

Quantitative Research

Have we left some behind? Trends in socioeconomic inequalities in breastfeeding initiation: A population-based epidemiological surveillance study

Running Title: Socioeconomic Inequalities in BF Initiation

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## Socioeconomic Inequalities in BF Initiation

**OBJECTIVES:** Breastfeeding is associated with improved health. Surveillance data show that breastfeeding initiation rates have increased; however, limited work has examined trends in socioeconomic inequalities in initiation. The study's research question was to identify whether socioeconomic inequalities in breastfeeding initiation changed over the past 20 years.

**METHODS:** This population-based study is a project within PATHS Equity for Children.

Analyses used hospital discharge data for Manitoba mother-infant dyads with live births, 1988-2011 (n=316,027). Income quintiles were created, each with ~20% of dyads. Three-year, overall and by-quintile, breastfeeding initiation rates were estimated for Manitoba and two hospitals.

Age-adjusted rates were estimated for Manitoba. Rates were modelled using Generalized Linear Models (GLMs). Three measures, rate ratios (RRs), rate differences (RDs), and Concentration Indices measured inequality at each time point. We also compared Concentration Indices with Gini coefficients to assess breastfeeding inequality vis-à-vis income inequality. Trend analyses tested for changes, over time.

**RESULTS:** Manitoba and Hospital A initiation rates increased; Hospital B rates did not change. Significant inequalities existed in nearly every period, across all three measures: RRs, RDs, and Concentration Indices. RRs and Concentration Indices suggested little to no change in inequality, from 1988 to 2011. RDs for Manitoba (comparing initiation in the highest to lowest income quintiles) did not change significantly over time. RDs decreased for Hospital A, suggesting decreasing socioeconomic inequalities in breastfeeding; RDs increased for Hospital B. Income inequality increased significantly in Manitoba during the study period.

**CONCLUSIONS:** Overall breastfeeding initiation rates can improve while inequality persists or worsens.

## Socioeconomic Inequalities in BF Initiation

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Evidence regarding the maternal/child health and economic outcomes associated with infant feeding practices has led to increased support for breastfeeding.<sup>1-3</sup> Systematic reviews have identified several factors that predict whether a mother-infant dyad initiates breastfeeding: socioeconomic status, maternal age, employment, prenatal intentions, breastfeeding self-efficacy, and hospital practices.<sup>4,5</sup> Much intervention research aims to address barriers and increase initiation rates, overall, rather than to reduce breastfeeding inequalities.<sup>6-9</sup> Few studied interventions' impact on breastfeeding inequalities.<sup>10, 11</sup> These studies focused on antenatal education and implementing hospital practices that support breastfeeding. And, although overall breastfeeding rates have increased,<sup>12</sup> inequalities in countries like Canada and the US persist.<sup>11,</sup>

13

Monitoring trends in health inequalities is important for public health.<sup>14</sup> A recent study found racial disparities in breastfeeding were decreasing.<sup>11</sup> However, research has not examined trends in socioeconomic inequalities in breastfeeding. Our epidemiological surveillance study addressed this gap by examining trends in socioeconomic inequalities in breastfeeding initiation at both hospital and provincial levels.

Our study had two research questions: (1) Have breastfeeding initiation rates changed between 1988 and 2011? and (2) Have socioeconomic inequalities in breastfeeding initiation changed between 1988 and 2011? We examined provincial initiation rates in Manitoba to inform future efforts to support breastfeeding and reduce socioeconomic inequalities in breastfeeding.<sup>15</sup> Additionally, we studied trends in initiation in two Manitoba hospitals –one rural and one urban– since many interventions designed to support initiation, including those enumerated in Manitoba's Provincial Breastfeeding Strategy, target hospital practices.<sup>6, 7, 10, 15</sup> Hospital-level

analyses serve both as illustrative case studies on the importance of monitoring trends at the facility-level and may inform future interventions to reduce breastfeeding initiation inequalities.

## **DATA AND METHODS**

This study was conducted as part of the PATHS Equity for Children program of research (PATHS). PATHS is a program of research focused on child health equity being conducted in Manitoba. PATHS was approved by the University of Manitoba Health Research Ethics Board (H2011:294) and the Manitoba Government Health Information Privacy Committee (2011/2012 – 24 and 2011/2012 – 24c).

### **Data**

Data came from the Repository at the Manitoba Centre for Health Policy.<sup>16</sup> The Repository contains health information for nearly every individual registered with Manitoba's universal healthcare system.<sup>16, 17</sup> Data came from three sources: the Manitoba Health Insurance Registry (containing dyads' postal code of residence), the hospital discharge abstract database (containing data on breastfeeding initiation), and Canadian Census data (containing data on income).

### **Analytic Cohort**

The Registry and hospital discharge abstracts were used to create the study's analytic cohorts for the provincial- and two hospital- level analyses:—all mother-infant dyads with live births and infant-gestational age  $\geq 37$  weeks (i.e., full term) born in Manitoba and in the two study hospitals between April 1, 1988 and March 31, 2011. Hospital A serves an urban

population with a median household income ~\$50,000. Hospital B serves a rural population with a median household income ~45,000.

Exclusion criteria included: (1) gestational age <37 weeks (33,626 records); (2) child born out of province (1 record); (3) missing hospital identification (1 record); (4) missing the mother's Public Health Insurance Number (211 records); and (5) missing breastfeeding data (3,839 records). Provincial analyses included 316,027 mother-infant dyads; Hospital A analyses included 24,263; Hospital B analyses included 7,055.

