Infant sensory patterns: associations with previous perinatal loss, maternal-foetal attachment and postnatal maternal sensory patterns

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Abstract

Purpose – This paper aims to investigate infant sensory patterns and their associations with previous perinatal loss, maternal-foetal attachment and postnatal maternal sensory patterns.

Design/methodology/approach – In a prospective cohort study, women with and without perinatal loss (N = 57) were recruited from an Australian public hospital. Participants were surveyed during pregnancy (maternal-foetal attachment, loss) and again postnatally (maternal/infant sensory patterns). Chi-square tests and logistic regression analyses controlling for previous perinatal loss were conducted with infant sensory patterns as outcome variables.

Findings – "More than typical" infant low registration was associated with poorer quality of maternal-foetal attachment. "More than typical" infant sensory seeking was associated with previous perinatal loss and higher levels of maternal sensory seeking. "More than typical" infant sensory sensitivity was linked with previous perinatal loss, poorer quality of maternal-foetal attachment and higher maternal low registration. "More than typical" infant sensory avoidance was associated with poorer quality of maternal-foetal attachment and higher levels of maternal sensory sensitivity.

Practical implications – To support more typical infant sensory patterns, results point to the potential benefit of occupational therapists supporting pregnant women with previous perinatal loss; facilitating favourable maternal-foetal attachment; and educating new mothers on how their sensory patterns impact on interactions with their infant. Sensory modulation strategies that consider the sensory patterns of both mother and infant may be beneficial to promote engagement in co-occupations.

Originality/value – These findings are the first to suggest that previous perinatal loss, poorer quality of maternal-foetal attachment and higher levels of maternal postnatal sensory patterns represent risk factors for infant sensory patterns that are "more than typical."

Keywords Co-occupations, Infant development, Maternal-foetal attachment, Maternity care, Perinatal loss, Sensory patterns

Paper type Research paper

Background

Infants vary in how they receive, process and respond to sensory information, with atypical infant sensory patterns

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known to disrupt infant occupational performance. With growing recognition of the importance of parent–infant co-occupation, there is a need to understand the perinatal factors that contribute to the development of infant sensory patterns. This, in turn, may offer avenues to support infant occupational performance. This study investigates the associations between infant sensory patterns and several perinatal factors: previous perinatal loss, maternal-foetal attachment and postnatal maternal sensory patterns.

Infant sensory patterns

Infants experience external and internal sensory stimuli across a range of modalities during everyday activities. Based on Dunn's (1997) theoretical model of sensory processing, the most widely used model of sensory processing in occupational therapy, infants vary in the level of sensory stimuli required for neuronal activation (known as their sensory *neurological threshold*), and in the response they make to the stimuli they perceive (known as their *behavioural response*). Four sensory patterns have been described based on these two dimensions: *sensory seeking* (high threshold, active response), *low registration* (high threshold, passive response), *sensory avoidance* (low threshold, active response) and s*ensory sensitivity* (low threshold, passive response) (Dunn, 1997). Each infant demonstrates varying levels on all four of the sensory patterns, which may be categorised as typical or atypical based on normative data (Dunn, 2002). While infants with typical sensory patterns adaptively respond to sensory stimuli, infants with atypical sensory patterns have more difficulty regulating sensory information, presenting as maladaptive responses which disrupt daily life.

Atypical sensory patterns in infants have been associated with regulatory difficulties that may affect occupational performance, such as fussing/crying (McGeorge *et al.*, 2015). Understanding the factors that contribute to the development of atypical sensory patterns provides insights into possible areas of assessment and treatment approaches to foster more optimal infant outcomes. While sensory patterns are acknowledged to have biological and genetic origins (Eeles *et al.*, 2013a), there are other influences on infant sensory patterns that arise in the prenatal (May-Benson *et al.*, 2009) and postnatal (Atchison, 2007) period. Perinatal maternal factors which are proposed to influence infant sensory patterns but are understudied are: a mother's previous perinatal loss, maternal-foetal attachment and postnatal maternal sensory patterns, which are explored below. A greater understanding of the maternal factors before and after birth that influence infant sensory patterns affords avenues to improve occupational performance.

