about air and the gut • Reassurance that it is not necessary to burp • Encouragement to cease burping
Back-arching during breastfeed	Sign of positional instability	• Ways to optimise fit and hold to optimise positional stability (gestalt breastfeeding program)
Marathon feeds or excessively frequent feeds	Sign of poor milk transfer	• Ways to optimise fit and hold to optimise milk transfer (gestalt breastfeeding program)
Bottle-feeding		
Back-arching and fussing	Positional instability	• Paced bottle-feeding
Back-arching and fussing	Does not want more milk	• Paced bottle-feeding—cease offering bottle for a time

Table 2 (continued)

Infant cue/communication	NDC interpretations of infant cues/communication ("possibilities for the family to consider")	NDC approach to responding to infant cues/communication
Cries and fusses with breast or bottle	Conditioned hyperarousal of sympathetic nervous system	• Gestalt breastfeeding • Paced bottle-feeding • Guidance to build healthy enjoyable feeding associations (e.g. offering feeds when baby is calm or sleepy, sensory nourishment during feeds), no coercion
Sleep		
Excessive night-waking in breastfed baby in first few months	Poor satiety	• Links between sleep and hunger (learning about infant needs and communication) • Recommendations to identifying and managing underlying breastfeeding problems –Gestalt breastfeeding to optimise milk transfer and satiety
Excessive night-waking in breastfed baby in first few months	Disruption of circadian clock	• Healthy function of biological sleep regulators 1. circadian clock 2. sleep pressure
Minimal day-time sleep	Poor satiety	• Links between sleep and hunger (learning about infant needs and communication) • Recommendations to identifying and managing underlying breastfeeding problems –Gestalt breastfeeding to optimise milk transfer and satiety
Minimal day-time sleep	Normal—low sleep need baby	• Information about normal sleep and sleep-needs for babies in first 12 months and beyond • Healthy function of biological sleep regulators 1. circadian clock 2. sleep pressure
'Resists' sleep	Sleep pressure not high enough yet	• Healthy function of biological sleep regulators 1. circadian clock 2. sleep pressure
Crying and fussing associated with attempts to self-settle	Conditioned hyperarousal of sympathetic nervous system ("conditioned dialing up")	• See crying and fussing section above

Table 3 Overview of Neuroprotective Developmental Care (NDC)/Possums services included in the study

Service	Means of access	Description
Individual support for feeding	On-site at the Possums Clinic	One-to-one support with an NDC Accredited Practitioner providing holistic care for feeding difficulties (Gestalt breastfeeding intervention)
Individual support for sleeping	On-site at the Possums Clinic	One-to-one support with an NDC Accredited Practitioner providing holistic care for sleep problems (Possums sleep intervention)
Individual support for cry-fuss problems	On-site at the Possums Clinic	One-to-one support with an NDC Accredited Practitioner providing holistic care for cry-fuss problems (Possums 5 domain approach to cry-fuss problems)
Other individual support	On-site at the Possums Clinic	One-to-one support with an NDC Accredited Practitioner for other challenges faced by parents
Individual support for mental health challenges	On-site at the Possums Clinic	One-to-one support with an NDC Accredited Practitioner for parent mental health
Shared medical appointments with clinic General Practitioner (GP) and other health professional	On-site at the Possums Clinic	After an initial one-to-one GP consultation, these shared medical appointments address issues related to feeding, sleeping, cry-fuss or other concerns for families of infants in a group setting, applying the NDC/Possums approaches
Face-to-face antenatal group for prevention of unsettled behaviour and breastfeeding problems	On-site at the Possums Clinic	'When Baby Comes Home' two hour sessions for expecting parents
Gestalt Breastfeeding Online Package	Online modules	An online program and workbook that aims to help mothers and their babies fit together for enjoyable, effective breastfeeding. It includes strategies for psychological resilience to deal with breastfeeding problems
Songs and sensory sessions	On-site at the Possums Clinic	Group sessions provided by a Paediatric Music Therapist
Possums Sleep Film	Online module	An online film and workbook that aims to teach mothers skills to improve the quality of infant and parental sleep (Possums sleep intervention)

