Do Adverse Birth Outcomes Explain the Association between Short Birth Spacing and Child Maltreatment?

A Cohort Study of Infants Born in North Carolina

Anna Rybińska-Campbell, PhD

Population Health and Equity Research Institute Seminar

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MetroHealth

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How did I get here?

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Do Adverse Birth Outcomes Explain the Association between Short Birth Spacing and Child Maltreatment?

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Do Adverse Birth Outcomes **Explain the Association** between Short Birth Spacing and Child Maltreatment?

A **Cohort Study** of Infants Born in North Carolina

The key term in the studies of birth spacing is *the inter-pregnancy interval*

Inter-pregnancy intervals: the **end** of a pregnancy and the **beginning** of another

Pregnancies should be spaced at least 18 months apart

American Association of Obstreticians and Gynecologists Foundation

"Optimal spacing of 18 months to 5 years"

World Health Organization

"At least 24 months"

Short birth spacing contributes to adverse maternal and infant health outcomes:

- **Preterm birth and low birth weight** (Conde-Agudelo, Rosas-Bermúdez, and Kafury-Goeta 2006)

Short birth spacing contributes to adverse maternal and infant health outcomes:

- Preterm birth and low birth weight (Conde-Agudelo, Rosas-Bermúdez, and Kafury-Goeta 2006)
- Maternal morbidity and mortality (Conde-Agudelo, Rosas-Bermúdez, amd Kafury-Goeta 2007)

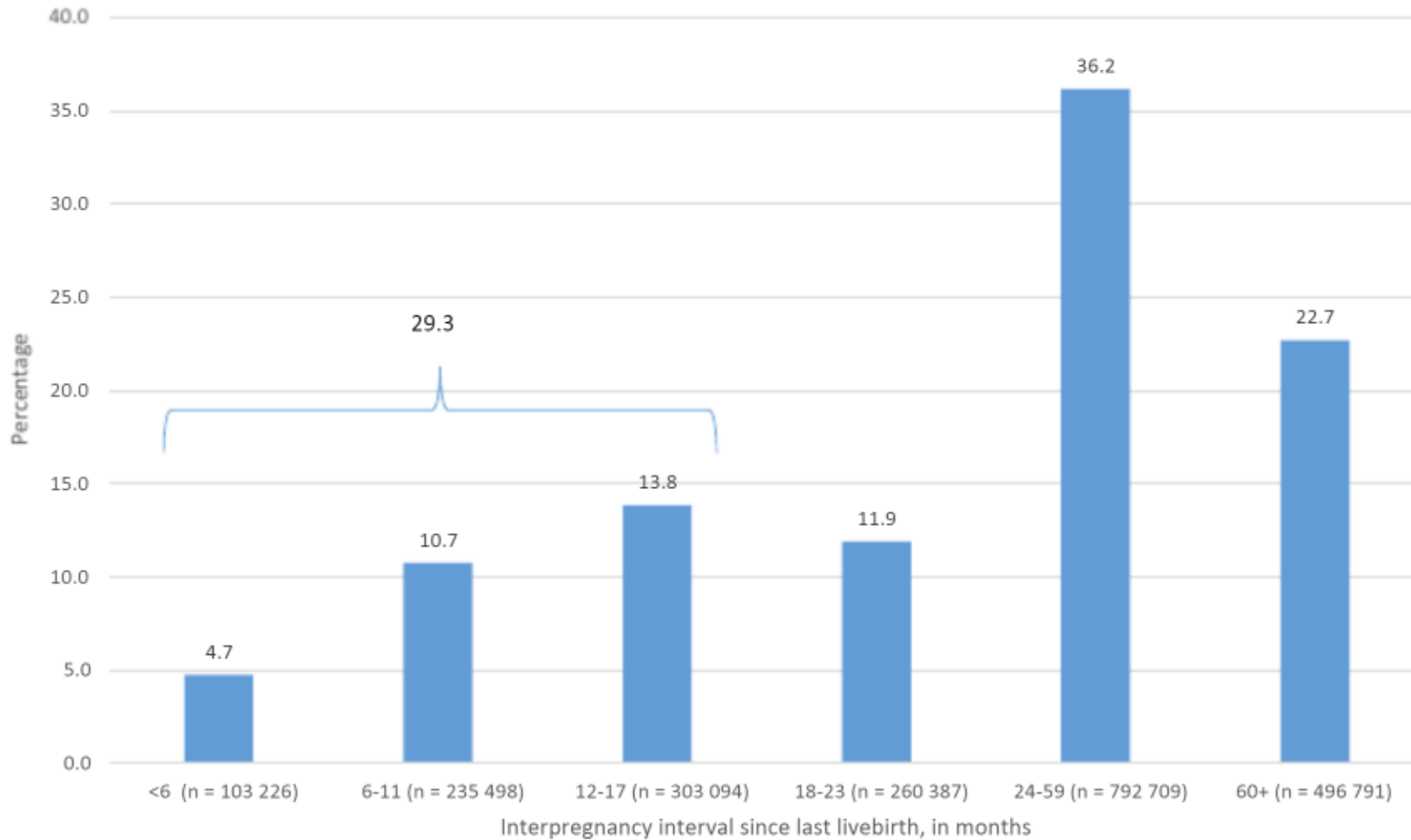# Short birth spacing is common in the United States

FIGURE 1 Distribution of interpregnancy intervals since last live birth among singleton, non-first births in the United States, 2016*. *50 reporting states and District of Columbia (Courtesy: Marie Thoma, University of Maryland, College Park, MD; July 2018)