## **Measures**

Breastfeeding initiation data came from the hospital discharge abstract database. Discharge abstracts report infant feeding status at hospital discharge as either (a) exclusively formula-fed during the hospital stay or (b) breastfed during the hospital stay. Breastfeeding initiation was defined as a dichotomous variable: the dyad did or did not initiate breastfeeding during birth-hospital-stay. Initiation during the birth hospital stay was chosen because reducing inequalities in hospital initiation is a provincial goal<sup>15</sup> and evidence suggests delayed initiation is associated with reduced breastfeeding duration.<sup>18</sup>

Income data came from the Canadian Census. The average household income for the census dissemination area (DA) where the dyad lived provided a proxy for the dyad's socioeconomic status. A DA includes ~400-700 individuals, and is the smallest geographic area for which census data are disseminated. DA average income has been validated as a measure for individual socioeconomic status.<sup>19</sup> DAs were categorized as rural or urban. Within each category, DAs were sorted from lowest to highest average income, then divided into income quintiles, each containing ~20% of the population: R1-R5 for rural and U1-U5 for urban. R1 and

U1 designate the lowest income quintiles for rural and urban DAs, respectively. Analyses for urban Hospital A used urban income quintiles to measure socioeconomic status; rural Hospital B analyses used rural quintiles. R5 and U5 designate the highest. Rural and urban quintiles were combined to create five overall income quintiles to use in Provincial analyses.

Approximately 1.5% of dyads had missing data for average census dissemination area income. Income data were missing for the following reasons: the dyad resided in an institution (e.g., ward of Public Trustee); one or both dyad members' addresses were recorded as a Child and Family Services office; or, the dyad's census area did not report income.

## **Statistical Analyses**

### *Breastfeeding Initiation Rates*

Initiation rates were defined as the ratio of the number of breastfeeding dyads to the total number of dyads. We estimated rates -comprising summarized counts within populations- for each three year period, 1988-2011. All rates were modeled using generalized linear modelling (GLM) with a Poisson distribution and a log-population offset to account for differential population sizes.

We estimated overall initiation rates at provincial and hospital levels for all of Manitoba (n=316,027) and two Manitoba hospitals, Hospital A (n=24,263) and Hospital B (n=7,055). Provincial initiation rates were adjusted for maternal age at first birth to account for differences in maternal age over time. Modeling age-adjusted rates has been used in other studies examining trends in population-level health inequalities.<sup>20</sup>

We estimated initiation rates for each income quintile; income-specific rates were estimated at provincial and hospital levels. Age-adjusted rates were estimated at the provincial

level. GLMs used to estimate age-adjusted rates at the hospital-level failed to converge (not shown).

### *Measures of Inequality*

Rate ratios (RRs) measured inequality as the ratio of the initiation rate in the lowest income quintile to the initiation rate in the highest income quintile. RDs measured inequality as the absolute percentage point difference in initiation rates between the highest and lowest income quintiles. RRs and RDs were estimated for each three-year period, 1988-2011. RRs and RDs were calculated using GLM at provincial and hospital levels. Standard errors from the models were used for precision measures and significance tests.

Both RRs and RDs measured health equality by making pairwise comparisons. We also used the Concentration Index to measure the distribution of breastfeeding initiation across the socioeconomic gradient.<sup>21, 22</sup> It ranges from negative one to positive one.<sup>21, 22</sup> A value of zero would indicate that breastfeeding was equally distributed across the entire socioeconomic gradient. A Concentration Index approaching positive one indicates that breastfeeding is concentrated among the wealthy; approaching negative one, breastfeeding is concentrated among the poor. Methods for estimating a Concentration Index for health are explained elsewhere.<sup>21-23</sup>

We estimated the Concentration Index for breastfeeding for each three-year period (1988-2011) at both the provincial- and hospital-levels. The provincial-level Concentration Index for breastfeeding was estimated using adjusted rates; hospital-level indices used crude rates.

Changes in the Concentration Index for breastfeeding may be related to changes in underlying income inequality. Therefore, it is informative to examine changes in the Concentration Index for breastfeeding vis-à-vis changes in income inequality. To do this we

estimated the Gini Coefficient (Gini) on income to examine changes in income inequality over the study period.

The Gini quantifies inequality in the distribution of income across the population. Ginis range from zero to positive one. A value of zero indicates that income is distributed equally across the population. A Gini of one indicates that all income belongs to a single individual: absolute inequality. Methods for estimating the Gini are presented in detail, elsewhere.<sup>21-23</sup>

We estimated the Gini to quantify equity in the distribution of family income across mother-infant dyads with a live birth, 1988-2011, using household income data from the Canadian Census. We estimated three-year Ginis from 1988-2011 for all of Manitoba (i.e., the distribution of income across all mother-infant dyads with a live birth in Manitoba for each three year period, 1988-2011) and for each hospital (i.e., the distribution of income across mother-infant dyads within each hospital).

Measures of precision (e.g., standard errors, 95% confidence intervals) for Concentration Indices and Ginis were estimated using bootstrapping.<sup>24</sup>

### *Time Trends*

Trends in RRs, RDs, Concentration Indices, and Ginis were analyzed using linear contrasts. Ratios were used to measure whether inequality in 2009/2011 was different than in 1988/1990 for each measure - RR, RD, Concentration Index, and Gini. Two-sided Z-tests were used to test statistical significance. A significance level of  $p < 0.05$  was used in all analyses.

We used Version 9.2 of the SAS System for Windows to conduct analyses (SAS Institute, Cary, NC).

## **RESULTS**

### **Descriptive Results**

Table 1 presents descriptive data for the analytic population. Average maternal age at first birth for each time period at the provincial-level ranged between 24.45 and 25.53 years. Average maternal age for each time period at Hospital A ranged from 24.35 to 25.23 years. Average age in Hospital B ranged from 21.98 to 24.20 years.

### **Breastfeeding Initiation Trends**

Table 2 presents the breastfeeding trends from 1988 to 2011 for all of Manitoba and for Hospitals A and B. Trend analyses showed that Manitoba had a statistically significant increase in both crude ( $p < 0.001$ ) and adjusted ( $p < 0.001$ ) breastfeeding initiation rates over this period. Hospital A experienced a statistically significant increase in initiation rates ( $p < 0.001$ ). Hospital B rates failed to show a trend ( $p = 0.58$ ).

