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Depressive symptoms among immigrant and Canadian born mothers of preterm infants at neonatal intensive care discharge: a cross sectional study

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Abstract

Background: Mothers of preterm infants are considered at higher risk for depressive symptoms, higher than for mothers of healthy term infants. Predictors of depressive symptoms in mothers of preterm infants are not yet well established. Immigrant mothers of term infants have higher prevalence of depressive symptoms than Canadian born mothers but the relative prevalence for immigrant mothers of preterm infants is unknown. This study had two aims: (i) to investigate the prevalence of depressive symptoms in immigrant as compared to Canadian born mothers of preterm infants, and (ii) to determine what factors are associated with depressive symptoms in mothers of preterm infants.

Methods: This is a multi-site, cross sectional study of mothers whose preterm infants required hospitalization in neonatal intensive care unit (NICU). Consecutive eligible mothers ($N = 291$) were recruited during the week prior to their infant's NICU discharge. Mothers completed a self-administered questionnaire booklet of validated psychosocial/cultural measures including the Center for Epidemiological Studies Depression Scale (CES-D), Parental Stressor Scale:NICU, General Functioning Subscale of the McMaster Family Assessment Device, Social Support Index, and Vancouver Index of Acculturation; and demographic characteristics questions. Infant characteristics included gestational age, birth weight, sex, singleton/multiple birth, and Score for Neonatal Acute Physiology-II.

Results: Immigrant mothers ($N = 107$), when compared to Canadian born mothers ($N = 184$), reported more depressive symptoms, poorer family functioning, less social support, and less mainstream acculturation. Hierarchical regression for a subsample of 271 mothers indicated that single parent status, high stress, poorer family functioning, and less social support were associated with increased depressive symptoms and accounted for 39% of the variance on the CES-D. Immigrant status did not contribute significantly to the final regression model.

Conclusions: Immigrant mothers of preterm infants are at increased risk for depressive symptoms. For immigrant and Canadian born mothers of preterm infants hospitalized in NICU and particularly for single mothers, interventions to reduce stress and increase family functioning and social support may reduce depressive symptoms. Given the effects of depression on maternal health and functioning, such an intervention may improve child outcomes.

Background

Postnatal depression affects 7 - 19% of mothers of healthy term infants [1,2] within the first year after childbirth [1]. Mothers of preterm infants (< 37 weeks gestation) are at greater risk for depression than mothers of term infants

[3]. Between 28 and 66% of mothers of preterm infants reported depressive symptoms [4-9] severe enough to meet the criteria for a diagnosis of depression (i.e., above the cutoff for the specific depression measure) [1,10]. Mothers of very preterm (< 30 weeks), medically fragile infants had sustained symptoms of depression for up to 2 years [11,12].

Maternal depression is of concern not only because of its effects on the mother's health and functioning, but

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also because it is associated with negative child developmental outcomes including cognitive delay, insecure attachment, and difficulties with behavioural and emotional development [1]. Preterm infants are particularly vulnerable to the effects of maternal depression in addition to an increased risk for developmental delays due to their immaturity, medical illness, and biological risk [13].

There is a significant gap in the current literature regarding the risk factors for depression in immigrant mothers [1,14]. This is an important question as many countries have a significant proportion of immigrants. In Canada, one in five individuals are identified as immigrants [15]. Immigrant women are at increased risk for preterm birth [16,17], a risk more strongly associated with higher education status (e.g., university education) [17]. The risk for immigrant women increases with increased time spent in Canada, especially for those who lived in poor neighbourhoods [16]. Recent Canadian research indicated that immigrant women were also at increased risk for depressive symptoms [14,18-22] and low received social support [22]. Measurement of immigration status varied greatly across studies, and typically was based on language spoken in the home, country of origin and/or length of residence in Canada. Acculturation or adaptation to the cultural beliefs and values of the new country were not considered. In Canada, where cultural pluralism is promoted, it is essential to address bi-dimensional acculturation: degrees of identity within mainstream and heritage cultures [23]. Acculturation is viewed as a more valid and predictive construct than measures of ethnicity, language, time in country, or race [24]. To date, no study has addressed immigration and/or acculturation factors and their association with depressive symptoms in mothers of preterm infants. The relative prevalence of depressive symptoms for immigrant mothers of preterm infants is also unknown.

