Life course epidemiology: the 1990 Birth to Twenty cohort in South Africa

Birth to Twenty

Research Programme

Overview

- Overview Birth to Twenty Cohort
- Attrition & maintaining the cohort
- Life course epidemiology
  - Early growth pathways and later outcomes
- 3rd Generation Study
- Conclusion

Rationale

Onset of demographic and health transition

- Increasing urbanisation
- Decreasing infant mortality (27/1000, 1985)
- Decreasing infectious diseases
- Increasing non-infectious diseases
- Increasing social problems
- Increasing child behaviour problems
- Working women and child care

To describe and understand the pattern and determinants of the health and development of children & youth within an urban environment

Birth to Ten

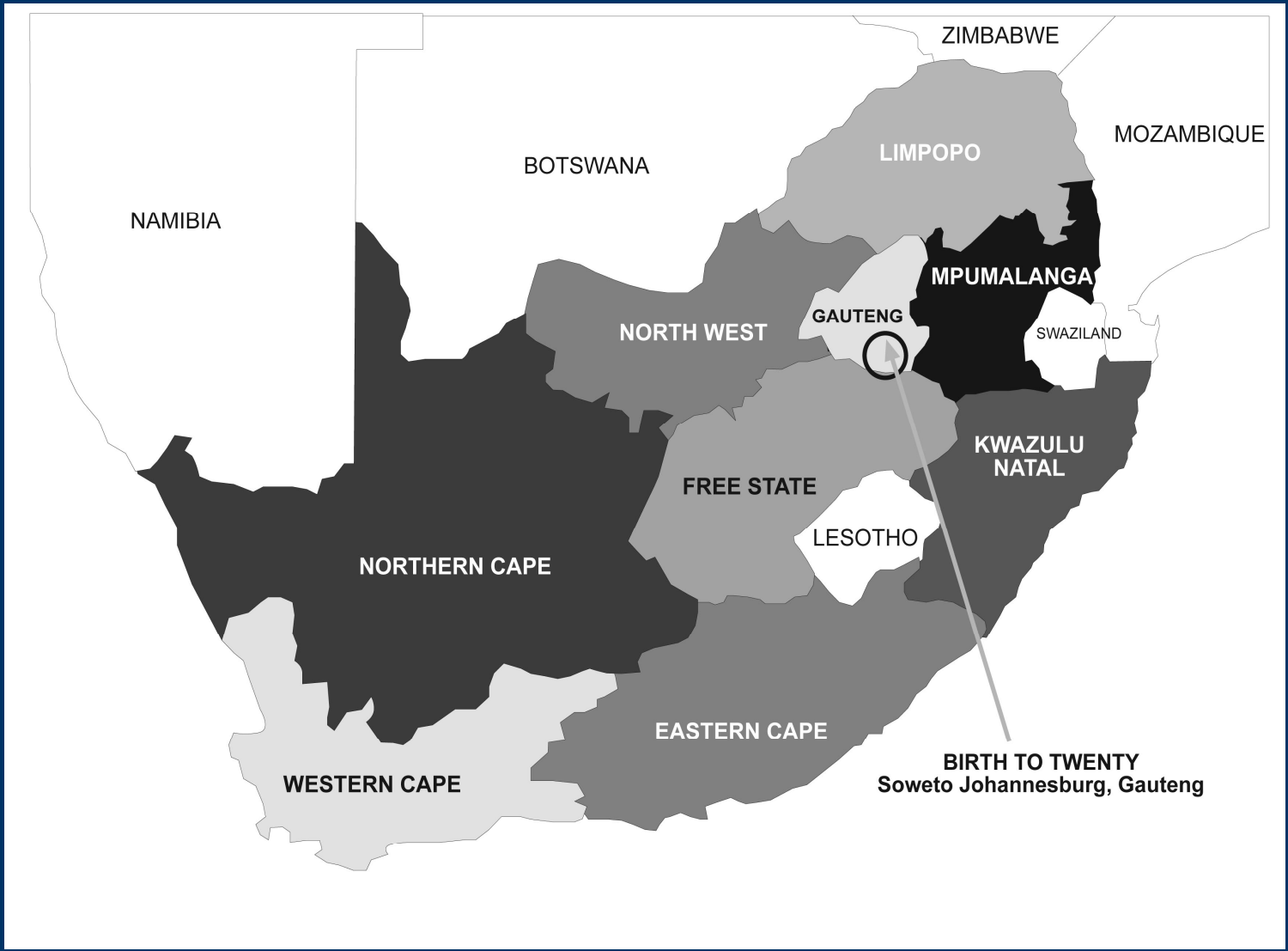
Pilot study (1988-89)
20% deliveries immediately lost to follow-up
20% unable to be contact by 9 months
Predicted: residential cohort = 40% of birth cohort

Why did women want to deliver in Johannesburg/Soweto when they actually lived somewhere else?
To entitle their children to urban residence
Perceived superiority of health services
Acknowledgement & support from father who may be an urban migrant labourer

Birth to Ten

- Birth to Ten: prospective longitudinal birth cohort study
- Phased enrollment:
  - Antenatal clinics (1989)
  - Delivery centres: cohort period
  - Immunization clinics in 1st year
  - Checked against Municipal notifications, required by law & mortuary records
- 5449 births in Johannesburg-Soweto area, April – June 1990
- Bt10 = 3273 Families
- Eve of political, demographic and health transition

