

Look Ma, I'm Okay!
Intergenerational Transfers of Health

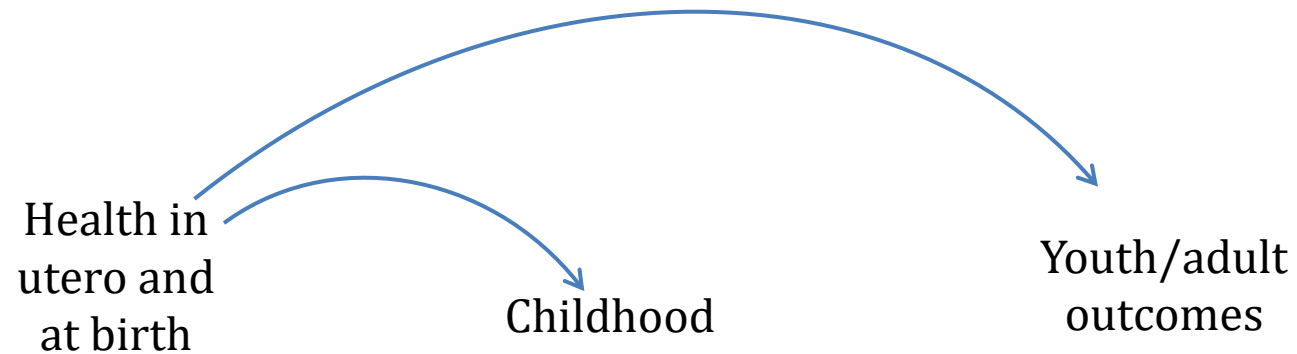
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Motivation

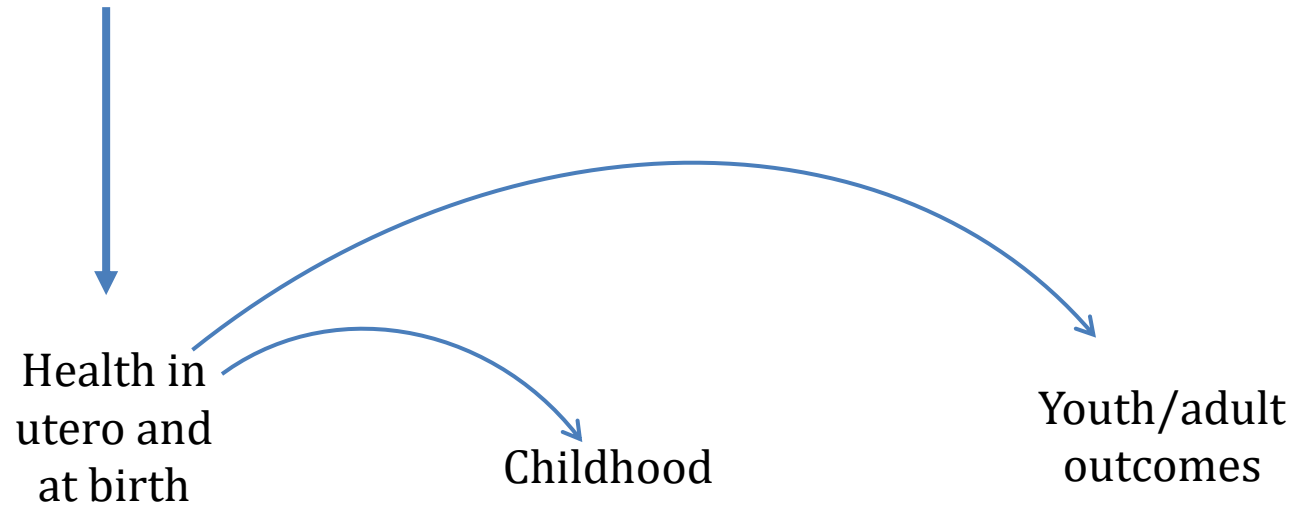
- Health *in utero*, at birth and in early childhood has been linked to outcomes later in life (Barker & Osmond, 1986; Gillman et al. 2007; Oreopolous et al., 2008, de Rooij et al., 2010, Currie, 2011, Jonhson & Schoeni, 2011, Scholte et al., 2015, Currie, 2020)
- Fetal origins hypothesis: chronic, degenerative health conditions in adulthood may be triggered by events and circumstances much earlier in life, particularly in utero (Barker, 1992)
 - Effects of fetal conditions are persistent
 - Health effects can remain latent for years
 - Mechanism: fetal programming