Short birth spacing is common in the United States

In 2023, 437,944 births with birth-to-birth interval of 4-24 months (CDC Wonder 2024).
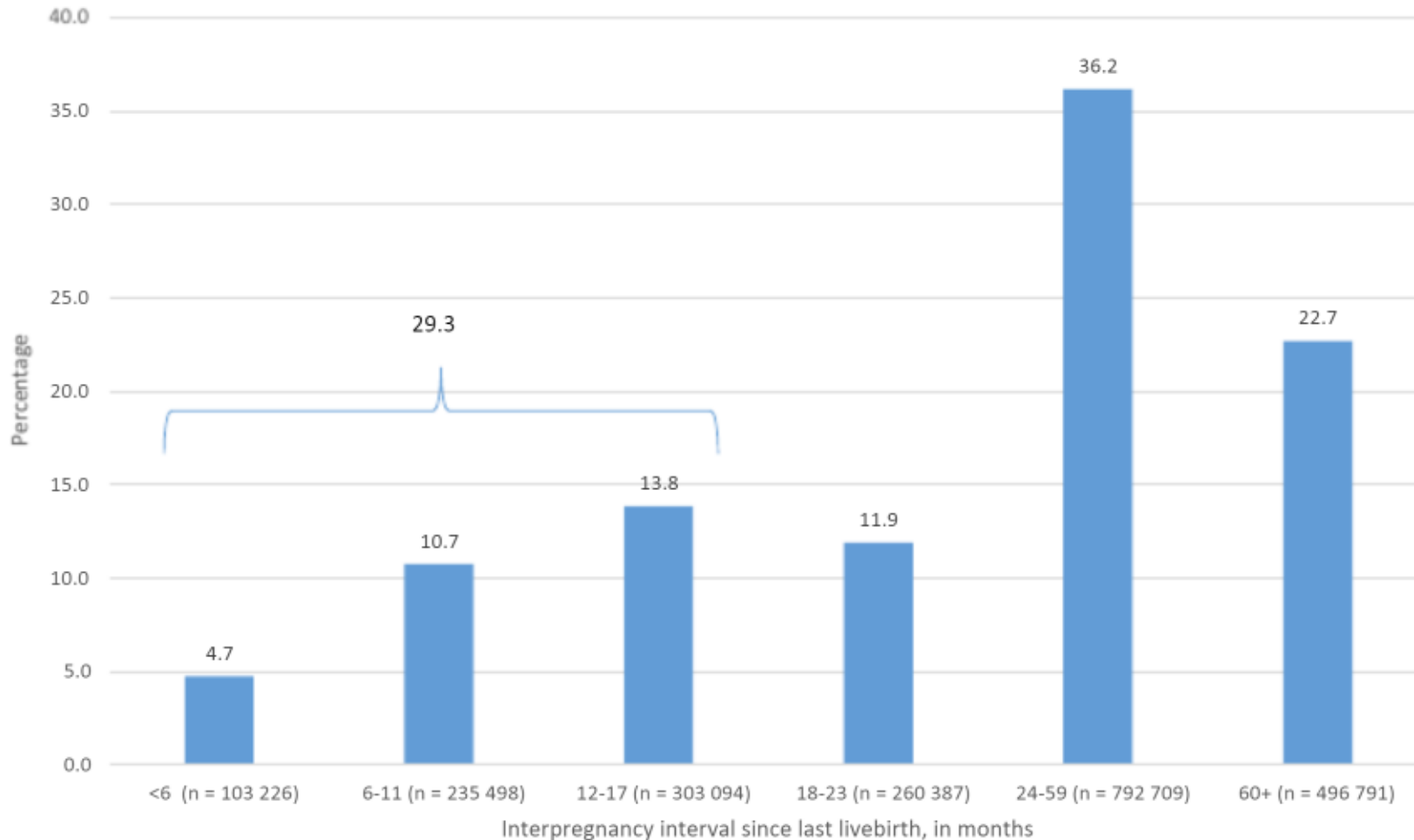
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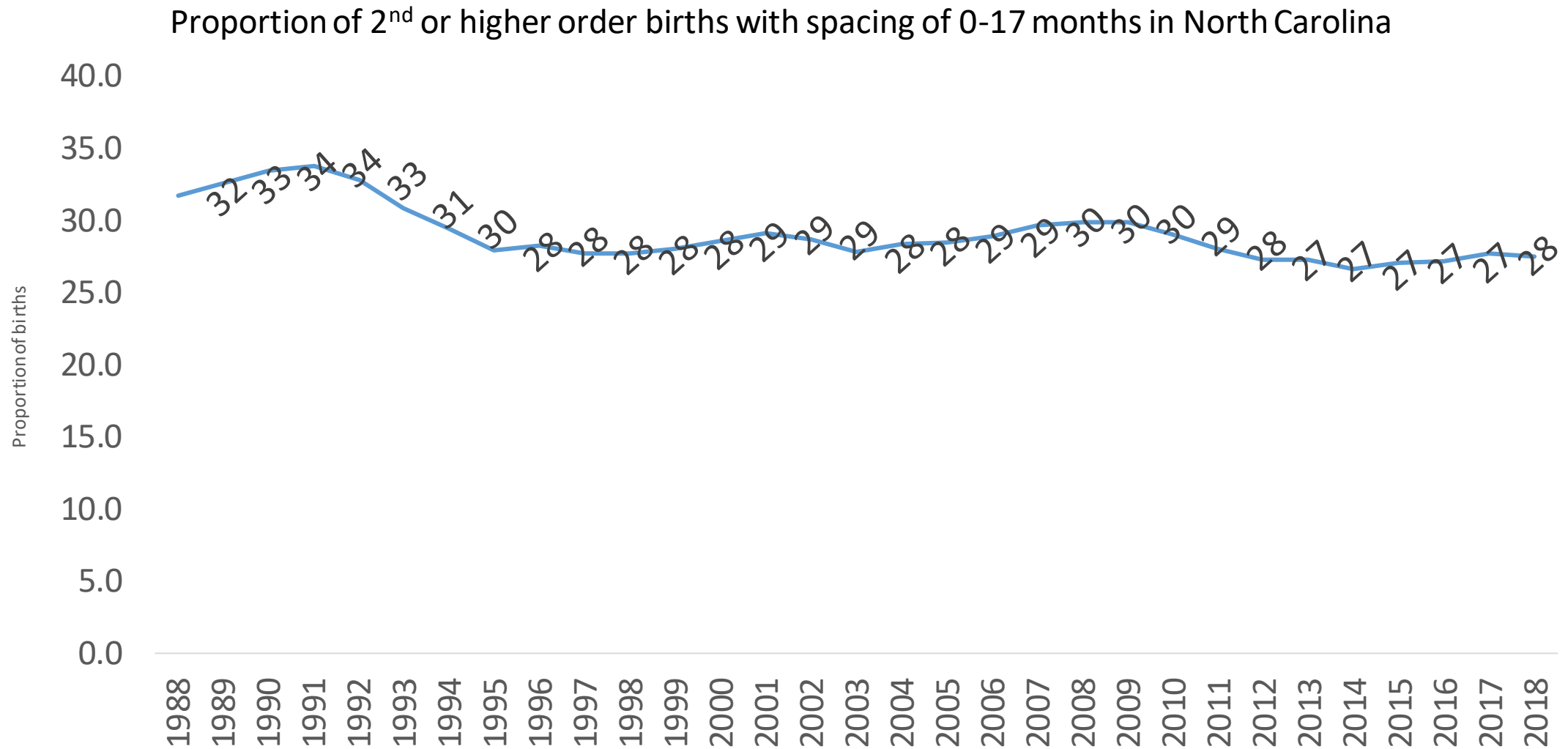
Ahrens and Hutcheon 2019

11

The prevalence of short birth spacing remains stable over time

Proportion of 2nd or higher order births with spacing of 0-17 months in North Carolina

Proportion of births

40.0

35.0

30.0

25.0

20.0

15.0

10.0

5.0

0.0

32 33 34 34 33 31 30 28 28 28 28 28 29 29 29 28 28 29 29 30 30 30 29 28 27 27 27 27 27 28

1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

Rybińska et al. 2021

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- **Outcome of interest: risk of maltreatment during early childhood**

Child maltreatment is common and detrimental to children's well-being

- Experience of maltreatment is linked to **poor developmental, behavioral, and health outcomes** (Reading et al. 2009)

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- **28.4%** of adolescents report experiencing physical abuse and **11.8%** report physical neglect (Hussey, Chang, and Kotch 2006)