### **Trends in Inequalities**

#### *Manitoba*

Figure 1 (panel A) presents trends in initiation rates, by income quintile for all of Manitoba. Trend analyses of Provincial data showed that initiation rates by quintile increased significantly over time ( $p < 0.001$  for each income quintile). Significant inequalities existed at each time point when measured by both the RR and RD ( $p < 0.001$ ). We failed to find changes in inequality over the study period using both trend tests and two-sided Z-tests comparing 1988/91 with 2009/11.

Figure 1 (panel B) presents trends in the Gini for income and Concentration Index for breastfeeding. Trend tests on the Gini show that socioeconomic inequality increased significantly over the study period ( $p < 0.05$ ). We failed to find differences in inequality over the study period using the Concentration Index for breastfeeding.

#### *Hospital A-Urban*

Figure 2 (panel A) presents trends in initiation rates for Hospital A. Trend analyses showed increases in initiation rates for quintiles U1 ( $p < 0.001$ ), U2 ( $p < 0.001$ ), U3 ( $p < 0.01$ ), and U4 ( $P < 0.05$ ) Trend analyses failed to show a significant increase in initiation for quintile U5 ( $p = 0.63$ ).

Hospital A had significant inequality, as measured by the RR, at the first time period, only; the RR was not statistically significant at all other time periods. There was a statistically significant absolute difference (RD) between U1 and U5 at each time period. We failed to find differences in RR and RD when comparing 1988/91 with 2009/11. Trend tests showed decreasing inequality for both measures: RR ( $p < 0.001$ ) and RD ( $p < 0.001$ ).

Figure 2 (panel B) presents trends in the Gini and Concentration Index for Hospital A. Analyses showed that the Gini increased over time ( $P < 0.001$ ) and that the Gini at 2009-2011 was significantly larger than the Gini at 1988-91 ( $p < 0.001$ ); income inequality among dyads at Hospital A increased significantly during the study period. Trend tests on the Concentration showed decreasing breastfeeding inequality ( $p < 0.01$ ); two-sided Z-tests failed to show a difference between 1988/91 and 2009/11.

*Hospital B-Rural*

Trend analyses by income quintile failed to show a change in initiation rates for quintiles R2-R5 (Figure 3, panel A). The lowest quintile had a significant decrease in breastfeeding ( $p=0.01$ ). Quintile regression further showed that the trend in the lowest quintile was significantly different from the trends in the other four quintiles ( $p<0.05$ ). There was significant inequality in rates between the highest and lowest quintiles, as measured by the RD, at each time period (Table 1). The RR failed to show significant inequality during the first three time periods. We failed to find a difference in RR and RD when comparing 1988/91 with 2009/11. Trend tests on both RR ( $p<0.01$ ) and RD ( $p<0.01$ ) suggested increasing inequality over the study period.

Figure 3 (panel B) presents trends in the Gini and Concentration Index for Hospital B. The Gini on income showed increasing income inequality with both the trend test ( $p<0.01$ ) and testing difference between 1988-91 and 2009-11 ( $p<0.001$ ). Trend tests on the Concentration Index showed that breastfeeding inequality also increased significantly ( $p<0.01$ ); furthermore, the Concentration Index in 2009/11 was significantly larger than in 1988/91 ( $p<0.001$ ).

## **DISCUSSION**

This article contributes to research on breastfeeding in three ways: (1) it demonstrates that overall breastfeeding initiation rates can improve while inequalities persist or worsen; (2) it highlights the utility of considering changes in underlying socioeconomic inequalities when monitoring trends in health inequalities; and (3) it provides a comparison of measures with respect to monitoring trends in health inequalities.

## **Interpretation**

Trends in overall breastfeeding initiation rates in North America show recent improvement.<sup>25</sup> Similarly, both Manitoba overall rates and Hospital A's overall rates increased over the study period; although, Hospital B's rates failed to show any change. Additionally, both provincial-level and Hospital A analyses showed that rates within each quintile improved, including rates among lower income dyads. These increasing rates could reflect recent increased attention in Manitoba to support breastfeeding:<sup>15</sup> emphasis on implementing hospital practices to support breastfeeding (i.e., Baby Friendly<sup>15, 26</sup>) and on prenatal education.<sup>15</sup> Indeed, Manitoba has been working extensively on increasing the number of Baby Friendly facilities (i.e., provide the care practices outlined in the Ten Steps to Successful Breastfeeding).<sup>15, 26</sup> The Ten Steps have been shown to increase breastfeeding initiation,<sup>6, 27</sup> and duration.<sup>6, 18, 27</sup>

Our observed increases among low-income populations are similar to recent studies which found improvement among racial/ethnic minorities.<sup>11</sup> The exception was Hospital B where rates among the lowest income quintile decreased over the study period. Future qualitative research interviewing mothers and healthcare staff from this hospital could help illuminate reasons for this decrease and identify strategies to support this population.

Although improvements were observed across the socioeconomic gradient, inequalities persisted throughout the observation period. Indeed, we found that initiation followed a socioeconomic gradient across the study period, which mirrors other published findings.<sup>13, 28</sup> Furthermore, breastfeeding inequality did not decrease in our provincial-level analyses and inequality increased in Hospital B; this is in contrast to a recent study in the US which found decreasing inequalities across racial/ethnic groups.<sup>11</sup>

Our results suggest a possible explanation for the minimal-to-no decreases in socioeconomic inequalities in breastfeeding: income inequality increased significantly in Manitoba over our study period, 1988/91 to 2009/11. Failing to consider the changing socioeconomic landscape may only provide half the story. Indeed, given the widening gap between the wealthy and the disadvantaged, one may expect socioeconomic breastfeeding inequalities to also increase. However, contrary to this expectation, we failed to find changes in breastfeeding inequalities in our provincial analyses and observed decreasing inequalities in Hospital A. Contextual factors may be mitigating the impact of increasing income inequality vis-à-vis socioeconomic inequalities in breastfeeding. Increasing income inequality may also partially explain why we found little decrease in breastfeeding inequalities when the US study found decreasing racial inequalities in breastfeeding.<sup>11</sup>

