

# Longitudinal Cohorts: What are they Good for? What can they tell Us?

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# Early life experiences are important to understand....

for child development.....

→ but really hard to identify, prioritize, measure and pinpoint when they have the greatest impact on children's health and development



# Randomized Clinical Trial (RCTs)

- Are the gold standard for practice guidelines and population health interventions
- but....
  - You need to know the important influences (variables)
  - You need to know when to change them
  - You need to know how to change them
  - You need to know what other variables affect them
  - You need to be able to ethically change them
  - You are limited to changing only a few variables in each study



# Limitations of RCTs



- → So RCTs are not the method of choice for investigating the effects of the many early life experiences on child health and development.

Examples of variables that are important to understand that RCTs **can't** be used to study:

- Limiting mothers **food intake during pregnancy** to understand the effect on childhood obesity
- Varying **alcohol consumption during pregnancy** to investigate the its effects on children's cognitive development
- Exposing mothers to **second hand smoke during pregnancy** to investigate the incidence of SIDS
- Any question that involves **controlling breast feeding initiation or duration**; you can't randomize mothers to exclusive breast or formula feeding of their infants nor can you stop breast feeding.
- Controlling **children's nutrition** until they are adults to determine the influence of childhood nutrition on rates of obesity in adults.

# If not RCTs, What then?

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## Case Control studies?

They are:

- **Economical**
- **Fast**
- **Seemingly straight forward**
- **Very useful for 'rare' or less frequently occurring conditions**



# Limitations of Case Control

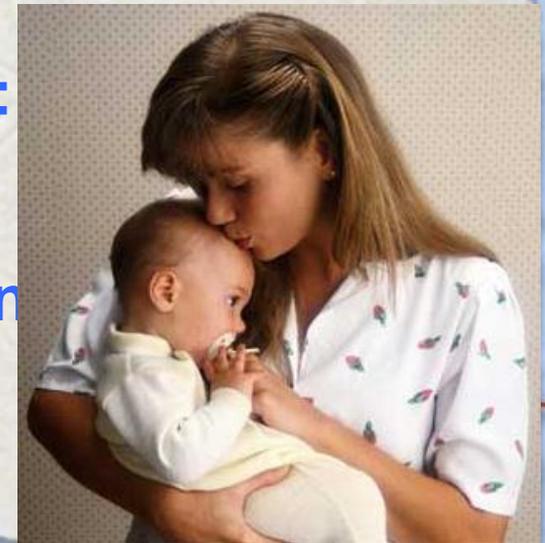
- Everything you find out depends on the comparison to the control group(s)
  - ➔ Who do you use as the control?
- All of the variables are collected retrospectively
- You have to know which variables you want to collect and they may **not** be the right ones or all of the ones you need.
- These studies rely on people's memory and are significantly impacted by recall bias (e.g. selective memory because you have the outcome)
  - ➔ in children with ADHD, parents may over report sugar consumption as they equate symptoms and cause with high sugar intake



# So What do we Use?

## Longitudinal Cohorts

- Alberta Pregnancy Outcomes and Nutrition (APrON)
- All Our Babies
- Developmental Coordination Disorder: From Genes to Behaviour
- The Canadian Healthy Infant Longitudinal Development (CHILD)



# Longitudinal Cohorts: Strengths & Opportunities

- Prospective data can be collected on everything we think is important
  - We can go back retrospectively and collect information we might have missed
  - We can repeated measures so critical times can be identified
  - We can quantify variables (exposures) that cannot be randomized in an experimental design
  - We can study development and developmental outcomes

