Ontario's Healthy Babies Healthy Children Screen tool: identifying postpartum families in need of home visiting services in Ottawa, Canada

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Received: 14 August 2017 / Accepted: 22 December 2017 / Published online: 20 April 2018
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Abstract

Intervention Across Ontario, the Healthy Babies Healthy Children (HBHC) postpartum screening tool is routinely used to identify families with potential risk of negative development outcomes for children.

Research question To identify screening questions associated with subsequent high-risk in-depth assessment (IDA) in order to prioritize services.

Methods Ottawa families who gave birth (2013–2016) consented to the postpartum HBHC Screen ($N = 29,162$). Maternal socio-demographics, perinatal indicators, and 36 questions assessing pregnancy/birth, family, parenting, infant development, and health professional observations were analyzed for association with a high-risk IDA using regression analysis.

Results Upon first screen, 51% of families scored two or more risks. Most commonly, labour/delivery complications (27%), previous loss (26%), health professional concerns (22%), and mental illness (17%) were identified. Among IDA completions, 41% were assessed as high risk and this proportion increased when screened with 4+ risks. Characteristics associated with high-risk IDA among families scoring two or three included the following: maternal age ≤ 19 years ($aRR = 2.0$, 95% CI 1.50–2.80), 20–29 years (1.3, 1.12–1.53), ≥ 35 years (1.2, 1.04–1.45); combination breast and formula feeding on discharge (1.2, 1.03–1.37); < 18 years old at birth of first child (1.7, 1.13–2.43); single parent and no partner involved (1.6, 1.07–2.33); high school incomplete (1.8, 1.45–2.35); newcomer support needed (1.8, 1.43–2.17); financial concerns (1.6, 1.27–2.14); history of mental illness (1.2, 1.01–1.33); and parent disability (1.7, 1.09–2.78).

Conclusion While offering the IDA when scoring 2+ risks is a provincial requirement, practices of increasing effort toward contacting families screened with 4+ risks are substantiated. An adapted approach to prioritize families screened with two or three risks is described.

Résumé

Intervention L'outil de dépistage post-partum du programme *Bébés en santé, enfants en santé* (BSES) est utilisé couramment partout en Ontario pour cibler les familles dont les enfants sont à risque d'obtenir des résultats négatifs en matière de développement.

Question de recherche Déterminer les questions de dépistage associées à une cote de risque élevé suite à une évaluation approfondie (ÉA) afin de hiérarchiser les services.

Méthodes Familles d'Ottawa ayant donné naissance entre 2013 et 2016 et ayant consenti à subir le dépistage post-partum du programme BSES ($N = 29,162$). Les données sociodémographiques de la mère, les indicateurs de la santé périnatale et 36 questions évaluant la grossesse, l'accouchement, la famille, la vie parentale, le développement du nourrisson et les observations des professionnels de la santé ont été étudiés au moyen d'une analyse de régression en vue de déterminer leurs liens avec la cote de risque élevée obtenue à l'ÉA.

Résultats Le premier dépistage a permis de cibler deux facteurs de risque ou plus chez 51% des familles. Ces facteurs étaient le plus souvent les complications durant le travail ou l'accouchement (27%), une fausse-couche ou le décès d'un bébé par le passé (26%), des inquiétudes des professionnels de la santé (22%) et des antécédents de maladies mentales (17%). Chez les familles ayant subi une ÉA, 41% avaient une cote de risque élevé; cette proportion augmentait lorsque quatre

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facteurs de risque ou plus avaient été identifiés. Les caractéristiques associées à une cote de risque élevé à l'ÉA chez les familles ayant obtenu deux ou trois facteurs de risque étaient les suivantes: âge maternel ≤ 19 ans (RR ajusté = 2,0; IC 95% 1,50 à 2,80), 20 à 29 ans (1,3; 1,12 à 1,53), ≥ 35 ans (1,2; 1,04 à 1,45); combinaison d'allaitement maternel et artificiel au moment du congé (1,2; 1,03 à 1,37); âge de la mère à la naissance du premier enfant < 18 ans (1,7; 1,13 à 2,43); parent monoparental et sans partenaire (1,6; 1,07 à 2,33); études secondaires non terminées (1,8; 1,45 à 2,35); besoin de soutien pour nouvel arrivant (1,8; 1,43 à 2,17); problèmes financiers (1,6; 1,27 à 2,14); antécédents de maladie mentale (1,2; 1,01 à 1,33); handicap du parent (1,7; 1,09 à 2,78).