Previous perinatal loss

After perinatal loss, women may experience prolonged grief and self-blame, as well as changes in social participation and sleep (Gold *et al.*, 2016), suggesting an impairment of occupational performance. The negative emotional sequelae experienced initially after the perinatal loss can extend to the next pregnancy. Women may be anxious about losing the unborn infant, vigilant of lack of foetal movements and delay in preparing practically for the baby (Meredith *et al.*, 2017). When exploring longer-term outcomes, women may have altered perceptions of their subsequent child's developmental abilities (Turton *et al.*, 2009).

Maternal-foetal attachment

The relationship between mother and infant, recognised as a foundation for infant developmental outcomes and occupational development (Whitcomb, 2012), is proposed to influence infant sensory patterns. This relationship begins antenatally and accompanies a woman's psychological adjustment into her new maternal role (Hart and McMahon, 2006). *Maternal-foetal attachment* encompasses the thoughts, feelings and behaviours a mother displays towards an unborn baby (Condon, 1993). Maternal-foetal attachment is influenced by a range of maternal characteristics and contextual factors, such as social support (Yarcheski *et al.*, 2009). Poorer maternal-foetal attachment has been identified as a precursor to a range of less adaptive outcomes, such as less favourable postnatal maternal–infant interactions (Siddiqui and Hägglöf, 2000) and negative infant developmental outcomes (Branjerdporn *et al.*, 2017 for review).

Postnatal maternal sensory patterns

A mother's sensory patterns may be theoretically understood using the same model as described earlier for infant sensory patterns by Dunn (1997). A parent's sensory sensitivity has been revealed to be associated with their parenting style of older children (Branjerdporn *et al.*, 2019). In qualitative analyses, mothers' sensory patterns were reported to influence the occupations a parent exposes their child to (Turner *et al.*, 2012). Preliminary evidence also suggests that maternal sensory patterns are likely to influence an infant's developing sensory patterns in unadjusted correlational analyses (McGeorge *et al.*, 2015). Given that transactional models emphasise mutual influence of both caregiver and child characteristics (Sameroff, 2009), a mother's and infant's sensory patterns may theoretically affect each other.

Aims and hypotheses

The aim of the present study is to investigate associations between each of the four infant sensory patterns and previous perinatal loss, maternal-foetal attachment and postnatal maternal sensory patterns. It is hypothesised that, compared with infants with typical sensory patterns, those with atypical sensory patterns will be more likely to have mothers with previous perinatal loss and poorer maternal-foetal attachment. Based on the work by McGeorge and colleagues (2015), it is predicted that lower maternal sensory seeking will be associated with "more than typical" infant sensory seeking; reduced maternal sensory sensitivity will be associated with "more than typical" infant sensory sensitivity and sensory avoiding; and less maternal sensory avoiding will be associated with "more than typical" infant sensory avoidance.

Methodology

Ethics approval for the study was obtained from the both the Mater Mother's Hospital Human Research Ethics Committee (Project No. RG-14-105-AM02) and The University of Queensland Behavioural and Social Sciences Ethical Research Committee (Project No. 2013000992). A prospective cohort study across the perinatal period was conducted to assess pregnant women (Time 1) who later became mother–infant dyads after birth (Time 2).

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Participants

Participants were women who received maternity care from a publicly funded tertiary-level hospital and health service in Australia. Women eligible to participate in the study attended a specialised clinic for women with previous perinatal loss, or a routine antenatal clinic at the hospital and health service. Women not eligible to participate were those from other specialised clinics (e.g. those with gestational diabetes, Aboriginal and Torres Strait Islander women). Women (n = 1) were later excluded if they had a multiple birth.