- **12.5%** of US children experience a **confirmed** case of maltreatment by 18 years of age (Wildeman et al. 2014)
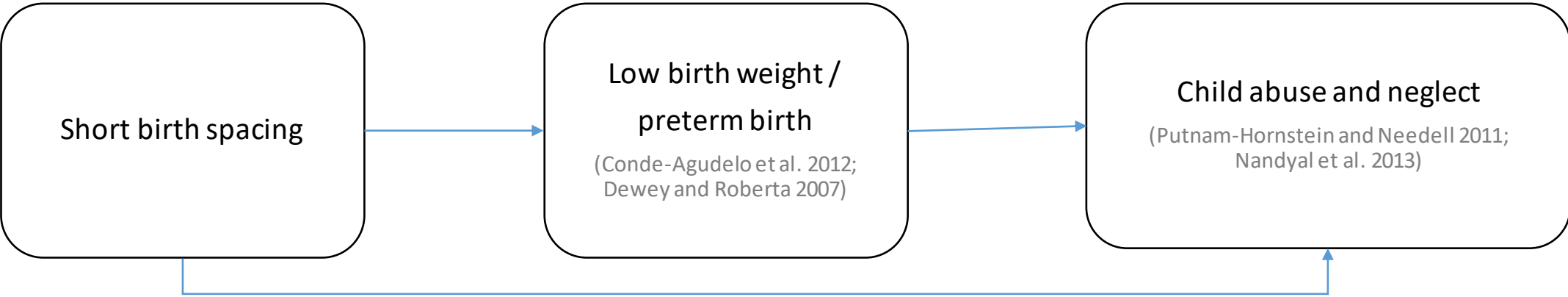
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- **12.5%** of US children experience a **confirmed** case of maltreatment by 18 years of age (Wildeman et al. 2014)

- The highest rates of maltreatment are observed in **early childhood** (Administration for Children and Families 2019)

Theoretical model

Short birth spacing → Low birth weight / preterm birth (Conde-Agudelo et al. 2012; Dewey and Roberta 2007) → Child abuse and neglect (Putnam-Hornstein and Needell 2011; Nandyal et al. 2013)

Theoretical model

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(Conde-Agudelo et al. 2012; Dewey and Roberta 2007) | → | Child abuse and neglect
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Children born following a birth-to-conception interval of <18 months.

Standard AAP guidelines.

Operationalized as having a CPS assessment.

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Data

North Carolina Birth Records
1988-2018
(N=3.6 million)

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North Carolina Child Protective
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1997-2018
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Cohort of children born in North
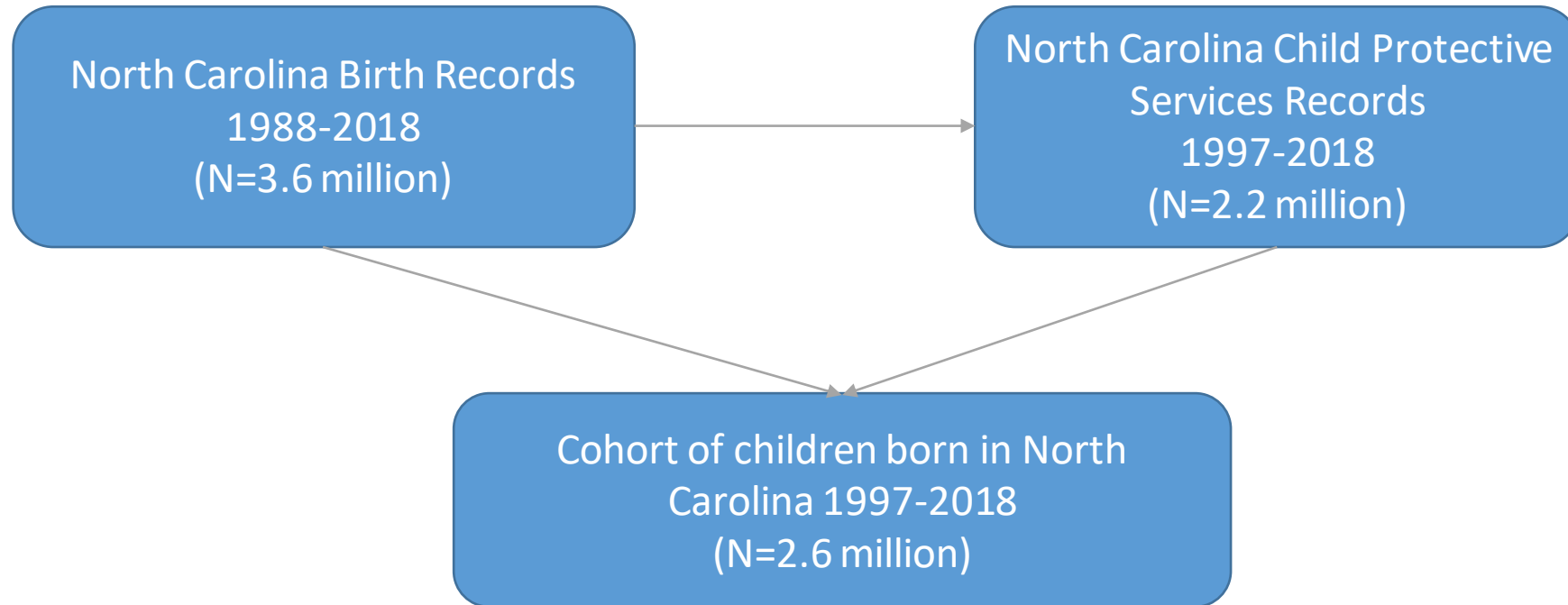Carolina 1997-2018
(N=2.6 million)

Sample selection

- Full population ➔
  - Select children born 2011-2017 ➔
    - 2nd or higher born only ➔
      - Singleton births only ➔
        - Short and recommended birth spacing ➔
          - Complete data on mediator ➔
            - 362,880

Socio-demographic characteristics

- Maternal race and ethnicity
- Source of payment for delivery (private insurance vs. Medicaid)
- Maternal age at conception and at birth
- Maternal educational attainment at birth
- Maternal marital status (married, unmarried father recorded, unmarried father not recorded)
- Mother foreign born
- Smoking
- BMI
- Prenatal care
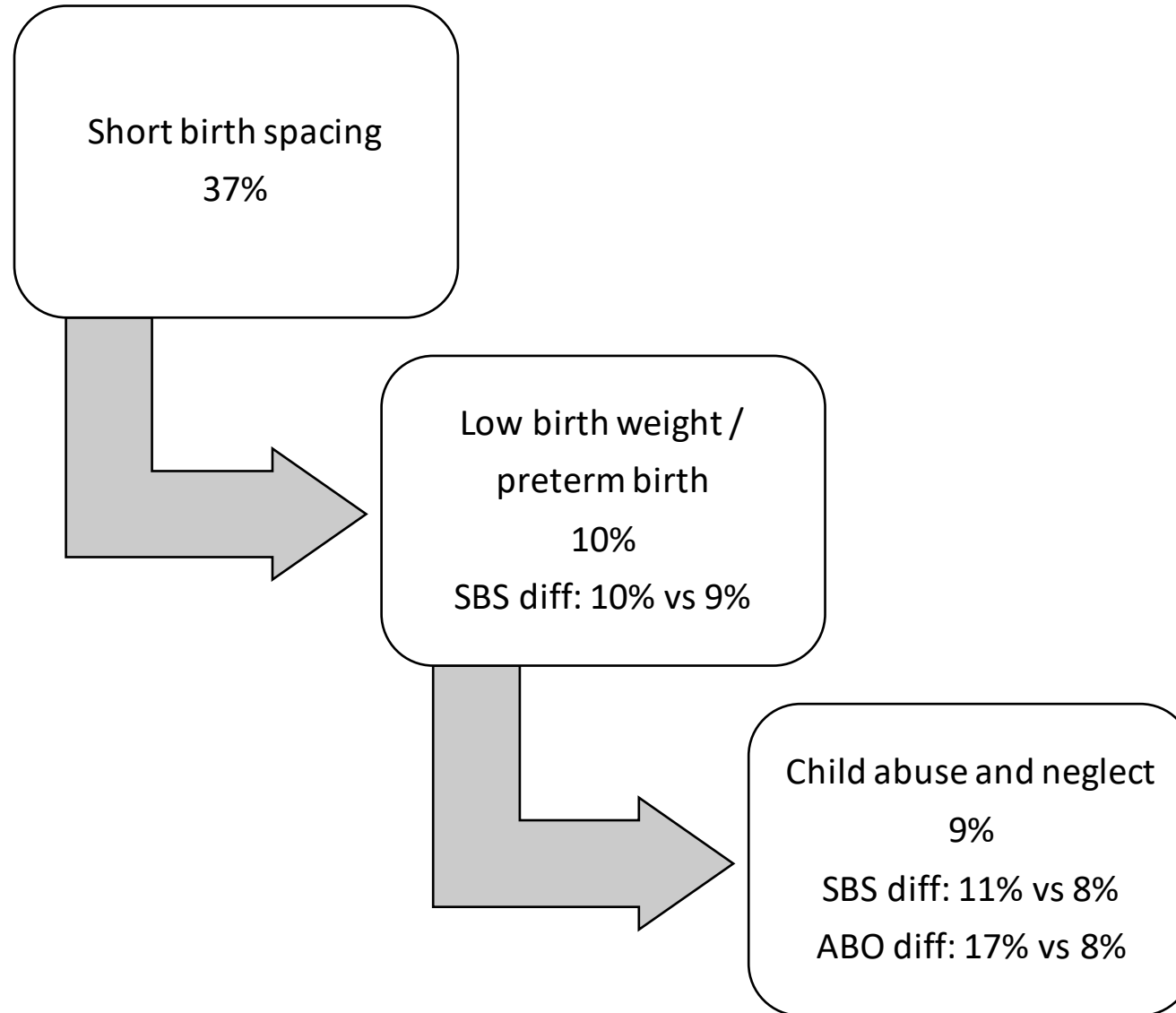- Birth order
- Infant's sex at birth