Conclusion Bien que le gouvernement provincial exige qu'une évaluation approfondie soit offerte lorsque le risque équivaut à deux ou plus, il est justifié d'accroître les efforts pour joindre les familles ayant quatre facteurs de risques ou plus à l'issue du dépistage. Une approche adaptée permettant d'accorder la priorité aux familles ayant obtenu deux ou trois risques sera décrite.

Keywords Screening · Postpartum women · Maternal health · Public health practice · Social determinants of health · Risk assessment

Mots-clés Dépistage · Femmes post-partum · Santé maternelle · Pratique en santé publique · Déterminants sociaux de la santé · Évaluation des risques

Introduction

Healthy Babies Healthy Children (HBHC) is a program funded by the Ontario Ministry of Children and Youth Services (MCYS) designed to give children the opportunity for a healthy start in life by focusing on families from the prenatal period until early childhood (Ontario Ministry of Children and Youth Services 2012). One component of the program includes the HBHC Screen, a comprehensive tool that replaced the Larson prenatal and Parkyn postpartum tools in 2013 to improve screening consistency provincially and to better identify families with potential risk of negative development outcomes for children (Ministry of Children and Youth Services 2012). The HBHC Screen assesses risk factors in the following areas: pregnancy and birth, family, parenting, infant/child development, and health care professional observations. A risk score is tallied from the responses and those scoring two or more are considered “with-risk.” The HBHC Screen can be completed by health care professionals during the prenatal, postpartum, or early childhood periods. An example of the HBHC Screen can be found in the Healthy Babies Healthy Children Guidance Document (Ontario Ministry of Children and Youth Services 2012).

Under the Ontario Public Health Standards, health units delivering the HBHC program are required to attempt contact with all postpartum clients within 48 h of discharge and to offer a home visit in order to complete an in-depth assessment (IDA) to families identified “with-risk” by the HBHC Screen. The IDA intends to confirm risk and, if necessary, to initiate a service plan and admit the family to HBHC services. The IDA is completed with families using the Family Assessment Instrument (FAI), covering areas influential toward the trajectory of child health and development, family strengths, and

their interaction with the identified risks (Ontario Ministry of Children and Youth Services 2012). The FAI was designed to be completed by a public health nurse (PHN) in the home through conversation and observation. The overall rating of the FAI (no/low risk, moderate risk, or high risk) and decision to admit the family is guided by criteria and professional nursing judgement (Ontario Ministry of Children and Youth Services 2012). Families who are identified as being moderate or high risk from the IDA and are admitted/referred to the HBHC blended home visiting program and other community services are those assessed with risk factors that can negatively impact healthy child development and who demonstrate need for health and/or social services. Families identified as being high risk tend to utilize more HBHC services than those identified as being moderate risk. For example, in Ottawa between 2013 and 2015, families identified on the IDA postpartum as being high risk received more attempted and completed home visits (mean 7.7, median 4) compared to those identified as moderate risk (mean 1.5, median 1) (Ottawa Public Health 2016).

Much of the literature has focused on the evaluation of home visiting as a population health intervention, and the approach to assess families for referral to home visiting is an important, yet understudied, component of this intervention in the Canadian context. One previous Canadian study examined characteristics of women who accepted a postpartum home visit at a time when they were universally offered in Ontario (Sword et al. 2006). Since the implementation of the universal HBHC Screen with targeted home visiting is fairly new in Ontario, to date, little has been described in the literature about it. In 2014, Public Health Ontario released an evaluation report on the first 6 months of enhancements to the HBHC program including the implementation of the HBHC screening tool (Ontario Agency for Health Protection and Promotion

(Public Health Ontario) 2014) and a MCYS report described the Screen's predictive validity or ability to identify those with- and without-risk as sufficient (sensitivity, 74%; specificity, 89%), based on the required cut point of at least two risks on the Screen (Ministry of Children and Youth Services 2014). Public health professionals have described the requirement to offer and conduct the IDA to those identified with two or more risks on the HBHC Screen, particularly among the high volume of families screened with lower risk, as a resource-intensive practice (Wooten and Dowsett 2012), and while highly sensitive, this practice may be less precise in identifying those who need further HBHC service at lower-risk levels. The purposes of this study are (1) to describe the HBHC Screen profile of postpartum families in Ottawa and (2) to determine screening questions that are associated with a postpartum family being assessed as high risk using the IDA and assess the sensitivity and specificity of prioritizing contact using these questions.

