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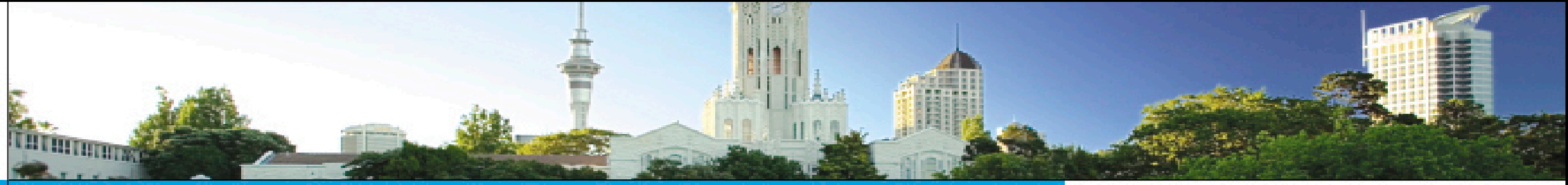

Knowledge Laboratory of the Early life Course

Barry Milne and COMPASS team

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COMPASS Seminar Series
4 August 2016

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI

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Outline

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- What is microsimulation?
  - A simple example
- MEL-C
  - Key features, Results, Insights & observations
- Knowledge Lab of the Early Life Course
  - Aims
  - 3 models: **Obesity, Education** & Mental health
  - Web deployment using Shiny

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What is Microsimulation?

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- Simulates plausible data for micro-level units (i.e., people, businesses, …)
- It (typically) uses empirical data as a basis to simulate real or alternative worlds, and their futures
- It enables experimentation in a virtual lab

Microsimulation: A virtual world

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- Start with a real (or realistic synthetic) sample of people
- Apply statistically-derived rules to reproduce patterns via a stochastic process
- We have created a virtual world (our simulation model)
- Predict what might happen if conditions were to change (i.e., by altering parameters)

A simple worked example (made up)

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- Suppose every child born has the same probability of attending early childhood education (ECE)
- p = 0.50 ← **transition probability**

- And that those who **do attend** have the probability of leaving school with qualifications (SCQUAL):
- p = 0.80 ← **transition probability**

- And that those who **don't attend** have the probability of leaving school with qualifications:
- p = 0.50 ← **transition probability**

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A simple worked example

- Simulation is a **stochastic** process, so you get different results each time
  - On each simulation run, different units may be simulated as
    (i) attended ECE
    (ii) left school with qualifications

Imagine 2 individuals

	Run1				Run2			
	p(ECE)	**ECE?**	**p(ScQ)**	**ScQ?**	**p(ECE)**	**ECE?**	**p(ScQ)**	**ScQ?**
Abby	0.5	Yes	0.8	Yes	0.5	No	0.5	No
Brian	0.5	No	0.5	No	0.5	No	0.5	Yes

A simple worked example

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- Simulation is a **stochastic** process, so you get different results each time
  - On each simulation run, different units may be simulated as
    (i) attended ECE
    (ii) left school with qualifications

- Best to take a number of runs and average…

- For 5 runs & 20 units
- Av=10.2/20 attended ECE
- Av=13.2/20 left school with qualifications

A simple worked example

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- Suppose an intervention is suspected to increase the probability of children attending ECE to
- p = 0.80

- But the probability of leaving school with qualifications remains the same (p=0.80 for attenders; p=0.50 for non-attenders)

- What would happen??

A simple worked example

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- For 5 runs & 20 units,
- Av=16/20 attended ECE
- Av=14.8/20 left school with qualifications,
  an increase from 13.2/20 (8% increase)

- A very simple model for which simulation probably not needed…
  …But if lots of factors affect ECE attendance, and its association with school qualifications (through potentially multiple pathways)

  Microsimulation can capture this in one model,
  and allows counterfactuals to be tested

A real simulation model:
Modelling the Early Life-course (MEL-C)

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1. Goals … what did we do?

- Developed a software application as a decision-support tool for policy-making

2. Rationale … why did we do it?

- To improve policymakers' ability to respond to issues concerning children and young people

3. Means … how did we do it?

- By building a computer simulation model (n=5000) with data from existing longitudinal studies to quantify the underlying determinants of progress in the early life course

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MEL-C
- Conceptual framework

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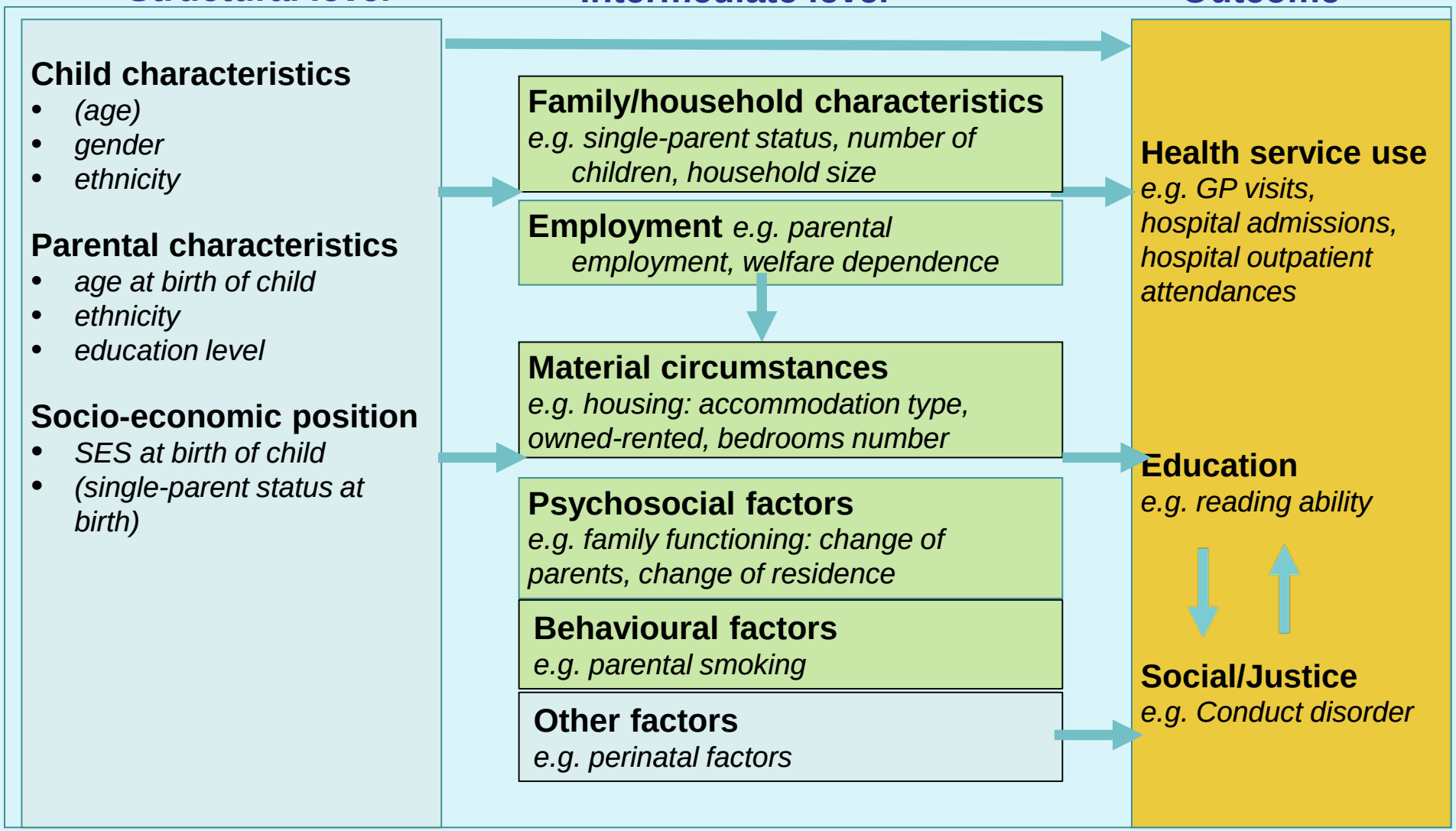

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MEL-C
- Insights

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- Able to model early life-course very well
- Changing factors in children's lives often had weak effects on child outcomes
  - Is that just the reality of policy impact?
  - Need to change multiple factors?
  - Most important factors sometime not the most policy amenable (maternal education)
- Policy relevance increased by increasing range of outcomes & factors

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MEL-C
- Observations

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- Astute observation 1
  - There are many well-established estimates for factors that impact the lives of children, but these exist in isolation; micro-simulation offers a way to bring these together
    - John Lynch, Professor of Public Health, University of Adelaide
- Astute observation 2
  - ‘Best’ estimates are thought to be derived from systematic reviews/meta analyses, but it is difficult to test their validity.
    - David Gough, Professor of Evidence Informed Policy and Practice, Institute of Education

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Knowledge Laboratory - Aims

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- Identify key determinants of child and adolescent outcomes
- Integrate estimates from systematic reviews/meta analyses into working model of early life course
  - Developed from MEL-C (n=5000); extended in breadth (more determinants and outcomes), and length (to age 21)
- Use as knowledge laboratory
  - Test the validity of 'best' estimates
  - Test policy scenarios using validated model

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End user engagement

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- Important role of policy reference “End User” group
  - Engage key people from government agencies
  - Use their expertise to get better model & policy-relevant scenarios

- Seven agencies involved
  - Health
  - Education
  - Social Development
  - Justice
  - Te Puni Kōkiri
  - Children’s Commission
  - SuPERU

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Knowledge Lab - Outcomes

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- Focus on three outcomes
  - Obesity
  - Education
  - Mental Health

- For each outcome
  - Determine conceptual framework
  - Get NZ prevalences and inter-relations for each predictor in the conceptual framework
  - Get meta-analytic estimates for each path in the conceptual framework
    - Harder than you might think…
    - Quality assessments undertaken

Literature comparing effect sizes for Māori vs non-Māori

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- Getting meta-analytic estimates from literature all very well
  - …But will they accurately represent estimates for Māori? (or Pacific, etc…)
- Searched the literature for papers looking at health, education, psychosocial functioning for Māori youth, and found..
  - Most in health area, e.g. smoking (n=49), asthma (n=30)
- Few papers looked at risk factors (n=68; 10%)
  - Largely found in the smoking literature (n=14; 20%)
  - Few of these assessed if magnitude of risk factor effect different Māori vs non-Māori, so a real gap in the literature

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Obesity
- Conceptual framework