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362,880-30,981=331,889
8% missing data on correlates

Descriptive statistics

Short birth spacing
37%

Low birth weight /
preterm birth
10%
SBS diff: 10% vs 9%

Child abuse and neglect
9%
SBS diff: 11% vs 8%
ABO diff: 17% vs 8%

Analytical approach

- Multiple variable logistic regression for modeling the likelihood of ABOs.
- Multiple variable logistic regression for modeling the likelihood of a child having a CPS assessments in the first year of the child's life.
- Single-mediator path model. Associations (direct, indirect, total) and standard errors are derived using bootstrapping methods (Preacher and Hayes 2004; Preacher, Rucker and Hayes 2007).
- Two moderated mediation models fitted to examine the role of maternal race and ethnicity and socio-economic status in the connections between short birth spacing, ABOs, and CPS assessments. We examine both first stage moderation of the association of the independent variable (birth spacing) on the mediator (ABOs) and the second-stage moderation of association of the mediator (ABOs) on the dependent variable (CPS assessments).

Findings – executive summary

- Short birth spacing predicts adverse birth outcomes and CPS assessments in the first year of the child's life.

- Adverse birth outcomes predict CPS assessments in the first year of the child's life.

- Adverse birth outcomes partially mediate the connections between short birth spacing and CPS assessments. This statement is true for all large racial/ethnic subpopulations of children in the state.

- **Important:** the mediation model works for the population of births covered by Medicaid/Self-pay **but** not for the population of births covered by private insurance. **What to make of this?**

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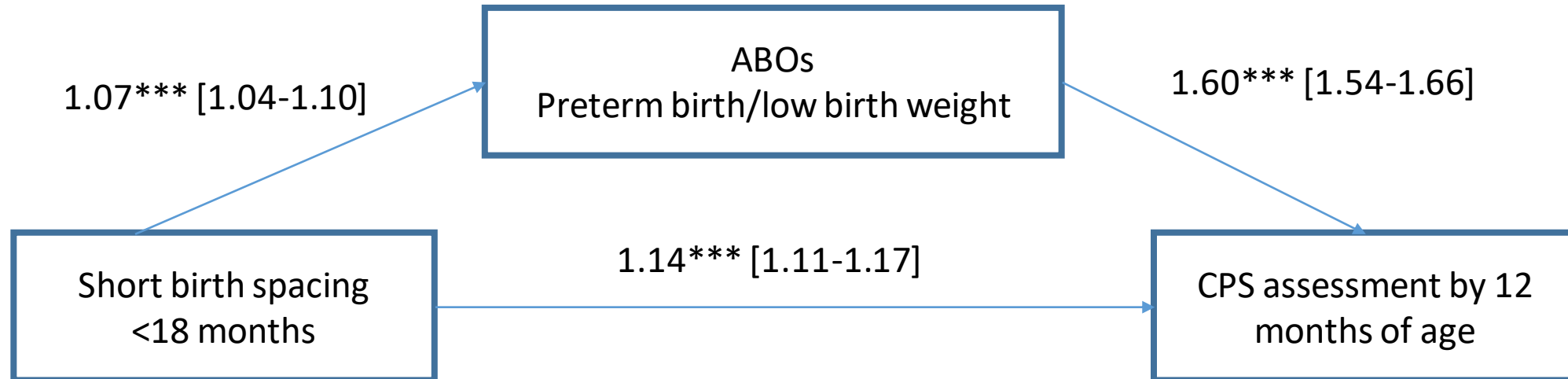
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Findings in detail – full population model

ABOs
Preterm birth/low birth weight

1.07*** [1.04-1.10]

1.60*** [1.54-1.66]

Short birth spacing
<18 months

1.14*** [1.11-1.17]

CPS assessment by 12 months of age

38

All models shown from this point onward include socio-demographic correlates.

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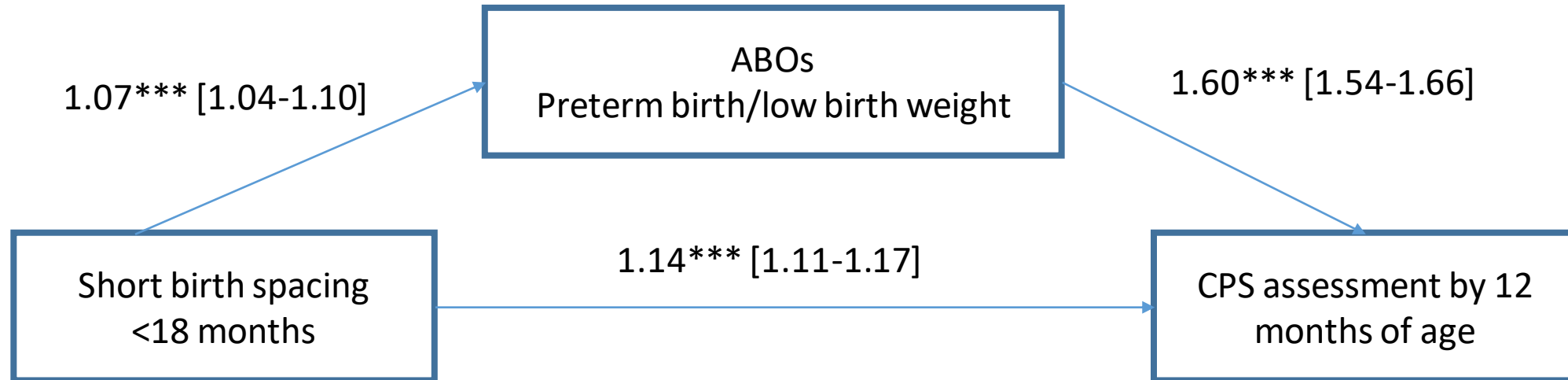
Table 2. Moderation coefficients for full population model.