In prior meta-analyses, the strongest predictors of depression for mothers of term infants included stressful life events [10,25,26], a poor marital relationship [10,26], lack of social support [10,25,26], previous history of depression [10,25,26], and anxiety or depression during pregnancy [10,25,26]. The maternal factors associated with depression in mothers of preterm infants are considered to be similar to those found in the literature for mothers of term infants [3]. Yet, maternal factors such as lack of social support, family functioning, and poor marital relationship have not been adequately studied in mothers of preterm infants.

Few infant-specific factors were considered as reported in meta-analyses [1,10,25,26]. Only difficult infant temperament and childcare stress [26] or obstetric factors (e.g., premature delivery) [25] were addressed. These infant factors were less strongly associated with depressive

symptoms in mothers of term infants [25,26]. Mothers of preterm infants experience additional stress related to their preterm infant's illness and early gestational age (GA). Evidence for the contribution of the infant's severity of illness to maternal depression was conflicting and inconclusive [3] with reports of both association [6,11,27] and non-association [8,9,28-30] with maternal depressive symptoms. The findings of these studies are limited by the use of non-validated clinical illness measures [9] or infant demographic characteristics and/or clinical diagnoses as a proxy for illness severity [6,8,11,27-29]. Given this conflicting evidence, further research is required using validated measures to determine if the infant's severity of illness is a risk factor that contributes to maternal depressive symptoms.

The two aims of the current study were: (i) to investigate the prevalence of depressive symptoms in immigrant as compared to Canadian born mothers of preterm infants, and (ii) to determine what factors are associated with depressive symptoms in mothers of preterm infants hospitalized in the neonatal intensive care unit (NICU). The factors included demographic characteristics (e.g., maternal and infant), psychosocial context factors (i.e., stress, family functioning, and social support); and factors not adequately or previously studied (i.e., immigrant status, bi-dimensional acculturation and severity of infant illness).

Methods

Sample

The current study employed data gathered in a larger study of mothers whose infants required NICU hospitalization [31]. Study participants were recruited between November 2006 and July 2008 from three Canadian tertiary-level NICUs located in Toronto and Hamilton. These cities are located in the area of the province of Ontario where 80% of all provincial births occur. Ontario is the most ethnically diverse Canadian province with 42 - 45% with of all immigrants residing there [32]. Mothers had universal access to care through the publicly funded Canadian health insurance system. Criteria for enrollment in the larger study were all mothers who assumed primary responsibility for their infant and whose infant required NICU admission (preterm [<37 weeks] and term). Of the 679 eligible mothers, 87 mothers were excluded (53 [7.8%] were non-English speaking; and 34 [5%] were too ill [e.g., critically ill and hospitalized] and/or denied custody of their infant). An additional 76 mothers (11%) were not invited to participate because of unavailability of the mother or research team. In all, 550 mothers were approached to participate of which 363 participated (66%) in the larger study. For this study, a subset of mothers whose infants were born preterm ($N = 291$) were included.

Procedures

Research ethics committees of three participating hospitals and the affiliated university approved the study. Consecutive eligible mothers were recruited through the NICUs during the week prior to their infant's planned discharge. This is a time point that represents the infant's transition to illness recovery and allows comparisons with previous studies, the majority of which were conducted at or near the point of NICU discharge. After the research nurse conducted written informed consent, mothers completed a self-administered questionnaire booklet at home or in a private location in the NICU. Mothers placed the completed questionnaires in a sealed envelope at the infant's bedside. The research nurse circulated daily to address questions and collect questionnaires. Study participants completed the maternal questionnaire with < 3% missing data. All mothers had ready access to professional mental health support and counseling (e.g., social workers and psychiatrists) in their respective NICU. Infant characteristics including GA, birth weight (BW), sex, single/multiple birth, and severity of illness (SNAP-II) were obtained from the NICU health record by the research nurse.

Measurement

The booklet addressed maternal demographic characteristics including age, marital status, parenting status, education, employment, income adequacy (i.e., annual household income that takes the number of person living in the home into account), language in the home, and country of birth, along with five previously validated psychosocial/cultural measures. All measures were reviewed for content validity and feasibility by eight experts. They were pilot tested with 19 mothers (9 immigrant, 10 Canadian-born) who met the eligibility criteria to ensure acceptability and feasibility (e.g., simplicity of language, ease of reading, and time to complete). These 19 mothers were included in the overall study since no changes were made to the measures or procedures.