Current Evidence



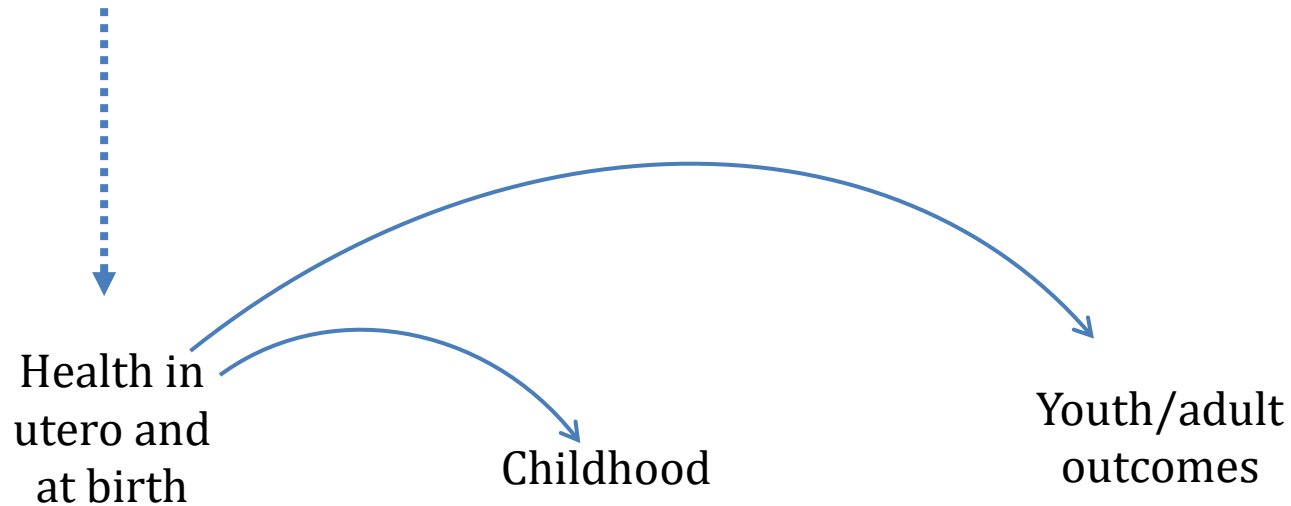
Current Evidence

Extreme Events



Current Evidence

Less Extreme Events



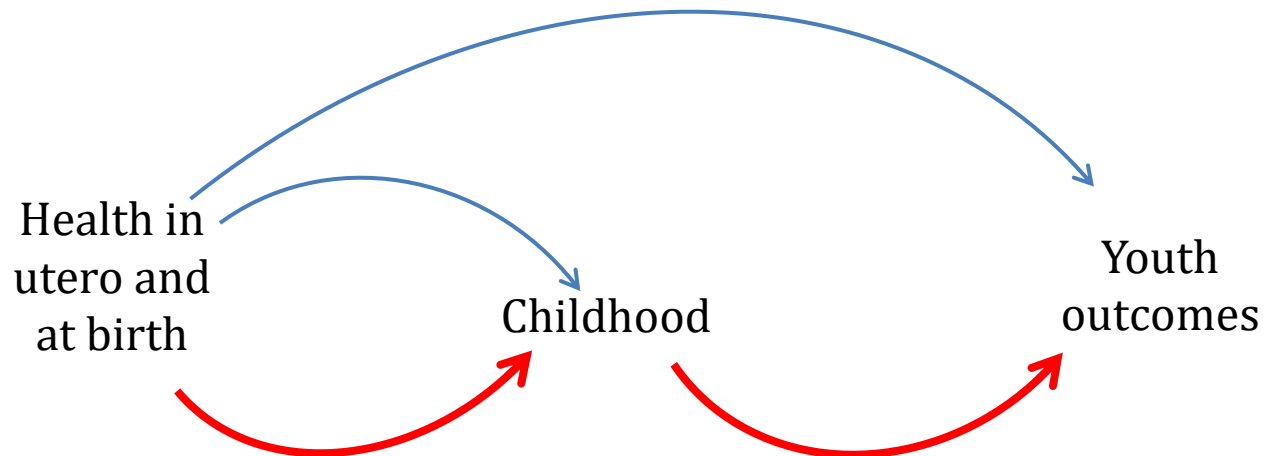
Current Evidence

- Focus on specific cause and effect periods
 - Data that captures adult outcomes well does not often include birth data
- Dynamics of health is generally missing
 - Health problems early in life increase risk of poor outcomes in young adulthood
 - Attenuated when controlling for health between birth and young adulthood (Currie et al., 2010)

“Missing Middle”

(Almond, Currie and Duque, 2018)

- Period that includes early and middle childhood

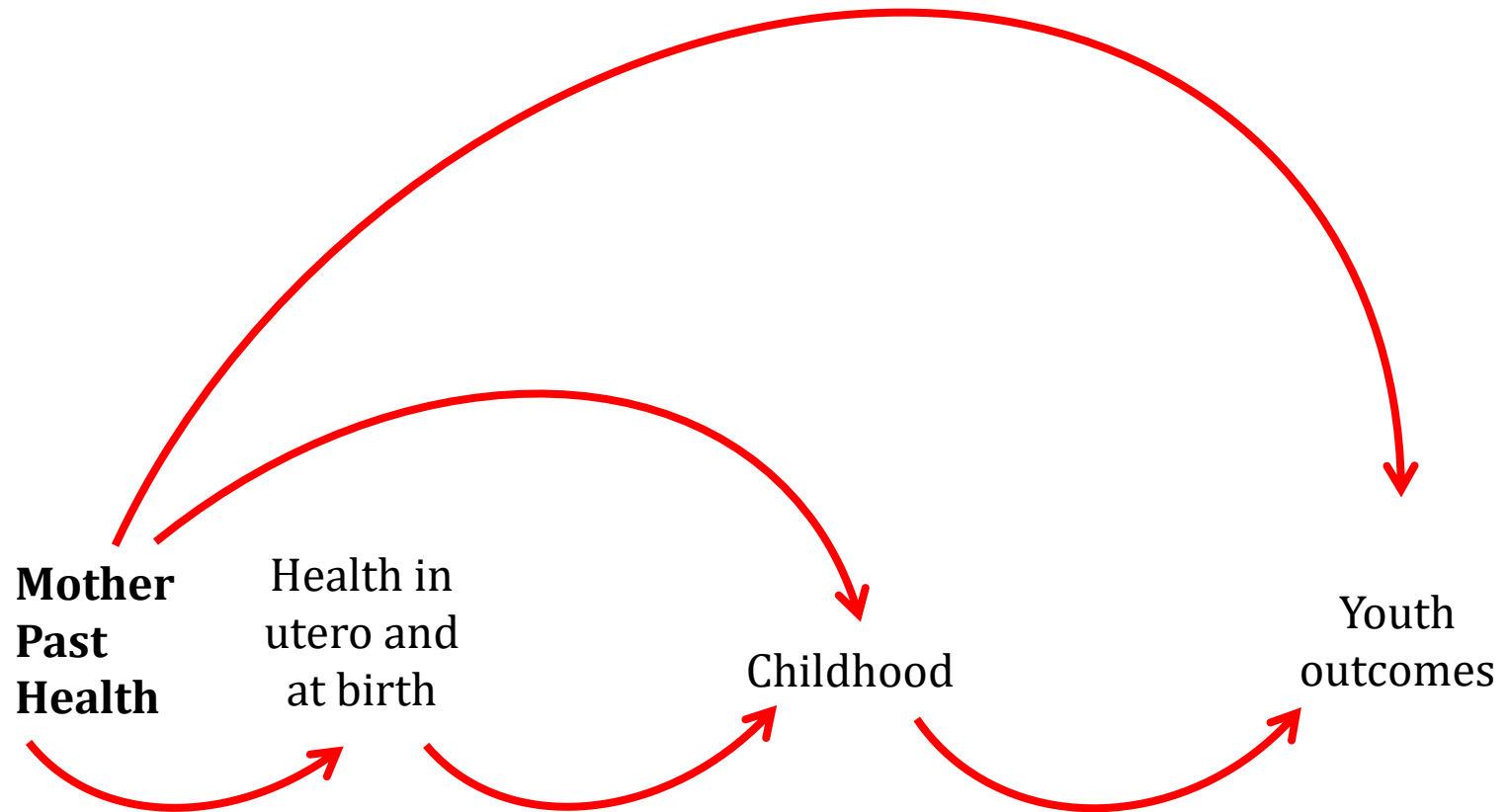


Health Before Conception

“... policymakers attempting to ameliorate inequalities among children cannot afford to ignore mothers, since what mothers do even before they know they are pregnant may have profound consequences.”