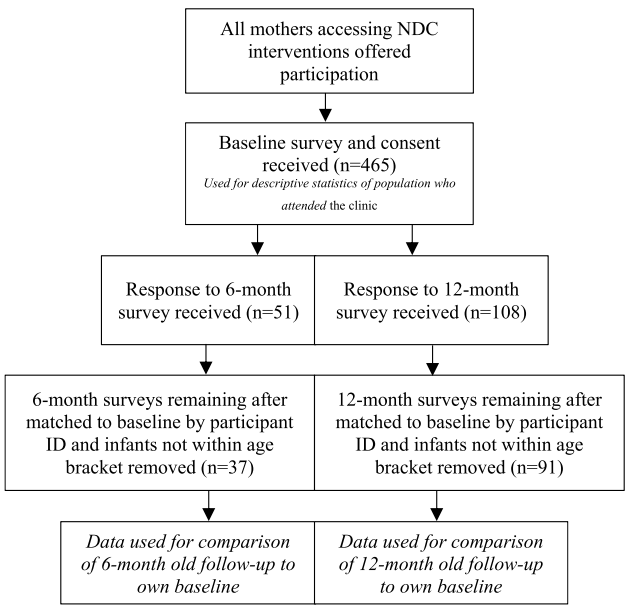

Fig. 1 Numbers of participants at each stage of the study

Measures

Outcome measures consisted of three standardised questionnaires and other questions to ascertain information regarding demographics, sleeping and feeding practices and mothers' perceptions of feeding. The same survey form was completed at baseline, 6-month and 12-months. Demographic details were sought at baseline only. The three standardised questionnaires included in the survey were: the Acceptance and Action Questionnaire-II (AAQ), a shortened version of the Crying Patterns Questionnaire (CPQ) and the Edinburgh Postnatal Depression Scale (EPDS).

The AAQ is the most frequently used measure of psychological inflexibility and experiential avoidance (Bond &Bunce, 2003; Hayes et al., 2004). Experiential avoidance is an unwillingness to engage with, by either accepting or working to alter, private experiences such as sensations, emotions, thoughts, memories, images or behavioural tendencies (Hayes et al., 2004). The AAQ measures various aspects of experiential avoidance, as conceptualized in acceptance and commitment therapy (ACT), including the need for emotional and cognitive control, avoidance of negative private events, inability to take needed action in the face of private events, and forms of cognitive entanglement.

Participants answered questions on a 7-point Likert scale and an overall result was calculated by summing all responses.

The use of the CPQ provides a measure of mothers' perceptions of their infant's crying throughout the course of the day (Alvarez & James-Roberts, 1996; St James-Roberts et al., 1993; Wolke et al., 1994). From this, a measure of the total crying time in minutes throughout the past 7 days was calculated. Additionally, each mother rated the extent to which her baby's sleeping was a problem and how satisfied she was with her own sleep.

The EPDS is a10-item self-rating scale developed by Cox et al. (1987), originally to detect postnatal depression (PND). It focuses on psychological symptoms of depression rather than somatic symptoms (i.e. poor sleep, weight gain/loss) which are common in the postpartum for women. The EPDS is one of the most widely used self-report instruments to assess depressive symptoms in postpartum women. It is scored by summing responses and reverse scoring certain questions (Cox et al., 1987). The cut-off point used to identify women at high-risk for postpartum depression varies across research and practice settings. A cut-off score of ≥ 13 (Cox et al., 1987; Venkatesh et al., 2017) was used for this study. Any participant with an EPDS score above the clinical cut-off were emailed information about support options. This information was conveyed by email because no other identifying information was obtained in the surveys. No other feedback or individual scores were available to participants.