Center for Epidemiologic Studies Depression Scale (CES-D)

The CES-D [33] is a 20-item self-report scale of depressive symptoms with ratings on a 4-point Likert scale that ranges from "rarely or none of the time (less than 1 day in the past week)" to "most of the time (5 - 7 days)" related to the frequency of feelings or behaviours such as the blues, loneliness, and sadness; not feeling as good as others or thinking one's life is a failure; difficulty concentrating; and sleep and appetite problems. The CES-D was originally validated in the general adult population [33]. It has been used extensively in studies of parents of premature and ill infants [4-6,34-39], allowing comparisons of our study results to other research. The CES-D is not diagnostic for depression but provides an estimate of depressive symptoms. Scores range from 0 to 60. A score

of 16 or greater indicates high risk for depression [40,41]. Cronbach's alphas of .87 to .91 were reported in mothers of preterm infants [6] and .88 to .90 in mothers of medically fragile infants [37]. For this study, Cronbach's alpha was .90.

Parental Stressor Scale: NICU (PSS:NICU)

The PSS:NICU [42] is a validated 34-item scale that measures parents' stress during their infant's NICU hospitalization related to alterations in parental role, the infant's appearance and behaviour, and the NICU environment. Mothers rated their overall experience on a 5-point Likert scale, from 1 (*not at all stressful*) to 5 (*extremely stressful*). Scale scores are calculated by averaging stress responses for the items on each scale and for the total scale to determine the overall stress level. Higher scores indicate higher stress. Stress scores were positively correlated with State Anxiety ($r = 0.45, p < .001$) [42]. High internal consistency scores were reported for the total scale at .89 (Cronbach's alpha) [6,42]. For this study, Cronbach's alpha was .88.

General Functioning Subscale of the McMaster Family Assessment Device (FAD-GF)

The FAD-GF [43] is a 12-item scale that measures the family's ability to make the adjustments required in the family system as a result of the stressor event (e.g., birth of a preterm infant) to maintain balance and family function [44]. Higher scores signify more family dysfunction (≥ 26 indicates low ability or inability to adjust and function [i.e., pathology]) [44]. Items are rated on a 4-point Likert scale with anchors ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Related to reliability, internal consistency was .86 (Cronbach's alpha) and a split-half coefficient (Guttman) was .83 based on a sample of 1,822 families in the Ontario Child Health Study [43,44]. Cronbach's alpha for mothers of high-risk infants ranged from .81 to .84 [5,45,46]. For this study, Cronbach's alpha was .87.

Social Support Index (SSI)

The SSI [47] is a 17-item scale measuring the degree to which families perceive their family and community as a source of support [47]. Community could mean, for example, their neighbourhood, network of friends, or religious groups. Using a 5-point Likert scale, respondents indicate the degree to which they agree or disagree with statements about their support resources and as a provider of emotional and esteem support. For example, "If I had an emergency, people I know in this community would be willing to help" and "The things I do for members of my family and they do for me make me feel part of this very important group." Cronbach's alpha was .82 and test-retest reliability was .83. For this study, Cronbach's alpha was .86. The SSI is correlated with family well-being and sense of fit within the community ($r = .40$) [47].

Vancouver Index of Acculturation (VIA)

The VIA [23] is a bi-dimensional, 20-item, self-report scale used to assess participation in or identification with mainstream (dominant) and heritage (non-dominant) cultures. Each subscale has 10 items with identical wording except for the culture. For example, “I often participate in my heritage cultural traditions” and “I often participate in mainstream North American cultural traditions.” The items assess three domains: values, social relationships, and adherence to traditions. The VIA items are rated on a 9-point Likert scale with anchors ranging from 1 (*strongly disagree*) to 9 (*strongly agree*). Higher scores indicate greater acculturation (maximum = 9). Cronbach’s alphas ranged from .85 to .89 for the mainstream subscale and .91 to .92 for the heritage subscale for a diverse sample of acculturating adults ($N = 728$; e.g., East, South and South East Asian, Italian, and Arabic) [23]. Individuals who identified more strongly with mainstream culture had better psychosocial adjustment (e.g., less depression) than those who identified with heritage culture [23]. For this study, Cronbach’s alphas were .89 for both subscales.