Methods

Families giving birth in Ottawa between April 1, 2013, and December 31, 2016, were asked for consent to participate in the HBHC Screen either by a hospital nurse (before discharge), midwife, public health nurse, or other health professionals. In the case of multiple births, one HBHC Screen was completed for each infant. The MCYS provides instructions on how to complete the HBHC Screen (Ontario Ministry of Children and Youth Services 2012), and Ottawa Public Health (OPH) provided further training to those administering the HBHC Screen to improve accuracy and completion of the questions. Completed screens were sent to the public health unit for entry into the Integrated Services for Children Information System (ISCIS) and for follow-up by HBHC as described previously.

The HBHC Screen included socio-demographic (maternal age, language) and perinatal indicators (parity, singleton/multiple, birth weight, gestational age, birth type, feeding method on discharge), 36 questions (listed in Table 1) split into five sections assessing the following: (A) pregnancy and birth, (B) family, (C) parenting, (D) infant/child development, and (E) health care professional observations. Responses to the 36 questions were categorized as “yes,” “no,” “requires further assessment,” “client declined to answer,” or “unable to assess.” As per HBHC program standards, the responses were coded as either “yes” amounting to a value of one point each for question 1 to 35 and a value of two points for question 36, or a value of zero for each question with another response. The sum of these points is the screen score. A screen score of two or more was defined as “with-risk” and these families were eligible for the IDA.

Families eligible for the IDA were contacted by a PHN via telephone and asked to consent for a home visit to complete the IDA using the FAI. The MCYS provides instructions for FAI completion (Ontario Ministry of Children and Youth Services 2012). The IDA was completed by the PHN in the home of the primary caregiver and child through conversation and observation. Completed IDAs were entered into ISCIS. The FAI contains 23 items covering the following: prenatal education and care, caregiver mental health and substance use, child temperament, caregiving, availability of support, family interactions, and living conditions. Three supplemental items identify family strengths and their interaction with the identified risks. While each item is scored, the overall rating of the FAI (no/low risk, moderate risk, or high risk) is not solely based on a tally of the items. Several criteria are recommended as a guideline to determine the overall rating and decision to admit the family. Criteria for moderate- or high-risk families who need admission include the following: several FAI items rated two or more; moderate to serious illness or disability of the child that may adversely affect their ability to achieve developmental milestones; a caregiver showing difficulty/inappropriateness with the child's temperament or development or with providing a nurturing and safe environment; or the family has inadequate/unreliable coping strategies, family support, or unsafe/unstable living conditions. Criteria for low- or moderate-risk families who do not need admission include observation of the following: most FAI items rated 0 or 1; items rated 2 or more are offset by individual or family strengths; the child experiencing healthy physical and emotional growth with no obvious delays; the family respects and supports the child's temperament and provides a physically and psychologically safe environment; no evidence of psychological risk factors such as isolation, substance abuse, family violence, unstable living conditions, or food insecurity; risks are significantly offset by other protective factors; and the caregiver is receptive to counseling from the PHN. As these criteria are recommended for guiding the overall rating, the PHN must also use their professional judgement to carefully consider the inter-relatedness of identified risks and family strengths (Ontario Ministry of Children and Youth Services 2012).

For this analysis, the postpartum screen result was used (if more than one screen was administered, only the first was used) and this was identified using the unique infant and screen identification numbers. Screens for infants whose families agreed to share their information with Ottawa Public Health were included. Screens were excluded where responses to some of the questions were missing and for families whose child was not discharged with the mother due to adoption, apprehension by child protection services, or neonatal death. This study was approved by the Ottawa Public Health Research Ethics Board.