	Coefficient	SE
Direct association	0.13***	0.01
Indirect association	0.03***	0.01
Total association	0.16***	0.01

Maternal race/ethnicity moderation

Table 3. Odds ratios for step 1 model (likelihood of adverse birth outcomes).

	Odds ratios	P-value	Confidence Interval
Short birth spacing	1.07	<0.001	1.04-1.10
Maternal race/ethnicity			
NH white	Ref. Category		
NH Black	1.65	<0.001	1.60-1.70
Hispanic	1.12	<0.001	1.07-1.18
NH American Indian/Alaska Native	1.18	<0.001	1.08-1.30
NH American Asian and Pacific Islander	1.55	<0.001	1.44-1.67
NH Other	1.21	0.141	0.94-1.55

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NH white	Ref. Category		
NH Black	0.74	<0.001	0.72-0.76
Hispanic	0.43	<0.001	0.41-0.46
NH American Indian/Alaska Native	1.18	<0.001	1.09-1.28
NH American Asian and Pacific Islander	0.63	<0.001	0.55-0.72
NH Other	0.74	0.034	0.56-0.98

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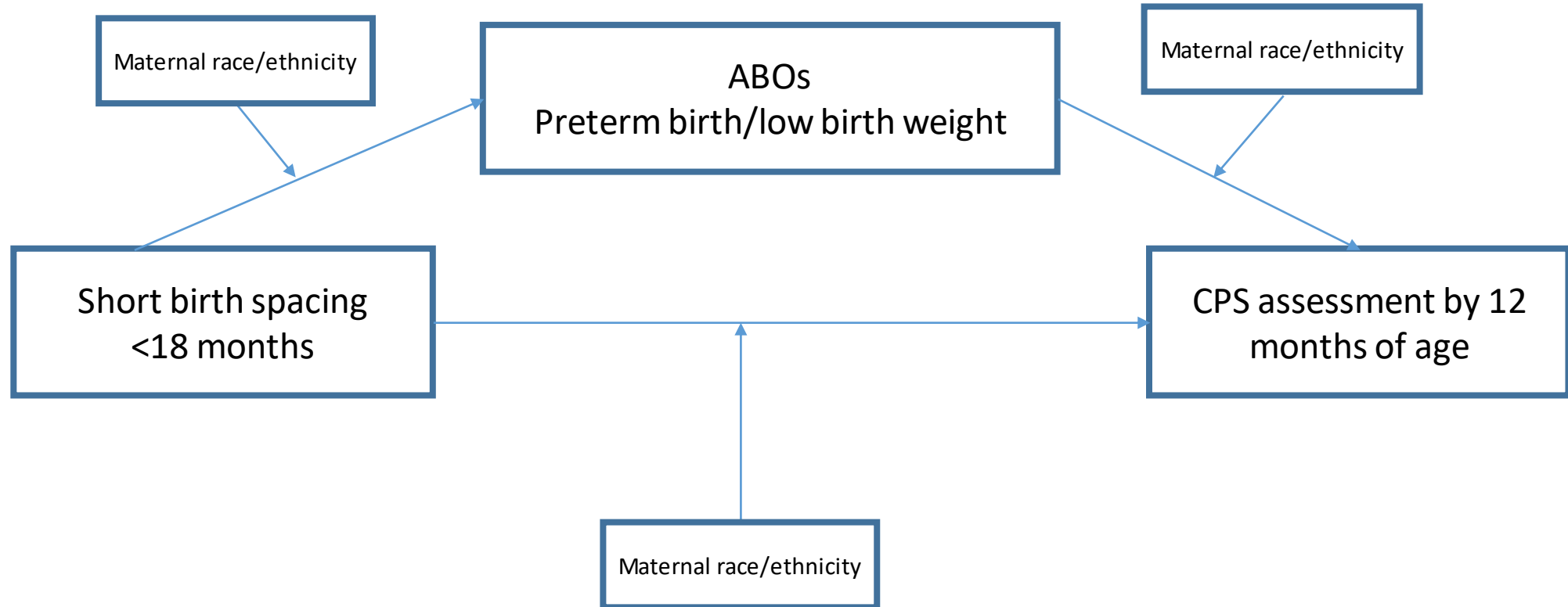Table 4. Odds ratios for step 2 model (likelihood of a CPS assessment).

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Moderated mediation model

Maternal race/ethnicity

ABOs
Preterm birth/low birth weight

Maternal race/ethnicity

Short birth spacing
<18 months

CPS assessment by 12
months of age

Maternal race/ethnicity

Maternal race/ethnicity moderation

Table 5. Mediation coefficients for race/ethnicity moderated mediation model.

	Coefficient	SE
Children of NH white mothers		
Direct association	0.08***	0.01
Indirect association	0.02*	0.01
Total association	0.10***	0.02
Children of NH Black mothers		
Direct association	0.17***	0.02
Indirect association	0.04***	0.01
Total association	0.21***	0.02
Children of Hispanic mothers		
Direct association	0.23***	0.04
Indirect association	0.03***	0.01
Total association	0.27***	0.04

Source of insurance moderation

Table 6. Odds ratios for step 1 model (likelihood of adverse birth outcomes).

	Odds ratios	P-value	Confidence Interval
Short birth spacing	1.07	<0.001	1.04-1.10
Private insurance	Ref. Category		
Medicaid/Self-pay	1.19	<0.001	1.15-1.23

Source of insurance moderation

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Table 7. Odds ratios for step 2 model (likelihood of a CPS assessment).

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Adverse birth outcomes	1.60	<0.001	1.54-1.66
Source of insurance			
Private insurance	Ref. Category		
Medicaid/Self-pay	**3.16**	**<0.001**	**3.00-3.31**