Score for Neonatal Acute Physiology-II (SNAP-II)

The SNAP-II is a composite measure of newborn illness severity measured at NICU admission [48-50]. It is a physiology-based score that uses 34 routinely available vital signs and laboratory test results. The SNAP-II was developed and validated prospectively on 25,429 admissions in 30 Canadian NICUs. SNAP-II correlates with therapeutic intensity ($r = .78$) and length of stay ($r = .59$) [49].

Data analysis

First, comparisons were made between immigrant and Canadian born mothers on the psychosocial/acculturation measures using Student *t* tests. Bivariate Pearson’s correlation and hierarchical linear regression were used to examine the relationships between the dependent (CES-D scores) and independent variables. Significance level of $p < .05$ was set for all statistical tests. Linearity and collinearity were evaluated prior to multiple regression analysis. Analyses were conducted with Statistical Package for Social Sciences (SPSS) – Version 20. Mothers of multiple births were included once with their lesser BW infant.

Results

Characteristics of immigrant and Canadian mothers ($N = 291$) and their infants are shown in Table 1. Overall, the majority of mothers lived in two-parent families, and were graduates of college or university, employed prior to their infant’s birth, spoke English at home, and had singleton infants. Immigrant mothers were older, had lower income adequacy, and spoke proportionately less English at home than Canadian born mothers.

Table 1 Characteristics of study population based on immigrant versus Canadian born status

Variable	Immigrant $N = 107$	Canadian Born $N = 184$
	Mean (SD)	Mean (SD)
Maternal Characteristics		
Mean maternal age, years ^a	33.28 (5.76)	31.64 (5.92)
	Frequency (%)	Frequency (%)
Single parent	10 (9.4)	13 (7.1)
First time parent	63 (59.4)	114 (62.0)
Employed at time of delivery	91 (85.0)	157 (85.8)
Education ^b		
No high school diploma	7 (6.7)	13 (7.1)
High school graduate or some college	31 (29.5)	54 (29.3)
College or university graduate	67 (63.8)	117 (63.6)
Income adequacy ^c		
Low	5 (4.9)	5 (2.8)
Lower middle	9 (8.8)	18 (9.9)
Middle	31 (30.4)	24 (13.3)
Upper middle	24 (23.5)	50 (27.6)
High	33 (32.4)	84 (46.4)
English as 1 st language in the home	60 (56.1)	180 (97.8)
Infant Characteristics		
Mean gestational age, weeks	Mean (SD)	Mean (SD)
Mean birth weight, grams	27.91 (3.22)	28.62 (3.32)
	(472.74)	(641.58)
Median SNAP-II score (IQR)	9 (17)	7 (14)
Gestational age by preterm categories		
	Frequency (%)	Frequency (%)
Extremely preterm, < 28 weeks GA	61 (57.0)	75 (40.8)
Very preterm, 28 to <32 weeks GA	31 (29.0)	72 (39.1)
Moderate/late preterm, 32 to < 36 weeks GA	15 (14.0)	37 (20.1)
Male	52 (48.6)	86 (46.7)
Multiples (e.g., twins or triplets)	12 (11.2)	27 (14.7)

Note: Income adequacy based on annual household income and number of persons in the home

SNAP-II = Score for Neonatal Acute Physiology-II; IQR = Interquartile range

^a Four missing data (2 immigrant, 2 Canadian born)

^b Two missing data (2 immigrant, 0 Canadian born)

^c Eight missing data (5 immigrant, 3 Canadian born)

Immigrant mothers were ethnically diverse. Seventy per cent of immigrant mothers were from the Caribbean (e.g., Jamaica, Barbados, Trinidad, St Lucia), South Asia (e.g., India, Pakistan, Bangladesh, Sri Lanka), Southeast Asia (e.g., Philippines, Vietnam), Western Europe (e.g., United Kingdom, Portugal) and Africa (e.g., Ghana, Nigeria, Egypt) comparable with reported immigration patterns to Canada during the study period [15].