– Janet Currie (2011), Richard T. Ely Lecture

Health Before Conception



Data from Manitoba, Canada

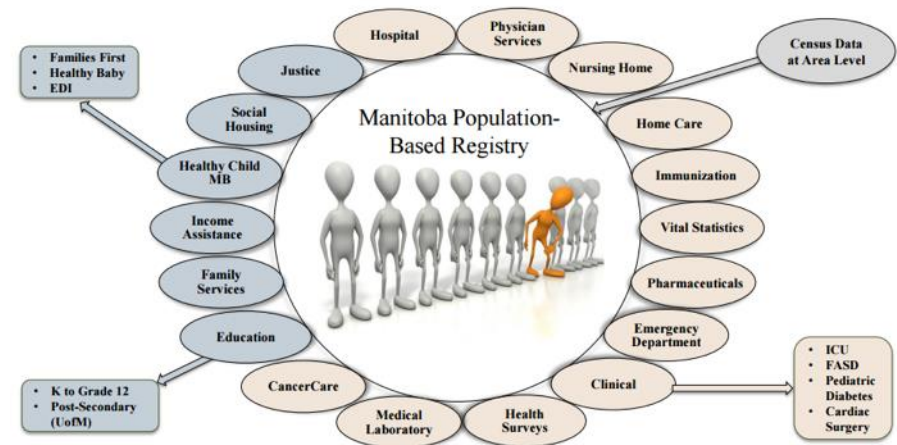


- **Manitoba**
- **Partially aware of Manitoba**
- **Forgets Manitoba even exists**

Manitoba Center for Health Policy Repository

- All contacts with health care since 1971
 - Longitudinal (patients, non-patients and doctors)
- Linked to
 - Income assistance
 - Census,
 - Education (early childhood to university),
 - Crime
 - ...

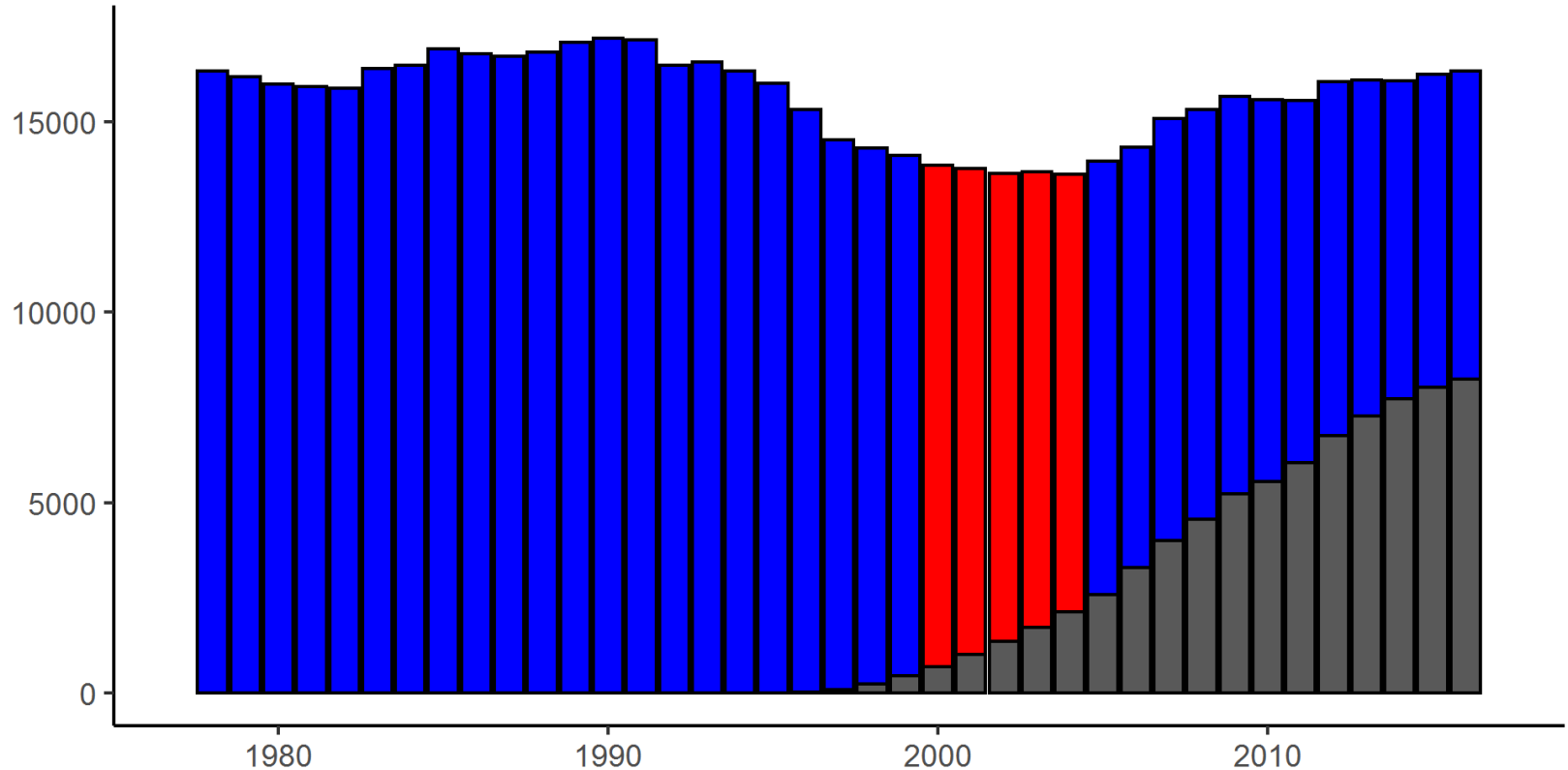
MCHP Houses the De-Identified Manitoba Population Research Data Repository