Soweto-Johannesburg



Soweto-Johannesburg

Soweto-Johannesburg

Soweto

Birth to Ten

CHARACTERISTICS		Total births (n=5 449)	BT20 cohort (n=3 273)
Population group	African	4029 (74%)	2569 (78%)
	White	677 (12%)	207 (6%)
	Coloured	546 (10%)	383 (12%)
	Indian	191 (4%)	115 (4%)
	Not known	6 (0.1%)	0
Maternal age	<17 years	155 (3%)	92 (3%)
	17-19	598 (11%)	392 (12%)
	20-38	4526 (83%)	2693 (82%)
	39+	168 (3%)	95 (3%)
	Not known	2	2
Birth weight	<1500gms	104 (2%)	30 (1%)
	1500-2499	563 (10%)	322 (10%)
	2500-3999	4614 (85%)	2827 (86%)
	4000+	149 (3%)	89 (3%)
	Not known	19 (0.3%)	6 (0.2%)

Mean birth weight = 3.07 ± 0.51 kg

Bias

Under-enrolment
Families using private facilities (Mainly White & some Indian South Africans)

Non-response
White families
-less than 50% participation

Compensation
Enrolled 125 additional White families in 2000

SES

SES measure	*0/2 years (%)*	*9/10 years (%)*	*SADHS 1998 (%)*	*Significance*
Caregiver married/cohabiting	23.60	45.00	46.70	
Caregiver has Grade 11-12 or higher at 0/2 years /Grade 12 or higher (completed High School or Secondary education) at 9/10 years	44.30	33.00	26.70	*
Lives in house/flat/cottage	90.90	87.10	-	
Indoor water source	47.60	50.50	54.30	
Inside flush toilet	23.90	37.20		
Has television in home	78.30	90.90	73.50	***
Has motor vehicle in home	28.20	26.50	19.40	*
Has refrigerator in home	75.40	91.30	66.20	***
Has washing machine in home	10.70	29.10	-	
Has telephone in home	60.20	65.00	-	
Has video machine in home	-	40.50	-	
Has microwave in home	-	24.90	-	
Child covered by medical aid	-	17.80	-	

Soweto

Landmark events

1990	Nelson Mandela released from prison on 11 Feb
	Major hospital strikes, including Baragwanath
1991	Repeal of Group Areas Act (1951)
1994	Democratic elections
	School feeding scheme
	Free health care - pregnant women & children
	Ratified Convention on the Rights of the Child
	Launched National Plan of Action for Children
	2000 people died in Soweto political conflicts
1996	Compulsory 9 years of schooling
	Free schooling
1997	Early Child Development White Paper
2000	Transition from Bt10 to Bt20