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Moderated mediation model
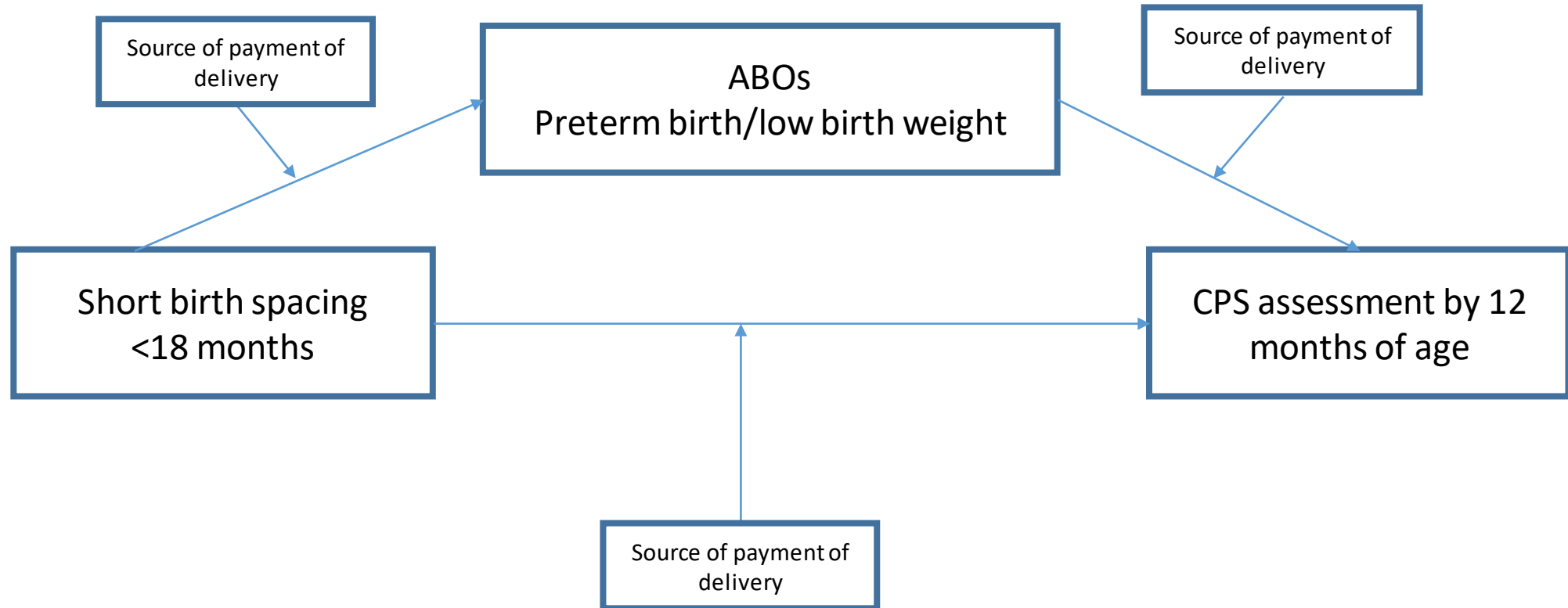
Source of insurance moderation

Table 8. Mediation coefficients for low-income moderated mediation model.

	Coefficient	SE
Births covered by private insurance		
Direct association	0.17***	0.04
Indirect association	0.00	0.01
Total association	0.17***	0.04
Births covered by Medicaid/Self-pay		
Direct association	0.10***	0.01
Indirect association	0.04***	0.01
Total association	0.15***	0.01

Conclusions and implications

- Short birth spacing predicts adverse birth outcomes and CPS assessments in the first year of the child's life.

- Adverse birth outcomes predict CPS assessments in the first year of the child's life.

- Adverse birth outcomes partially mediate the connections between short birth spacing and CPS assessments. This statement is true for all large racial/ethnic subpopulations of children in the state.

- **Important:** the mediation model works for the population of births covered by Medicaid/Self-pay **but** not for the population of births covered by private insurance. **What to make of this?**

Some planned extensions

- Very short birth spacing
- Fixed effects model

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Additional information

Birth spacing variable

Child ID	Date of birth	Sex at birth	Birth order	Last live birth to the same mother	Gestational age	Birth spacing
987654	1/1/97	F	1	N/A	37	N/A
876543	1/1/98	M	3	1/1/96	38	15
765432	1/1/99	F	2	1/1/98	37	3

Sample selection

- Full population ➜ 2,647,406
  - Select children born 2011-2017 ➜ 844,499
    - 2nd or higher born only ➜ 498,095 (plus ~200 with missing order information)
      - Singleton births only ➜ 481,468
        - Short and recommended birth spacing ➜ 363,183
        ~118,000 births with long spacing 60+ months
        ~4,000 missing data on spacing
        - Missing data on low birth weight and preterm birth (~300) ➜ 362,880
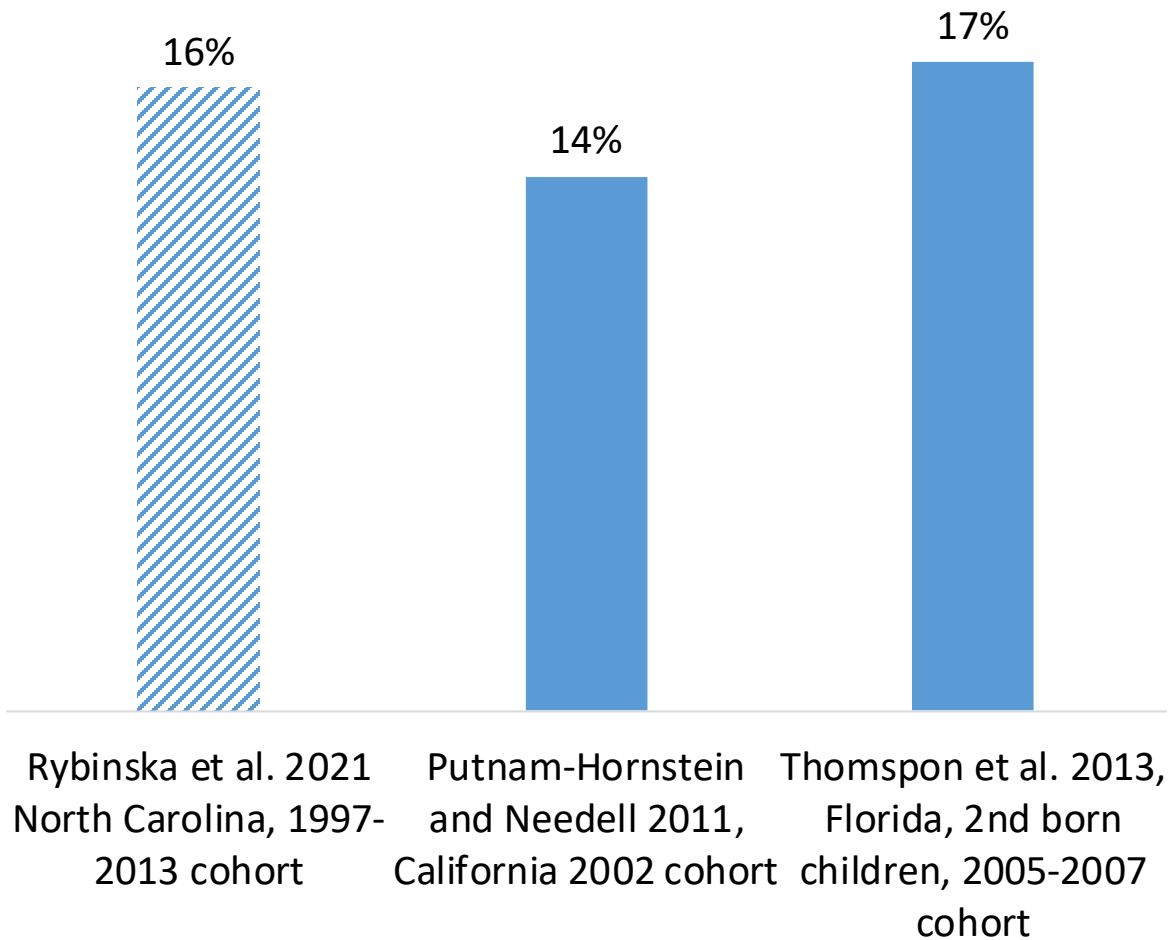
Birth records-CPS data match

- **<u>Important:</u>** this strategy has been designed by a Senior Data Analyst at Duke upon collaboration with DSS.
- Until 2016 - the NC CPS Registry system:
  - An internal DSS child ID considered an exact match;
  - If children do not match on DSS child ID: use first, last, bio sex, and DOB to check for matches.
    - DOB can vary **IF** first, last, bio sex are exact matches;
    - First name can vary **IF** last, bio sex, and DOB exact matches;
    - Last name can vary **IF** first, bio sex, and DOB exact matches;
    - Sex is usually the most flexible and Matt has done some testing of matching with/without sex for smaller subsamples;
    - DOB match: usually exact day, month, year, but there is some flexibility if all other identifiers match
- 2016-2018:
  - No DSS child ID, only first, last, bio sex, DOB

What is an exact match?