Table 1 Prevalence of risk identified on the first postpartum HBHC Screen

HBHC Screen section	Screen question	All screens (%) (<i>N</i> = 29,162)	Screens 2+ risks, IDA completed (%) (<i>N</i> = 5412)	Screens 2+ risks, IDA not completed (%) (<i>N</i> = 9513)	Screens 2+ risk complete vs. not completed IDA χ^2 <i>p</i> value	Screens with 2 or 3 risk and completed IDA* (%) (<i>n</i> = 2710)
A	1) Multiple birth	4.1	4.8	8.0	0.000	3.3
	2) Premature	8.7	11.4	15.2	0.000	6.0
	3) Birth weight < 1500 g	1.2	1.1	2.9	0.000	0.1
	4) Birth weight > 4000 g	9.4	13.2	16.5	0.000	12.0
	5) Apgar score < 5	1.1	1.7	2.4	0.005	0.8
	6) Health conditions/medical complications in pregnancy	14.0	23.1	23.6	0.428	17.4
	7) Labour/delivery complications	26.7	42.3	39.5	0.001	39.7
	8) Smoked during pregnancy	6.1	10.7	12.6	0.001	3.2
	9) Smoked > 100 cigarettes prior to pregnancy	9.6	15.8	18.7	0.000	6.9
	10) Alcohol use during pregnancy	1.8	3.2	3.6	0.140	1.3
	11) Drug use during pregnancy	4.0	8.3	7.0	0.002	3.2
	12) No prenatal care before 6 months	1.8	3.4	3.0	0.249	1.8
B	13) Age < 18 years	0.6	1.7	0.9	0.000	0.1
	14) Age < 18 years (at 1st birth)	1.9	4.0	3.4	0.066	0.8
	15) Experienced previous loss of pregnancy or infant	25.8	35.1	38.8	0.000	30.6
	16) Single parent	4.1	9.1	7.0	0.000	2.4
	17) No primary care provider	3.8	8.3	6.0	0.000	4.4
	18) No OHIP number	2.8	5.7	4.2	0.000	3.7
	19) High school not completed	3.6	8.0	6.0	0.000	2.1
	20) Health challenge	2.6	4.4	4.6	0.536	2.0
	21) Maternal separation > 5 days	4.7	6.7	10.2	0.000	0.6
	22) Partner not involved	3.3	7.7	5.4	0.000	1.9
	23) No support person (parenting)	1.0	2.7	1.6	0.000	0.1
	24) No support person (child care)	1.0	2.7	1.5	0.000	0.1
C	25) Newcomer support needed	3.3	9.2	4.2	0.000	4.6
	26) Concerns about money	3.7	10.1	5.6	0.000	2.3
	27) Depression/anxiety/other mental illness	17.1	30.2	27.7	0.001	21.8
	28) Client/partner has disability	0.8	2.0	1.2	0.000	0.7
	29) Concerns about ability to parent baby	0.5	1.4	0.6	0.000	0.3
	30) Concerns about ability to care for baby	0.8	2.2	1.2	0.000	0.3
	31) Relationship with partner strained	1.8	4.5	3.1	0.000	0.9
	32) Involved with child protective services	2.1	4.7	3.6	0.001	0.5
	33) Child difficult to manage	0.4	1.0	0.5	0.001	0.3
	34) Inappropriate response to child	0.5	1.2	0.8	0.014	0.2
D	35) Parent(s) identified a risk factor	2.2	4.7	3.9	0.014	1.4
E	36) Health professional has concerns for client/baby	21.9	49.0	39.2	0.000	31.7

Section A: pregnancy and birth; B: family; C: parenting; D: infant/child development; E: health care observation

*Excludes screens from families with infants admitted to a neonatal intensive care unit

Statistical analysis

The socio-demographics and perinatal indicators and the 36 questions were compared using a Pearson chi-square test to explore differences between those completing the IDA and those not completing the IDA among those “with-risk.”