Psychosocial and acculturation measures – comparison between groups (Aim 1)

The mean CES-D score for immigrant mothers was significantly higher than for Canadian born mothers ($t = 3.02$,

$p = .002$) (see Table 2). For example, the mean CES-D score for immigrant mothers was 20.7 as compared to 16.7 for Canadian born mothers. Fifty-nine percent of immigrant and forty-seven percent of Canadian born mothers had scores indicative of high risk for clinical depression (≥ 16). The Cronbach's alpha for the CES-D was consistent with other studies of mothers of ill and pre-term infants. Immigrant mothers had FAD-GF scores indicative of significantly poorer family functioning than Canadian born mothers ($t = 2.50, p = .01$) and significantly lower SSI scores ($t = -4.25, p < .001$), indicative of lower social support. Mean scores on the FAD-GF were well below the clinical cut-off (>26). Immigrant mothers reported significantly lower mainstream cultural identity on the VIA ($t = -5.19, p < .001$) than Canadian born mothers with no differences based on heritage cultural identity ($t = 1.15, p = .25$). Immigrant mothers' scores on the mainstream and heritage subscales were quite similar. The mean stress scores on the PSS:NICU were similar ($t = 1.36, p = .17$) for immigrant and Canadian born mothers.

Pearson's correlations (Aim 2)

Stress, family functioning, social support, mainstream acculturation identity, immigrant status, and single parent status were significantly correlated with depressive symptoms on the CES-D (see Table 3). CES-D scores increased with increased stress, poorer family functioning, low social support, less mainstream acculturation identity, immigrant

versus Canadian born status, and single versus married status. Maternal variables including age, first time parent, employment, education, income adequacy, and English as first language in the home, and infant variables (i.e., GA, BW, sex, singleton/multiples, and severity of illness [SNAP-II score] were not correlated with depressive symptoms.

Multiple linear regression (Aim 2)

Hierarchical linear regression was employed to test the variance explained in depressive symptoms as measured by the CES-D for the 271 mothers with complete data for all variables (Table 4). Variables with a significant zero-order correlation with the CES-D were tested as potential predictors of mothers' symptoms of depression in the hierarchical regression analysis. Since immigrant status and acculturation were correlated ($r = .30, p < .001$), immigrant status was used to represent this construct as its correlation with depressive symptoms was higher. Variables were entered in blocks: Step 1, single parent status and immigrant/Canadian born status (maternal characteristics); Step 2, PSS:NICU (maternal internal psychosocial context); and Step 3, FAD-GF and SSI [1] (maternal external psychosocial context).

In Step 1, single parent and immigrant status contributed significantly to the model and explained 7% of the total variance in CES-D scores. In Step 2, PSS:NICU contributed significantly and added an additional 20% to the total variance explained. In Step 3, FAD-GF and SSI contributed significantly and added an additional 12% to the variance explained. Together, four variables (single parent, PSS:NICU, FAD-GF, and SSI) explained 39% of the total

Table 2 Scores on psychosocial measures based on immigrant versus Canadian born status

Variable	Immigrant N = 107 Mean (SD)	Canadian Born N = 184 Mean (SD)	t score	p- value
Depression (CES-D) ^a	20.73 (11.41)	16.65 (10.08)	3.02	.002
Stress (PSS:NICU) ^a	3.22 (0.81)	3.09 (0.74)	1.36	.17
Family Functioning (FAD-GF) ^b	19.36 (4.96)	17.80 (5.19)	2.50	.01
Social Support (SSI) ^c	47.65 (9.47)	52.19 (8.26)	-4.25	< .001
Acculturation (VIA-Mainstream) ^d	6.39 (1.18)	7.12 (1.12)	-5.19	< .001
Acculturation (VIA-Heritage) ^a	6.63 (1.31)	6.43 (1.46)	1.15	.25

Note: t score = independent samples t-test; CES-D = Center for Epidemiologic Studies Depression Scale; PSS:NICU = Parental Stressor Scale: neonatal intensive care unit; FAD-GF = Family Assessment Device - General Functioning Scale; SSI = Social Support Index; VIA = Vancouver Index of Acculturation - Mainstream and Heritage Scales.

^a Seven missing data (CES-D, 4 immigrant, 3 Canadian born; PSS:NICU, 2 immigrant, 5 Canadian born; VIA-Heritage, 2 immigrant, 5 Canadian born)

^b Two missing data (2 immigrant, 0 Canadian born)

^c Four missing data (2 immigrant, 2 Canadian born)

^d Six missing data (2 immigrant, 4 Canadian born)

Table 3 Summary of Pearson's correlations and descriptive statistics for validated measures