- For first and last name: either exact wording, or option "sounds like" (e.g. Sarah vs Sara), or spelling distance <30
  - Some of these are SAS designed commands to match text fields
- For DOB: usually day, month, year.
- For bio sex: exact match

Birth records – CPS match: how did we do?

% of children with a CPS report by 5th birthday

16% — Rybinska et al. 2021 North Carolina, 1997-2013 cohort

14% — Putnam-Hornstein and Needell 2011, California 2002 cohort

17% — Thomspon et al. 2013, Florida, 2nd born children, 2005-2007 cohort

Birth records – CPS match: how did we do?

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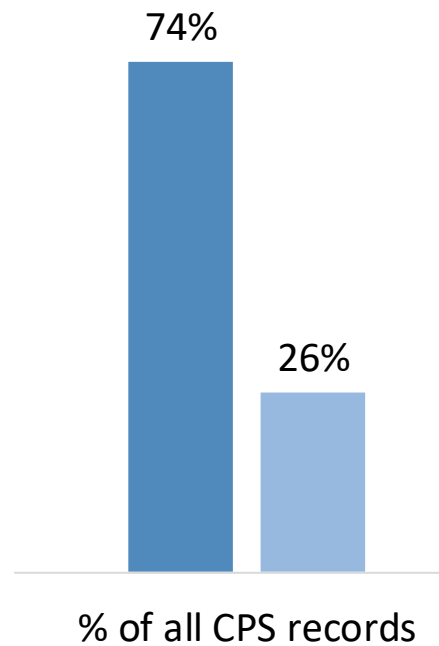- Thomspon et al. 2013, Florida, 2nd born children, 2005-2007 cohort: 17%
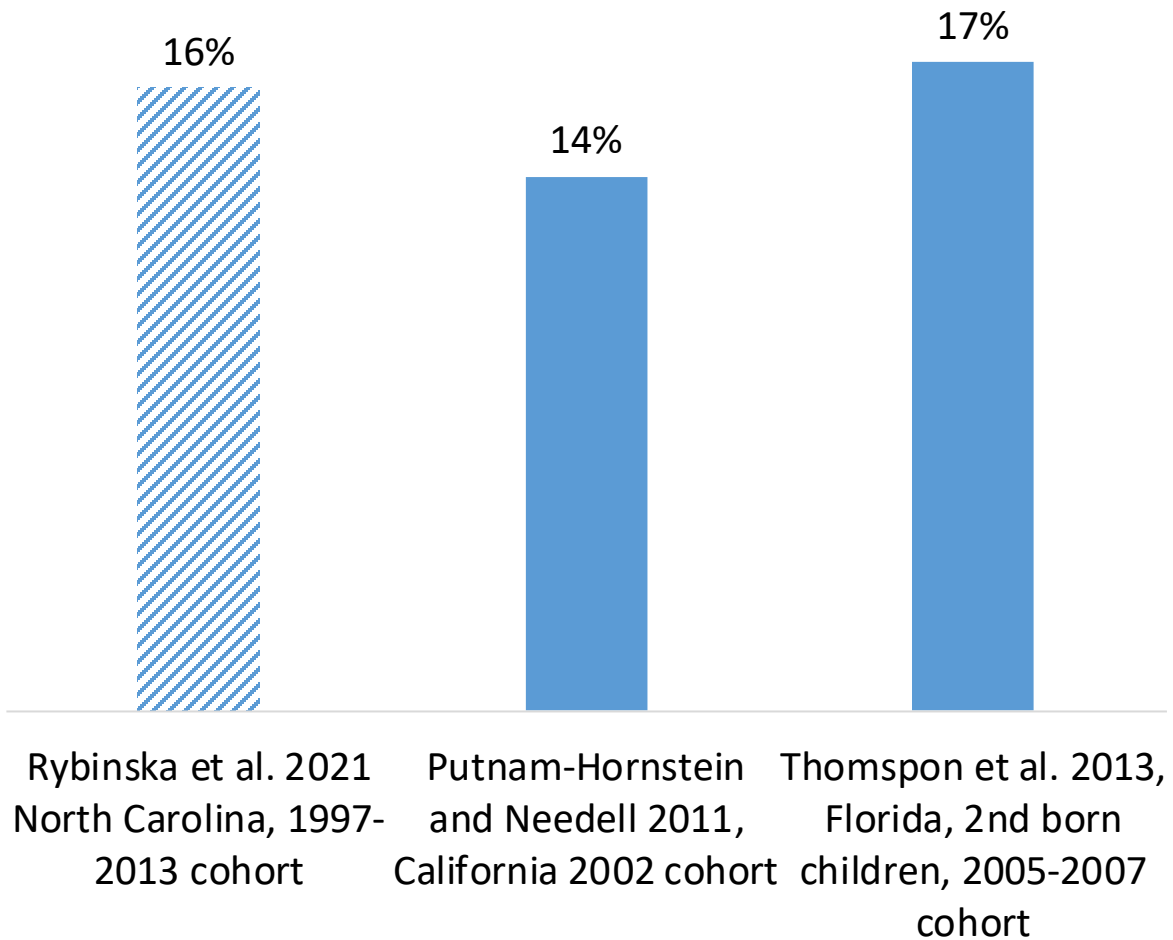
% of children with any CPS assessment by 5th birthday by year of birth
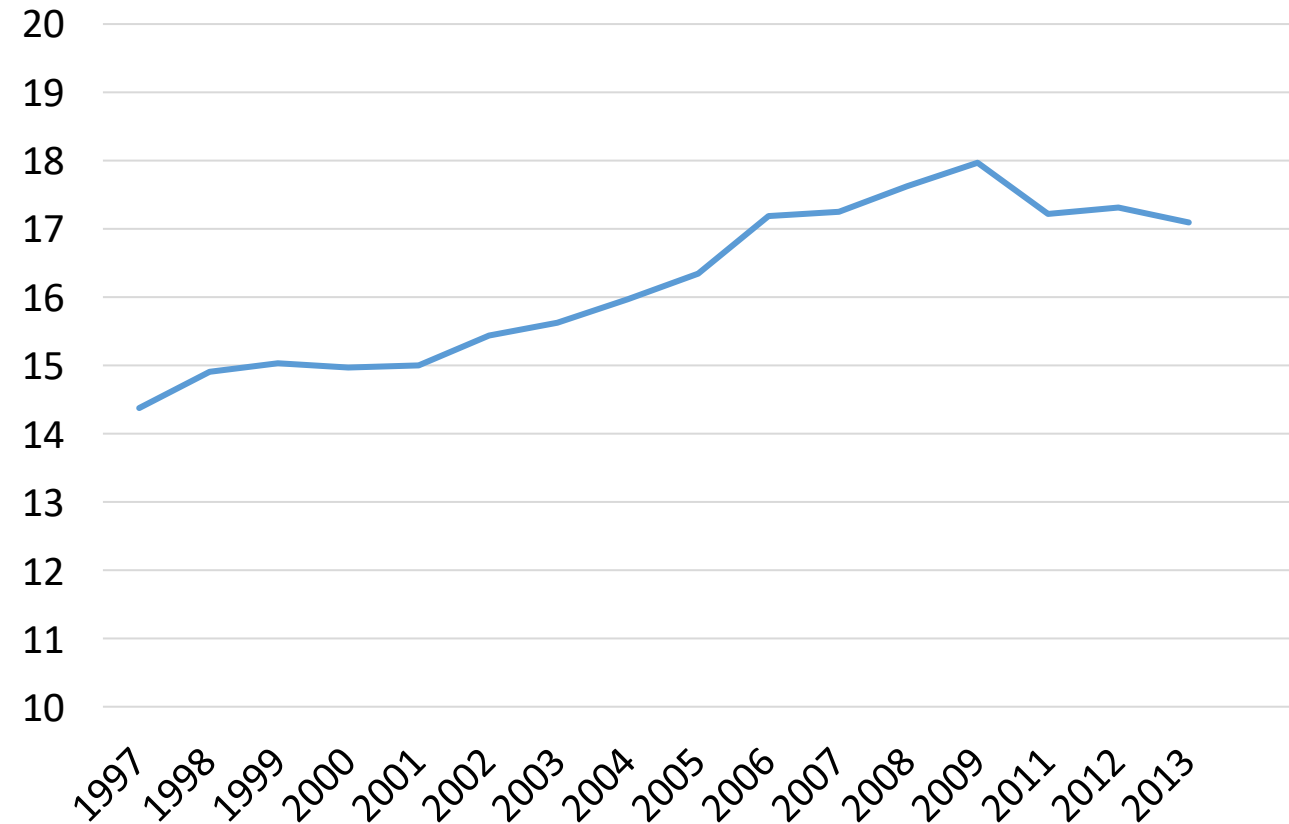
Birth records – CPS match: how did we do?