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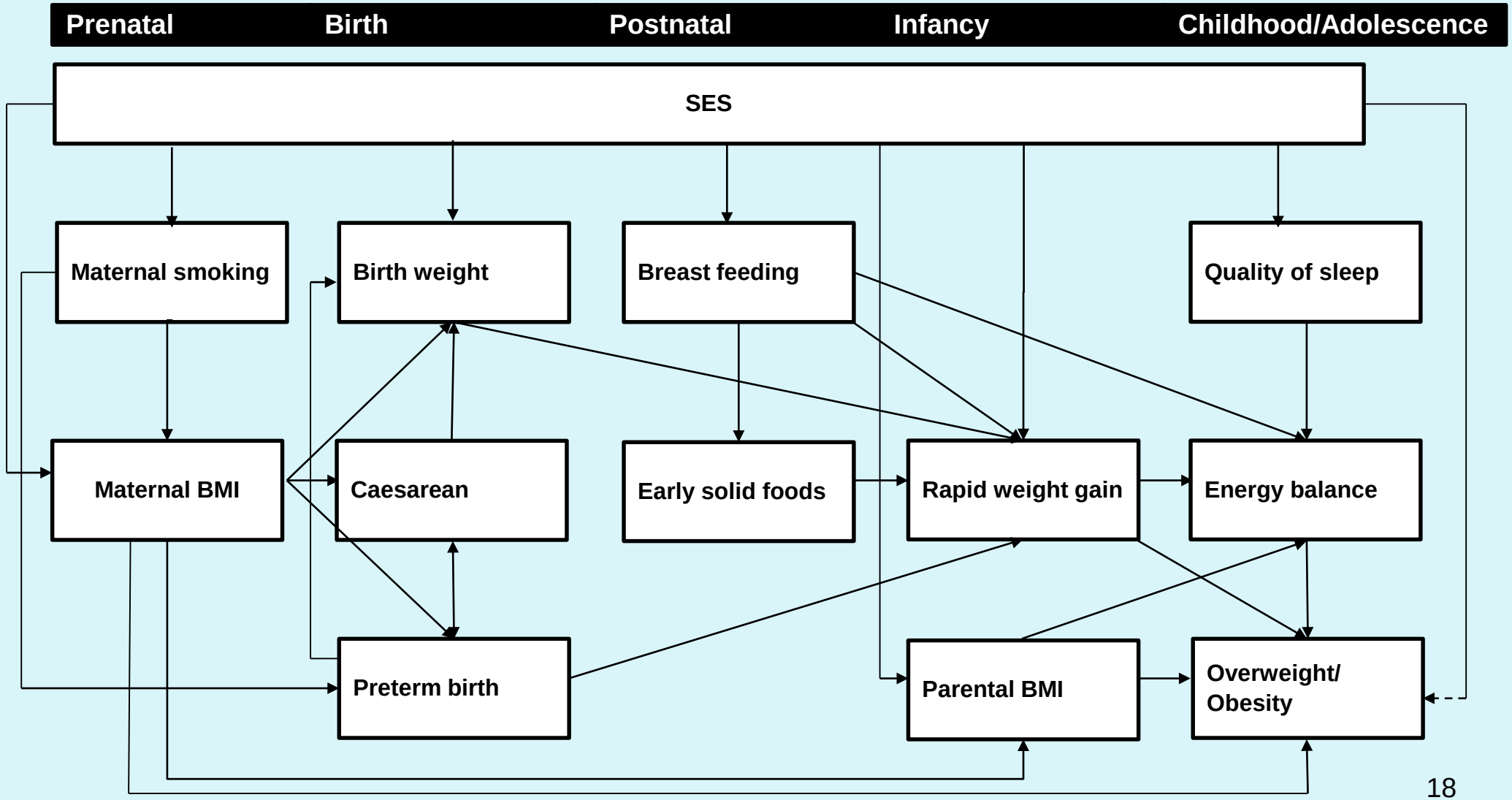

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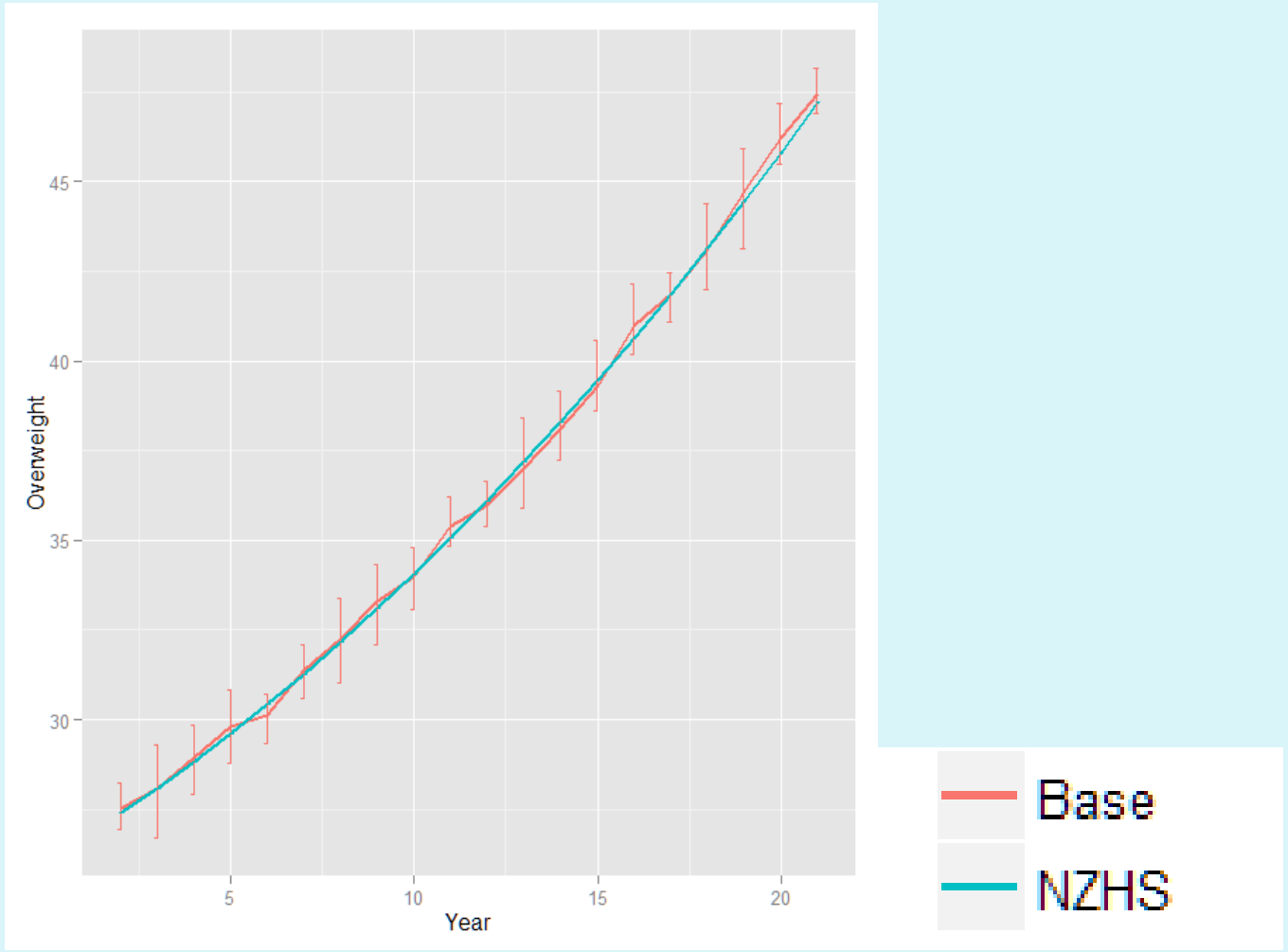
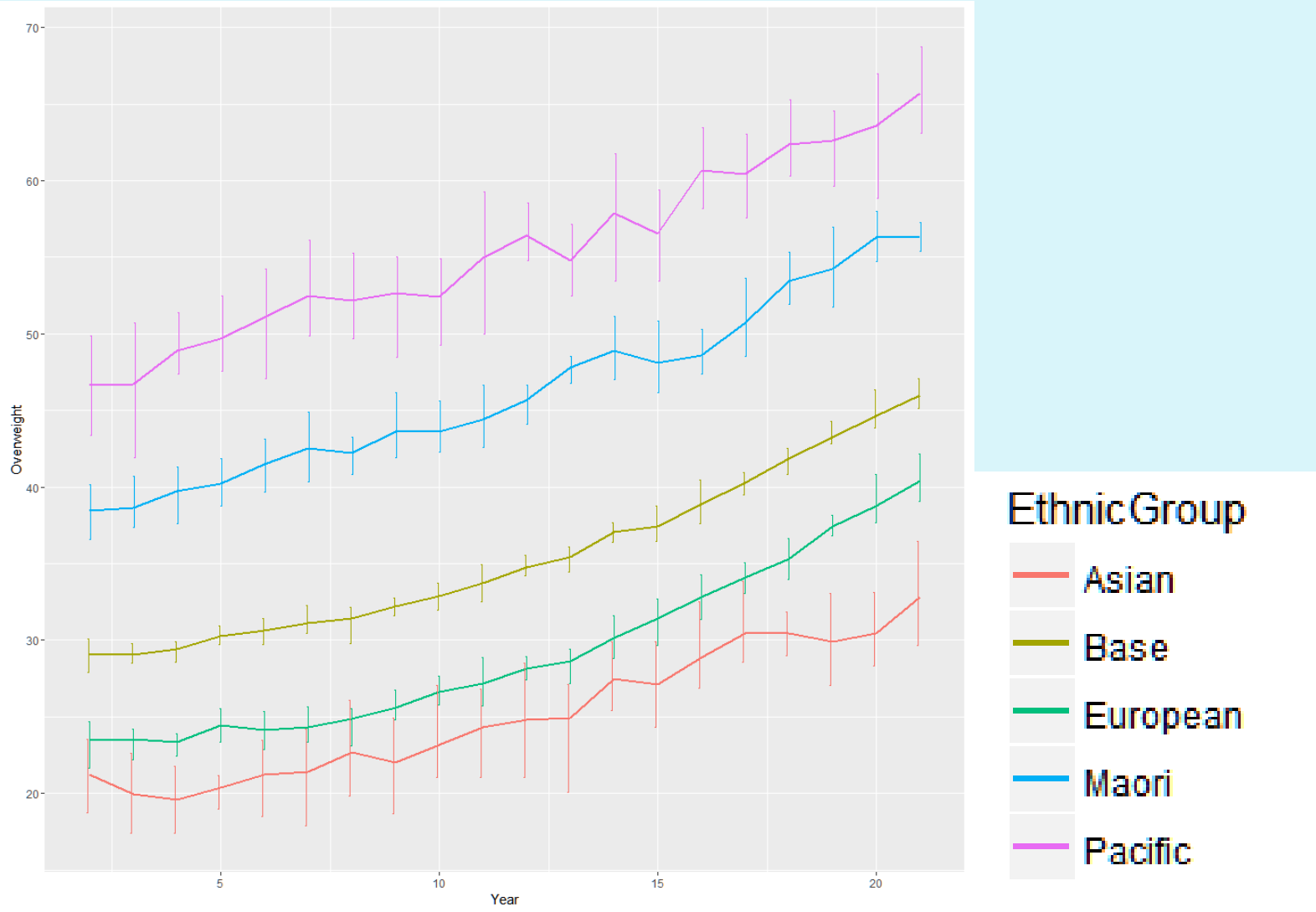
Base simulation