Sample

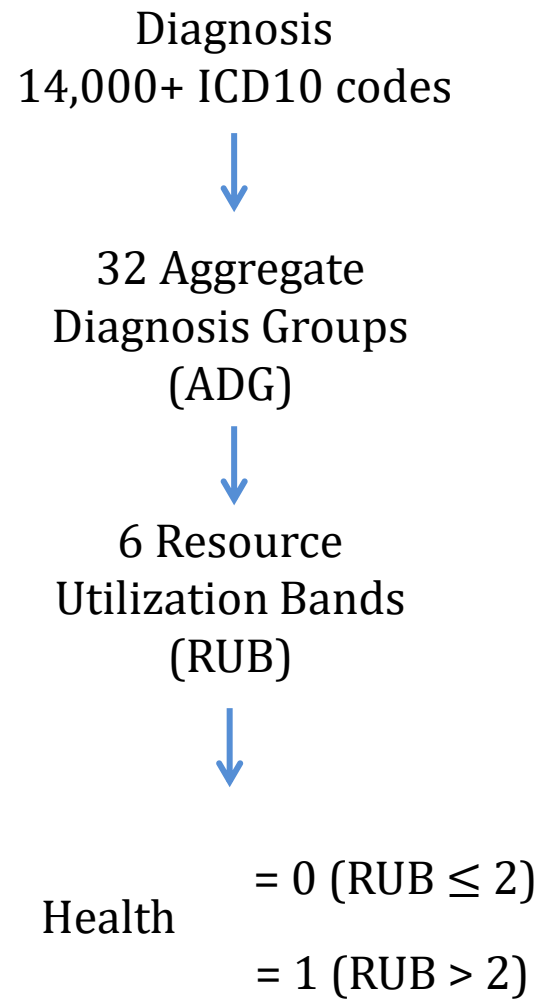
Number of Births in the MCHP Repository

Current sample (2000 - 2004) in red, number of mothers' own birth in grey



Note: 2017 data covers up to March

Health outcomes



Health outcomes

[1] Medium to very high morbidity

[2] Major Health cond.

[3] Specific cond.

Child at age 15 – 17

- *also other ages*

Mother 1 – 5 years before pregnancy

Diagnosis
14,000+ ICD10 codes



32 Aggregate
Diagnosis Groups
(ADG)



6 Resource
Utilization Bands
(RUB)



Health = 0 (RUB ≤ 2)
= 1 (RUB > 2)

Demographics

Measured at birth of child:

- **Child:** sex, birth order, number of siblings
- **Mother:** age, marital status, family size, income assistance, prenatal health/visits, distance to GP, regional FEs, rural/urban income quintiles (Census).

Multivariate Model

$$\begin{aligned} Child_{mt} = & a + b_1 Mother_{-T} \\ & + b_2 Child_{m,t-s} \\ & + b_3 X + \theta_m + \lambda_t + e_t \end{aligned}$$

$Child_{mt}$

Child health at 15 – 17

$Child_{m,t-s}$

Child Past health

$Mother_{-T}$

Mother health 1 – 5 years before pregnancy

TABLE: CHILD HEALTH AT AGE 15 – 17

	(I)	(II)	(III)
MOTHER HEALTH	0.17***	0.16***	0.16***
1 - 5 PRE-PREG.	(0.009)	(0.009)	(0.009)
INCOME	NO	YES	YES
HCARE PREG.	NO	NO	YES
Sibling FEs	NO	NO	NO
Mean of Outcome	0.43	0.43	0.43
NOBS	39906	39906	39722

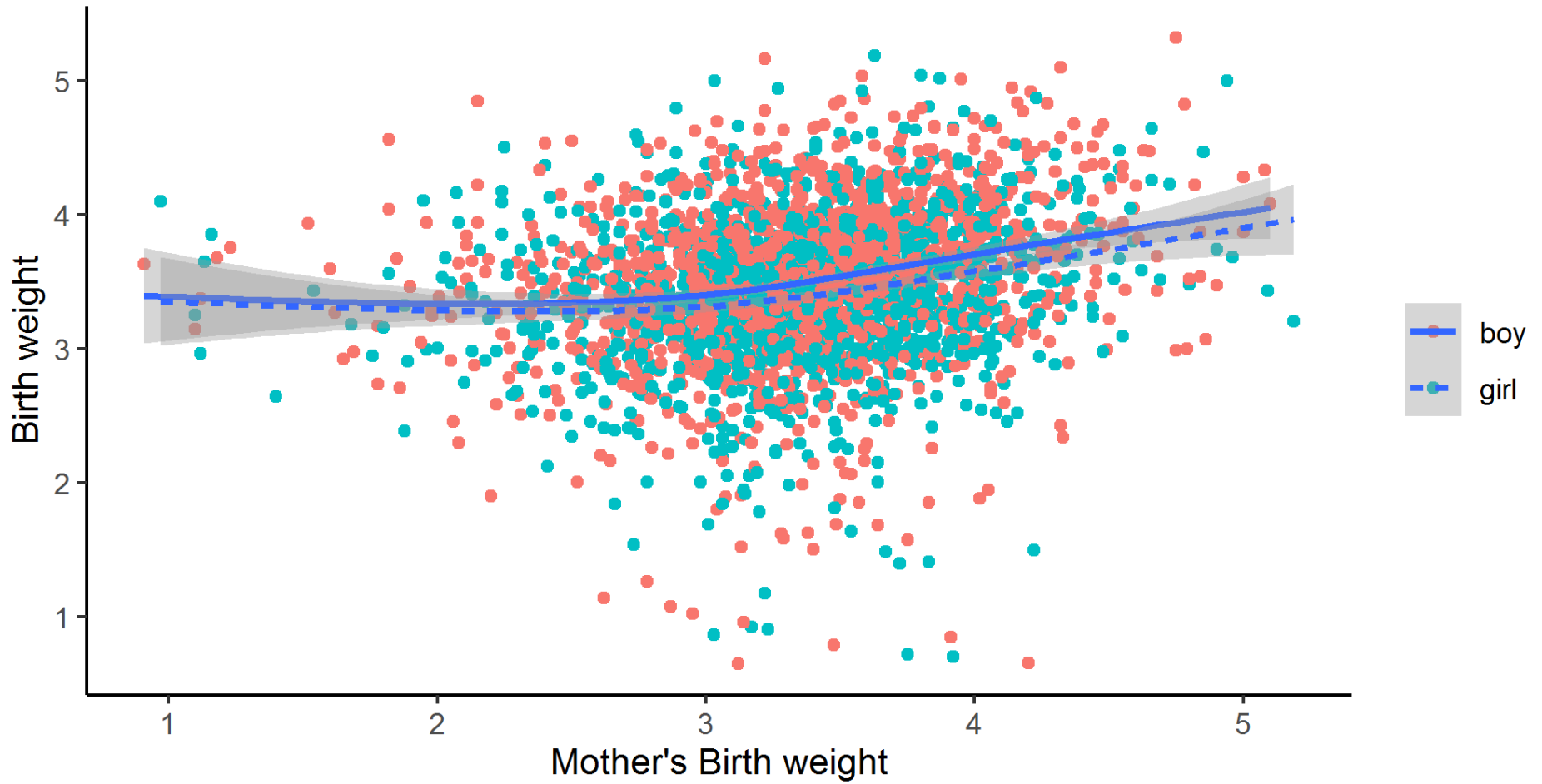
Note: All models include, sex of the child, birth order, number of siblings, family size, mother age at birth. Income measures are income assistance during pregnancy, rural/urban income quintiles based on Census postcode. HCARE PREG. Refers to health care during pregnancy which include number of doctor visits and distance to doctor. Standard Errs are in parenthesis. ***, **, * represent significance at 1%, 5%, 10%