That breastfeeding inequality did not decrease may also suggest that targeted efforts among vulnerable populations are required to close the inequality gap between high- and low-income populations. A recent study from Belarus found that a population-based strategy, i.e., Baby Friendly Initiative, did not reduce breastfeeding inequalities between highly educated and less educated mothers.<sup>10</sup> That being said, the hypothesis that Baby Friendly does not reduce income inequalities in breastfeeding has not, yet, been tested; moreover, the Belarus findings may not generalize to high-income countries. To our knowledge the Belarus study is the first to study the impact of policies on breastfeeding inequalities. Future research exploring the impact Baby Friendly has on breastfeeding inequalities in high-income countries is required to assess the generalizability of the Belarus findings. More broadly, research is required that identifies whether targeted strategies, universal strategies, or a combination of both, are best suited to reduce income inequalities in breastfeeding.<sup>14</sup>

## **Limitations and Strengths**

A limitation of this study is that income was recorded at the area-level. However, research shows that area-level measurement provides a good approximation of individual-level socioeconomic status.<sup>19</sup> Our measure for breastfeeding initiation came from administrative data which may misclassify dyads' infant feeding status. For example, a dyad may attempt to breastfeed but have unsuccessful latch during the hospital stay; such a dyad could be classified as "breastfed" in administrative data. However, our initiation rates are comparable to, and slightly lower than, those reported in the Canadian Community Health Survey.<sup>29</sup> Additionally, we do not have population-level measures for duration. Trends in initiation inequalities may not generalize to trends in breastfeeding duration inequalities. Other covariates are known to predict breastfeeding at the individual-level;<sup>4, 5</sup> stratifying on these characteristics may yield differing trends in breastfeeding inequalities over the study period.<sup>20, 23</sup> Observed trends in inequalities are not generalizable. Other studies using different populations will likely find differing trends.

A strength of this study is its use of data capturing breastfeeding information for nearly every live birth within Manitoba. This facilitates study of initiation rates among, sometimes, hard-to-reach individuals such as dyads from low-income areas. The data also allowed examination of initiation rates across a 20+ year period facilitating the identification and analyses of trends.

## **Conclusion**

Monitoring trends in socioeconomic inequalities in breastfeeding is important for ensuring that less-advantaged persons are not left behind. Our results showed that improvements

## Socioeconomic Inequalities in BF Initiation

in overall rates can be achieved even while inequality persists. We also demonstrated that considering changes in income inequality is important when studying trends in socioeconomic inequalities in health. We showed that presenting more than one indicator provides a more complete picture of changes in health inequalities<sup>14, 23, 30</sup> Using multiple measures may facilitate progress towards reducing socioeconomic inequalities in breastfeeding.<sup>30</sup> Finally, we identified situations where marginalized populations (i.e., low-income dyads) may need focused support to reduce health inequalities.

Socioeconomic Inequalities in BF Initiation

Table 1. Descriptive statistics for analytic cohort by time period, 1988-2011

	1988/89- 1990/91	1991/92- 1993/94	1994/95- 1996/97	1997/98- 1999/00	2000/01- 2002/03	2003/04- 2005/06	2006/07- 2008/09	2009/10- 2010/11
<b>Manitoba</b>								
(n=# mother-infant dyads)	46344	45268	42579	38759	37292	37325	40516	27944
Average Maternal Age (mean)	25.54 (25.49,25.59)	25.04 (24.99,25.09)	24.81 (24.76,24.86)	24.62 (24.57,24.68)	24.50 (24.45,24.56)	24.56 (24.50,24.62)	24.46 (24.40,24.51)	24.66 (24.60,24.73)
Infant's Sex (%)								
Male	50.89 (50.43,51.34)	50.93 (50.47,51.39)	51.02 (50.54,51.49)	51.32 (50.82,51.82)	51.23 (50.72,51.73)	50.90 (50.40,51.41)	50.59 (50.11,51.08)	51.08 (50.49,51.66)
Female	49.11 (48.66,49.57)	49.07 (48.61,49.53)	48.98 (48.51,49.46)	48.68 (48.18,49.18)	48.77 (48.27,49.28)	49.10 (48.59,49.60)	49.41 (48.92,49.89)	48.92 (48.34,49.51)
<b>Hospital_A</b>								
(n=# mother-infant dyads)	3157	3007	3064	2790	2936	3042	3624	2643
Average Maternal Age (mean)	25.23 (25.07,25.39)	25.03 (24.85,25.21)	24.78 (24.61,24.95)	24.60 (24.42,24.78)	24.35 (24.17,24.53)	24.53 (24.35,24.71)	24.47 (24.31,24.64)	24.59 (24.40,24.78)
Infant's Sex (%)								

<b>Socioeconomic Inequalities in BF Initiation</b>								
	50.81	51.11	49.22	51.04	52.59	52.14	50.14	51.95
Male	(49.06,52.55)	(49.33,52.90)	(47.45,50.99)	(49.18,52.89)	(50.78,54.39)	(50.36,53.91)	(48.51,51.77)	(50.04,53.85)
	49.19	48.89	50.78	48.96	47.41	47.86	49.86	48.05
Female	(47.45,50.94)	(47.10,50.67)	(49.01,52.55)	(47.11,50.82)	(45.61,49.22)	(46.09,49.64)	(48.23,51.49)	(46.15,49.96)
<b>Hospital B</b>								
(n=# mother-infant dyads)	1153	1064	902	859	833	865	827	552
Average Maternal Age (mean)	24.19	22.89	22.37	22.27	22.41	22.25	21.98	22.38
	(23.91,24.46)	(22.60,23.18)	(22.06,22.68)	(21.93,22.61)	(22.07,22.75)	(21.91,22.58)	(21.66,22.30)	(21.96,22.80)
Infant's Sex (%)								
	49.00	54.04	49.33	54.37	52.34	49.48	48.85	51.81
Male	(46.12,51.89)	(51.05,57.04)	(46.07,52.60)	(51.03,57.70)	(48.95,55.73)	(46.15,52.81)	(45.44,52.26)	(47.64,55.98)
	51.00	45.96	50.67	45.63	47.66	50.52	51.15	48.19
Female	(48.11,53.88)	(42.96,48.95)	(47.40,53.93)	(42.30,48.97)	(44.27,51.05)	(47.19,53.85)	(47.74,54.56)	(44.02,52.36)