Ethnicity


70
60
50
40
30
20
Overweight
5
10
15
20
Year
Ethnic Group
Asian
Base
European
Maori
Pacific

Obesity Scenario:
1. Maternal Overweight

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- Maternal Overweight
  - Base: 43%
  - Scenario: Decrease to 21%

	Child Overweight % reduction (av over ages 6-12)
All	4.4% (2.5% - 6.4%)
Māori	6.7% (2.9% - 10.1%)
Pasifika	6.1% (-0.5% - 12.3%)
Low SES	5.7% (2.5% - 8.1%)

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Obesity Scenario:
2. Breakfast consumption

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- Breakfast consumption
  - Base: 81%
  - Scenario: Increase to 100%

	Child Overweight % reduction (av over ages 5-21)
All	2.4% (0.3% - 4.3%)
Māori	4.0% (0.1% - 7.8%)
Pasifika	3.0% (-3.6% - 9.6%)
Low SES	3.5% (0.1% - 6.8%)

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Obesity model - Summary

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- Modest effects of maternal overweight and breakfast consumption
- Effect of risk factors on population obesity determined by
  - Size of effect of risk factors
  - Prevalence of risk factor in population
  - …as such, often small population effects, though bigger effects for the group that has been changed

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Education
- Conceptual framework

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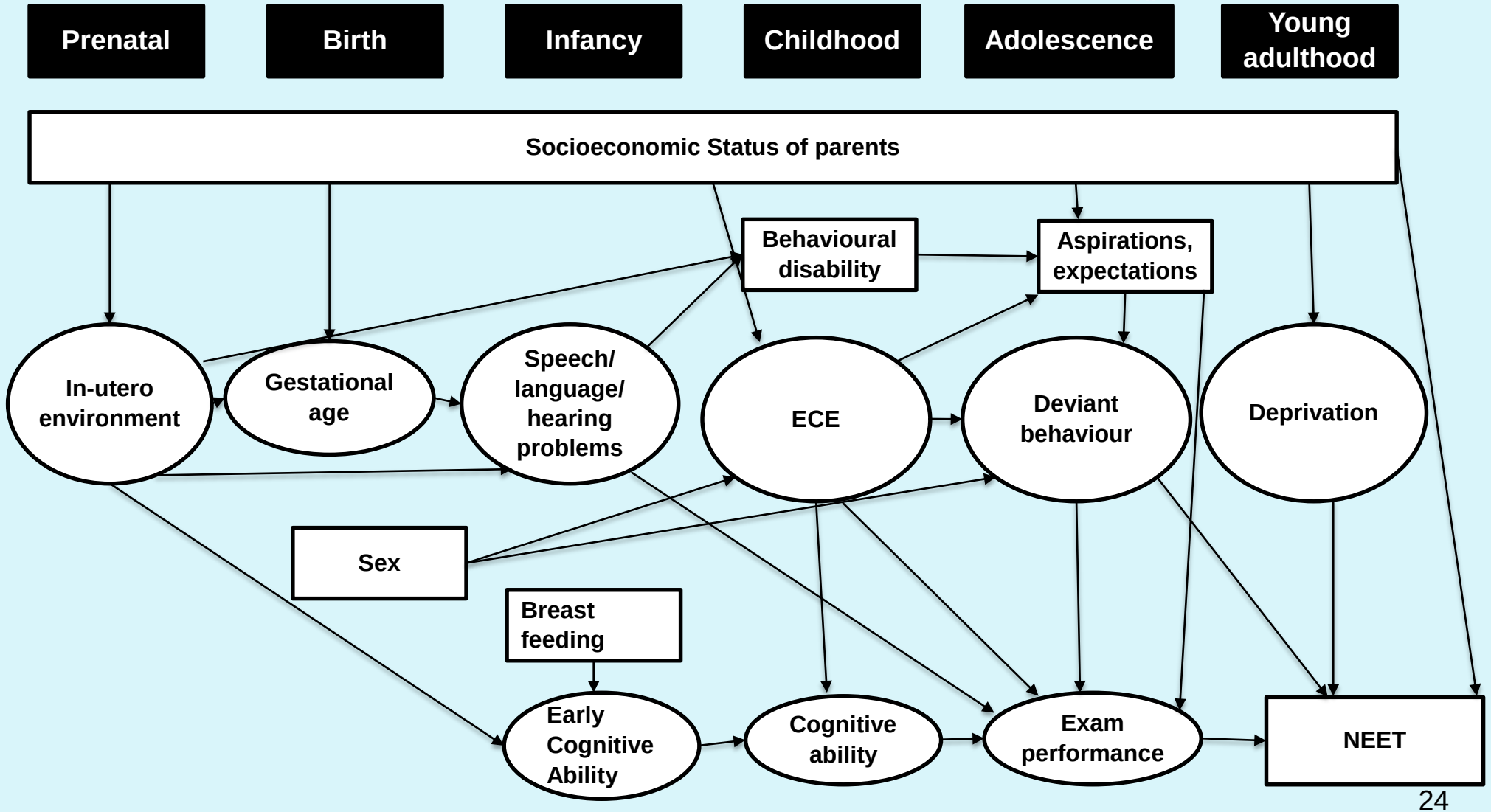

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School and region effects

- To allow school interventions to be modelled
  - Education, but also Obesity and mental health
- And to allow for school- and/or teacher and/or peer-level effects

- Nest children within schools in the simulation
  - More realistic simulation as can account for dependence in data
  - Child who attend same school more similar

- One (easiest?) way to do this:
  - Assign children to regions (deterministically)
  - Assign children to schools within regions (stochastically)

School and region effects

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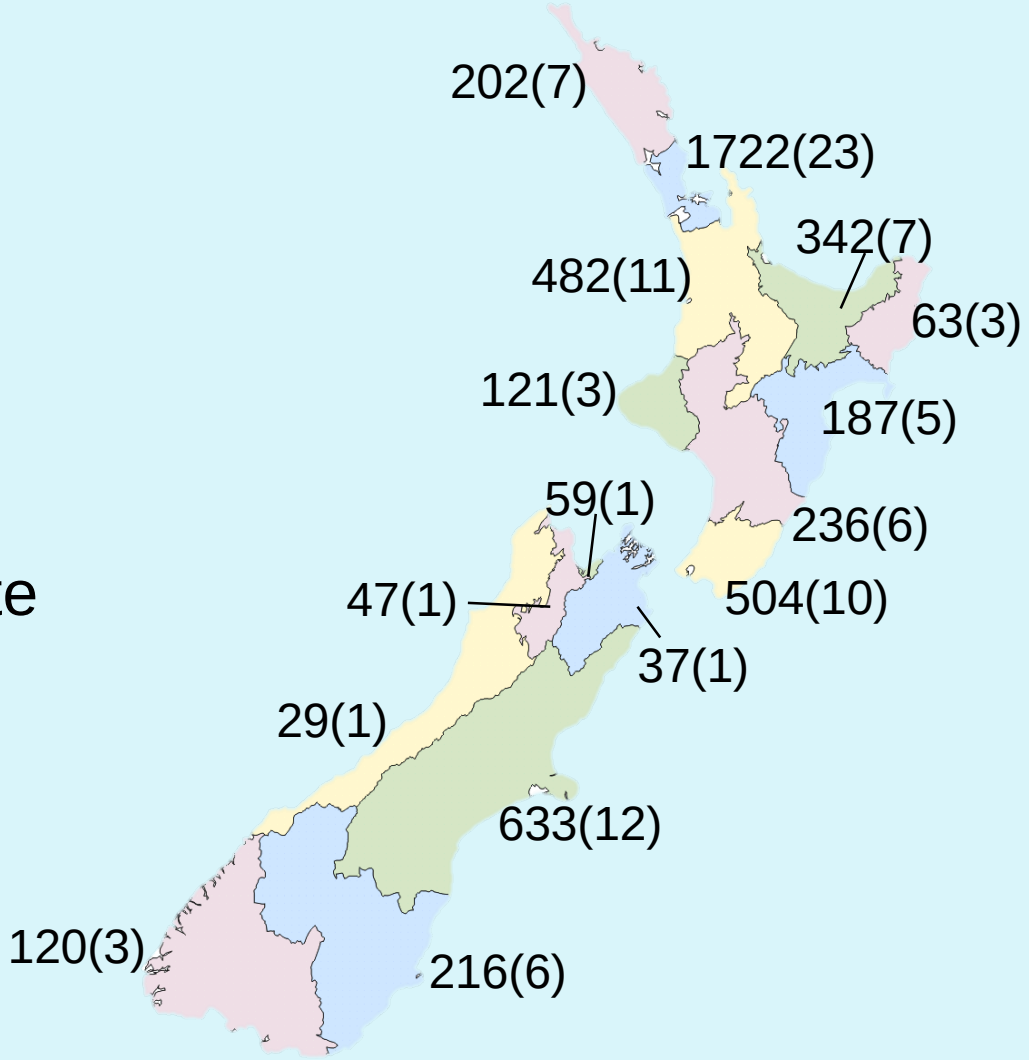
- 5000 Children
- 16 Regions
- 100 Schools (from 479)
  - 69 Secondary, 31 Composite
  - 79 Co-ed, 12 Girls, 9 Boys
  - 7 Kura Kaupapa
  - 3 Designated Character



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Education Scenario: 1. Breastfeeding

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- Breastfeeding
  - Base: 35.7% never breastfeed, 23.1% breastfed >6 months
  - Scenario: Decrease never breastfed to 18%; Increase breastfed >6 months to 40%

	Cognitive Development (IQ)			NCEA 2 Attainment (%)		
	Base	**Scen**	**Diff**	**Base**	**Scen**	**Diff**
All	99.9	100.4	0.5 (0.1-1.0)	79.0	79.5	0.5 (-0.6-2.0)
Māori	99.4	100.0	0.6 (-0.3-1.8)	66.8	67.4	0.6 (-1.9-2.6)
Pasifika	99.9	100.2	0.2 (-1.8-2.1)	74.3	75.7	1.4 (-5.0-7.3)
Low SES	99.7	100.5	0.7 (-0.2-1.9)	71.2	72.4	1.2 (-1.6-4.1)

Education Scenario: 2. Otitis media

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- Otitis media
  - Base: 40% of children, at least episode age <5 years
  - Scenario: Reduce to 20%

	Cognitive Development (IQ)			NCEA 2 Attainment (%)		
	Base	**Scen**	**Diff**	**Base**	**Scen**	**Diff**
All	99.9	100.9	1.0 (0.7-1.5)	79.0	79.9	0.9 (-0.5-2.3)
Māori	99.4	100.4	1.0 (0.0-2.3)	66.8	67.7	0.9 (-2.5-3.3)
Pasifika	99.9	100.9	1.0 (-0.9-3.3)	74.3	75.7	1.3 (-6.7-8.3)
Low SES	99.7	100.7	1.0 (0.0-2.0)	71.2	71.9	0.7 (-2.2-3.4)

Education Scenario:
3. Early Childhood Education (ECE)

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- ECE Enrolment
  - Not enrolled 95.9%; Enrolled 4.1%

- What if the small number of children not receiving ECE ALL received it?