Mechanism?

- How does mother's health affect the health of her baby?
- Genetic and non-genetic factors

Birth weight : Mother vs Baby

First Child



Sample : Babies born 2000 - 2004

TABLE: CHILD HEALTH AT AGE 15 – 17

	(I)	(II)	(III)	(IV)
MOTHER HEALTH	0.17***	0.16***	0.16***	0.13***
1 - 5 PRE-PREG.	(0.009)	(0.009)	(0.009)	(0.024)
BIRTHWEIGHT				-0.05** (0.027)
INCOME	NO	YES	YES	YES
HCARE PREG.	NO	NO	YES	YES
Sibling FEs	NO	NO	NO	NO
Mean of Outcome	0.43	0.43	0.43	0.47
NOBS	39906	39906	39722	5149

Note: All models include, sex of the child, birth order, number of siblings, family size, mother age at birth. Income measures are income assistance during pregnancy, rural/urban income quintiles based on Census postcode. HCARE PREG. Refers to health care during pregnancy which include number of doctor visits and distance to doctor. Standard Errs are in parenthesis. ***, **, * represent significance at 1%, 5%, 10%

Environment

- Environment that children grow up in
- Limited socio-demographic data

→ Sibling FEs

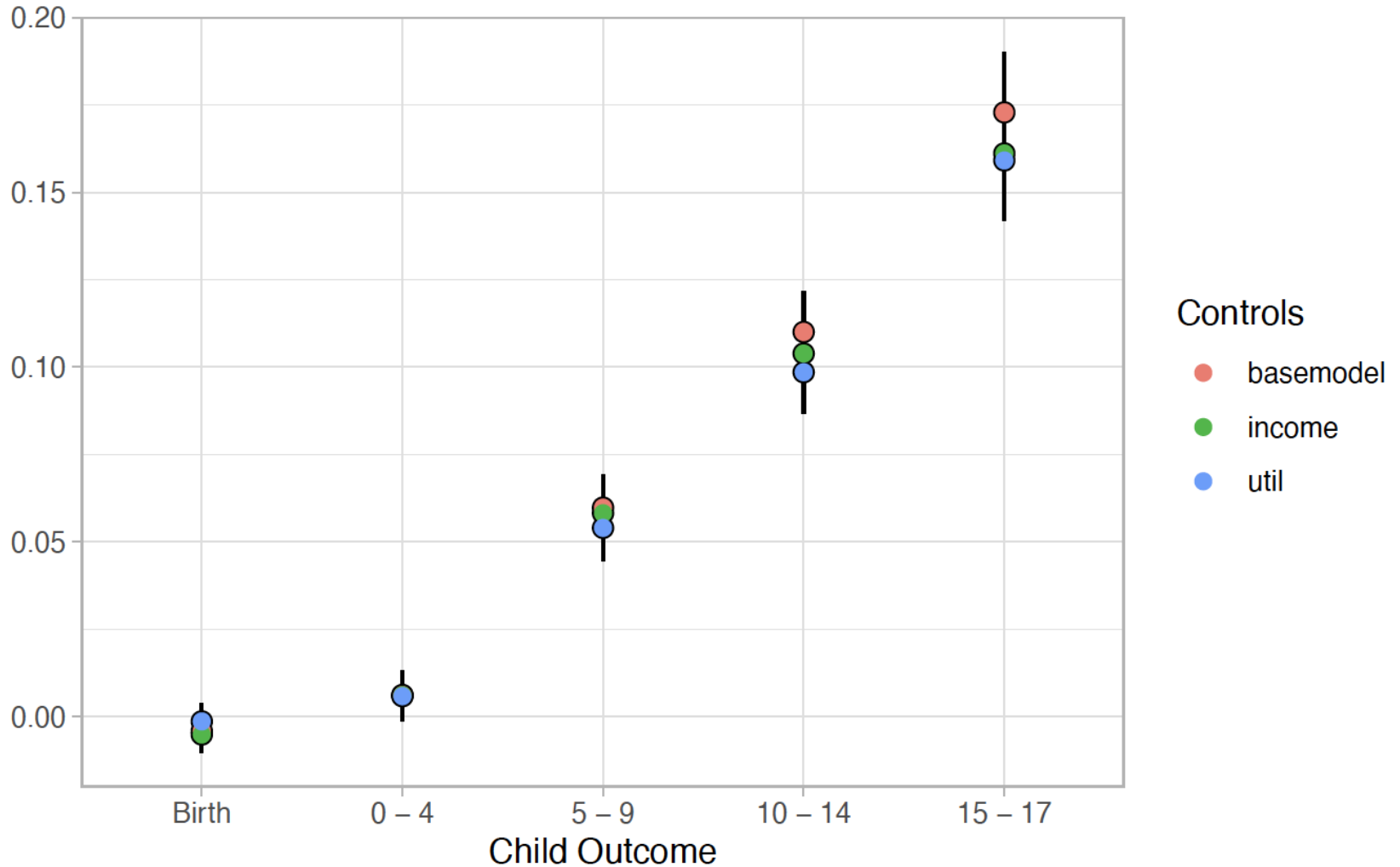


TABLE: CHILD HEALTH AT AGE 15 – 17

	(I)	(II)	(III)	(IV)	(V)
MOTHER HEALTH	0.17***	0.16***	0.16***	0.13***	0.07***
1 - 5 PRE-PREG.	(0.009)	(0.009)	(0.009)	(0.024)	(0.016)
BIRTHWEIGHT				-0.05** (0.027)	
INCOME	NO	YES	YES	YES	YES
HCARE PREG.	NO	NO	YES	YES	YES
Sibling FEs	NO	NO	NO	NO	YES
Mean of Outcome	0.43	0.43	0.43	0.47	0.43
NOBS	39906	39906	39722	5149	39722

Note: All models include, sex of the child, birth order, number of siblings, family size, mother age at birth. Income measures are income assistance during pregnancy, rural/urban income quintiles based on Census postcode. HCARE PREG. Refers to health care during pregnancy which include number of doctor visits and distance to doctor. Standard Errs are in parenthesis. ***, **, * represent significance at 1%, 5%, 10%

Effect of Mother's Pre-Pregnancy Health on Child Health



Note : Each estimate comes from a separate Linear probability model.
Birth = Low Birth Weight. 0 - 4 , 5 - 9 , 10 - 14, 15 - 17 refer to health (measured by RUB>2) at given age i

TABLE: CHILD HEALTH MAJOR ADG AT AGE 15 - 17

	(I)	(II)	(III)	(IV)	(V)	(VI)
Mom Past Health	0.017*** (-0.002)	0.011*** (-0.003)	0.011*** (-0.003)	0.008* (-0.004)	0.005 (-0.004)	0.005 (-0.004)
Mom Pregnancy Health		0.016*** (-0.003)	0.016*** (-0.003)		0.011*** (-0.003)	0.011** (-0.003)
NICU			0.022*** (-0.006)			0.018* (-0.009)
Low Birthweight			-0.002 (-0.008)			-0.011 (-0.011)
High Birthweight			0.002 (-0.006)			0.003 (-0.009)
Gestation (Months)			0.001 (-0.001)			-0.001 (-0.001)