## Socioeconomic Inequalities in BF Initiation

Table 2. Overall Breastfeeding initiation rates, 1988-2011

	1988/89- 1990/91	1991/92- 1993/94	1994/95- 1996/97	1997/98- 1999/00	2000/01- 2002/03	2003/04- 2005/06	2006/07- 2008/09	2009/10- 2010/11
<b>Manitoba (n=316,027)</b>								
Initiation Rate % <sup>*,†,‡</sup>	72.04	75.97	75.73	77.32	80.52	81.52	77.78	79.64
(95 % CI)	(69.78, 74.37)	(73.84, 78.17)	(72.64, 78.95)	(74.12, 80.65)	(77.29, 83.90)	(78.26, 84.92)	(74.36, 81.35)	(76.06, 83.39)
<b>Hospital A(n=24,263)</b>								
Initiation Rate (%) <sup>*,†</sup>	74.69	76.39	80.58	79.86	83.21	83.66	84.69	84.30
(95 % CI)	(73.17, 76.21)	(74.87, 77.91)	(79.18, 81.98)	(78.37, 81.34)	(81.86, 84.56)	(82.35, 84.98)	(83.51, 85.86)	(82.91, 85.69)
<b>Hospital B (n=7,055)</b>								
Initiation Rate (%)	76.24	75.75	74.17	73.11	71.07	74.91	73.76	76.09
(95 % CI)	(73.78, 78.69)	(73.18, 78.33)	(71.31, 77.03)	(70.14, 76.07)	(67.99, 74.15)	(72.02, 77.80)	(70.76, 76.76)	(72.53, 79.65)

\* Breastfeeding initiation rate in 2009/10-2010/11 statistically significantly different from breastfeeding initiation rate in 1988/89-1990/91 (p<0.05).

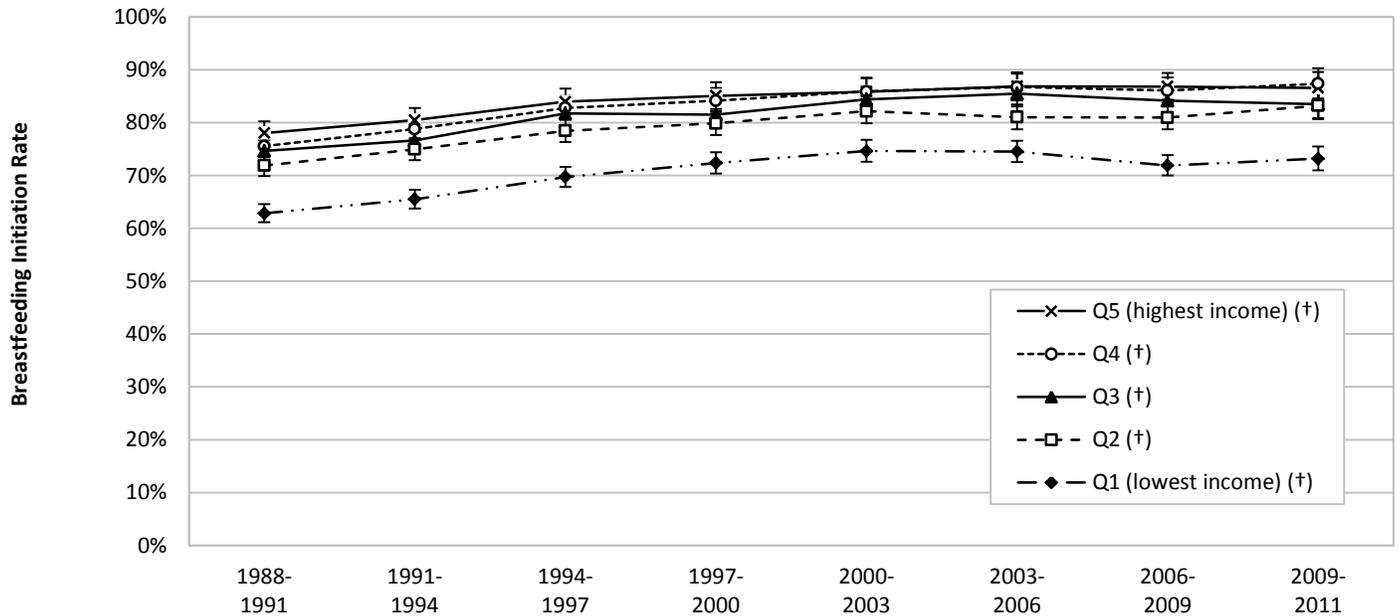
† Statistically significant linear trend in breastfeeding initiation rates, over time (p<0.05).

‡ Adjusted for maternal age at first birth.