Measures

Demographic information

A demographic questionnaire (standard antenatal care) and hospital records (perinatal loss clinic) were used to collect demographic information at Time 1. To represent participants' social-economic status, the Index of Relative Socio-economic Advantage and Disadvantage percentile rank within Australia (Australian Bureau of Statistics, 2011) was used.

Infant/Toddler Sensory Profile. The Infant/Toddler Sensory Profile (ITSP) (0–6 month version) is a caregiver-report tool that was used to measure infant sensory patterns at Time 2 (Dunn, 2002; Dunn and Daniels, 2002). The 36 items refer to the frequency with which mothers report observing infants' responses to stimulation from sensory modalities. Subscale totals are generally classified based on normative data from the USA ("less than typical," "typical performance" and "more than typical") (Dunn, 2002). An expert panel reported excellent content validity of the ITSP for infants in Australia (Eeles *et al.*, 2013b).

Maternal Antenatal Attachment Scale. The relationship between the pregnant woman and her unborn child was measured using the Maternal Antenatal Attachment Scale (MAAS) (Condon, 1993) at Time 1. The 19 items are aggregated into two subscales: *quality of attachment*, evaluating the nature of cognitions and feelings towards the unborn baby, and *time spent in attachment*, assessing the frequency of thoughts and behaviours towards the unborn baby. The MAAS has previously demonstrated adequate reliability and validity (van Bussel *et al.*, 2010).

Adolescent/Adult Sensory Profile. The Adolescent/Adult Sensory Profile (AASP) was used to examine postnatal maternal sensory patterns at Time 2 (Brown and Dunn, 2002). The 60 items are rated on a five-point scale, based on the frequency of response to sensory information across four sensory patterns. The AASP has been shown to have adequate internal consistency in Australian women in the prenatal period (Branjerdporn *et al.*, 2021).

Procedure

Pregnant women were recruited from two antenatal clinics (standard antenatal clinic and specialised pregnancy after perinatal loss clinic) at a public hospital and health service in metropolitan Australia. At Time 1, a research nurse obtained informed consent to participate in the study from women during an antenatal visit. Participants were assured that participation in the study was voluntary and would not affect clinical care. At Time 2, women were mailed postnatal questionnaires within the first three to six months postnatally, determined by administrative staff capacity and advised that surveys be completed in reference to the infant's first six months.

Anonymity was assured as data were deidentified with a unique identification code by the research nurse at the hospital. While 108 women completed the MAAS during pregnancy, only 57 (52.78%) completed questionnaires postnatally.

Statistical analysis

Data were analysed using Version 24 of Statistical Package for Social Sciences, with significance levels set at $p = 0.05$. Women with and without a history of perinatal loss were compared on study and demographic variables using independent sample t-tests and chi-square tests (Table 1). Descriptive statistics for all variables, and Cronbach's alpha values for subscales, were calculated. Data were checked for assumptions prior to conducting logistic regression analyses. Owing to low numbers in the "less than typical" category across all infant sensory patterns, this category was omitted. A range of logistic regression analyses were conducted with demographic variables to determine inclusion in the final models. Logistic regression models, controlling for significant demographic variables, were conducted between infant sensory patterns, when categorised as "typical performance" vs "more than typical," with the reference category as "typical performance." Perinatal loss, maternal-foetal attachment and postnatal sensory patterns variables were explanatory variables considered in the logistic regression models. To check the accuracy of the results, additional logistic regression analyses were conducted with infant sensory patterns categorised (within, and >1 standard deviation) based on the *mean* of the present sample.

Results

Demographic characteristics of women with and without perinatal loss

Demographic characteristics, chi-square results and independent sample t-test statistics comparing women with and without perinatal loss are outlined in Table 1. Women with and without perinatal loss were similar in terms of most parameters such as: age (mean = 31.86/29.59 years old), relationship status (in a relationship = 95.45%/91.43%) and infant gender (male = 55.00%/64.71%). Women with perinatal loss completed questionnaires at 3.57 months postpartum, which was statistically significantly earlier than women without perinatal loss who completed the questionnaires at 5.63 months postpartum. Finally, there were no statistically significant demographic differences between women who completed both time-points (participants included in the study), and women who completed questionnaires at Time 1 but did not complete questionnaires at Time 2 (participants not included in the study).