All socio-demographic and perinatal indicators and the HBHC Screen questions listed in Table 1 were entered into a multivariate analysis to identify those associated with a high-risk IDA. To minimize collinearity, screen questions (multiple birth, gestational age (premature), birth weight (< 1500 or >

4000 g), < 18 years old) were excluded from the model if they were also collected and included from the demographics/perinatal section or if there was another similar construct in the questionnaire: smoking during pregnancy (included) and smoking prior to pregnancy (excluded). Further, questions with very few “yes” responses ($n < 20$ or $< 0.7\%$ in the last column of Table 1) were excluded (birth weight < 1500 g, maternal separation > 5 days, no support person for parenting, no support person for parenting or child care, client expressed concern for ability to parent or care for child, involvement with child protection services, client expressed that child is

difficult to manage, and client was observed to have inappropriate responses to child). Effect modification was explored by including interaction terms between being a single parent and not having a partner/support person involved with the care of the child and between maternal age and being < 18 years old at first birth. We first tried fitting a log-binomial model, which is an appropriate method for estimating relative risk in cross-sectional studies with common outcomes (> 10%) (Wilber and Fu 2010). However, this failed to converge, due to smaller cell sizes among some of the less prevalent questions. Since we did not want to omit less prevalent questions, we used the log Poisson regression analysis with robust error variance to estimate adjusted relative risks (aRR) and 95% confidence intervals (Barros and Hirakata 2003). Variables in the full model that were not found associated with the outcome ($p > 0.3$) were removed. In order to test whether this model could be accurately applied as a way of identifying high-risk families, those variables that were associated with the outcome ($p < 0.05$) or borderline associated ($p < 0.1$) were used to calculate the sensitivity and specificity of the model. All analyses were performed using Stata v14.0.

Results

HBHC Screen profile of postpartum families

Between April 1, 2013, and December 31, 2016, there were an estimated 36,700 live births in Ottawa and 29,162 (79%) first postpartum HBHC Screens were extracted from ISCIS based on the inclusion and exclusion criteria. The proportion of screening questions marked as “requires further assessment” or “unable to assess” was low (range 0.7–4.0%). The proportion of questions with missing responses ranged between 0.4% and 2.7%, and 82% of screens had no questions with missing responses. Twenty-five percent ($n = 7379$) of screens scored zero risk, 24% ($n = 6858$) scored one risk, and 51% ($n = 14,925$) scored two or more risks. The proportion scoring two or more risks increased from 48% in 2013 to 55% in 2016 ($p = 0.000$). Table 1 shows the prevalence of each risk identified on the HBHC Screen. The four most commonly identified risks were labour/delivery complications (27%); previous pregnancy or infant loss (26%); health professional concerns for well-being of client or infant (22%); and client or parenting partner has a history of depression, anxiety, or other mental illness (17%).

Of those with a postpartum screen score of two risks or more, HBHC attempted to contact 95% of these families and had a two-way contact with 83% of them. The IDA was not completed on 56% of these families, of whom 87% declined further HBHC services or lost contact, 9% the service was no longer required, 1% moved, and 1% were referred to another agency. The IDA was completed on 91% of families who were

successfully contacted and agreed to have the IDA completed upon a home visit. The average time from completing the Screen to IDA completion was 11.2 days (median 9 days) and from IDA contact to completion was 8.8 days (median 7 days). Table 1 presents the differences in prevalence of each risk identified on the HBHC Screen between those completing the IDA and those not completing the IDA among those “with-risk.” Additionally, those “with-risk” who completed the IDA were more frequently primiparous (62.6% vs. 47.2%, $p = 0.000$) and feeding both breast milk and formula on discharge (24.3% vs. 19.3%, $p = 0.000$) compared to those who did not complete the IDA.

Of those who completed the IDA, 52% of families were assessed as no/low risk, 7% were with moderate risk, and 41% were high risk. Figure 1 shows the flow from postpartum screen to home visiting program of families initially scoring a two or more on the HBHC Screen. While over half (58%) of families eligible for the IDA score either a two or three on their HBHC Screen, the proportion who are assessed as high risk on the IDA increases rapidly for those who score a four or more on the HBHC Screen (e.g., score = 2|3, 29%; score = 4, 38%; score = 5, 54%; score = 8, 72%; score = 9, 81%; score = 13+, 100%). Given this, we were interested in exploring which of the screening questions among those scoring a two or three were associated with a high-risk IDA and determining how sensitive and specific these questions would be in identifying those likely needing further home visiting services. A small proportion of families scoring a two or three (6%) had infants admitted to a neonatal intensive care unit (NICU) (compared to 19% of those scoring a four or more), and we decided to remove these families from our multivariate analysis given that they are a group underrepresented in the IDA results (Ottawa Public Health. In-depth assessment results 2017) and require a specific approach in reaching them shortly after birth (O'Brien 2016). The total sample size of families who completed the IDA after scoring a two or three without infants who were admitted to NICU (referred to as families screened with “lower risk”) was $N = 2710$. The prevalence of each risk identified on the HBHC Screen among this population is described in the last column of Table 1.