## Socioeconomic Inequalities in BF Initiation

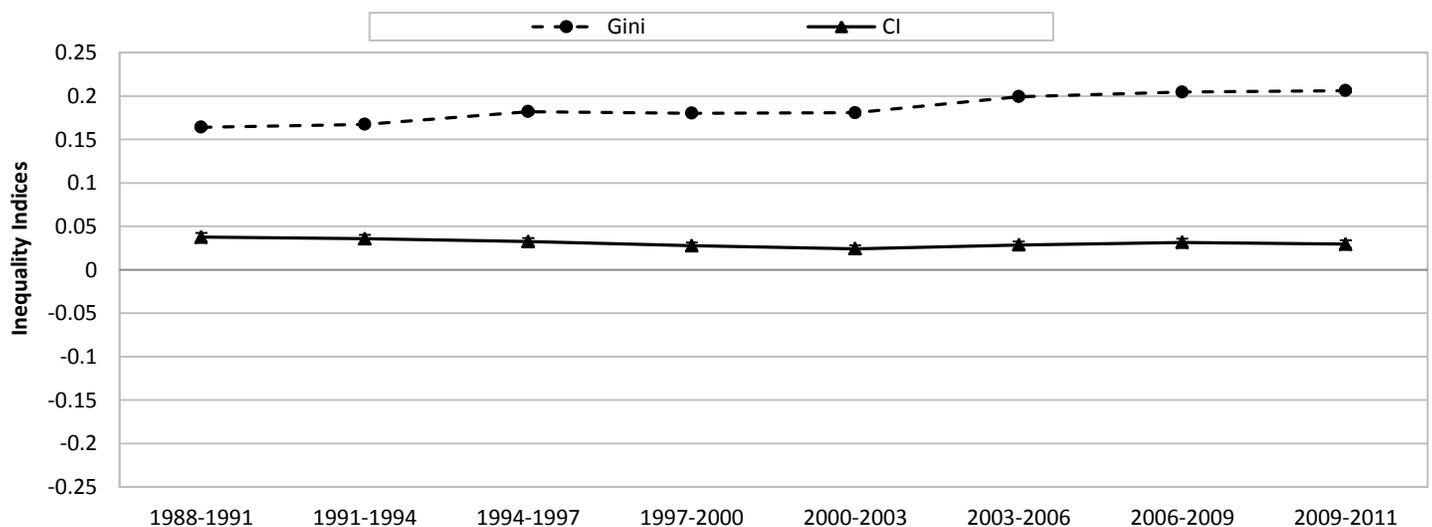
Figure 1: Breastfeeding and socioeconomic inequality indices for Manitoba (n=316,027): 1988-2011

(a) Breastfeeding Initiation Rate by Income Quintile. (\*) denotes significant different between 1988-1991 and 2009-2011; (†) denotes significant trend, over time



Rate Ratios Q1/Q5, (95% CI)	0.81 (0.78, 0.83)	0.81 (0.79, 0.84)	0.83 (0.80, 0.86)	0.85 (0.82, 0.88)	0.87 (0.84, 0.90)	0.86 (0.83, 0.89)	0.83 (0.80, 0.86)	0.85 (0.81, 0.88)
Rate Differences Q5-Q1, (95% CI)	-15.20 (-16.48,-13.93)	-14.96 (-16.22,-13.71)	-14.24 (-15.47,-13.01)	-12.71 (-13.96,-11.47)	-11.23 (-12.46,-9.99)	-12.36 (-13.56,-11.16)	-14.92 (-16.10,-13.74)	-13.41 (-14.83,-11.98)

(b) Trends in the Concentration Index (CI) in breastfeeding initiation and Gini on Income for Manitoba

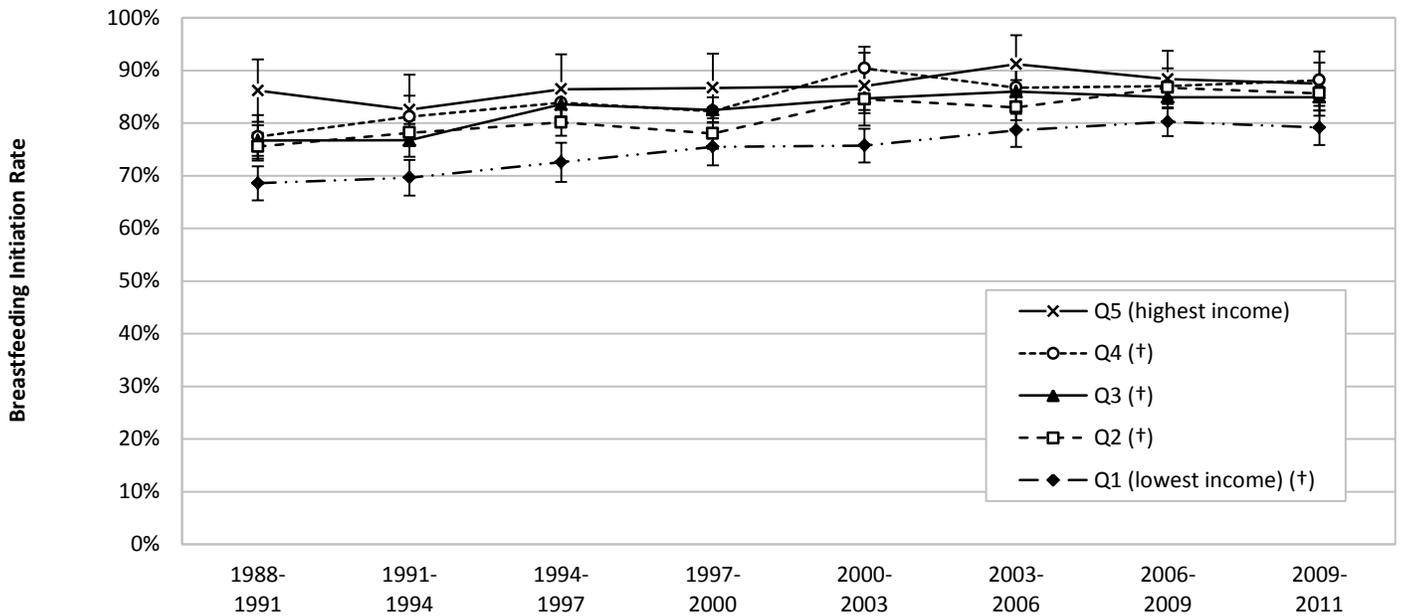


Gini (*,†)	0.164 (0.162,0.166)	0.167 (0.165,0.169)	0.182 (0.180,0.184)	0.180 (0.178,0.182)	0.181 (0.179,0.183)	0.199 (0.197,0.201)	0.205 (0.203,0.206)	0.206 (0.204,0.208)
CI	0.038 (0.033,0.042)	0.036 (0.031,0.040)	0.032 (0.028,0.037)	0.028 (0.024,0.032)	0.024 (0.020,0.028)	0.029 (0.025,0.033)	0.032 (0.027,0.036)	0.030 (0.025,0.034)