Data collection waves

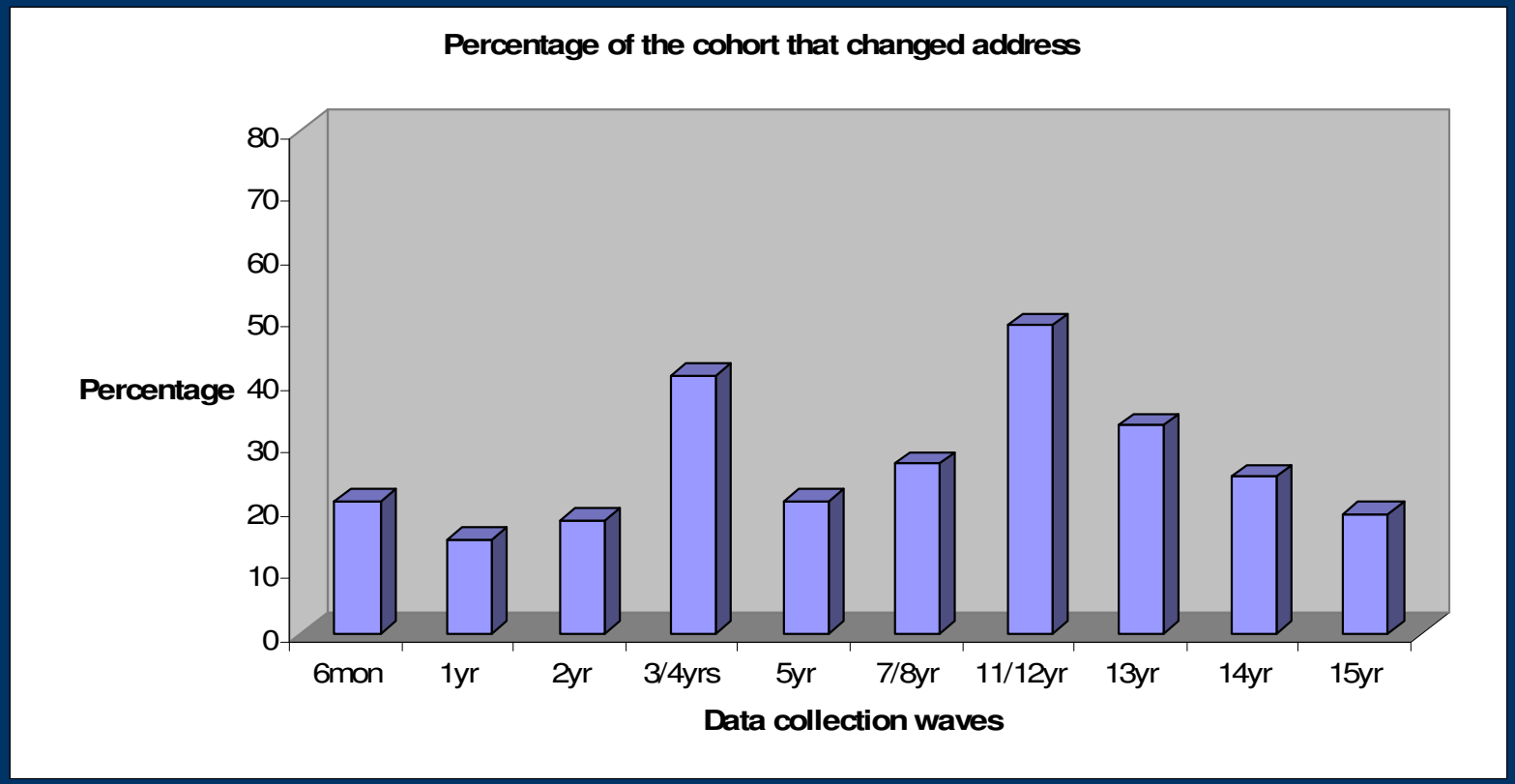
ANTENATAL	– clinics, 26 wks pregnancy ->
DELIVERY	- hospitals and clinics
6 MONTHS	- clinics and homes
1 YEAR	- clinics and homes
2 YEARS	- homes and BTT Soweto site
3 YEARS	- SEARCH FOR CASES
4/5 YEARS	- homes and BTT Soweto site
7/8 YEARS	- homes and BTT Soweto site
9/10 YEARS	- INCOMPLETE – TRANSITION TO BT20
11/12 YEARS	- homes, BTT Soweto & Jhb sites
13 YEARS	- Data collection twice a year, site & home
14 YEARS	- Data collection twice a year, site & home
15 YEARS	- Data collection twice a year, site & home
16 YEARS	- Data collection twice a year, site & home
17 YEARS	- Data collection twice a year site only
18 YEARS	- Data collection twice a year, site & home

+ Available records:
Birth notifications, clinic files, Road-to-Health cards, school reports