Screen questions associated with a high-risk IDA

Results of the regression analysis of the socio-demographic and perinatal indicators and screen questions associated with a high-risk IDA for families whose infants were not admitted to a NICU and with a screen score of two or three risks are shown in Table 2.

The demographic and perinatal indicators associated (** $p < 0.05$) or borderline associated (* $p < 0.1$) with increased risk of a high-risk IDA included the following: maternal age of ≤ 19 years old (aRR = 2.0**, 95% CI 1.50–2.80), 20–29 years old (aRR = 1.3**, 95% CI 1.12–1.53), and ≥ 35 years old

Fig. 1 Flow from postpartum screen to home visiting program for clients scoring a two or more on the HBHC Screen tool

(aRR = 1.2**, 95% CI 1.04–1.45) compared to those aged 30 to 34 years; and feeding both breast milk and formula on discharge (aRR = 1.2**, 95% CI 1.03–1.37) compared to those feeding only breast milk. From the section on pregnancy

and birth, the only question borderline associated with increased odds of a high-risk IDA included the following: no prenatal care before 6 months (aRR = 1.4*, 95% CI 0.97–1.95). Questions from the section on family that were

Table 2 Factors associated with high-risk IDA when HBHC postpartum screen = 2 or 3 risks and mother and infant discharged together ($n = 2521$)

HBHC Screen section	Socio-demographic and perinatal indicators and HBHC Screen questions	Adjusted RR (95% CI)	<i>p</i> value
A	Age		
	≤ 19	2.0 (1.50–2.80)	0.000
	20–29	1.3 (1.12–1.53)	0.001
	30–34	1.0	
	≥ 35	1.2 (1.04–1.45)	0.017
	Feeding method on discharge		
	Breast milk	1.0	
	Both	1.2 (1.03–1.37)	0.019
	Breast milk substitute	1.2 (0.90–1.73)	0.177
	Birthweight		
B	1500–4000 g	1.0	
	> 4000 g	0.8 (0.63–0.97)	0.027
	Apgar score of less than 5 at 5 min	0.4 (0.10–1.29)	0.115
	Maternal smoking of cigarettes during pregnancy	1.3 (0.93–1.76)	0.128
	No prenatal care before 6th month	1.4 (0.97–1.95)	0.078
C	Was less than 18 years old when the 1st child was born	1.7 (1.13–2.43)	0.010
	Not a single parent and partner/support person involved with care of child	1.0	
	Not a single parent and partner/support person not involved with care of child	1.4 (0.83–2.35)	0.211
	Single parent and partner/support person involved with care of child	1.4 (1.00–2.10)	0.052
	Single parent and partner/support person not involved with care of child	1.6 (1.07–2.33)	0.023
	Did not complete high school	1.8 (1.45–2.35)	0.000
	Client/family in need of newcomer support	1.8 (1.43–2.17)	0.000
	Concerns about money	1.6 (1.27–2.14)	0.000
	Client or parent partner history of mental illness	1.2 (1.01–1.33)	0.039
	Client or parent partner has disability that may impact parenting	1.7 (1.09–2.78)	0.019
	Client's relationship with parenting partner is strained	1.5 (0.96–2.41)	0.074

RR relative risk, CI confidence interval

associated with increased odds of a high-risk IDA included the following: were less than 18 years old when the first child was born (aRR = 1.7**, 95% CI 1.13–2.43); being a single parent and the partner/support person was not involved with the care of the child (aRR = 1.6**, 95% CI 1.07–2.33); being a single parent and the partner/support person was involved with the care of the child (aRR = 1.4*, 1.00–2.10); and did not complete high school (aRR = 1.8**, 95% CI 1.45–2.35). Questions from the section on parenting that were associated with increased odds of high-risk IDA included the following: in need of newcomer support (aRR = 1.8**, 95% CI 1.43–2.17); had concerns about money (aRR = 1.6**, 95% CI 1.27–2.14); had a history of depression/anxiety/other mental illness (aRR = 1.2**, 95% CI 1.01–1.33); had a disability that may impact parenting (aRR = 1.7**, 95% CI 1.09–2.78); or the client's relationship with the parenting partner was strained (aRR = 1.5*, 95% CI 0.96–2.41).