Income Support	0.010** (-0.003)	0.008* (-0.003)	0.008* (-0.003)	0 (-0.008)	-0.001 (-0.008)	-0.001 (-0.008)
Siblings FE	NO	NO	NO	YES	YES	YES
Region FE	YES	YES	YES	YES	YES	YES
N	35283	35283	35245	35283	35283	35245

Notes: Mom Past Health is RUB ≥ 3 within 1 to 5 years before pregnancy; all models include: mother's age and marital status at birth, urban/rural specific income quintiles, sex, birth order, no. of siblings of child, family size, income assistance indicator for mother, distance to physician during pregnancy. SEs are clustered at region and sibling level.

Persistence

- Healthy children grow up to be healthy adults

→ Add missing middle



TABLE: CHILD HEALTH AT AGE 15 – 17 Effect of Past Health

	(I)	(II)	(III)	(IV)	(V)
MOTHER HEALTH					
1 – 5 PRE-PREG.	0.16*** (0.009)	0.14*** (0.009)	0.13*** (0.009)	0.07*** (0.007)	0.02 (0.014)
CHILD HEALTH					
Low-BW	0.02 (0.02)	0.03 (0.02)	0.02 (0.02)	-0.01 (0.017)	-0.01 (0.026)
High-BW	0.06** (0.025)	0.06** (0.024)	0.05** (0.024)	0.06*** (0.021)	0.05* (0.028)
at AGE : 0 – 4		0.27*** (0.012)	0.16*** (0.012)	0.06*** (0.011)	0.06*** (0.017)
at AGE : 5 – 9			0.26*** (0.011)	0.04*** (0.01)	0.08*** (0.015)
at AGE : 10-14				0.55*** (0.008)	0.50*** (0.012)
INCOME	YES	YES	YES	YES	YES
HCARE PREG.	YES	YES	YES	YES	YES
Sibling FEs	NO	NO	NO	NO	YES
Mean of Outcome	0.43	0.43	0.43	0.43	0.43
NOBS	39712	39712	39712	39712	39712

Note: All models include, sex of the child, birth order, number of siblings, family size, mother age at birth. Income measures are income assistance during pregnancy, rural/urban income quintiles based on Census postcode. HCARE PREG. Refers to health care during pregnancy which include number of doctor visits and distance to doctor. Standard Errs are in parenthesis. ***, **, * represent significance at 1%, 5%, 10%.

Robustness

- First born sample & Boys vs Girls
- Effect on different age intervals for child
- Alternative definition and timing of health measures

Health at 15 to 17 years - Boys vs. Girls (First Born Sample)

	Full Sample		Boys		Girls	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Mom Past Health	0.130***	0.152***	0.135***	0.156***	0.123***	0.132***
	(0.007)	(0.025)	(0.010)	(0.036)	(0.011)	(0.038)
Mom Birthweight		-0.027		-0.046		0.034
		(0.022)		(0.032)		(0.035)
Region FE	X	X	X	X	X	X
N	18177	1500	9385	765	8792	735
R2	0.12	0.27	0.13	0.35	0.13	0.32

* p < 0.1, ** p < 0.05, *** p < 0.01

Note: Mom past health is health 1 to 5 years prior to pregnancy

All models include demographic controls. Serrs are clustered at sibling and region level.