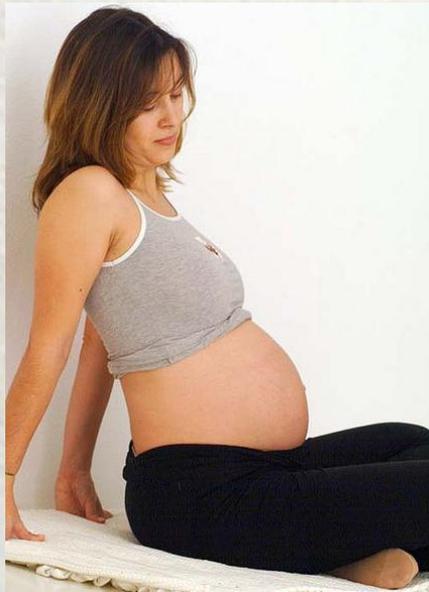


# Longitudinal Cohorts: Strengths & opportunities (continued)

- We have the opportunity to follow the children into adulthood and beyond (their children's children)
- We can do nested case control studies and avoid some of the limitations of case control studies
- Data can be shared with new collaborators to answer new pressing or urgent health concerns that may not have been part of the initial study (i.e., obesity, environmental toxins, asthma)



# What have Longitudinal Cohorts Taught Us?



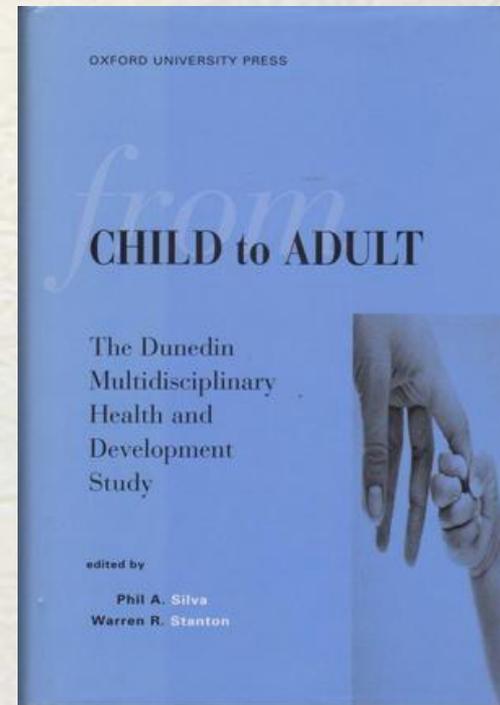
# Dunedin Multidisciplinary Health and Development Study

- The *Dunedin Multidisciplinary Health and Development Study* is an ongoing, longitudinal study of the health, development and well-being of a large sample of New Zealanders.
- The cohort includes 1037 babies born in 1972-1973
- Children were assessed at 3, 5, 7, 9, 11, 13, 15, 18, 21, 26, and 32 and years of age
- Assessment at 38 years of age is ongoing



# Dunedin Multidisciplinary Health and Development Study (1972-1973)

- Initial purpose was to look at the impact on new medical procedures in and interventions for newborns on child outcomes
- What has it looked at?
  - Psychosocial Functioning
  - Cognitive Development
  - Mental health
  - Respiratory health
  - Obesity
  - Cardiovascular health
  - Oral health



# Dunedin Multidisciplinary Health and Development Study (continued)

## Over 1100 peer reviewed publications:

- Raised blood levels of lead associated with problems in hyperactivity and attention in eleven-year-old children (1988)
- Male sex, parental atopy, and maternal smoking during pregnancy are risk factors for asthma in young children. (1996)
- Adolescents with low self-esteem had poorer mental and physical health, worse economic prospects, and higher levels of criminal behavior during adulthood, compared with adolescents with high self-esteem (2006)
- Childhood television viewing associated with attention problems in adolescence (2007)
- Breastfed children attain higher IQ scores than children not fed breast milk, presumably because of the fatty acids uniquely available in breast milk; however, the association between breastfeeding and IQ is moderated by a genetic variant in FADS2, a gene involved in the genetic control of fatty acid pathways (2007)
- Sleep restriction in childhood increases the long-term risk for obesity in adults 32 years of age (2008)
- Childhood self-control predicts physical health, substance dependence, personal finances, and criminal offending outcomes (2011)
- Children mistreated in the first decade of their lives show elevated levels of biomarkers (C-reactive protein, fibrinogen, white blood cell count) by the age of thirty. These biomarkers signal inflammation, which are predictors for heart attacks and dementia in adults (2012).