Children with at least one CPS record within the first 60 months of life
AND born 1997-2013:

74%

26%

% of all CPS records

■ Matched to BR   ■ Unmatched to BR

Birth records – CPS match: how did we do?

Children with at least one CPS record within the first 60 months of life
AND born 1997-2013:

	% white	% black	% female
Matched to BR	53%	36%	49%
Unmatched to BR	58%	30%	48%

■ Matched to BR   ■ Unmatched to BR
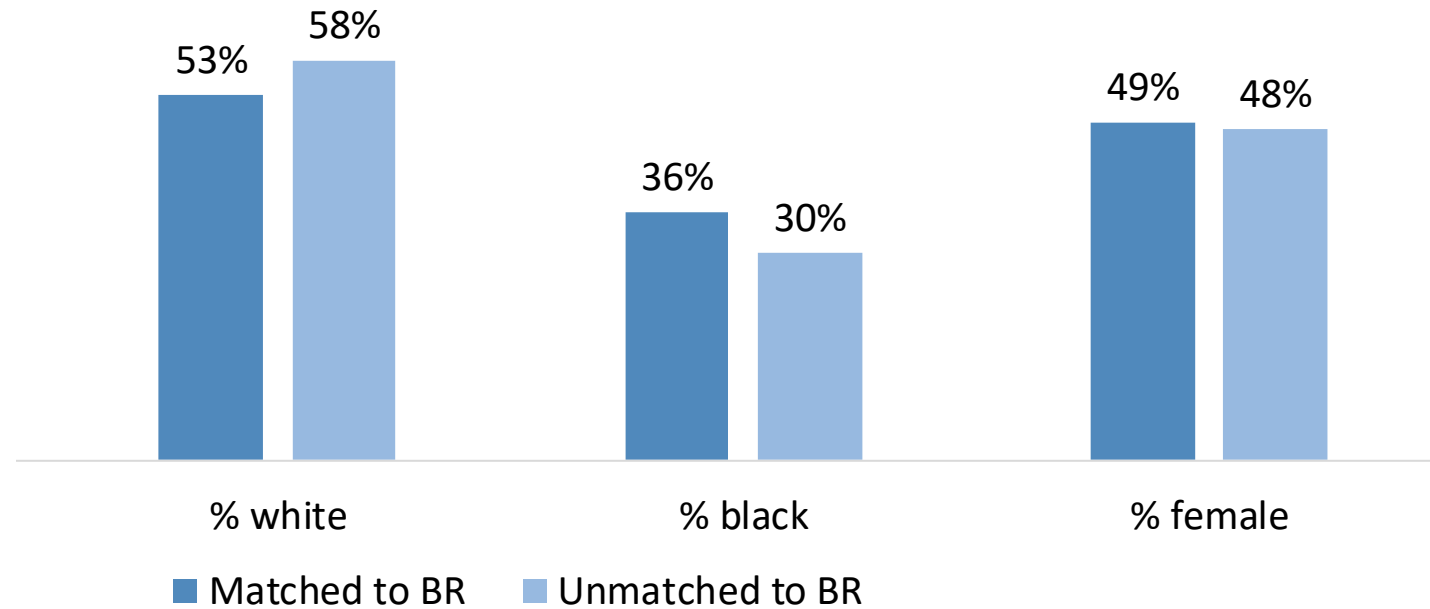
Births to white women

Short birth spacing	37%	
Adverse birth outcomes	8%	
Any assessment by 12 months of life	8%	

	ABOs	
short birth spacing	yes	no
yes	8%	92%
no	8%	92%

	Any assessment by CPS by 12 months of life	
short birth spacing	yes	no
yes	9%	91%
no	7%	93%

	Any assessment by CPS by 12 months of life	
ABOs	yes	no
yes	17%	83%
no	7%	93%

Births to NH Black women

Short birth spacing	40%	
Adverse birth outcomes	15%	
Any assessment by 12 months of life	15%	

short birth spacing	ABOs	
	yes	no
yes	16%	84%
no	14%	86%

short birth spacing	Any assessment by CPS by 12 months of life	
	yes	no
yes	18%	82%
no	13%	87%

ABOs	Any assessment by CPS by 12 months of life	
	yes	no
yes	21%	79%
no	14%	86%

Births to Hispanic women

Short birth spacing	32%	
Adverse birth outcomes	8%	
Any assessment by 12 months of life	5%	

short birth spacing	ABOs	
	yes	no
yes	9%	91%
no	8%	92%

short birth spacing	Any assessment by CPS by 12 months of life	
	yes	no
yes	6%	94%
no	4%	96%

ABOs	Any assessment by CPS by 12 months of life	
	yes	no
yes	7%	93%
no	4%	96%

Births covered by private insurance

Short birth spacing	34%	
Adverse birth outcomes	7%	
Any assessment by 12 months of life	2%	

	ABOs	
short birth spacing	yes	no
yes	7%	93%
no	7%	93%

	Any assessment by CPS by 12 months of life	
short birth spacing	yes	no
yes	2%	98%
no	2%	98%

	Any assessment by CPS by 12 months of life	
ABOs	yes	no
yes	4%	96%
no	2%	98%

Births covered by Medicaid

Short birth spacing	39%	
Adverse birth outcomes	12%	
Any assessment by 12 months of life	14%	

short birth spacing	yes ABOs	no
yes	13%	87%
no	11%	89%

short birth spacing	yes Any assessment by CPS by 12 months of life	no
yes	17%	83%
no	13%	87%

ABOs	yes Any assessment by CPS by 12 months of life	no
yes	23%	77%
no	13%	87%