Explanatory variables

Descriptive statistics, independent samples t-statistics comparing women with and without perinatal loss and Cronbach's alphas of explanatory variables (MAAS and AASP) are shown in Table 2. There were no statistically significant differences between women with and without perinatal loss on the AASP or MAAS subscales. Internal consistency results

Table 1 Descriptive statistics, chi-square results and independent sample *t*-test statistics of categorical variables comparing women with and without perinatal loss, $N = 57$

Variable	Women with perinatal loss ($n = 22$)		Women without perinatal loss ($n = 35$)		
	n	%, Mean (SD)	*n*	%, Mean (SD)	χ^2, *t*
Marital status	22	100.00	32	91.43	1.48
In a relationship	21	95.45	32	100.00	
Not in a relationship	1	4.55	0	0.00	
Maternal ethnicity	22	100.00	32	91.43	1.09
Caucasian	16	72.73	27	84.38	
Not Caucasian	6	27.27	5	15.63	
Maternal mental health diagnosis	22	100.00	30	85.71	0.06
Never	17	77.27	24	80.00	
Current or history of diagnosis	5	22.73	6	20.00	
Infant gender	20	90.91	34	97.14	0.50
Male	11	55.00	22	64.71	
Female	9	45.00	12	35.29	
Mother's age (years)	22	31.86 (4.95)	32	29.59 (4.00)	1.86
Number of other living children	22	0.09 (0.29)	31	0.48 (0.93)	−1.92
Socio-economic status$^{\sim}$	22	75.82 (18.43)	32	73.47 (21.35)	0.42
Time 1 – weeks' gestation	19	29.42 (2.34)	32	31.30 (7.29)	−1.08
Time 2 – months postpartum	21	3.57 (2.31)	35	5.63 (3.55)	−2.37*

Notes: $^{*}p \leq 0.05$, χ^2 = chi-square statistic; *t* = independent sample *t*-tests *t*-statistic; $\sim$ = based on Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) percentile rank within Australia. NB. Total numbers in each variable may not equate to the totals for each sample owing to missing data

Table 2 Descriptive statistics, independent samples *t*-statistics and Cronbach's alpha of the explanatory variables of maternal-foetal attachment (Maternal Antenatal Attachment Scale) and postnatal maternal sensory patterns (Adolescent/Adult Sensory Profile) for women with and without perinatal loss, $N = 57$

	Women with perinatal loss ($n = 22$)					Women without perinatal loss ($n = 35$)						
	n	Mean	SD	Min	Max	*n*	Mean	SD	Min	Max	*t*	α
Maternal antenatal attachment scale												
Quality of attachment	20	50.05	3.52	44.00	55.00	30	50.97	4.04	38.0	55.00	−0.97	0.79
Time spent in attachment	20	29.20	5.08	18.00	35.00	30	27.67	4.16	19.00	35.00	1.17	0.77
Adolescent/adult sensory profile												
Low registration	22	30.23	8.34	17.00	49.00	35	30.46	8.89	17.00	55.00	−0.10	0.86
Sensory seeking	22	49.09	6.29	38.00	63.00	35	49.57	8.13	30.00	63.00	−0.24	0.72
Sensory sensitivity	22	34.86	9.95	21.00	50.00	35	31.83	7.29	22.00	53.00	1.24	0.82
Sensory avoidance	22	35.41	8.26	20.00	52.00	35	33.63	6.93	20.00	53.00	0.88	0.73

Notes: *t* = independent sample *t*-tests *t*-statistic; α = Cronbach's alpha. NB. Total numbers in each variable may not equate to the totals for each sample owing to missing data

using Cronbach's alphas were adequate for AASP and MAAS subscales (all >0.60).