# Raine Study (1989)



- The Raine Study is an ongoing pregnancy cohort health research project
- 2900 pregnant women were enrolled
- The mothers were assessed at 18 weeks of pregnancy, then some of them again at 24, 28, 34 and 38 weeks of pregnancy
- Information was collected on the mother and the father (e.g., diet, exercise, work, health, etc.)
- After the children were born, they were assessed at birth, 1, 2, 3 and 5 years of age. Information on their height, weight, eating, walking, talking, eating, behaviour, any medical conditions or illness etc was collected.
- Further follow ups of the cohort have been conducted at eight, ten, fourteen, and seventeen years of age. At each follow-up information is collected from the parents and the child. The current follow up is being done at 20 years of age.

# Raine Study (continued)

- Health Research project - initial purpose was to look at the impact of ultrasound imaging
- What has it looked at?
  - Aboriginal health
  - Asthma, allergy & respiratory disorders
  - Cardiovascular & metabolic Disease
  - Children's cancer
  - Children's development and well being
  - Disability & developmental disorders
  - Environmental impact on health
  - Genetic impacts on health
  - Obesity & Physical Activity
  - Mental Health
  - Pregnancy & maternal health
  - Infectious disease
  - Nutrition
  - Dental health



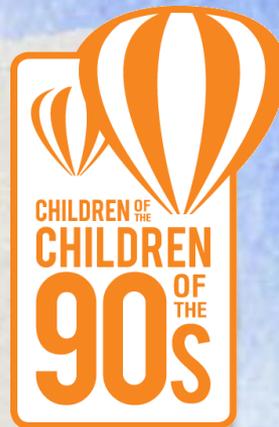
# Raine Study



## Over 1000 peer reviewed publications:

- Exposure to multiple prenatal ultrasound examinations from 18 weeks' gestation onwards associated with in childhood with growth and measures of developmental outcome similar to those in children who received a single prenatal scan (2004)
- Higher levels of behaviour and emotional problems associated with a more Western-style way of eating (i.e., a diet high in takeaway foods, red meat, soft drinks, candy, and white bread) (2009).
- Children who are breastfed for longer than six months have a lower risk of mental health problems as they enter their teen years (2010).
- Late-talking toddlers are no more likely to experience behavioural and emotional difficulties during childhood and adolescence than children who have normal language development (2011)
- Repeated stressful events during pregnancy are linked to increased risk for behaviour problems in children (2011)
- Children exposed to anesthesia before age 3 had a higher relative risk of language and abstract reasoning deficits at age 10 than unexposed children (2012)

# Avon Longitudinal Study (1990)



- The **AVON Longitudinal Study** or **Children of the 90s** study is examining the interaction between genes and environment on the health and development of children and their parents
- 14,000 mothers were enrolled during pregnancy in 1991 and 1992
- Data have been collected using self-administered questionnaires, data extraction from medical notes, linkage to routine information systems and from research clinics that all the children have been invited to attend regularly from the age of seven years.
- Biological samples have been collected for genetic studies
- Follow ups of the cohort have been conducted at 8, 10, 14, and 17 years of age. At each follow-up information is collected from the parents and the child. The current follow up is being done at 20 years of age.

# Avon Longitudinal Study (1990)

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- What is it looking at?
  - understanding of the early life influences (prenatal and during early childhood) on ***cognitive and psychosocial development and chronic diseases***
  - the causes of important childhood conditions
  - the determinants of health-related behaviours
  - the genetics of common diseases and continuous traits (i.e., learning styles, shyness, etc...)



# Avon Longitudinal Study (1990)



## Over 700 peer reviewed publications:

- Maternal drinking before conception and in early pregnancy associated with lower infant birth weight (1996)
- Infants sleeping in a supine positions not associated with any other conditions (1997,1998)
- Children brought up in very hygenic homes more likely to develop asthma (2002)
- Peanut allergy found to be related to cutaneous application of peanut oil (2003)
- Use of air fresheners and aerosols associated with more diarrhea in babies and more headaches and depression in mothers (2004)
- Increased seafood consumption in pregnancy associated with higher IQs, and better social, communication and fine motor performance in children(2007)
- Children who spend more time outdoors at age 8-9 years less likely to be short-sighted at age 15 (2012)

# Project Viva

- Longitudinal birth cohort in the US (Boston area approx. 1100 participants).. Children are now 7-12 yrs old
- The goal was to find ways to improve the health of mothers and their children by looking at:
  - ➔ the effects of mother's diet and other factors during pregnancy and after birth on her health and the health of her child.
    - obesity, asthma
    - how a woman's pregnancy is affected by lifetime experiences of racism or violence.