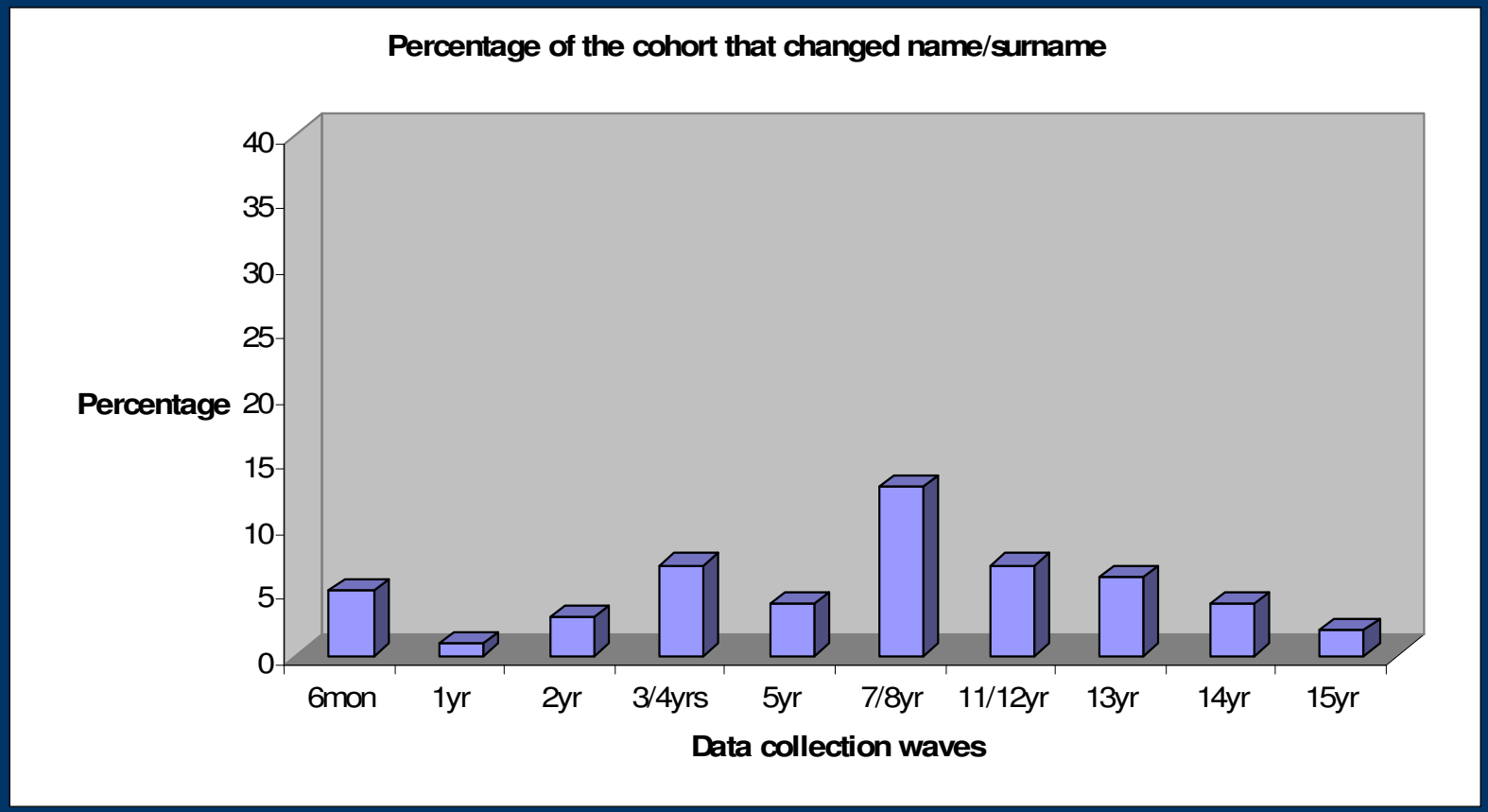
Research themes

1. Infant, child and adolescent physical and mental health
2. Influence of home, school and family environments on the children and adolescents
3. Sexual and other risk behaviours emerging during adolescence
4. Body composition, obesity and emerging non-communicable disease risk during adolescence
5. Nutrition, physical development and bone health through childhood and adolescence
6. Methodological issues involved in studying children and adolescents.
7. Genetic-environment interactions

Challenges


Percentage of the cohort that changed address
Percentage
80
70
60
50
40
30
20
10
0
6mon
1yr
2yr
3/4yrs
5yr
7/8yr
11/12yr
13yr
14yr
15yr
Data collection waves

Challenges


Percentage of the cohort that changed name/surname
Percentage
40
35
30
25
20
15
10
5
0
6mon
1yr
2yr
3/4yrs
5yr
7/8yr
11/12yr
13yr
14yr
15yr
Data collection waves

Attrition

BT20 cohort	3273 Families	%
Reported child mortality	44	1
In contact	2291	70
Family moved out of study area	241	7
Family moved to unknown address	609	20
Caregiver death	58	2

Total attrition over 18 years = 30%

Average annual attrition rate = 1.7%

Learning points

- In developing countries limited resources (staff; funding) can significantly deter tracking initiatives
- Temporal perspective – circular migration
  - Lost and found
  - Participate or decline
- High retention in a residentially unstable urban environment
  - Creation of **trust** and confidence in the study (confidentiality & professionalism)
  - Respondents feel part of the study (newsletters; parent workshops; media; fun cohort activities; toll-free number; free post)
  - Short gap between contacts
  - Intensive tracking procedures (staff training & motivation; telephonic; letters; home visits; school visits)