Sensitivity and specificity calculations

Table 3 describes the values for sensitivity and specificity, and positive and negative predictive values (PPV, NPV) for an approach where an IDA would be offered in cases whereby at least one of the associated or borderline-associated demographic and perinatal indicators and screen questions described above were identified on the HBHC Screen among those with two or three risks and whose infants were not admitted to a NICU. Within this lower-risk population, this approach offers a sensitivity of 85%, or the probability that those flagged for IDA completion would be truly high risk, and a specificity of 23%, or the ability to appropriately not offer the IDA to families who would truly not be assessed as high risk. Because the high-risk IDA outcome is not as common among families with two or three risks identified and whose infants were not admitted to a NICU (28%), this approach offers a PPV of 31%, while achieving a NPV of 80%, or the probability that the family is truly not high risk when they are not flagged for IDA completion. Applying this

approach would have resulted in offering 20% fewer (554/2708) IDAs to families screened with lower risk.

Discussion

This study reports several findings relevant to public health and community practice for postpartum services. First, the proportion of families who are assessed as high risk and likely require more postpartum services increases as more risks are identified on the HBHC Screen, particularly after three risks are identified. While offering a home visit to families identified with two or more risks is a provincial requirement, this finding substantiates practices of prioritizing contact with families who identify four or more risks on their postpartum screen.

More families in Ottawa (51%) were screened with two or more risks identified on their first postpartum screen, compared to 46% across Ontario in 2013 (Ontario Agency for Health Protection and Promotion (Public Health Ontario) 2014). It is possible that this difference is in part due to a higher completion of postpartum screening questions in Ottawa compared to Ontario (Ontario Agency for Health Protection and Promotion (Public Health Ontario) 2014), and as a result, a greater measured prevalence. The prevalence of the most common risk factors identified in Ottawa was slightly higher compared to Ontario for labour/delivery complications (27% vs. 23%), previous loss of pregnancy or infant (26% vs. 20%), health professional has concerns for client/baby (22% vs. 11%), and client or parenting partner history of depression, anxiety, and other mental illness (17% vs. 13%); however, Ottawa was lower for the prevalence of maternal smoking of more than 100 cigarettes before pregnancy (10% vs. 15%) (Ontario Agency for Health Protection and Promotion (Public Health Ontario) 2014).

Finally, several socio-demographic and perinatal indicators and HBHC Screen questions were found to be independently associated with a high-risk IDA among those identified with

Table 3 Sensitivity, specificity, and positive and negative predictive values of factors associated with a high-risk IDA

Screen had at least 1 factor* associated with high-risk IDA	In-depth assessment (IDA) rating			Positive predictive value	Negative predictive value
	High risk (n = 770)	Not high risk (n = 1938)	Total completed IDA (n = 2708)		
Yes	657	1497	2154	657/2154 (31%)	441/554 (80%)
No	113	441	554		
Sensitivity	657/770 (85%)				
Specificity		441/1938 (23%)			

*Screen includes a “yes” response to least one of the following: age ≤ 19, 20–29, or ≥ 35 years; feeding both breast milk and formula on discharge; no prenatal care before 6 months; < 18 years at first birth; single parent; high school not completed; newcomer support needed; concerns about money; history of depression/anxiety/mental illness; disability may impact parenting; or relationship with partner strained

two or three risks. Notably, most of the variables associated with a high-risk IDA were socio-demographic constructs from the family and parenting sections (i.e., being a first-time teenage parent, single parent, not completing high school, in need of newcomer support, having concerns about money, and having a disability that might impact parenting abilities). These constructs are identified as determinants of health by several social determinants of health frameworks (Canadian Council on Social Determinants of Health 2015) and have been recognized as contextual risk factors for child health and well-being, including cognitive and emotional development, school readiness, and access to resources such as quality care, food, and secure housing (Human Resources and Skills Development Canada 2008; Phipps and Lethbridge 2006; Mikkonen and Raphael 2010; Bradley and Corwyn 2002). Other factors that were associated or borderline associated with a high-risk IDA, including family history of mental illness, no prenatal care before 6 months, and client relationship with partner strained, have been described as contributing factors toward child health, well-being, and development, particularly when other socio-economic disadvantages are present (Human Resources and Skills Development Canada 2008; Kim and Krall 2006; Ramchandani and Psychogiou n.d.; Bernard-Bonnin 2004; Belsky 2005).