# Some of the lessons learned from project Viva

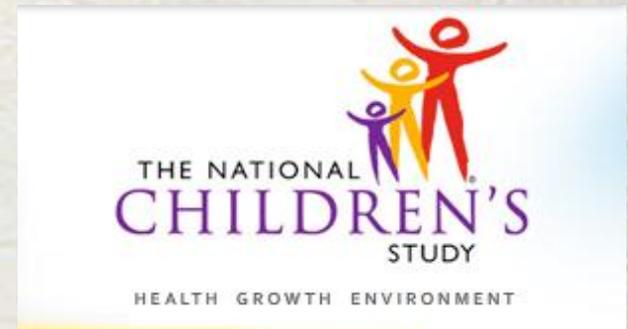
Over 120 peer reviewed publications:

- Weight Gain In Pregnancy Linked To Overweight In Kids (2007)
- Pregnant women who eat more fish, including canned tuna, have children who score higher on cognition tests (2008)
- Babies who sleep less gain more weight (2009)
- Risk of Childhood Obesity Higher Among Minorities in the US (2010)
- Introducing Solid Food Too Soon Puts Babies at Risk for Early Obesity (2011)
- 3-year-olds who had been born by cesarean section were twice as likely to be obese as those who had been delivered vaginally (2012)

# National Children's Study



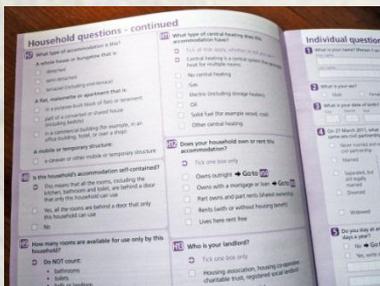
- Will examine the effects of the environment (i.e., air, water, diet, sound, family dynamics, community and cultural issues and genetics) on children's health and development
  - Plan for ~100,000 kids
  - Followed until 21 years
  - Received ~\$193M
    - requested ~\$165M this year
- (President's budget)



<http://www.nationalchildrensstudy.gov>

# The Challenges of Longitudinal Cohorts

- How much information on each participants is enough?
  - Burden on the participants & family
- Funding of longitudinal cohorts- who should fund these beyond the initiation?
  - Consistent funding to maintain the cohort, not just to do studies on it



# Other Challenges of Longitudinal Cohorts

- The time needed to establish the cohort
- The time needed to investigate the outcomes
- Retention...
  - Maintaining participants interest and involvement
- Incorporating new tools and techniques to address new questions
- Challenges of working with multidisciplinary and multigenerational researchers
- Transition – Researchers, Funders, Participants

# How have Cohort Studies changed Health Practice and Public Policy?

- They have changed how parent put their infants to sleep
- They have changed recommendations about what women should eat during pregnancy
- They have brought to our attention of health practitioners, policy makers and the public at large the importance of early life experiences on children's health and cognitive and psychosocial development



# How Can Cohort Studies Affect our Future Health?

- Identifying factors in early life that influence obtaining and maintaining a healthy body weight throughout life
- Identifying early risk factors that could be altered to reduce the risk of cancer, cardiovascular disease or type 2 diabetes
- Identifying genetic and environmental factors that put children and adults at higher risk for mental health disorders; if can't identify them you can't develop interventions
- Optimizing nutrition and physical activity guidelines during pregnancy to ensure health growth and development of the baby
- Determining if there is added value taking nutrient supplements during pregnancy

# What do we Need?



- A cohort that:
  - best represents us or the people we work with.
  - that measures the outcomes that are important to us
  - That answers the questions that will improve the health of our children and their future children.

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