Outcome variable

In Table 3, the descriptive statistics and chi-square results of the ITSP for women with and without perinatal loss are outlined. Similar percentages across the three categories for infant low registration and infant sensory avoidance were exhibited for women with perinatal loss and those without perinatal loss. In contrast, there were statistically significant differences in the variation of infant sensory seeking and infant sensory sensitivity results for women with and without perinatal loss. Perinatal loss was retained as a control variable during further analyses as a result of the varying levels of infant sensory seeking and infant sensory sensitivity.

Logistic regression analyses

Logistic regression models were conducted with demographic variables (e.g. infant age, infant gender, socioeconomic status, maternal age, parity) as explanatory variables and dichotomous infant sensory pattern variables ("more than typical" vs "typical performance") as outcome variables. Most analyses were insignificant and demographic variables were not retained in the final logistic regression models. The one significant factor, previous loss, was retained in future analyses.

As shown in Table 4, MAAS quality of attachment was negatively associated with ITSP infant low registration. Both AASP maternal sensory seeking and perinatal loss were significantly positively associated with ITSP infant sensory seeking. Both AASP maternal low registration and perinatal loss were positively associated with ITSP infant sensory sensitivity in the same model. In another model, MAAS quality

Table 3 Descriptive statistics and chi-square results of dependent variable (infant/toddler sensory profile) for women with and without perinatal loss, $N = 57$

Infant/toddler sensory profile	Women with perinatal loss ($n = 22$)		Women without perinatal loss ($n = 35$)		
	n	(%)	*n*	(%)	χ^2
Low registration	22	100.00	32	91.43	0.59
Less than typical	11	50.00	12	37.50	
Typical performance	9	40.91	17	53.13	
More than typical	2	9.09	3	9.38	
Sensory seeking	22	100.00	33	94.29	6.89*
Less than typical	2	9.09	0	0.00	
Typical performance	14	63.64	30	90.91	
More than typical	6	27.27	3	9.09	
Sensory sensitivity	21	100.00	33	94.29	6.49*
Less than typical	1	4.55	0	0.00	
Typical performance	13	59.09	29	87.88	
More than typical	8	36.36	4	12.12	
Sensory avoidance	20	100.00	20	100.00	1.11
Typical performance	17	85.00	19	95.00	
More than typical	3	15.00	2	5.00	

Notes: $^*p \leq 0.05$, χ^2 = chi-square statistic NB. Total numbers in each variable may not equate to the totals for each sample owing to missing data

Table 4. Logistic regression analyses between "typical performance" and "more than typical" infant sensory patterns and perinatal loss, maternal-foetal attachment and postnatal maternal sensory patterns, $N = 57$

Variables			95% CI			
Dependent independent	**B**	**OR**	**Lower**	**Upper**	χ^2	**Nagelkerke R^2 (%)**
Infant low registration						
Quality of attachment	−0.57	0.57*	0.33	0.96	7.26*	45.58
Perinatal loss	−0.56	0.57	0.02	13.49		
Infant sensory seeking						
Maternal sensory seeking	0.15	1.16*	1.01	1.32	9.47**	27.36
Perinatal loss	1.81	6.13*	1.09	34.37		
Infant sensory sensitivity						
Quality of attachment	−0.22	0.81*	0.67	0.97	11.00**	29.95
Perinatal loss	1.53	4.64*	1.03	20.96		
Maternal low registration	0.09	1.10*	1.02	1.20	10.94**	28.06
Perinatal loss	1.72	5.58*	1.24	25.26		
Infant sensory avoidance						
Quality of attachment	−0.38	0.68*	0.51	0.92	10.26**	38.16
Perinatal loss	1.21	3.36	0.33	33.88		
Maternal sensory sensitivity	0.13	1.14*	1.02	1.28	7.00*	25.81
Perinatal loss	0.45	1.57	0.18	12.52		

Notes: $^*p \leq 0.05$, $^{**}p \leq 0.01$. OR = odds ratio; CI = confidence interval; χ^2 = chi-square statistic. NB. Only models with significant maternal-foetal attachment and maternal sensory patterns variables are reported

of attachment was negatively associated, and perinatal loss was associated with ITSP sensory sensitivity.