Setting the Scenario

Variable Adjustment

Level	Early Childhood Education
No (%)	0.00
Yes (%)	1.00

Base value

	Early Childhood Education
No	4.12
Yes	95.88

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Education Scenario:
3. Early Childhood Education (ECE)

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- ECE Enrolment
  - Not enrolled 95.9%; Enrolled 4.1%

- What if the small number of children not receiving ECE ALL received it?

	NCEA 2 Attainment (%)		
	Base	**Scen**	**Diff**
All	60.1	69.3	9.2 (0.8-18.1)

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Education model - Summary

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- Small effects overall
- Attending early childhood education will have a positive impact on later school achievement

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Mental health
- Conceptual framework

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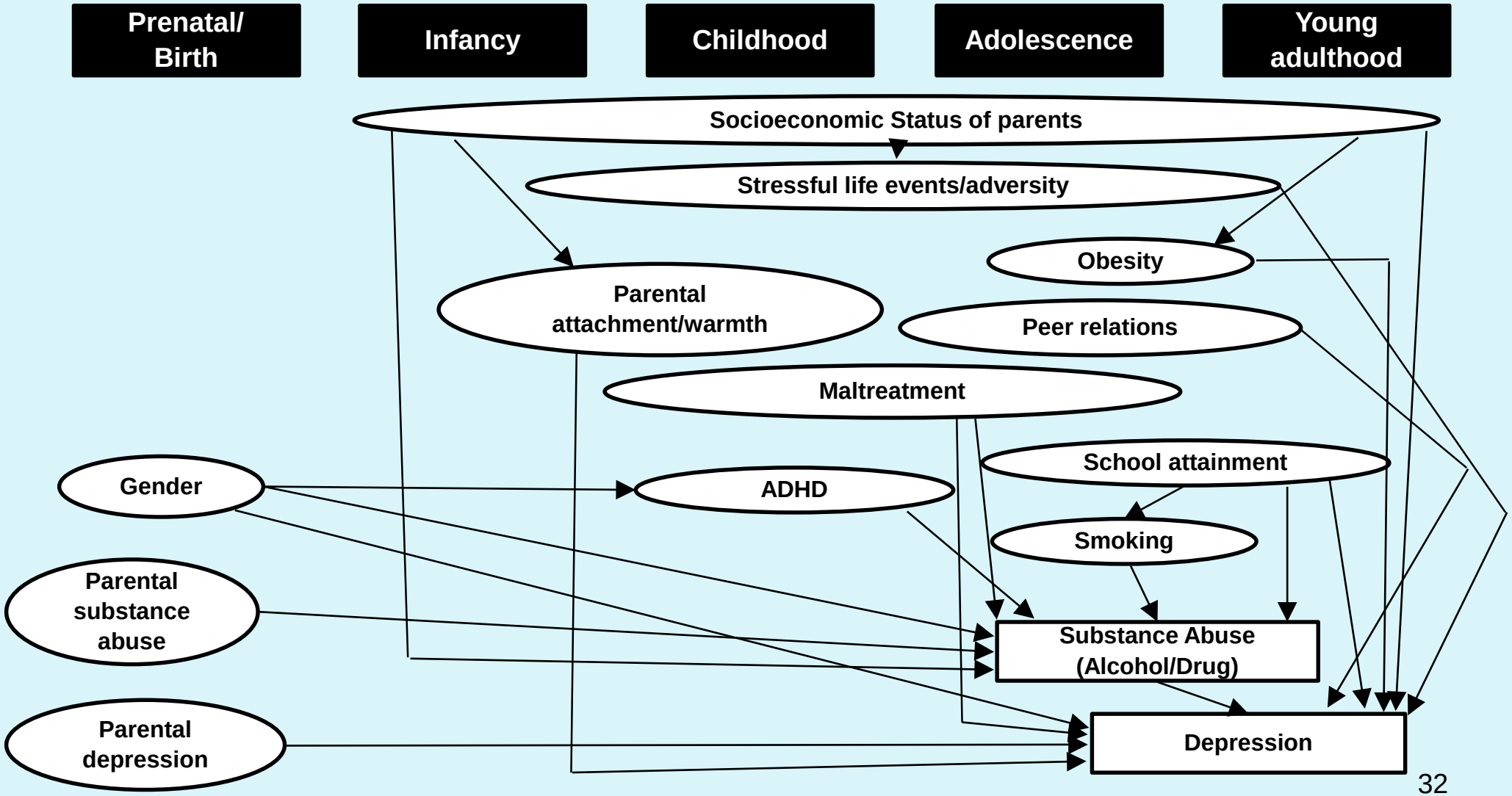

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Summary

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- Knowledge Lab is a microsimulation model focussing on three outcomes: Obesity, Education and Mental Health
  - Transitions in the model derived from meta-analytic estimates
- It can be used to tests scenarios/counterfactuals
  - May be policy amenable; may not be
- Will be web-deployed (end 2016) using SHINY
  - Sneak peak coming up!

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Demonstration - Start

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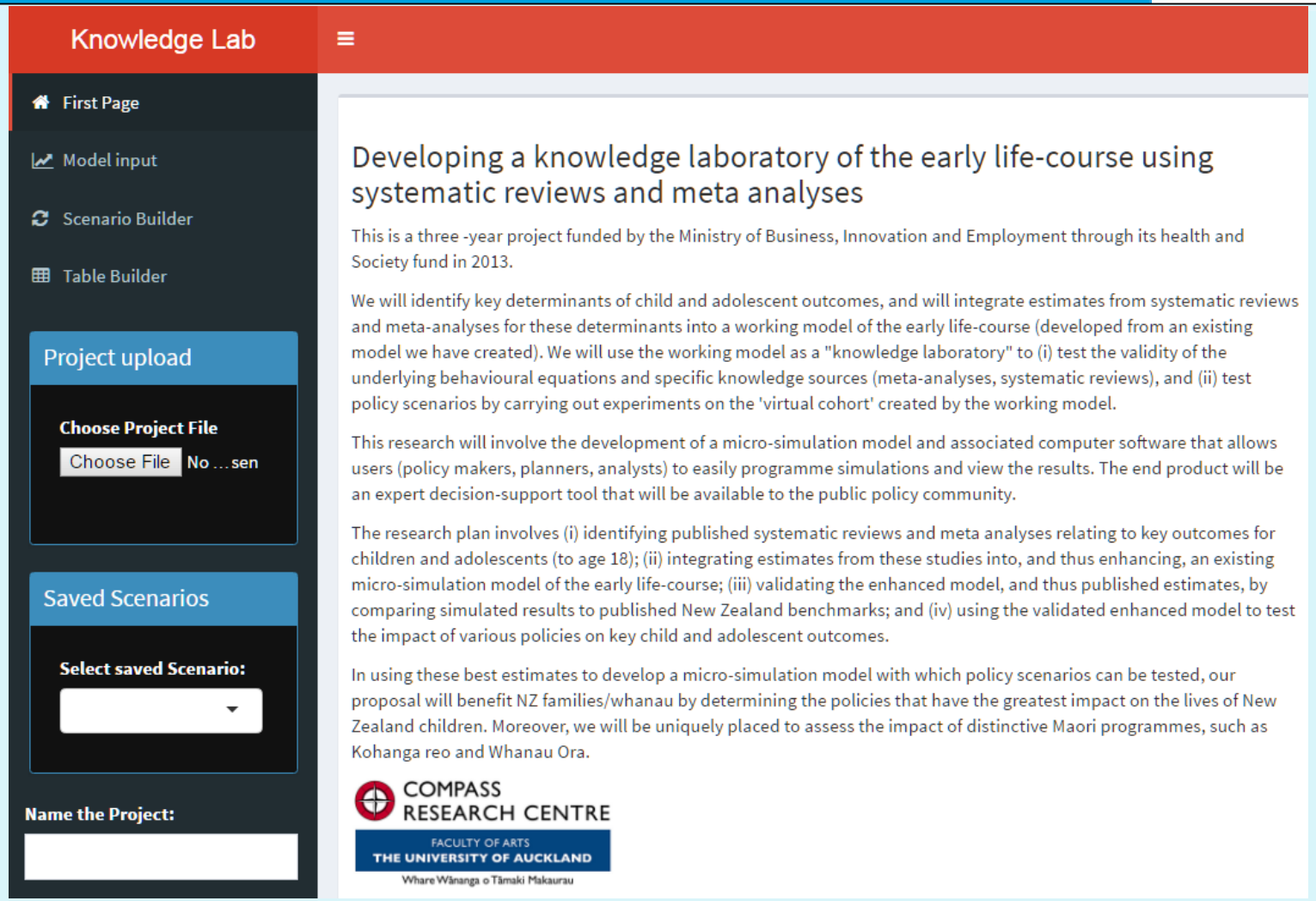