Preliminary Remarks

- Mother pre-pregnancy health has a significant impact on adolescent health
 - More pronounced at older ages
 - Less pronounced for severe conditions
- Effect not mitigated by controlling for demographics, income, family environment
- Youth health outcomes are highly persistent



THANKS

Norman
Rockwell

“Look, Mom—no cavities!”



Crest Toothpaste stops soft spots from turning into cavities—means far less decay for grownups and children.

APPENDIX

Health Outcomes

Aggregate Diagnosis Groups (ADG)

ADGs and Common Diagnosis Codes Assigned to Them

ADGs	ICD9-CM	ICD-10	Diagnosis
1. Time Limited: Minor	558.9 691.0	K52.9 L22	Noninfectious Gastroenteritis Diaper or Napkin Rash
2. Time Limited: Minor- Primary Infections	079.9 464.4	B09 J05.0	Unspecified Viral Infection Croup
3. Time Limited: Major	451.2 560.3	I80.3 K56.7	Phlebitis of Lower Extremities Impaction of Intestine
4. Time Limited: Major- Primary Infections	573.3 711.0	K75.9 M00.9	Hepatitis, Unspecified Pyogenic Arthritis

Major ADGs for Adult and Pediatric Populations

Pediatric Major ADGs (ages 0-17 years)	Adult Major ADGs (ages 18 and up)
3 Time Limited: Major	3 Time Limited: Major
9 Likely to Recur: Progressive	4 Time Limited: Major-Primary Infections
11 Chronic Medical: Unstable	9 Likely to Recur: Progressive
12 Chronic Specialty: Stable-Orthopedic	11 Chronic Medical: Unstable
13 Chronic Specialty: Stable-Ear, Nose, Throat	16 Chronic Specialty: Unstable-Orthopedic
18 Chronic Specialty: Unstable-Eye	22 Injuries/Adverse Effects: Major
25 Psychosocial: Recurrent or Persistent, Unstable	25 Psychosocial: Recurrent or Persistent, Unstable
32 Malignancy	32 Malignancy

Resource Utilization Bands (RUB)

0: Invalid

2: Low

4: High

1: Healthy Users

3: Moderate

5: Very High

Final ACG Categories, Reference ACG Concurrent Risks, and RUBs

ACG	Description	Non-Elderly (0 to 64 Years)	Elderly (65 Years and Older)	RUB
0100	Acute Minor, Age 1	0.314	N/A	2
0200	Acute Minor, Age 2 to 5	0.135	N/A	1
0300	Acute Minor, Age > 5	0.131	0.081	1
0400	Acute Major	0.283	0.144	2
0500	Likely to Recur, w/o Allergies	0.193	0.116	2
0600	Likely to Recur, with Allergies	0.199	0.090	2
0700	Asthma	0.210	0.111	2
0800	Chronic Medical, Unstable	1.220	0.312	3
0900	Chronic Medical, Stable	0.298	0.127	2

TABLE : HEALTH MEASURES MOTHER AND CHILD

Variable	Mean	Std. Dev.	Min.	Max.
Mom RUB >2 years 0 to - 5	0.69	0.46	0	1
Mom RUB >2 years - 1 to - 5	0.64	0.48	0	1
Mom ADG years 0 to - 5	14.55	12.52	0	91
Mom ADG years - 1 to - 5	11.82	10.71	0	75
Baby LBW	0.04	0.2	0	1
Baby HBW	0.03	0.18	0	1
Baby APGAR \geq 7	0.98	0.13	0	1
Child RUB > 2 age 0 to 4	0.07	0.26	0	1
Child RUB > 2 age 5 to 9	0.17	0.38	0	1
Child RUB >2 age 10 to 14	0.33	0.47	0	1
Child RUB > 2age 15 to 17	0.42	0.49	0	1
Number prenatal visits	13.54	5.77	0	93

Note: RUB is Resource Utilisation Band. Number of prenatal visits includes all physician visits during pregnancy. years 0 to - 5 and - 1 to - 5 refer to periods before child's birth. ADG is the sum of ADG groupings.

Demographics

CHILD:

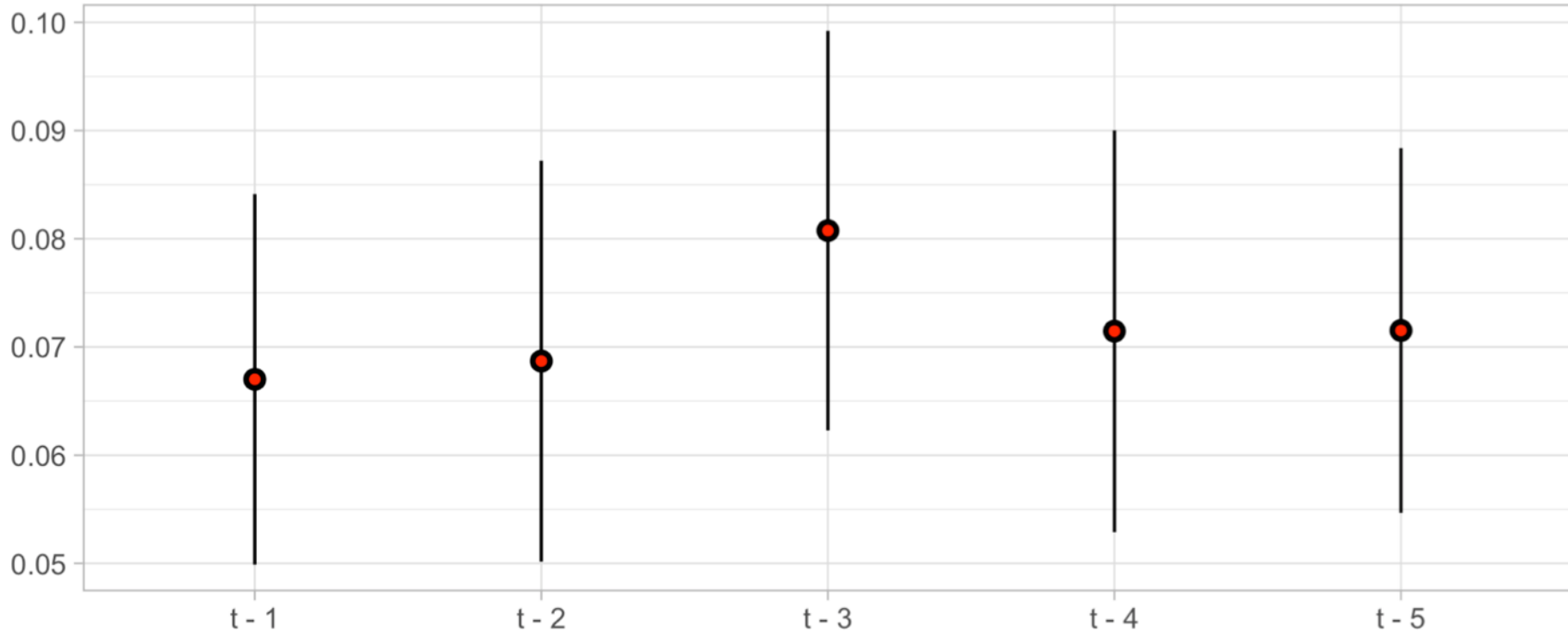
Variable	Mean	Std. Dev.	Min.	Max.
Sex = girl	0.49	0.50	0.00	1.00
# siblings	1.54	0.66	1.00	5.00
First child	0.49	0.50	0.00	1.00
Second child	0.29	0.45	0.00	1.00
Third or later child	0.22	0.42	0.00	1.00
0 siblings	0.55	0.50	0.00	1.00
1 sibling	0.37	0.48	0.00	1.00
2 siblings	0.07	0.26	0.00	1.00
≥ 3 siblings	0.01	0.08	0.00	1.00