Variable	1	2	3	4	5	6	7	8
1. CES-D	-							
2. PSS:NICU	.48**	-						
3. FAD-GF	.35**	.16**	-					
4. SSI	-.44**	-.15*	-.48**	-				
5. VIA-Mainstream	-.15*	-.02	-.16**	.26**	-			
6. VIA-Heritage	.00	.04	-.08	.11	.35**	-		
7. Immigrant/Canadian born	-.18**	-.08	-.15*	.24**	.30**	-.07	-	
8. Single parent	.18**	.07	.21**	-.16**	-.12	-.10	-.04	-
M	18.13	3.1	18.37	50.53	6.85	6.50		
SD	10.74	.77	5.15	8.98	1.19	1.40		
Range	0-49	1-10	4-26	16-68	4-9	1-9		

Note: CES-D = Center for Epidemiologic Studies Depression Scale; PSS:NICU = Parental Stressor Scale: Neonatal Intensive Care Unit; FAD-GF = Family Assessment Device - General Functioning Scale; SSI = Social Support Index; VIA = Vancouver Index of Acculturation - Mainstream and Heritage Scales; M = Mean, SD = Standard deviation

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 4 Hierarchical multiple regression analysis predicting maternal depressive symptoms (N= 271)

Variable	B	SE B	β
Step 1			
Single parent	8.25	2.39	.20**
Immigrant/Canadian born	- 4.09	1.30	-.18**
Step 2			
Single parent	7.38	2.12	.18**
Immigrant/Canadian born	- 3.03	1.16	-.14*
Stress (PSS:NICU)	6.42	.74	.45***
Step 3			
Single parent	4.63	1.98	.11*
Immigrant/Canadian born	- 1.31	1.09	-.06
Stress (PSS:NICU)	5.62	.68	.40***
Family functioning (FAD-GF)	.28	.11	.14*
Social support (SSI)	- .34	.07	-.28***

$R^2 = .07$ for Step1, $\Delta R^2 = .20$ for Step 2, $\Delta R^2 = .12$ for Step 3
 * $p < .05$, ** $p < .01$, *** $p < .001$

variance in CES-D scores. Thus, the final model indicated that being a single parent and having higher stress, poorer family functioning, and lower social support, but not immigrant status, were significant predictors of maternal depressive symptoms.

Discussion

Findings from this study contribute to our knowledge about the impact of preterm birth and NICU hospitalization on the mother's risk for depressive symptoms with particular attention to the impact of immigrant status. Our findings indicate that 59% of immigrant and 47% of Canadian born mothers in this sample report depressive symptoms above the cutoff. These proportions are similar to studies of mothers of preterm infants with comparable GA (28 weeks mean GA) where 40 to 63% of mothers had mean depression scores above the cutoff for the measure used and indicating high risk of clinical depression [6,8,9,28]. Only two studies reported either low risk for depressive symptoms [51] or no difference in risk for mothers of preterms as compared to term controls [27] during NICU hospitalization. The findings of these two studies may have differed because the mothers had preterm infants of higher GA (e.g., 31 to 35 weeks mean GA) who typically have lower illness severity than younger GA infants [49].

To our knowledge, this is the first study to address immigrant mothers with preterm infants and their psychosocial adjustment. These mothers had significantly increased depressive symptoms as compared to Canadian born mothers. Because mothers were recruited from consecutive eligible infants, the sample is more likely to represent the population of women in Ontario who have children born preterm, although the participation rate was only 66%. The proportion (37%) of our sample who

were immigrant mothers is similar to the proportion of Canadian immigrants (42%) who reside in Ontario [32] and their origins are similar to the Canadian immigration pattern. The findings related to depressive symptoms of immigrant mothers of preterm infants are similar to other Canadian studies of immigrant women with healthy term infants who were at greater risk for depressive symptoms than Canadian born mothers [14,18-20,52]. However, more research is warranted to guide our understanding of how cultural identity within immigrant mothers and the birth of a preterm infant uniquely and collectively contribute to maternal depressive symptoms in order to inform and provide effective interventions. Women who could not read English were excluded from the study, so this population is not represented in the findings.