The NDC/Possums Sleeping Practices Questionnaire was created for this study. Questions to ascertain sleeping practices that mothers used with their baby were scored as being either aligned with NDC/Possums or not. An overall sleeping practices score was calculated by reverse scoring practices which weren't aligned with NDC/Possums and summing all responses. The questionnaire consisted of six questions scored on a 7-point Likert scale from always to never. A high overall score meant that sleep practices were highly aligned with NDC/Possums approach sleep.

The full survey with all questionnaires took approximately 10 min to complete and required no professional assistance. Online survey data was collated through Qualtrics and downloaded for analysis in SPSS version 22.

Results

Sample characteristics of all participants who completed the baseline survey only, those who completed both a baseline survey and 6-month old follow-up and those who completed a baseline survey and 12-month old follow-up survey are presented in Table 4. Mothers accessing NDC/Possums were predominantly from middle to high income households according to Australian Bureau of Statistics classifications (Australian Bureau of Statistics, 2017a), with no mothers of low income participating at follow-up. Most participating mothers had a post-secondary qualification with 88% having university degrees or higher qualifications. Participants were predominantly first-time mothers (69.9%) and married or in a defacto relationship (98.3%). The EPDS identified 17.4% of those screened were at risk of PND at baseline. On average, the 6-month surveys were completed 3.67 months (SD = 1.39) after completion of the baseline survey and the 12-month surveys completed 8.22 months after baseline (SD = 2.36).

Table 5 shows a breakdown of the different services accessed at each point of data collection with most mothers not having accessed any intervention at baseline. At 6-month and 12-month follow-up, most mothers reported accessing services that aimed to address feeding and sleep concerns such as individual support for feeding, the Gestalt Breastfeeding Online Package, individual support for sleeping, the Possums Sleep Film, and shared medical appointments which delivered NDC/Possums programs. The Possums Sleep Film was the most accessed service (54% or n = 20 at 6 months; 57.1% or n = 52 at 12 months), followed by individual support for feeding problems (35.1% or n = 13 at 6 months; 31.9% or n = 29 at 12 months), and then the Gestalt Breastfeeding Online Package (27.0% or n = 10 at 6 months; 16.5% or n = 15 at 12 months).

A series of paired t-tests compared data at baseline to 6-months and baseline to 12-months. A Bonferroni adjusted alpha level of 0.025 (0.5/2) was used for all t-tests because two t-tests were carried out for each measure. No statistically significant improvements were seen on any variables apart from the EPDS ($p = 0.016$) at 6-months. From completion of the baseline survey to when the baby was 12-months old, a statistically significant improvement was seen in the baby's crying time ($p < 0.001$), mother's perception of their baby's sleep problems ($p < 0.001$), mother's own sleep satisfaction ($p = 0.02$), mother's AAQ score ($p = 0.016$) and mother's EPDS score ($p < 0.001$). A statistically significant improvement was seen in the mother's EPDS score from baseline to when the baby was 6-months old. No difference was found in alignment to NDC/Possums in terms of sleep practices. Table 6 reports the results of these t-tests in full.

At baseline, 14 participants had completed the baseline survey when their baby was within the 12-month age range and had not accessed any NDC/Possums services. While no control group existed in the study, this group acted as a *pseudo*-control group to the 89 mothers with babies of the same age who had accessed NDC/Possums services at the 12-month old follow-up. The unequal size of the groups was due to the natural formation of the groups, and so caution interpreting results is required. A series of independent groups t-tests was conducted. A statistically significant difference was seen in the baby's crying time ($p = 0.005$), mother's perception of her baby's sleep problems ($p < 0.001$),