MOTHER:

Variable	Mean	Std. Dev.	Min.	Max.
Married	0.40	0.49	0.00	1.00
Age at birth	27.01	6.05	13.00	49.00
On Income Assistance	0.18	0.39	0.00	1.00
Family size	3.08	1.65	1.00	14.00
Distance to GP	39.84	92.00	0.00	1,096.50

Effect of Mother's Pre-Pregnancy Health

Mother's health measured at a specific year



Note : Each estimate comes from a separate Linear probability model.

Birth = Low Birth Weight. 0 - 4 , 5 - 9 , 10 - 14, 15 - 17 refer to health (measured by RUB>2) at given age intervals.

t-s is Mother's health s year before birth

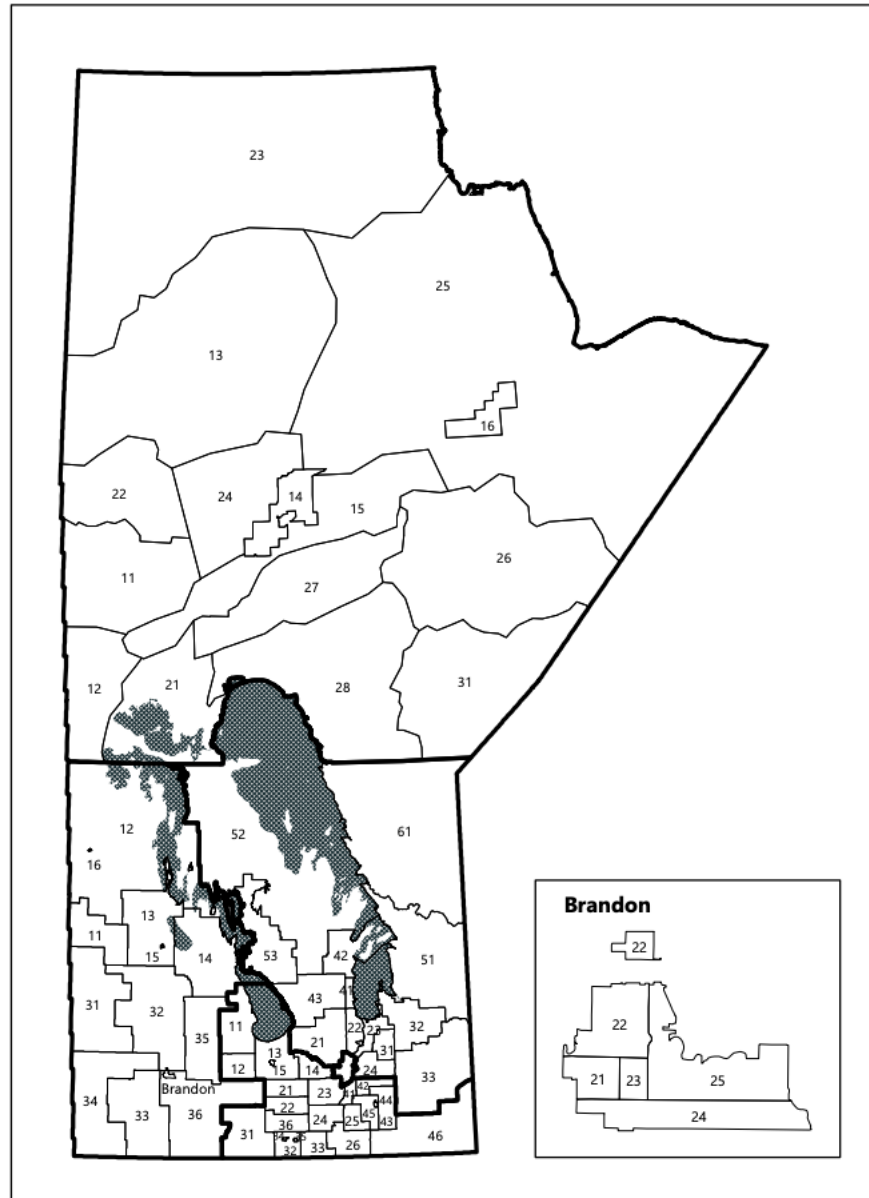
Still to do

- Health condition type
- Number of health conditions
- Current socio-economic variables
- Excluding injuries

Future Analyses

- Education outcomes
 - Early Development Index (Kindergarten)
 - Standardized test scores grades 3, 7, 8, 12
 - University and College enrollment and grades
- Justice data
 - Corrections and criminal courts
 - Offenders and victims

Map of Regional Health Authorities and Districts in Manitoba, 2016



Distance

- “As the crow flies”
- Users:
 - Patient to Physician (based on postal code)
- Non-users:
 - Closest physician

Physician Assignment