Demonstration - Table Builder

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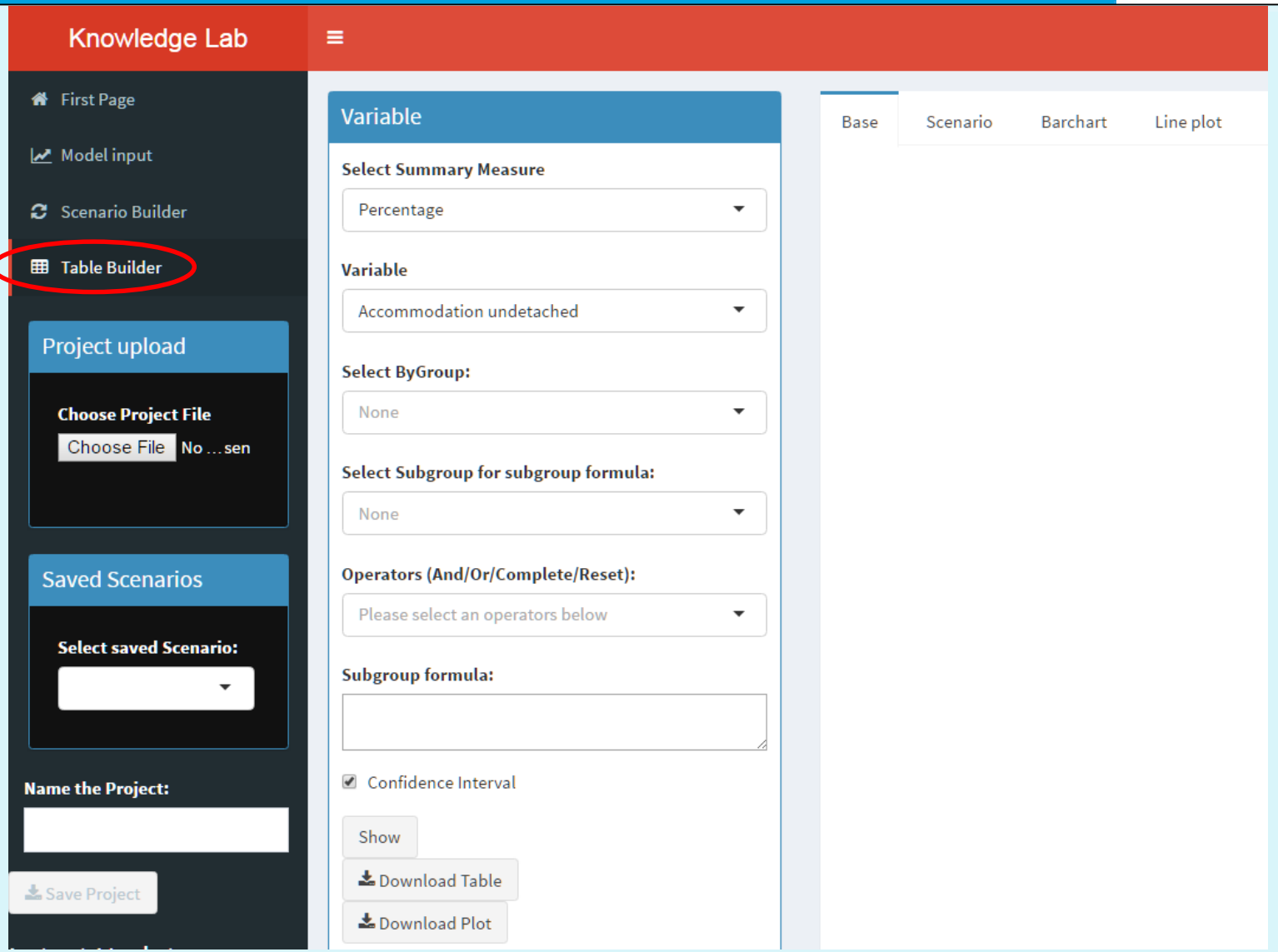

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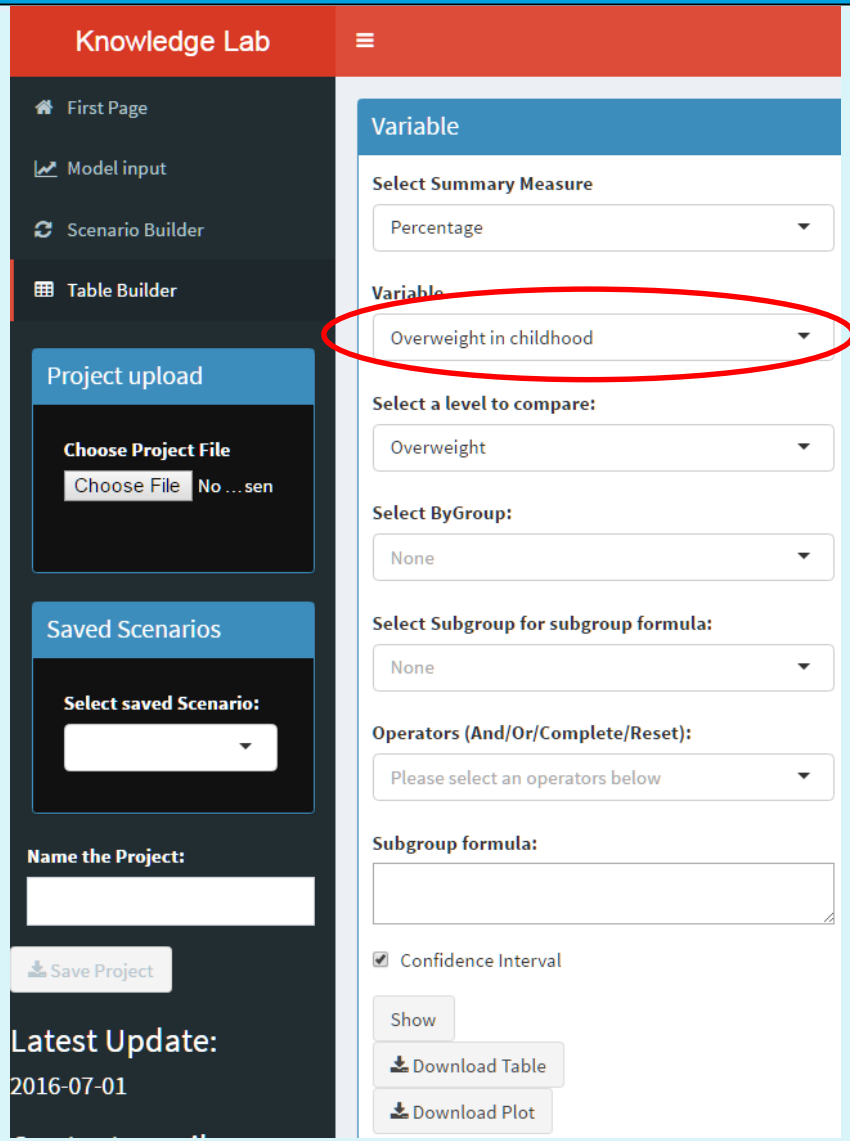

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Demonstration - Line graph

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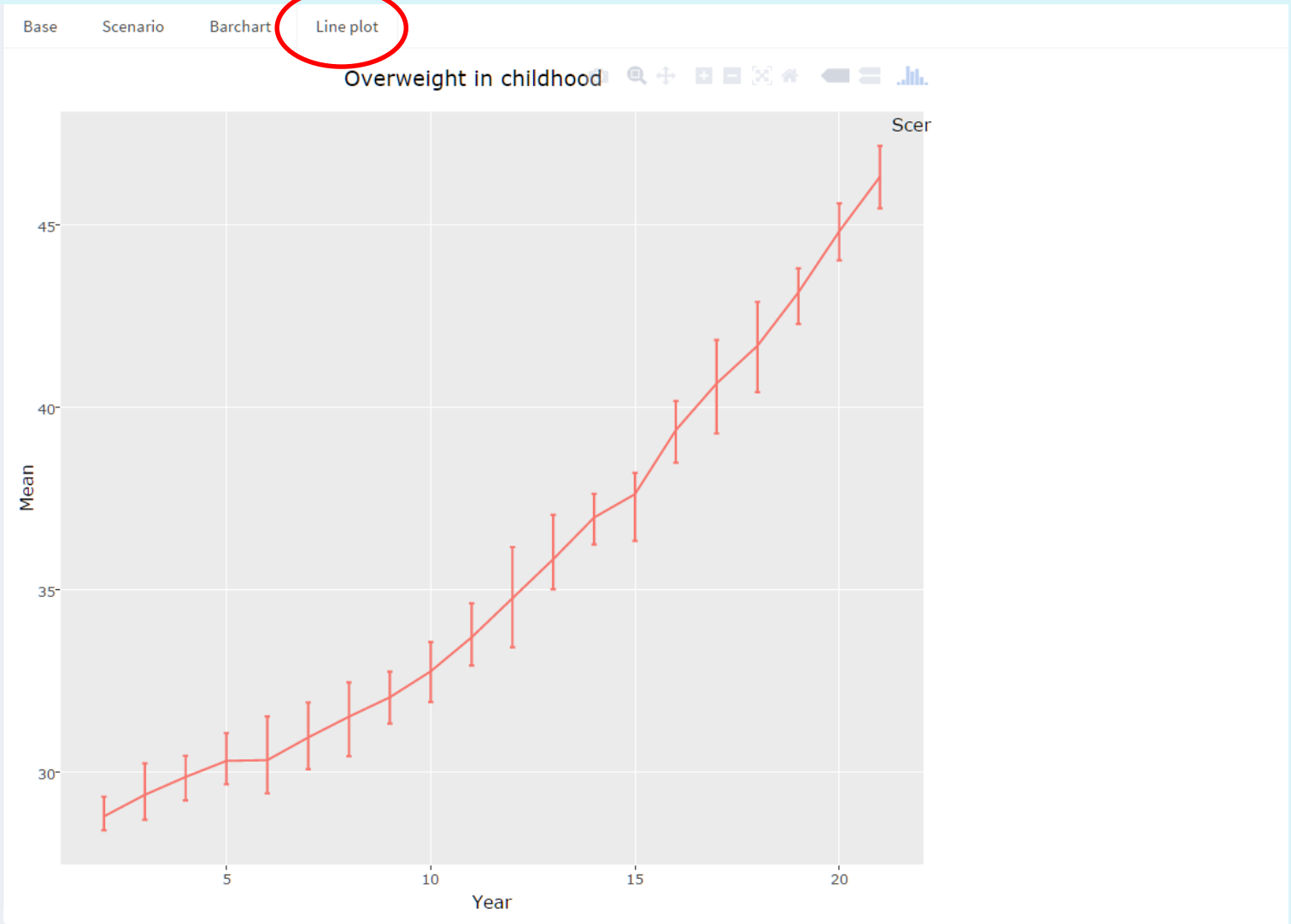