Table 4 Characteristics and experiences of participating mothers

	Baseline survey group (n = 465)	6-month old follow-up group (n = 37)	12-month old follow-up group (n = 91)
Demographics	Mean	Mean	Mean
Child age (months)	4.99 (SD = 3.37)	6.21 (SD = 0.20)	12.14 (SD = 0.18)
Mother age (years)	33.89 (SD = 3.04)	34.32 (SD = 3.94)	34.51 (SD = 3.89)
No. previous children	% (n)	% (n)	% (n)
0	69.9 (325)	70.1 (26)	67.0 (61)
1	19.8 (92)	13.5 (5)	23.1 (21)
2	3.2 (15)	10.8 (4)	2.2 (2)
3	0.9 (4)	0.0 (0)	0.0 (0)
4	0.2 (1)	0.0 (0)	1.1 (1)
Not specified	6.0 (28)	5.4 (2)	6.6 (6)
Gestational age			
Full term	93.3 (434)	91.9 (34)	97.8 (89)
Preterm	6.0 (28)	8.1 (3)	2.2 (2)
Relationship status			
Married/defacto	98.3 (457)	97.3 (36)	98.9 (90)
Divorced/separated	0.4 (2)	0.0 (0)	0.0 (0)
Single	1.3 (6)	2.7 (1)	1.1 (1)
Education			
Postgraduate	43 (199)	51.4 (19)	49.5 (4)
University degree	45 (208)	43.2 (16)	44 (40)
College/TAFE/trade	7.8 (39)	5.4 (2)	3.3 (3)
Year 12 high school	3.7 (17)	0.0 (0)	2.2 (2)
< Year 12 high school	0.4 (2)	0.0 (0)	1.1 (1)
Household annual income			
$100,000 +	66.0 (307)	78.4 (29)	74.7 (68)
$75,000–100,000	20.6 (96)	13.5 (5)	15.4 (14)
$50,000–75,000	9.2 (43)	8.1 (3)	9.9 (9)
$25,000–50,000	2.4 (11)	0.0 (0)	0.0 (0)
< $25,000	1.3 (6)	0.0 (0)	0.0 (0)
Type of milk used			
Breastmilk	81.5 (379)	86.5 (32)	70.3 (64)
Formula	4.7 (22)	5.4 (2)	17.6 (16)
Combination of both	13.8 (64)	8.1 (3)	12.1 (11)
Feeding method			
Breastfeeding	78.3 (364)	89.2 (33)	64.8 (59)
Bottle feeding	6.2 (29)	8.1 (3)	15.4 (14)
Combination of both	14.4 (67)	2.7 (1)	13.2 (12)
Bottle feeding solo[a]	0.6 (3)	0.0 (0)	4.4 (4)
Other	0.4 (2)	0.0 (0)	2.2 (2)
Provision of solids			
Regularly	32.9 (153)	73.0 (27)	100.0 (91)
Sometimes	7.5 (35)	24.3 (9)	0.0 (0)
Not at all	59.6 (277)	2.7 (1)	0.0 (0)
Risk of PND[b]	17.4 (81)	11.1 (4)	5.7 (5)

[a] 'Bottle feeding solo' was defined as propping the baby up with the bottle so that the baby holds his/her own bottle

[b] Participants who scored ≥ 13 on the EPDS were considered at risk for PND

Table 5 Types of services accessed by mothers included in the study

	Baseline % (n)	6-month % (n)	12-month % (n)
Individual support for cry-fuss problems	1.1 (5)	10.8 (4)	5.5 (5)
Face to face antenatal group for prevention of unsettled behaviour	0.4 (2)	0 (0)	1.1 (1)
Individual support for feeding	7.5 (35)	35.1 (13)	31.9 (29)
Gestalt Breastfeeding Online Package	2.2 (10)	27.0 (10)	16.5 (15)
Individual support for sleeping	2.8 (13)	32.4 (12)	34.1 (31)
Possums sleep film	1.7 (8)	54.1 (20)	57.1 (52)
Individual support for mental health challenges	1.5 (7)	2.7 (1)	3.3 (3)
Other individual support	12.9 (60)	5.4 (2)	3.3 (3)
Shared medical appointments with Possums GP and other health professional	1.1 (5)	21.6 (8)	13.2 (12)
Song and sensory sessions	0.4 (2)	5.4 (2)	6.6 (6)
Other[a]	13.3 (62)	10.8 (4)	5.5 (5)
No intervention	71.4 (332)	2.7 (1)	2.2 (2)
Total services accessed	503	77	164