AASP maternal sensory sensitivity was positively associated with ITSP infant sensory avoidance. In another model, MAAS quality of attachment was significantly negatively associated with ITSP infant sensory avoidance. Perinatal loss retained its significance in logistic regression models with other explanatory variables such as AASP maternal sensory seeking, AASP maternal sensory avoidance and MAAS time spent in attachment. Finally, additional analyses were conducted with infant sensory patterns categorised based on the mean of the sample; all findings were consistent with those reported above.

Discussion

This study adds to our understanding of the perinatal characteristics associated with infant sensory patterns and highlights possible areas of assessment and treatment that may

foster more optimal infant outcomes. Perinatal loss was linked with "more than typical" infant sensory seeking and sensory sensitivity. Poorer quality of maternal-foetal attachment was associated with "more than typical" infant sensory patterns (low registration, sensory sensitivity and sensory avoidance). Finally, higher maternal sensory seeking was associated with "more than typical" infant sensory seeking; increased maternal low registration was linked with "more than typical" infant sensory sensitivity; and more maternal sensory sensitivity was associated with "more than typical" infant sensory avoidance. An explanation of these results, and the implications of each, is provided in the following sections.

Previous perinatal loss

Compared to mothers without previous perinatal loss, mothers with perinatal loss were more likely to report that their infants actively sought out further sensory input ("more than typical" sensory seeking) and/or were easily distressed by sensory information ("more than typical" sensory sensitivity). This suggests that the infants born of women with perinatal loss were perceived to have more atypical sensory patterns, which may disrupt occupational performance. Results are somewhat similar to Turton and colleague's study (2009) which identified that mothers having previously lost a baby to stillbirth reported that their children at age six to eight had increased social difficulties compared to women without loss, notwithstanding differences in the child outcome explored. While further research into the mechanisms is required, Turton and colleagues (2009) proposed that mothers with previous perinatal loss may be more vigilant of their children's problems as they believe their child is more "fragile" (Solnit and Green, 1964) and compare the child to their idealised lost child (Cain and Cain, 1964). An additional explanation is that women with perinatal loss have higher prenatal anxiety associated with the fear of losing another child, which may lead to atypical infant sensory processing.

Maternal-foetal attachment

Pregnant women with more negative cognitions and feelings about their unborn baby (poorer quality of maternal-foetal attachment) were more likely to report, following birth, that their infants were irritated by ("more than typical" sensory sensitivity) or resistant to ("more than typical" sensory avoidance) sensory stimuli. Both infant sensory sensitivity and sensory avoidance are patterns with low neurological thresholds, indicating that these infants may easily notice and be bothered by sensory stimuli.

Women with less optimal feelings and thoughts towards their unborn baby were also more likely to report that their infants were largely unaware of surroundings or position changes ("more than typical" low registration). While not previously investigated, such findings are consistent with theoretical expectations derived from earlier studies showing that poorer maternal-foetal attachment is linked with sub-optimal infant outcomes, as outlined in a systematic review (Branjerdporn *et al.*, 2017). The study extends the current literature, demonstrating that less favourable maternal-foetal attachment may contribute to mother's later perception of how her infant responds to sensory stimuli. While mechanisms for this relationship between poorer maternal-foetal attachment and atypical infant sensory patterns require further research, prenatal and postnatal pathways may contribute to infant patterns, as well as a mothers' negative attitude towards her baby.

Postnatal maternal sensory patterns

Mothers who actively seek out sensory stimuli (higher sensory seeking) were more likely to report that their infants were very active throughout the day and enjoyed a range of stimulating activities, such as making sounds with mouth, looking at shiny or moving objects, and rhythmical motions ("more than typical" sensory seeking). While there may be a temperamental or genetic explanation for this finding (Eeles *et al.*, 2013a), it is also plausible that mothers desire to see their baby as similar in sensory preferences to them, and that sensory seeking women tend to interact and select co-occupational experiences with their infants (e.g. bouncing baby, playing with loud objects) that also meets their sensory needs and stimulates the infant's sensory system.