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Demonstration - Line graph

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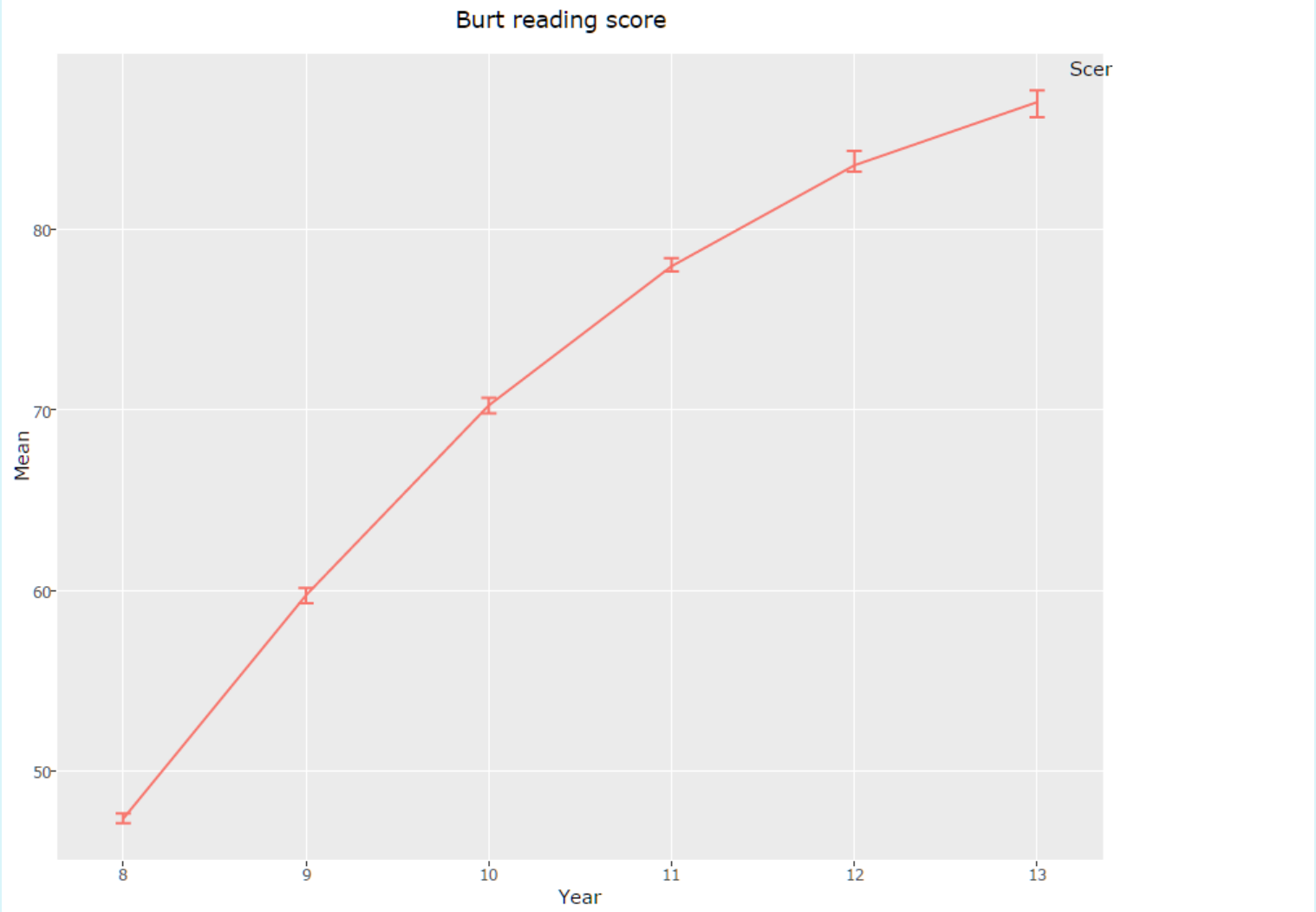
Base | Scenario | Barchart | Line plot



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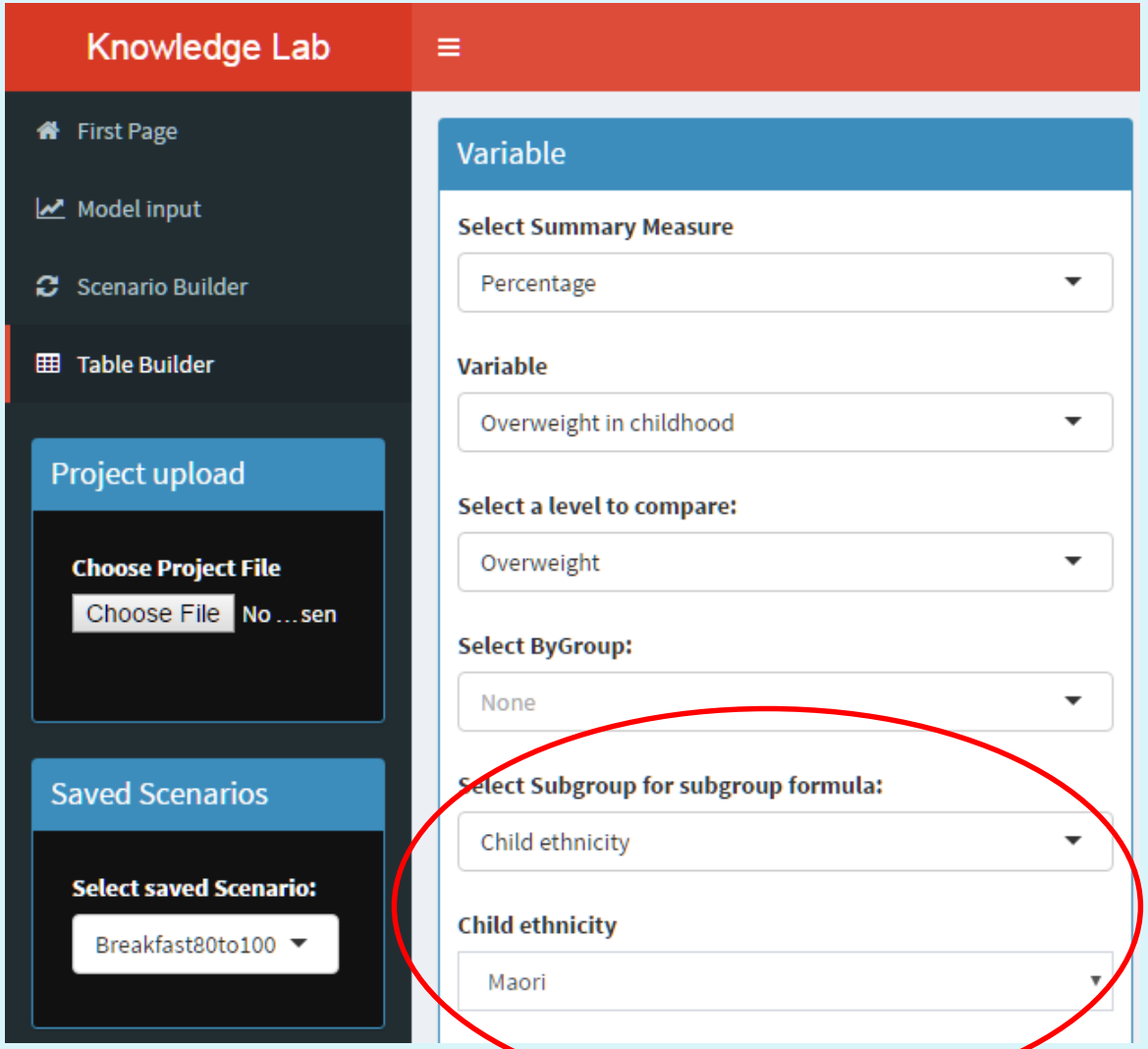
Demonstration
- Table Builder (subgroup)



Demonstration
- Table Builder (subgroup)

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Base | Scenario | Barchart | Line plot

Year	No_Mean	Overweight_Mean
2	71.28	28.72
3	70.26	29.74
4	70.24	29.76
5	69.7	30.3
6	69.82	30.18
7	69.01	30.99
8	69.05	30.95
9	68.85	31.15
10	67.25	32.75
11	65.45	34.55
12	63.94	36.06
13	64.04	35.96
14	62.81	37.19
15	63	37
16	61.04	38.96
17	59.61	40.39
18	58.45	41.55
19	56.87	43.13
20	54.84	45.16
21	54.49	45.51

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Demonstration - Scenario builder

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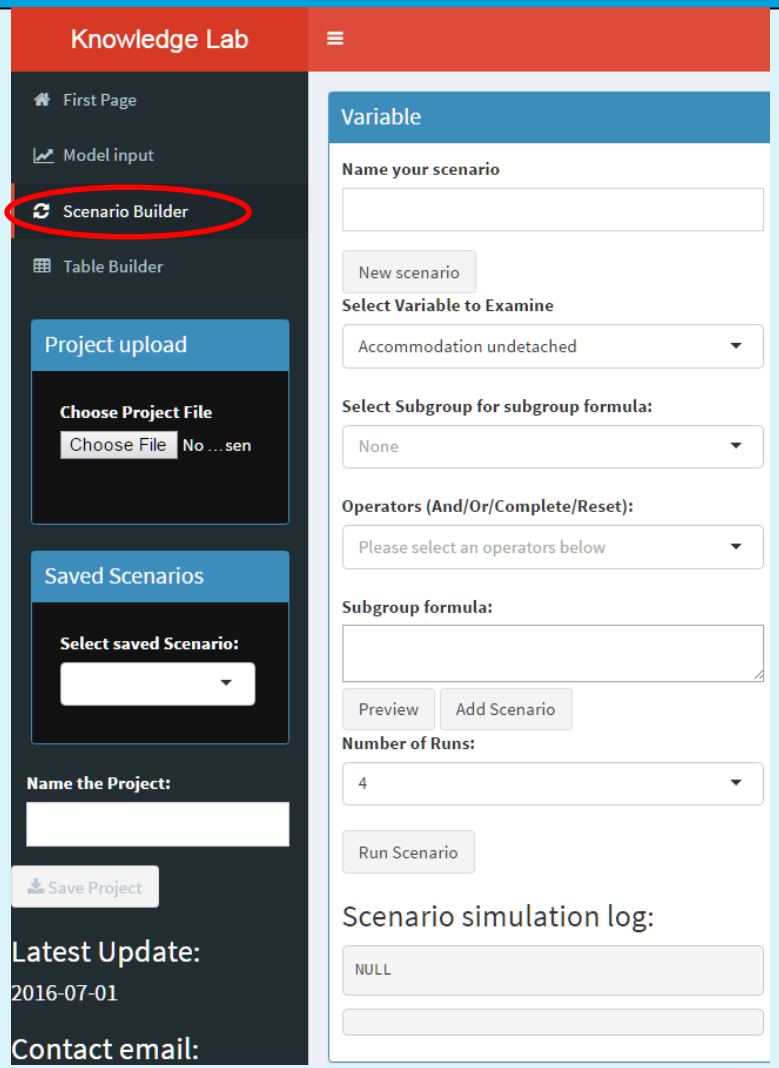