Socioeconomic Inequalities in BF Initiation

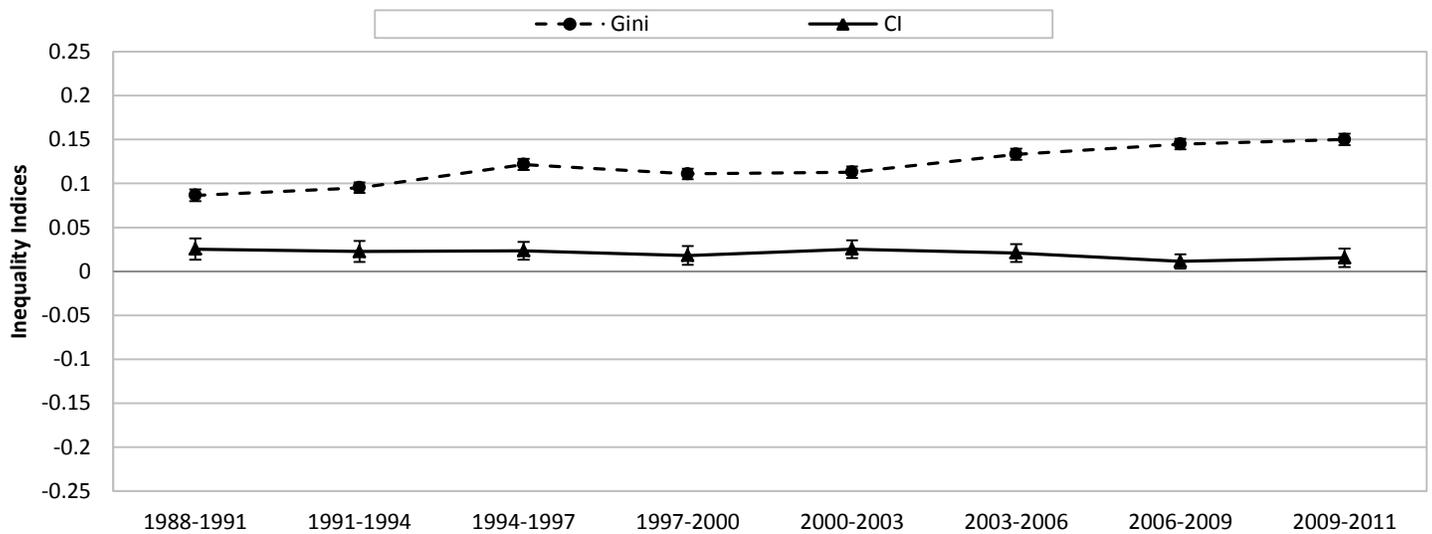
Figure 2: Breastfeeding and socioeconomic inequality indices for Hospital A (urban) (n=24,263): 1988-2011

(a) Breastfeeding Initiation Rate by Income Quintile. (\*) denotes significant different between 1988-1991 and 2009-2011; (+) denotes significant trend, over time



Rate Ratios (+)	0.80	0.84	0.84	0.87	0.87	0.86	0.91	0.90
Q1/Q5, (95% CI)	(0.65, 0.98)	(0.68, 1.04)	(0.67, 1.06)	(0.69, 1.09)	(0.67, 1.12)	(0.69, 1.08)	(0.75, 1.10)	(0.73, 1.12)
Rate Differences (+)	-17.59	-12.92	-13.86	-11.19	-11.28	-12.56	-8.08	-8.35
Q5-Q1, (95% CI)	(-24.35,-10.83)	(-20.36,-5.48)	(-21.44,-6.28)	(-18.58,-3.79)	(-19.45,-3.11)	(-18.89,-6.24)	(-14.10,-2.06)	(-15.31,-1.40)

(b) Trends in the Concentration Index (CI) in breastfeeding initiation and Gini on Income for Hospital A(urban)