% was calculated by dividing the number who accessed by the total amount of participants who completed that round of the survey

[a]Other services accessed:

GP/medical check, 'Discontented Little Baby Book', Skype, Possums conference, Academic papers/literature, Web page and Facebook page, Lactation consultant, Lip tie, attended an NDC/Possums presentation for parents, vaccinations

Table 6 Paired samples t-tests

	Baseline and 6-month (n = 37)			Baseline and 12-month (n = 91)		
	p-value	baseline mean	6-month mean	p-value	baseline mean	12-month mean
Sleep practices alignment to NDC	0.498	33.19 (SD = 5.36)	34.03 (SD = 6.95)	0.292	33.25 (SD = 6.49)	32.56 (SD = 6.75)
Crying time (minutes in 7 days)	0.067	166.78 (SD = 130.77)	114.46 (SD = 135.58)	**< 0.001**	125.40 (SD = 137.71)	59.79 (SD = 70.08)
Perceived sleep problems	0.819	5.49 (SD = 1.79)	5.57 (SD = 1.70)	**< 0.001**	5.79 (SD = 2.00)	4.45 (SD = 1.69)
Own sleep satisfaction	0.780	5.66 (SD = 1.63)	5.54 (SD = 1.96)	**0.020**	5.64 (SD = 1.92)	6.22 (SD = 2.20)
AAQ score	0.258	16.31 (SD = 5.78)	15.49 (SD = 7.07)	**0.016**	15.40 (SD = 6.59)	13.83 (SD = 6.53)
EPDS score	**0.016**	7.31 (SD = 3.76)	5.69 (SD = 4.52)	**< 0.001**	6.92 (SD = 4.35)	4.69 (SD = 3.82)

Bold values indicate significant result

Table 7 Independent samples test

	Nil 'intervention' 12-month old babies (n = 14) and follow-up 'intervention' 12-month old babies (n = 89)		
	p-value	Nil intervention mean	Intervention mean
Sleep practices alignment to NDC	0.857	32.86 (SD = 6.40)	32.51 (SD = 6.81)
Crying time (minutes in 7 days)	**0.005**	120.69 (SD = 76.06)	59.26 (SD = 70.44)
Perceived sleep problems	**< 0.001**	6.83 (SD = 1.64)	4.49 (SD = 1.74)
Own sleep satisfaction	**0.005**	4.42 (SD = 1.73)	6.21 (SD = 2.24)
AAQ score	**0.025**	18.50 (SD = 8.50)	13.72 (SD = 6.57)
EPDS score	**0.017**	7.50 (SD = 3.68)	4.63 (SD = 3.84)

Bold values indicate significant result

mother's own sleep satisfaction (p = 0.005), mother's AAQ score (p = 0.025) and mother's EPDS score (p = 0.017) in 12-month old babies who had accessed NDC/Possums services compared to those who had not. Results are detailed below in Table 7.

Discussion

This research aimed to investigate the experiences and characteristics of mothers with infants who accessed a range of NDC/Possums services at point of access and the effectiveness of NDC/Possums services when the infants were 6 and 12 months old. Mothers primarily accessed services related to crying, feeding and sleeping with a minority attending the clinic for a medical General Practitioner appointment.

At baseline, most participants were highly educated, first-time mothers who were married or in defacto relationships, living in middle to high income households. NDC/Possums programs are evidence-based and deviate from mainstream approaches to breastfeeding, cry-fuss and sleep problems. These demographic characteristics might reflect a propensity for highly educated mothers to seek evidence-based services regardless of mainstream views. If this is the case, and future research continues to demonstrate effectiveness of NDC/Possums services, consideration should be made regarding relevance and accessibility of these services to mothers from varying educational backgrounds.