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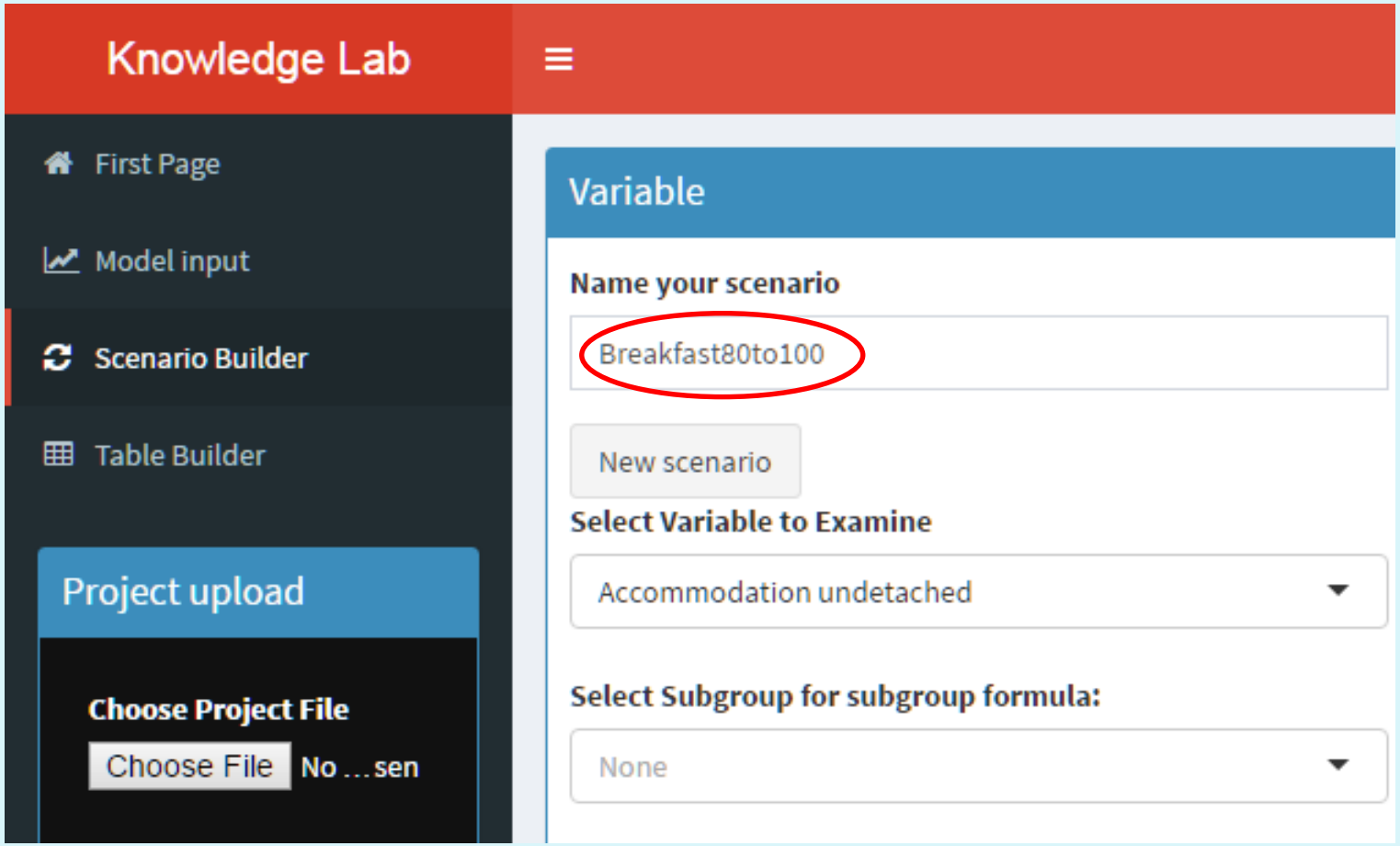
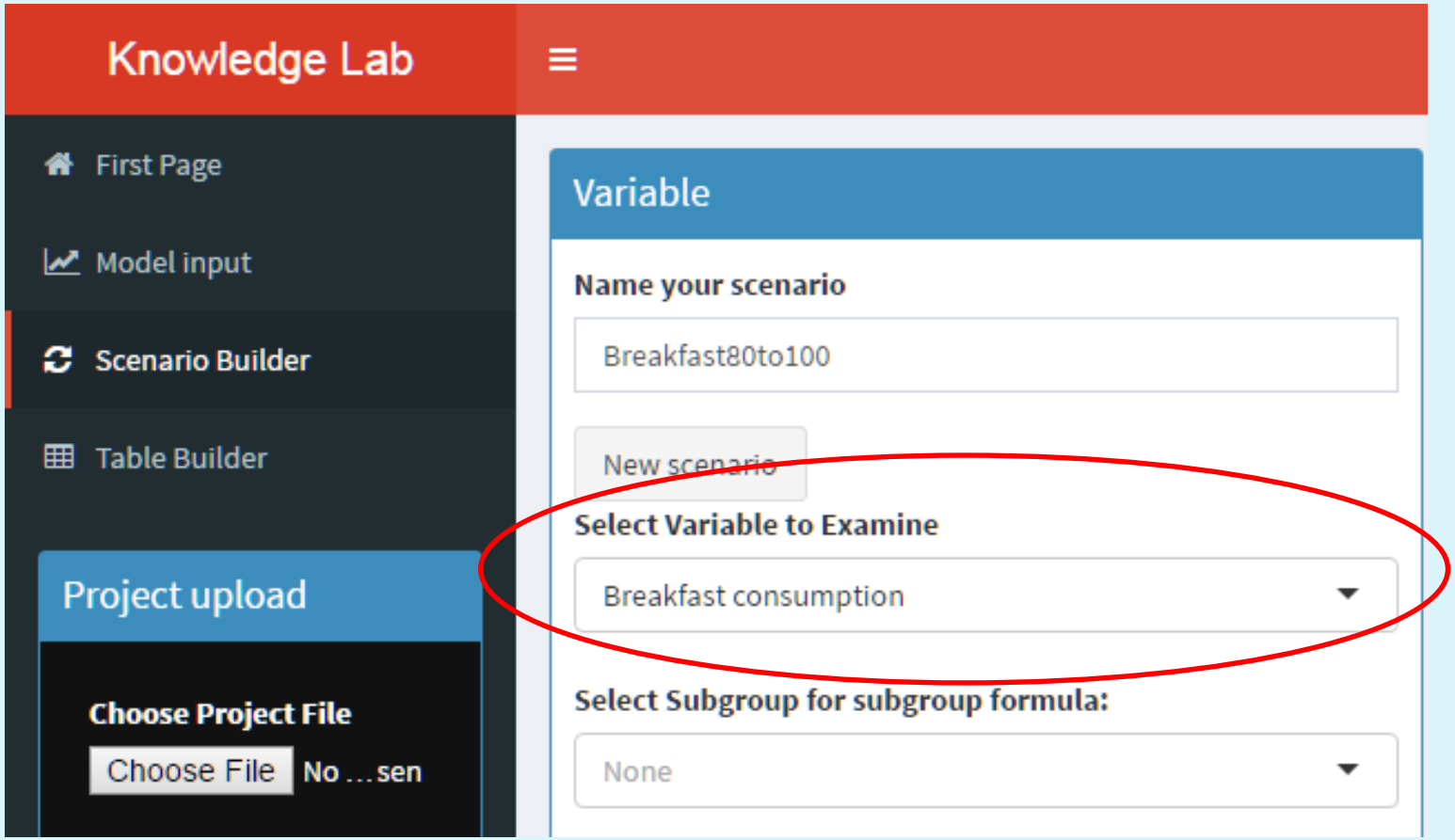
Demonstration - Naming Scenario

- Testing the effect of increasing breakfast consumption on obesity



Demonstration
- Selecting vars to change



Demonstration

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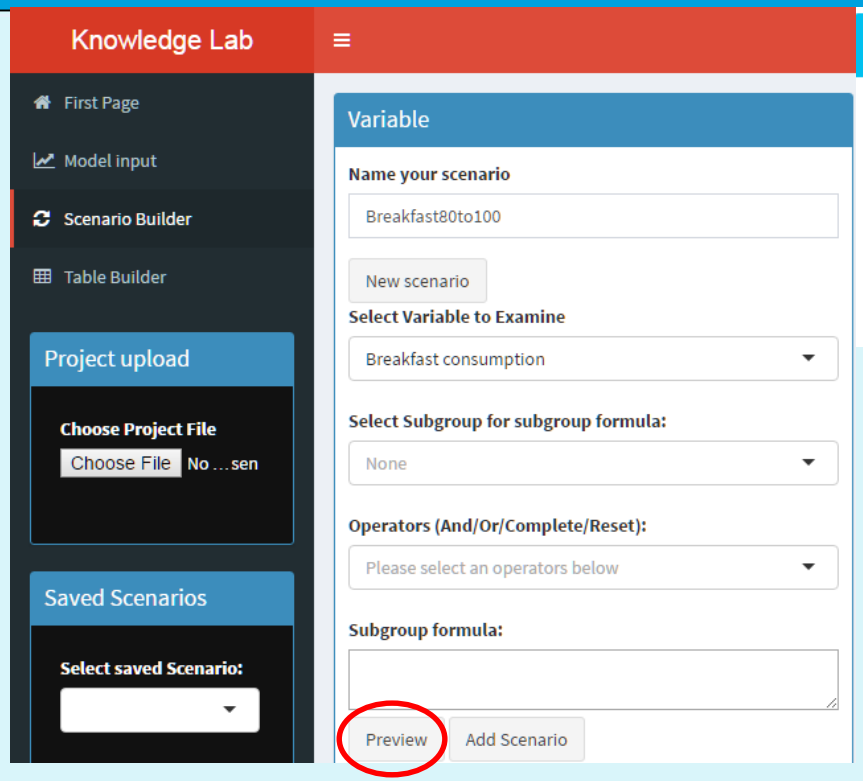