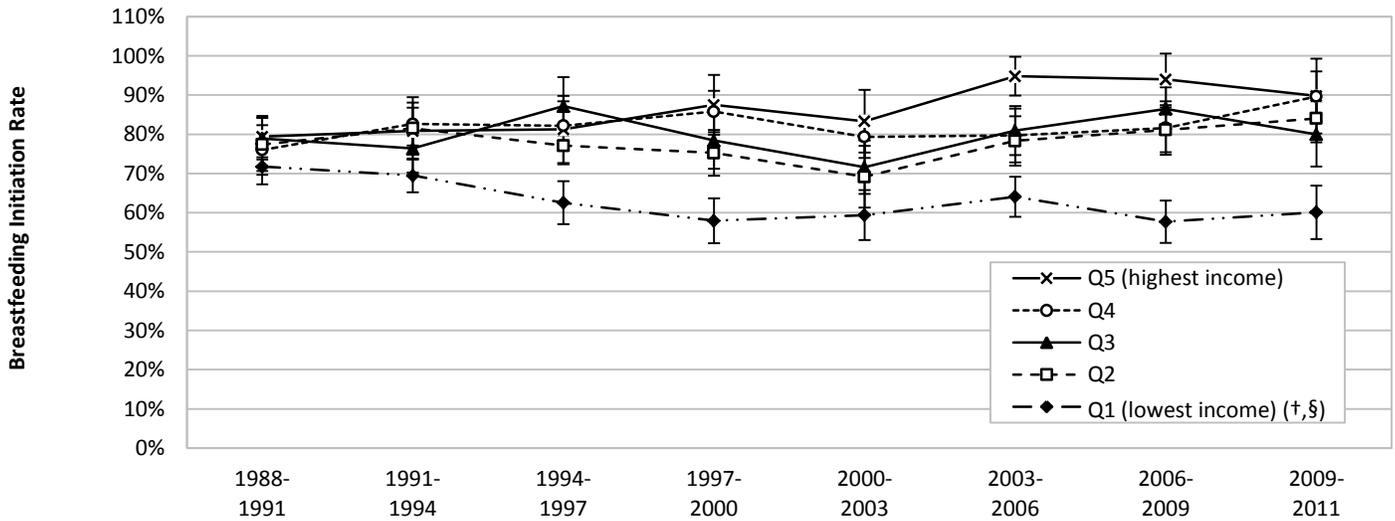


Gini (*,+)	0.087	0.095	0.122	0.111	0.113	0.133	0.145	0.150
	(0.080,0.093)	(0.089,0.101)	(0.115,0.128)	(0.105,0.117)	(0.106,0.119)	(0.127,0.140)	(0.139,0.151)	(0.143,0.157)
CI (+)	0.025	0.023	0.023	0.018	0.025	0.021	0.011	0.015
	(0.013,0.037)	(0.011,0.034)	(0.013,0.034)	(0.007,0.029)	(0.015,0.035)	(0.011,0.031)	(0.003,0.019)	(0.005,0.026)

Socioeconomic Inequalities in BF Initiation

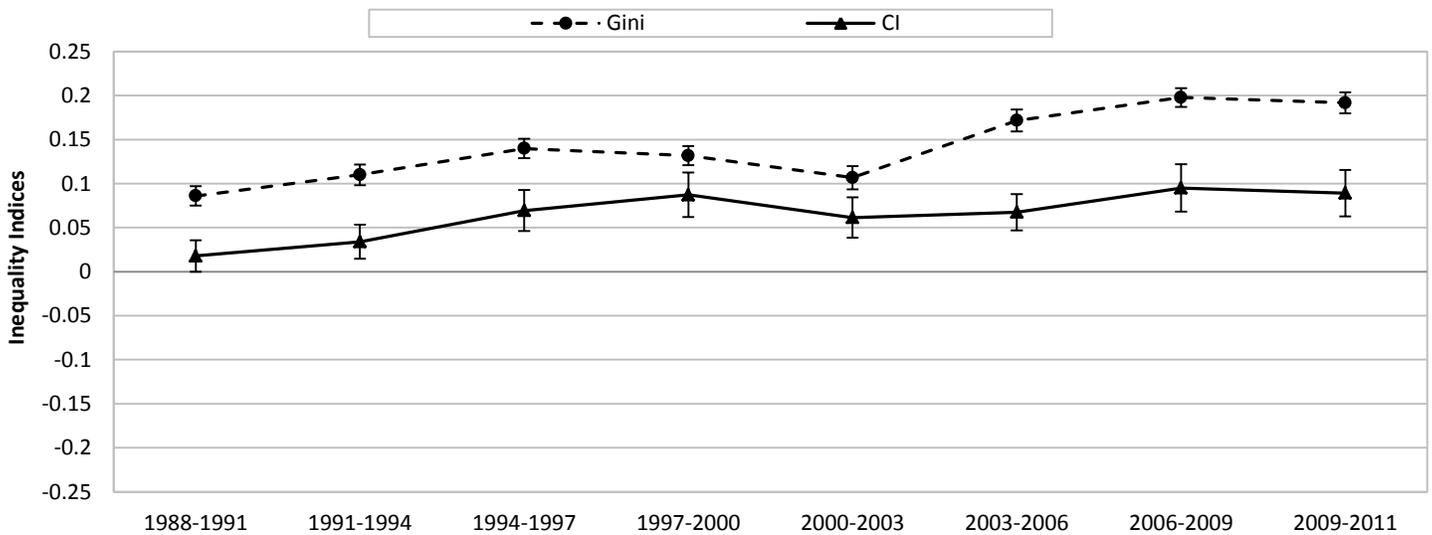
Figure 3: Breastfeeding and socioeconomic inequality indices for Hospital B (rural) (n=7,055): 1988-2011

(a) Breastfeeding Initiation Rate by Income Quintile. (\*) denotes significant different between 1988-1991 and 2009-2011; (+) denotes significant trend, over time; (§) denotes quintile trend significantly different from other quintiles



Rate Ratios (+) Q1/Q5, (95% CI)	0.90 (0.75, 1.09)	0.86 (0.70, 1.05)	0.77 (0.58, 1.02)	0.66 (0.50, 0.89)	0.71 (0.53, 0.95)	0.68 (0.52, 0.88)	0.61 (0.45, 0.85)	0.67 (0.46, 0.98)
Rate Differences (*,+) Q5-Q1, (95% CI)	-7.61 (-14.58,-0.65)	-11.36 (-18.72,-4.00)	-18.71 (-28.87,-8.55)	-29.55 (-39.11,-19.99)	-23.94 (-34.14,-13.75)	-30.71 (-37.84,-23.58)	-36.28 (-44.79,-27.78)	-29.64 (-41.36,-17.93)

(b) Trends in the Concentration Index (CI) in breastfeeding initiation and Gini on Income for Hospital B (rural)



Gini (*,+)	0.086 (0.075,0.097)	0.110 (0.098,0.122)	0.140 (0.129,0.151)	0.132 (0.121,0.142)	0.107 (0.094,0.120)	0.172 (0.159,0.184)	0.198 (0.187,0.208)	0.192 (0.180,0.204)
CI (*,+)	0.018 (0.000,0.036)	0.034 (0.015,0.053)	0.069 (0.046,0.093)	0.087 (0.062,0.113)	0.061 (0.038,0.084)	0.068 (0.047,0.088)	0.095 (0.068,0.122)	0.089 (0.063,0.115)

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