We tested the sensitivity and specificity of the approach presented by the model to see if it could be used in practice to better prioritize offering the IDA to families screened with lower risk. This approach presents the ability to cast a wide enough net to capture 85% of high-risk IDA families with a specificity of 23%. While the ability to detect those truly at high risk (PPV 31%) is somewhat low, this approach offers the benefit of a greater ability to identify and reduce unnecessary IDA completions (NPV 80%). While this particular formulaic approach of using only the indicators and screen questions associated with a high-risk IDA to target postpartum families presenting with lower screen scores for further assessment offers some opportunity to improve resource allocation toward equitable services, this approach should not be used in isolation when reviewing screens. Clinical nursing judgement remains an essential tool in the prioritization process of reaching and assessing families that have screened with lower risk to minimize the chance that vulnerable families are not identified and appropriately serviced through gaps in the screening and assessment tools and protocols.

We found that primiparous families and those feeding both breast milk and formula on discharge more frequently completed the IDA, two groups that may require more support early in the postpartum period. Additionally, several of the items in the family and parenting sections are more prevalent among IDA completers (single parent, no primary care provider, high school not complete, partner not involved, newcomer, concern for money, relationship with partner strained). As mentioned, families with infants admitted to the NICU are

underrepresented by IDA completion, characterized by lower prevalence of screen items such as premature birth, birth weight < 1500 g, Apgar score < 5, and maternal separation > 5 days. While important to consider the reasons for IDA non-completion, these results may indicate that public health is attempting to target families who benefit from support early in the postpartum period and families who are indicated on the screen to be at risk for child health and development, but should consider how to better reach families with infants admitted to the NICU.

This study utilizes HBHC postpartum screening information from ISCIS, which is an administrative database primarily used for case management and service delivery. As mentioned, the HBHC Screen is typically completed before discharge by a hospital nurse, midwife, or other health professionals and OPH provided training to those administering the HBHC Screen to enhance data quality and completion. While screening and IDA completion in this study were higher than the provincial average (Ontario Agency for Health Protection and Promotion (Public Health Ontario) 2014), there is likely some non-response bias which could affect the validity of the estimates. Further, while the proportion of unanswered and undetermined individual screening questions is low, the screening results are self-reported and subject to social desirability and recall biases. Although we utilized 4 years of data to increase the power of our overall sample size, several screening questions produced a very small number of responses and, thus, were not included in the regression model. Although likely, it is not clear whether these variables, though rare in prevalence for clients scoring a two or three on their postpartum HBHC Screen, may in fact be important predictors of high-risk in-depth assessment and further HBHC service need. It is also important to consider that with the advent of electronic screen completion and submission, there may be opportunities to improve screen completion (Alton et al. 2017) and to propose more complex (e.g., combinations or clusters of screen questions) and perhaps improved approaches to identifying families needing further assessment.

Conclusion

Future research should consider learning more about the outcomes and reasons for the high proportion of “with-risk” families who do not receive an IDA after the postpartum screen and to assess other validity measures of the HBHC Screen, such as how well it aligns with the areas identified by the IDA/Family Assessment Instrument.

As public health endeavours to deliver effective, appropriate, and innovative services, the results of this study are directly applicable to other public health jurisdictions using the HBHC Screen and IDA for referral to postpartum services. Other Canadian and international jurisdictions, along with

health providers serving families, may also apply these findings in the design or renewal of postpartum screening and service referral.

Acknowledgements We would like to recognize and thank all of the nurses, midwives, physicians, and Ottawa families who took the time to complete the HBHC Screen.

Compliance with ethical standards

Families giving birth in Ottawa between April 1, 2013, and December 31, 2016, were asked for consent to participate in the HBHC Screen either by a hospital nurse (before discharge), midwife, public health nurse, or other health professionals. This study was approved by the Ottawa Public Health Research Ethics Board.

Conflict of interest The authors declare that they have no conflict of interest.

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