The second aim of the study was to identify factors associated with depressive symptoms in mothers of preterm infants. Three psychosocial contextual factors (stress, family functioning, and social support), and one maternal characteristic (single parent status) significantly predicted maternal depressive symptoms. Maternal perception of stress was one of the most significant psychosocial predictors of depressive symptoms for all mothers of preterm infants in this large cross sectional study. This finding is consistent with other studies where stress was associated with depressive symptoms in mothers with preterm infants during NICU hospitalization [6,8,9,28]. Only Miles and colleagues [9] reported an association between stress and depression related to the mother's worry. While we did not address mother's worry, stress in our study was related to the alterations in the parental role, appearance and behavior of their infant, and the sights and sounds of the NICU. Other concurrent stressors such as additional changes within the family, job loss, and family health concerns were not addressed in this study. Mean stress scores were similar between immigrant and Canadian born mothers indicative that having a preterm infant hospitalized in the NICU was stressful for all parents regardless of their immigrant status.

Unique to this study was the finding that low family functioning was associated with depressive symptoms in mothers of preterm infants, consistent with studies in mothers of term infants [1,3,10,25,26]. There are no studies of mothers of preterm infants that adequately addressed family functioning (i.e., the family's ability to adjust and function to the stressful event of preterm birth and NICU hospitalization). Instead, Miles and colleagues [9] investigated maternal perception of father's involvement in care, a measure of relationship functioning rather than family functioning, and reported that it was unrelated to depressive symptoms [9]. More research is needed to investigate the association between family functioning, relationship functioning, and depressive

symptoms for mothers of preterm infants to inform the development of interventions to strengthen family functioning during NICU hospitalization with the intention to decrease stress and depressive symptoms.

Low social support was a significant predictor of depressive symptoms in the present study. This finding is consistent with meta-analyses that have reported low social support as strongly associated with depressive symptoms in mothers of term infants [1,3,10,25,26]. Independent of preterm or term infant status, Logsdon et al. (2001) also reported that low social support was strongly associated with depressive symptoms [53]. By contrast, two studies conducted in mothers of preterm infants reported no association between social support and depressive symptoms [8,28]. The measurement of social support in the aforementioned studies [8,28] differed from our study. Davis and colleagues [8] addressed nursing support and family support, and reported that low support from nurses, rather than family support, predicted depressive symptoms. Lefkowitz and colleagues [28] addressed perceived social support using a non-validated checklist. The use of a reliable measure for social support, and a larger sample size in part may account for our finding in mothers of preterm infants. Another explanation may be our heterogeneous sample with a large proportion of immigrant mothers who reported significantly less social support than Canadian born mothers. Immigrant mothers may be physically and culturally separated from their extended family support systems [14]. From a clinical perspective, supports (e.g., social and professional) beyond those currently available need to be considered in order to buffer the risk of depressive symptoms progressing to depression. In all three NICU research sites, mothers had open access to their infants, the support of health professionals (e.g., social workers, nurses) and parent support groups, yet compared to Canadian born mothers, lower support was reported by immigrant mothers. Further research is needed to address the unique needs for social support and professional support for mothers of preterm infants, and to conduct analyses of immigrant and Canadian born mothers separately to investigate what support interventions best match the needs of immigrant and Canadian born mothers with preterm infants.

Similar to Miles and colleagues [9], in this study single parent status predicted depressive symptoms. In one meta-analysis, single parent status was a predictor of depression in mothers of term infants [26]. However, O'Hara [1] described marital status as less strongly related to depressive symptoms than psychosocial factors or history of depression. Overall, single mothers may have increased depressive symptoms related to low social support (i.e., without partner support) and lower income and employment. The additive effect of low resources, low support, and an ill preterm infant hospitalized in NICU

may account for this factor being a significant predictor of depressive symptoms for single parents. The percentage of mothers who were single parents was similar between immigrant (9.4%) and Canadian born (7.1%) mothers. It cannot be assumed that the mechanisms underlying depressive symptoms are the same for single immigrant and single Canadian born mothers. Overall, immigrant mothers reported significantly lower social support and family functioning than Canadian born mothers. The cumulative effect of being single, an immigrant and experiencing the psychosocial strain related to preterm birth merits further investigation.

A strength of this study was the measurement of the infant's severity of illness with a validated instrument (SNAP-II). The SNAP-II is limited in that severity of illness is measured at NICU admission and although correlated with therapeutic intensity and length of stay [49], it does not address illness severity throughout the infant's NICU hospitalization. No other researchers have used a validated severity of illness measure. Rather, Miles and colleagues [9] measured cumulative risk for neurological insults during hospitalization. The SNAP-II and cumulative risk both failed to predict maternal depressive symptoms similar with earlier studies where infant demographic characteristics were used as a proxy for illness severity [8,9,28,30,54]. Maternal perception of her infant's health (e.g., psychosocial factors) rather than objective indicators of illness severity may make a greater contribution to understanding the risk for depressive symptoms [9].