Bt20 Birthday Bash

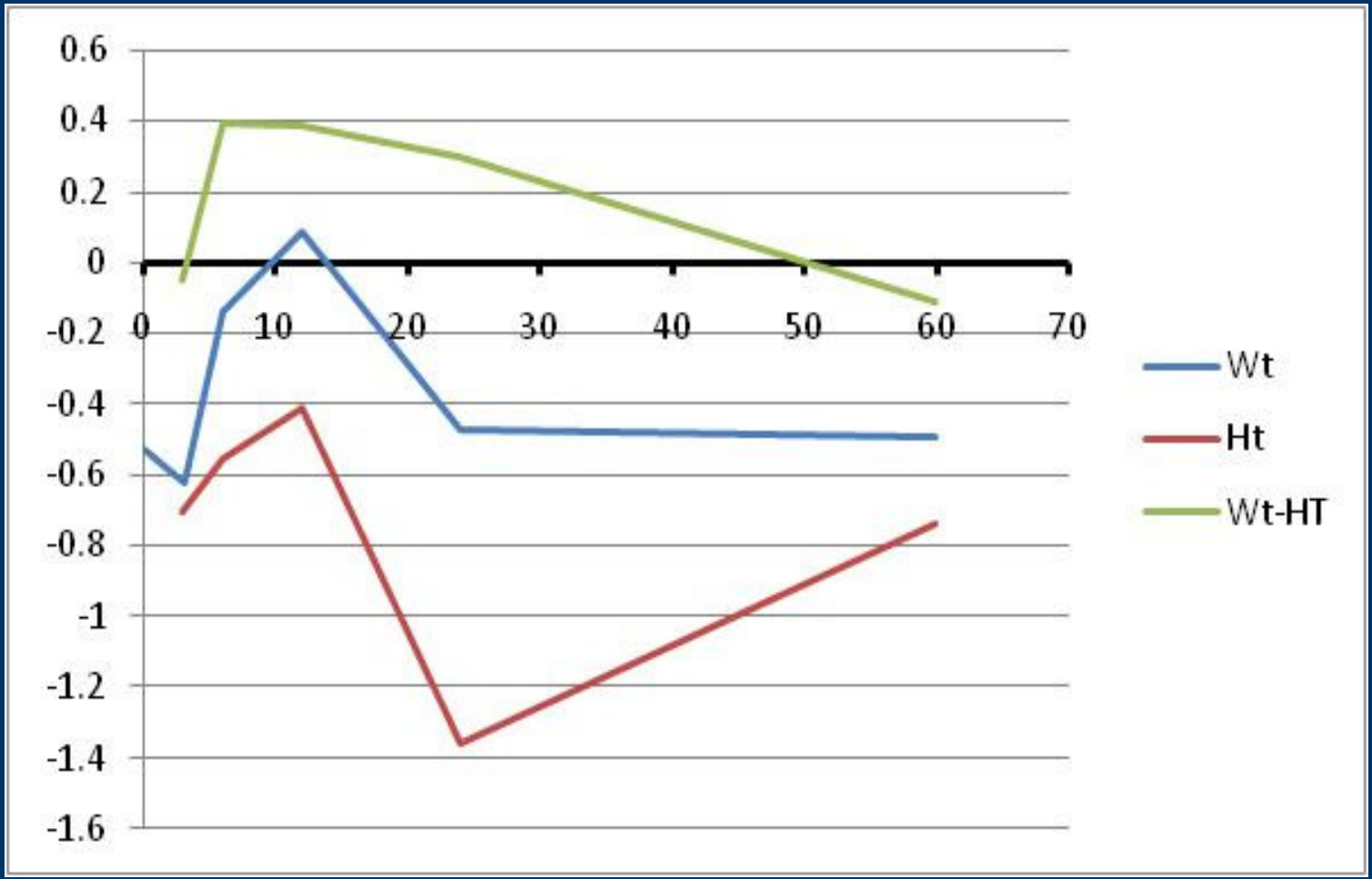
Retention strategy

- From primary contacts with caregivers
  - Relatives addresses
  - Work addresses
- To primary contacts with adolescents
  - Schools
  - Mobile phones
  - Promoting identification with the study
- Field work staff

Complex burden of disease in SA

1. HIV/AIDS
2. Poverty related infectious diseases
    1. Child morbidity & mortality (diarrhoea; upper respiratory tract infection)
3. Malnutrition
    1. Stunting: urban 10%; rural 45%
4. Increasing obesity & chronic disease
    1. Transitioning societies
    2. 40% of Black SA women obese
    3. Type II diabetes expected to increase by 161% between 2000 and 2030
5. Intergenerational transfer of risk

Infant & early child growth (birth - 5 years)