Mothers who tended to miss sensory information (higher low registration) reported that their infants were easily distressed by incoming sensory information ("more than typical" sensory sensitivity). One possible explanation for this is that, these mothers have difficulties noticing infant cues, leading to infants escalating to have their needs met. If verified, such mothers may benefit from support to attune to the infant's needs (e.g. reminders to intentionally check the infant regularly), and self-regulation strategies (e.g. mindfulness).

Mothers who were easily bothered by sensory stimuli (higher sensory sensitivity) reported that their infants tended to readily notice sensory stimuli and withdraw from stimuli ("more than typical" sensory avoidance). Plausible explanations for this relate to: genetics and temperament, hyperawareness of unsettled behaviour, more easily labelling sensitive behaviour and providing less sensory stimulation to their infants causing infants to habituate less to sensory stimulation.

While results were not in the direction of our hypotheses based on negative correlations identified by McGeorge *et al.* (McGeorge *et al.*, 2015), differences may be attributable to different ways of computing infant sensory patterns, statistical analyses used and exploration of different populations.

Methodological considerations and limitations

While results are consistent with theoretical expectations, they are preliminary, and methodological factors limit conclusions. For example, self-report questionnaires were used, and there may be selection bias. Although the AASP in this study demonstrated high internal consistency for each of the sensory patterns, no validity studies have been conducted with women postnatally. While sensory patterns are conceptualised as trait-like characteristics, sensory functioning soon after birth may differ from the general population, possibly owing to hormonal differences associated with pregnancy. As the AASP and ITSP were measured cross-sectionally, causality cannot be inferred regarding the associations revealed between maternal sensory patterns and infant sensory patterns. Owing to the nature of the research question examined, AASP was computed as a continuous variable; however, future research may compute AASP as a categorical variable based on normative data to show cross-tabulations with ITSP categorisation. While the present

study was conducted in Australia, results of the ITSP were categorised based on normative data from the USA. Although infant age was not associated with infant sensory patterns in the present study, the infant age when ITSP data was collected varied across several months. Further, while it may be helpful to view the ITSP in terms of sub-modalities (e.g. taste, smell, vision, audition, movement and touch), normative data is not available for infants under six months old. Finally, caution must be taken in generalising results owing to the relatively small sample size.

Clinical implications

This research highlights the potential value of focusing on the mother during assessment and intervention to support adaptive infant development, and in turn occupational performance. While further research is required, eliciting a women's obstetric history, as well as sensitive, trauma-informed enquiry about the impact and meaning of the previous perinatal loss, is warranted. For women with *previous perinatal loss*, recommendations to attend occupation-based retreats with crafts and yoga, for example, may be helpful to support favourable mental well-being and self-compassion (Hanish *et al.*, 2019). It may also be prudent for occupational therapists to facilitate *maternal-foetal attachment* using a range of interventions (Borg Cunen *et al.*, 2017), in the view to support the development of typical infant sensory patterns.

Furthermore, *maternal sensory patterns* should be considered when assessing and supporting the development of typical infant sensory patterns. Occupational therapists may educate mothers about their sensory patterns. This awareness will enable mothers to understand their feelings and reactions to their infant's behaviour based on their sensory preferences. Mothers may use sensory modulation strategies that consider maternal and infant sensory patterns to support self-regulation and baby's regulation as the occupations and environments are aligned with sensory needs.

Conclusions

The present study is the first to investigate infant sensory patterns in the context of previous perinatal loss, maternal-foetal attachment and postnatal sensory patterns. Although preliminary, findings suggest that risk factors for atypical infant sensory patterns are perinatal loss, not feeling as warm towards baby during pregnancy, and higher levels of sensory patterns after birth. Further empirical attention is required to clarify mechanisms for these associations and develop occupational therapy interventions that consider these factors.

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