No mothers from low-income households participated at follow-up which may suggest barriers to service access for mothers from lower socio-economic backgrounds. Participant demographics of those who attended the clinic may reflect its geographic location, which was inner-city Brisbane. Despite bulk-billing for all infant appointments and for shared medical appointments, equity of access appears limited; family access may be influenced by other costs such as for mothers' appointments, uncertainty about what would be bulk-billed and what costs would not be covered, location of the clinic, transportation to attend the clinic, access to technology such as an appropriate device and internet for video access, health literacy considerations or previous negative experiences with healthcare/infant/family services. Further research regarding outcomes of NDC/Possums services along with accessibility and relevance of this type of services and associated interventions for more diverse populations is needed to understand the applicability and effectiveness of NDC/Possums services for a broader range of mothers.

The response rate was much higher at the 12-month old follow-up compared to the 6-month old follow up and this pattern was consistent across the duration of data collection. This may be reflective of changes in the infants' and mothers' lives across the first year which may result in mothers being more available to respond to online surveys. For example, mothers become more available for other tasks as infants develop (e.g. locomotion, introduction of solid foods) and become less reliant on as much hands-on involvement from their caregivers.

Mothers accessing the NDC/Possums services have longer duration of breastfeeding in comparison to the general population. The Australian Bureau of Statistics (2017b) National Health Survey data from 2014 to 2015 indicates that approximately 24.7% of babies in Australia are exclusively breastfed at 6-months of age and between 7 and 12 months of age 42.4% of infants are receiving some breastmilk. Of the mothers in this study, 89.2% were breastfeeding when their baby was 6-months of age. At 6-months, 70 percent of mothers were offering solids to their babies so exclusive breastfeeding rates at this age were not determined. At 12 months of age, 64.8 percent of babies were breastfeeding which is substantially higher than comparable community breastfeeding rates. The World Health Organization recommends exclusive breastfeeding for 6 months and continued breastfeeding up to 2 years of age or beyond (World Health Organisation, 2011). With 62.1% of participants reporting they had accessed a form of feeding intervention by 6-months, the high breastfeeding success in this sample may reflect the efficacy of the NDC/Possums services for feeding (Gestalt breastfeeding). However, it may also be reflective of a well-educated and high-income sample who self-selected to access additional support for feeding and other concerns. This may be a sample of mothers who were particularly committed to breastfeeding and had access to the kinds of resources, information and supports that support sustained breastfeeding (Dunn et al., 2015). A randomised controlled trial (RCT) of the Gestalt breastfeeding intervention is needed.

At 12-months, all variables had significantly improved from baseline with the exception of alignment of sleep practices to the NDC/Possums approach to sleep. This was likely due to a ceiling effect as sleep practices were already highly aligned with the NDC/Possums at baseline. This makes sense as the sample was self-selected, and mothers seeking support from NDC/Possums did so due to an alignment between NDC/Possums and their own approaches and values concerning infant care. While alignment with NDC/Possums practices did not change, changes were seen in all other outcome variables. Perhaps this is reflective of the program aims in supporting mothers to attune their knowledge, skills and strategies for managing issues that arise in the first 12 months of an infant's life, rather than introducing new or different skills and strategies to mothers. This warrants further investigation.

The percentage of mothers considered to be high risk of PND shows a significant reduction from baseline to both 6-month and 12-month old follow-up. When compared to

population statistics, the EPDS shows a similar percentage of those considered high risk at 6-month and 12-month old follow-up to those diagnosed with PND at the same time-points (4.9% and 4.8% respectively; Mccall-Hosenfeld et al., 2016). It should be noted that the EPDS is a screening tool and not a clinical diagnosis, thus it is difficult to directly compare EPDS scores to studies involving diagnosis. However, it may be expected that rates of mothers presenting as at risk of PND would be higher than the general population amongst a sample of mothers who are actively seeking support for difficulties associated with parenting an infant such as cry-fuss problems, feeding, sleep, and maternal mental health.