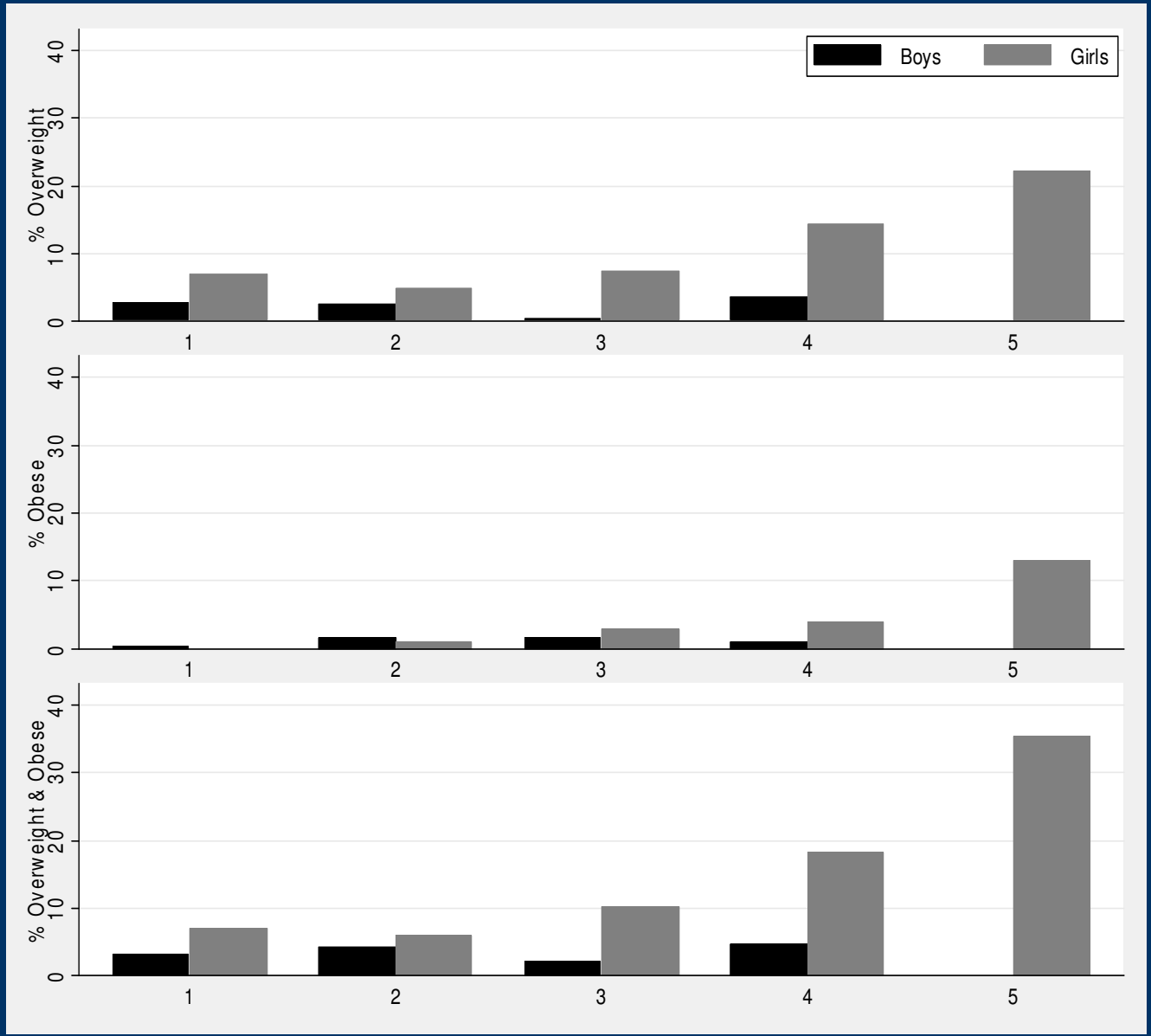


Malnutrition (2yrs)

- Stunting: 26.5%
- Underweight: 8.7%
- Overweight: 12%
- Wasting: 6.5%

Age 5 yrs

Adolescence



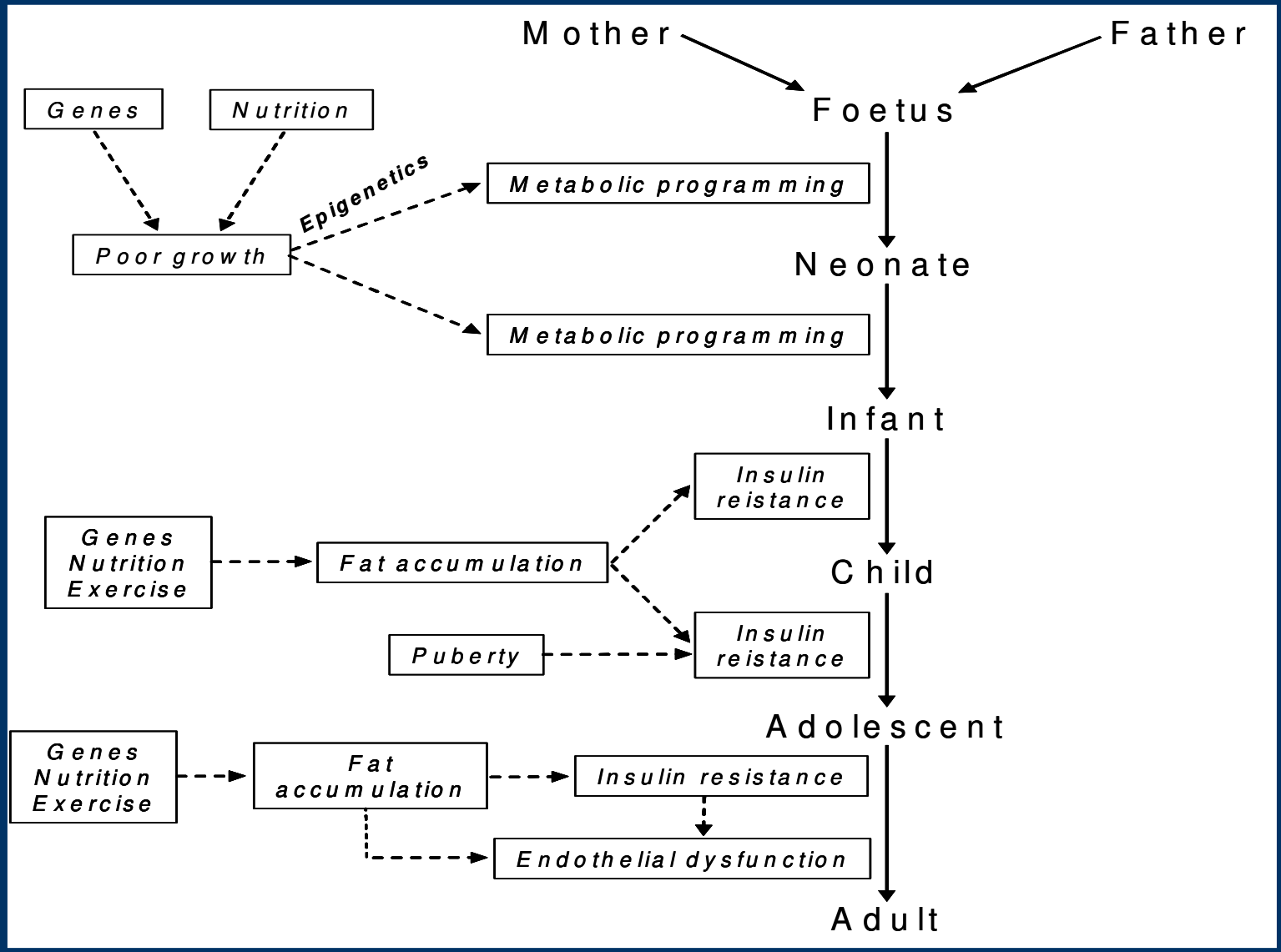
Adolescence

Developmental Origins of Adult Disease

FOETAL INSULT

Brain sparing	Growth switches off	Stress response	Body composition
↓	↓	↓	↓
Less circulation to lower extremities	Decreased IGF/Insulin	Increased cortisol	Decreased muscle mass
↓	↓	↓	↓
Hypertension	Insulin resistance	Early maturation	Increased fat mass (central obesity)

Metabolic disease risk



Early growth and later obesity risk

Low birth weight (intrauterine growth restriction) has been associated with obesity and metabolic disease risk in adults (Hales et al, 1991; Barker et al, 1993)

Rapid postnatal weight gain (0.67 change in z-score) has also been associated with greater risk for obesity:

1.26 - 4.55 odds ratio across 9 population studies (Ong and Loos, 2006).