Factors identified as predictors of depressive symptoms in mothers of preterm infants during the NICU hospitalization period that were not addressed in this study included prior history of depression and/or anxiety [28,30] and knowledge of infant development [51]. Consistent with meta-analyses from studies with mother of term infants [1,25,26], maternal education level and first born children were non-predictive of depressive symptoms in this study. Income adequacy was not associated with depressive symptoms in this study different from meta-analyses that report low income as associated, although less strongly, with depressive symptoms in mothers of term infants [1,25,26]. The fact that maternal educational level and income adequacy were not significant predictors in our study may be related to the fact that the sample included primarily mothers with higher education and income [31].

Clinical implications are derived from the study's findings and relate to strategies targeted at reducing the risk for depressive symptoms in mothers of preterm infants. For practice, our findings highlight the need to screen all mothers, especially those at greatest risk for depressive symptoms (e.g., single parent status, high stress, poorer family functioning, and less social support) while in the NICU setting. Interventions should focus on reducing

stress and supporting coping strategies for all mothers. The stress related to the preterm infant and concurrent stressors may differ greatly across mothers. Single mothers and immigrant mothers may need additional and different types of support than married or Canadian born mothers. Social support interventions are required in addition to those supports currently offered in the NICU. Nurses have a supportive influence as evidenced by Davis et al [8]. Nurses have a continuous presence in caring for infants and their mothers and have the greatest opportunities to identify needs and seek out additional supports. In a small Canadian study, Preyde and Ardal [55] reported that mothers who voluntarily participated in a NICU-based peer support intervention had significantly less stress and anxiety, and greater perceived social support than mothers of preterm infants who did not receive the intervention. While this study cannot be generalized due to volunteer bias and a small sample, the effectiveness of a peer support intervention for mothers of preterm infants merits further investigation in a randomized controlled trial. Longitudinally, maternal depressive symptoms with low social support were associated with lower cognitive functions in preterm infants [56,57].

Limitations

This study has a number of limitations. First, depression was measured using a self-report measure (CES-D) that was originally validated in the general adult population and used to screen for postpartum depression. As such, measurement error may occur because some questions on this general depression measure overlap with typical postpartum adjustment symptoms (e.g., sleeping difficulty). As well, mothers may screen positive for depressive symptoms but may not meet more rigorous depression specific criteria for a diagnosis of depression. Second, one of the known predictors of postnatal depression, history of depression [1] was not addressed in this study. Third, immigrant status was based on the mother's birth country being other than Canada. This approach did not take into consideration the number of years in Canada which is an important consideration once residence is longer term (greater than 10 years) [19]. Lastly, the mothers in this study were primarily married, highly educated and over half were classified as having upper middle or high-income adequacy [31]. The study findings can be generalized only to mothers and preterm infant populations with similar characteristics, and the benefit of universal access to health care coverage as in Canada.

Conclusions

In summary, these data provide the first view that immigrant mothers of preterm infants are at increased risk for depressive symptoms compared to Canadian born mothers.

Further, these findings provide additional support that four factors (single parent status, high perceived stress, poorer family functioning and less social support) are important and significant predictors of depressive symptoms for immigrant and Canadian born mothers of preterm infants. For mothers of preterm infants hospitalized in NICU, and particularly for single mothers, interventions to reduce stress and increase family functioning and social support are required to reduce the development of depressive symptoms. Ultimately, by providing additional interventions the consequences of maternal depressive symptoms that are associated with negative child outcomes may also be reduced.

List of abbreviations used

BW: birth weight; CES-D: Center for Epidemiologic Studies Depression Scale; FAD-GF: Family Assessment Device – General Functioning Scale; GA: gestational age; NICU: Neonatal Intensive Care Unit; PSS:NICU: Parental Stressor Scale: Neonatal Intensive Care Unit; SNAP-II: Score for Neonatal Acute Physiology-II; SSI: Social Support Index; VIA: Vancouver Index of Acculturation - Mainstream and Heritage Scales.

Authors' contributions

MB and KMB developed the design for the research with input from BT. MB and BT analyzed the data. MB, KMB, and BT interpreted the data. All authors read and approved the final version.

Competing interests

The authors declare that they have no competing interests.

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Declarations

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