Improvements were observed at the follow-up when infants were 12 months old and mothers had engaged with services for an average of 8.22 months. These included significant differences in crying time; sleep problems; mothers' own sleep satisfaction; experiential avoidance or lack of willingness to engage with physical, affective or behavioural private events as measured by the AAQ; and risk of postnatal depression as measured by the EPDS. This, in conjunction with the findings from other research (Ball et al., 2018; Douglas et al., 2013), suggests that the NDC/Possums Programs are effective over time.

No significant differences were found for outcome measures other than the EPDS at 6 month follow-up. Possible explanations may include no actual effect, lack of sensitivity of measures, lack of power, or limited time for intervention to result in a measurable effect. Further research using a wider range of measures, greater numbers of participants, measuring at shorter and longer follow-up timepoints is needed.

Effectiveness after longer periods since first accessing the programs may be attributed to an infant maturational effect or participating mothers' increasing experience with mothering over time. Babies are prone to cry-fuss problems in the first months of life, but this is time-limited with significant reductions in crying by 10–12 weeks, compared to the levels of crying in the first weeks of life (Wolke et al., 2017). Similarly, sleeping patterns become more regulated and therefore more manageable over the first year (Galland et al., 2012; Henderson et al., 2011; Kahn et al., 2018). However, significant differences on outcome measures between the pseudo-control group and 'intervention' group are consistent with an intervention effect. This aspect of the study should be interpreted with caution due to the small and unequally distributed groups and lack of randomisation, however, it indicates the need for an RCT to establish if the NDC/Possums interventions are responsible for any changes observed over time. If efficacy is established in RCTs then the NDC/Possums approach might be considered in public health and mass communication interventions as well as antenatal and postnatal clinical service delivery models in community and hospital settings. Infant feeding, sleep, cry-fuss problems, maternal mental health and infant mental health are not only relevant to perinatal care specialists but should also be considered in a broad range of health practice areas. For example, knowledge of perinatal care is important for health professionals in paediatric or general emergency hospital settings and disability services. Considering the relevance of these findings to a broad range of service settings, these findings might also inform tertiary or continuing education for health professionals working across a range of paediatric settings and not only in perinatal care.

Limitations

Without a control group, definite conclusions about the efficacy of NDC/Possums cannot be drawn and these findings should be considered preliminary, suggesting a need for further research using a RCT design. Data was not collected regarding referral sources to the programs which may have provided insights regarding the mothers accessing NDC/Possums programs. There was a high rate of attrition. This caused the 6-month-old follow-up group to be relatively small. Technical and data collection issues applied equally to 6-month and 12-month follow up. Additionally, participant motivation, experiences of benefits (or lack thereof), and duration of engagement with services may have influenced attrition. While the findings are suggestive of positive outcomes at 12 months, these findings must be interpreted with caution given the high level of attrition and lack of a control group. Nonetheless, these preliminary findings warrant larger scale RCT evaluation of NDC/Possums interventions. The baseline survey did not ask about cultural or linguistic background or geographical area of residence. The impact of NDC/Possums services across economic and cultural groups should be evaluated. This data may have provided additional insights regarding program accessibility and effectiveness in relation to diversity.

Conclusion

Findings of this study are consistent with access to NDC/Possums services being efficacious for infants' crying, maternal perception of their baby's sleep problems, maternal sleep satisfaction, maternal experiential avoidance and maternal risk of postnatal depression. An RCT which includes a broader range of participants from more diverse backgrounds is needed to establish efficacy. These preliminary findings suggesting that NDC/Possums programs are effective are relevant to public health, clinical practice, and health professional education settings.

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