These two growth patterns are interlinked, as infants with low birth weight generally compensate by gaining weight rapidly in the first year of life.

Early growth and earlier onset of puberty

There is evidence that girls who experience rapid weight gain in infancy have an earlier age at menarche than those with slower weight gain (Adair 2001; Sloboda et al 2007).

Empirical data on the relationship between the onset of pubertal development in boys and early growth is lacking.

Hypothesis

Rapid weight gain in infancy may be a marker for a trajectory towards both accelerated obesity and physical maturation in children living in Soweto.

Investigated

The association of weight gain in infancy (0-12 months) and prepubertal outcomes (height, weight, and body fat) at age 8/9 years, and the subsequent onset of pubertal development in the Birth to Twenty cohort.

Methods

We assessed pubertal development annually from age 9 years using Tanner's pubertal development scale.

Assessed age of menarche, and pubic hair and breast development in females

Assessed pubic hair and genital development in males

Also, collected a hand x-ray annually from age 9 years, and applied TW3 to determine bone age (proxy for skeletal development)

Methods

Exposure:

Weight gain (0-12months)

[Change in 0.67 z-score]

Outcome:

BMI

Sum of skinfolds

Menarche (F)

Genital (M)

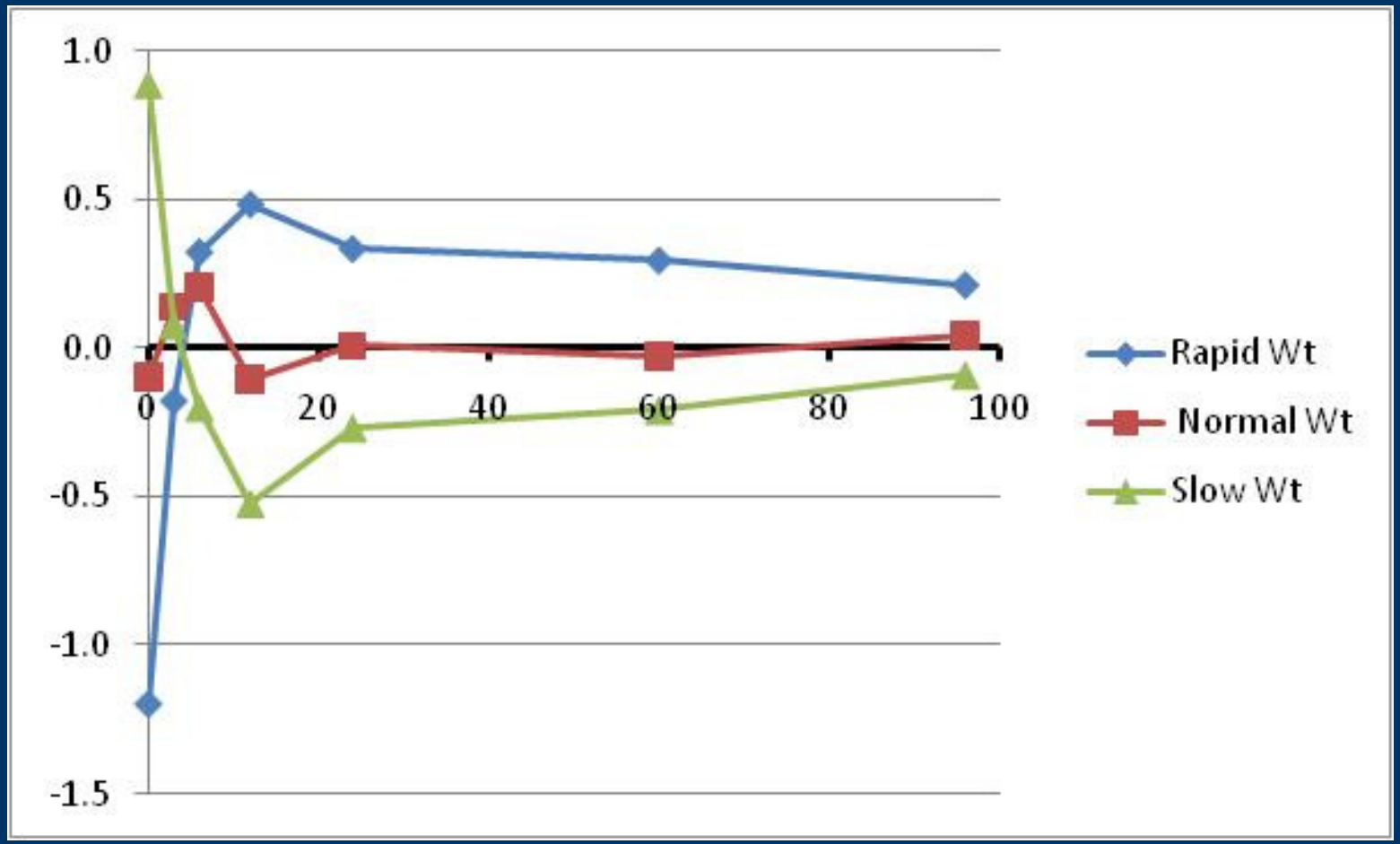
Skeletal age

Confounders:

Gender*, height*, birthweight, gestational age, breastfeeding, socio-economic status,

Results

Mean weight z-score changes over time



Results

BMI and sum of skin-folds (adjusted values)

	Rapid weight gain	Normal weight gain	Slow weight gain	p-value
BMI at age 8 years ($kg.m^{-2}$)	17.8 ± 1.4	15.9 ± 1.1	14.9 ± 1.7	0.001
Sum of skin folds at age 8 years (mm)	49 ± 16	37 ± 16	30 ± 14	0.001

Rapid weight gain group 2.8 greater risk (odds ratio) of being classified as overweight (>2 z-score for weight-for-age) at age 8 years

Results

DXA Body composition (adjusted values)

- DXA-derived Bone Mineral Content:
  - No significant differences
- DXA-derived Fat mass:
  - significantly increased in rapid wt gain group
- DXA-derived Fat Free Mass:
  - significantly decreased in rapid wt gain group

Results

Onset of puberty (adjusted values)

	Rapid weight gain	Normal weight gain	Slow weight gain	p-value
Male age of onset of puberty: genital development (years)	12.7 ± 1.5	12.5 ± 1.3	12.5 ± 1.4	0.181
Female age of onset of puberty: menarche (years)	12.3 ± 1.2	12.6 ± 1.2	12.8 ± 1.3	0.01

Hypothesis revisited

Rapid weight gain in the first year of life does seem to result in an obesity risk pathway with greater risk of being classified as overweight and higher BMI and body fat (as measured by sum of skin-fold thicknesses) by age 8 years.

Early rapid weight gain does result in accelerated pubertal development in females with an earlier onset of menarche, but no significant effect in males.

Early rapid weight gain results in advanced skeletal development in both males and females

Implication

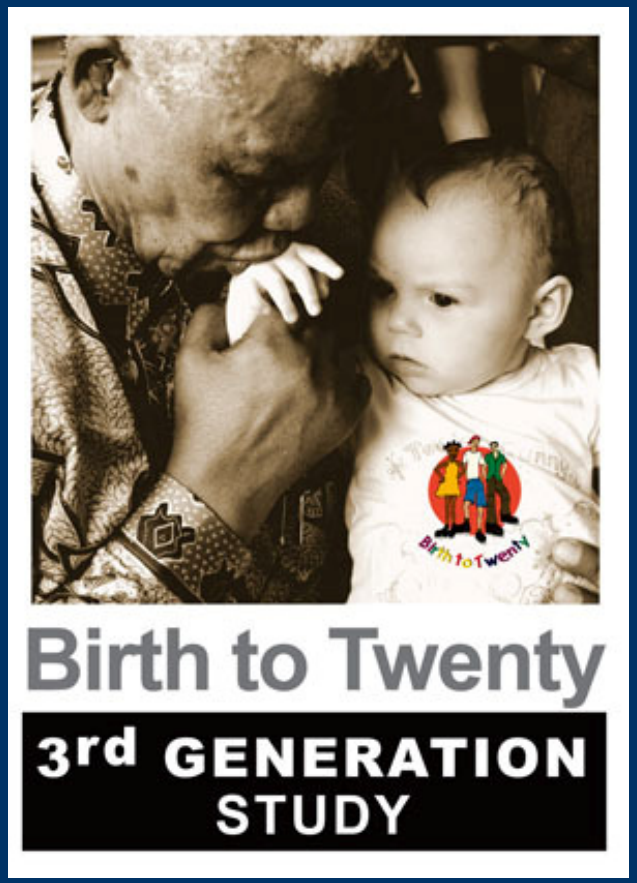
Research indicates that individuals that are overweight as children are more likely to be overweight adolescents and adults with increased risk of obesity and metabolic disease.

Data from SWEDES showed that rapid weight gain (0-6 months) predicted clustered metabolic risk at age 17 years.

Also, early onset of puberty has been shown to be associated with an increased risk of obesity.

Therefore, early interventions to moderate rapid weight gain at very young ages may help to reduce adult cardiovascular disease risks.

3rd Generation Cohort



3rd G Teen pregnancy cohort (n=110)

3rd G Adult cohort

Intergenerational transfer of risk

Conclusion

Life course epidemiology is an important framework to investigate the presentation of early risk factors and potential environmental modifiers for chronic disease in developing country populations.

Life course epidemiology is critical to enable the understanding of intergenerational risk patterns.

Life course epidemiology can assist with the development of targeted interventions at different developmental stages.

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www.wits.ac.za/birthto20