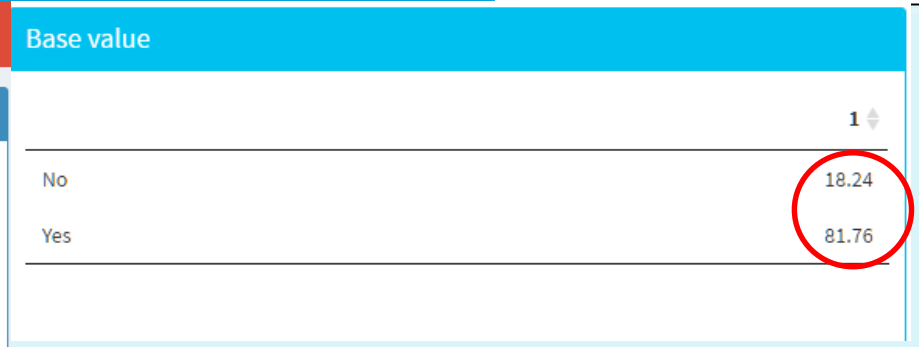

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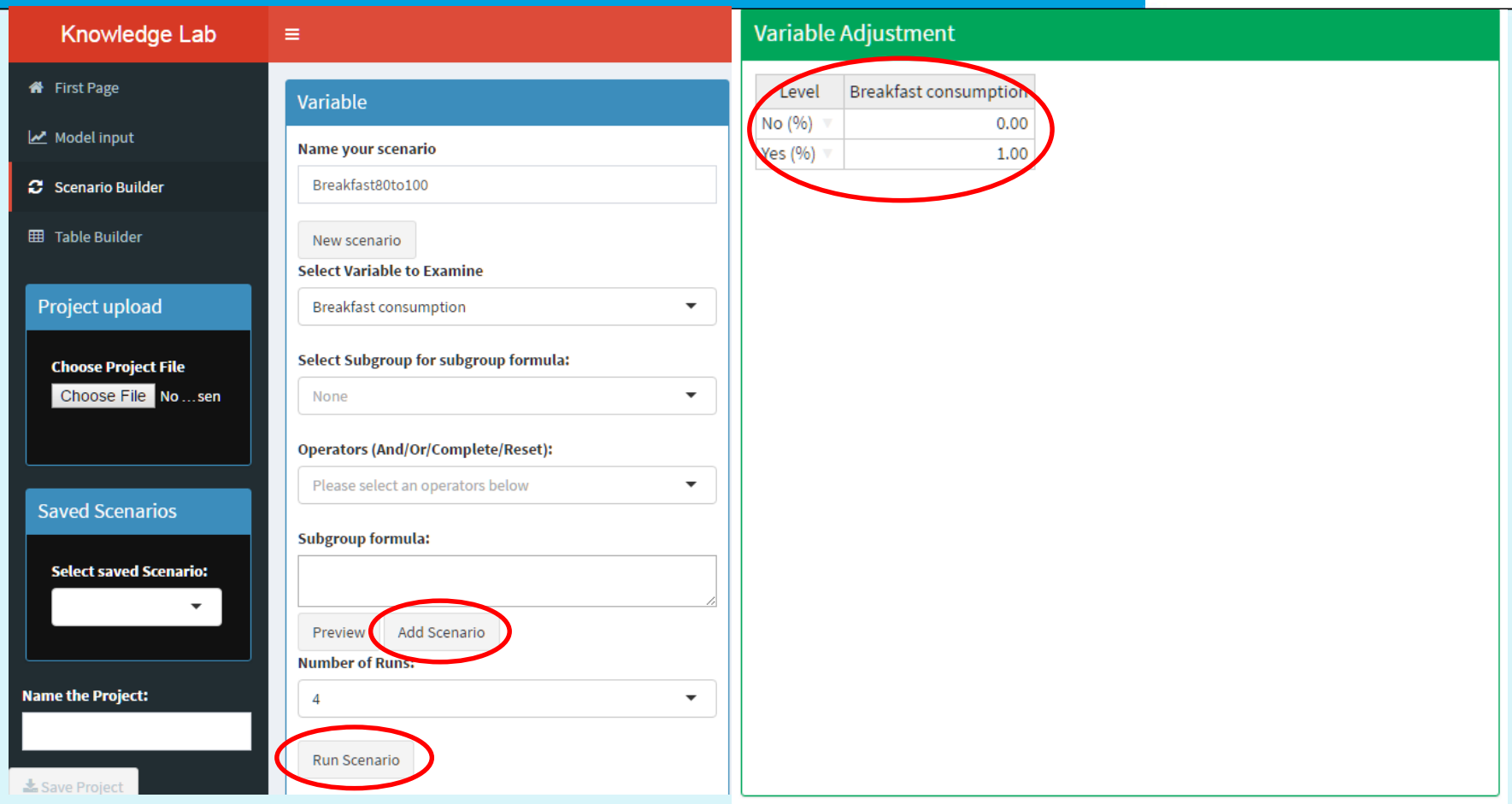

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Demonstration

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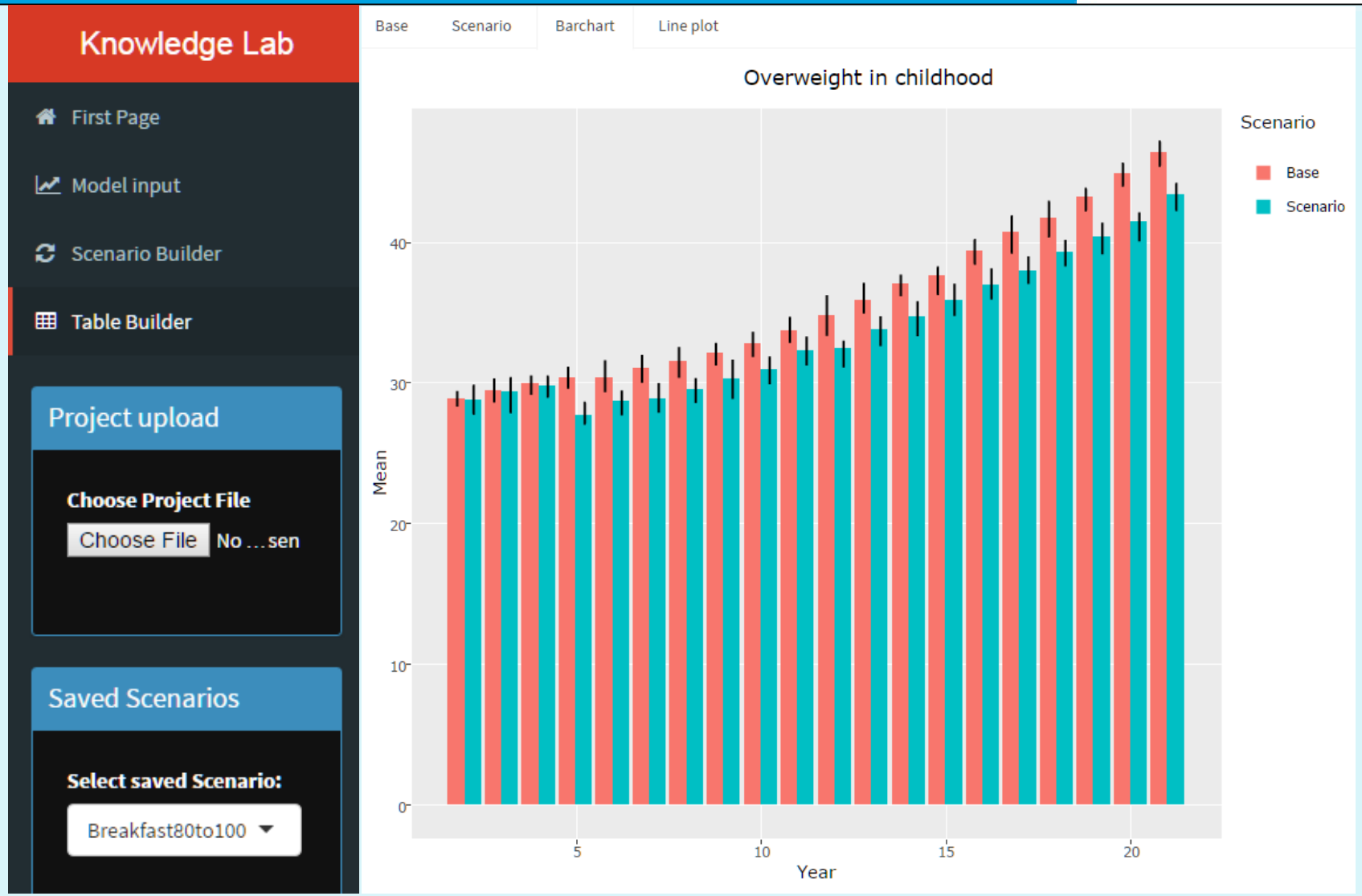
THE UNIVERSITY OF AUCKLAND
Whare Wānanga o Tāmaki Makaurau



New Zealand

The University of Auckland

Demonstration - ECE scenario

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- Testing the effect of increasing ECE on school qualifications

Setting the Scenario

Variable Adjustment

Level	Early Childhood Education
No (%)	0.00
Yes (%)	1.00

Base value

	Early Childhood Education
No	4.12
Yes	95.88

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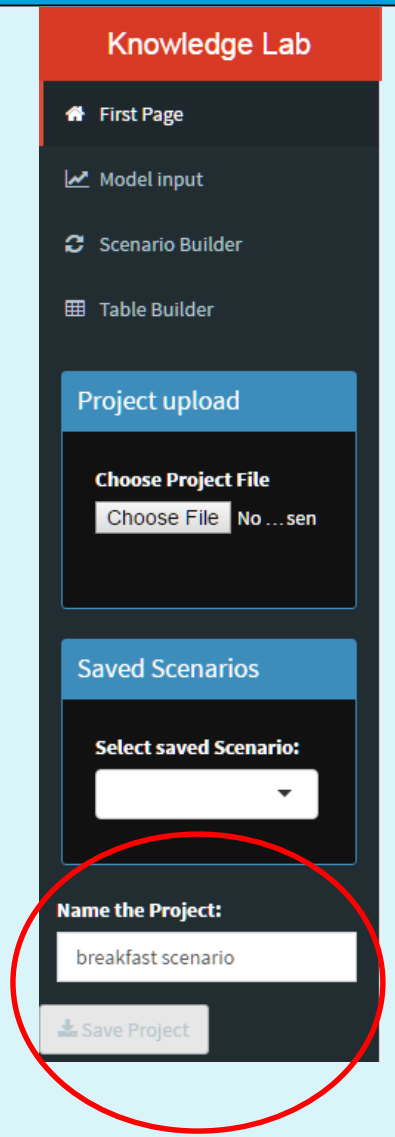
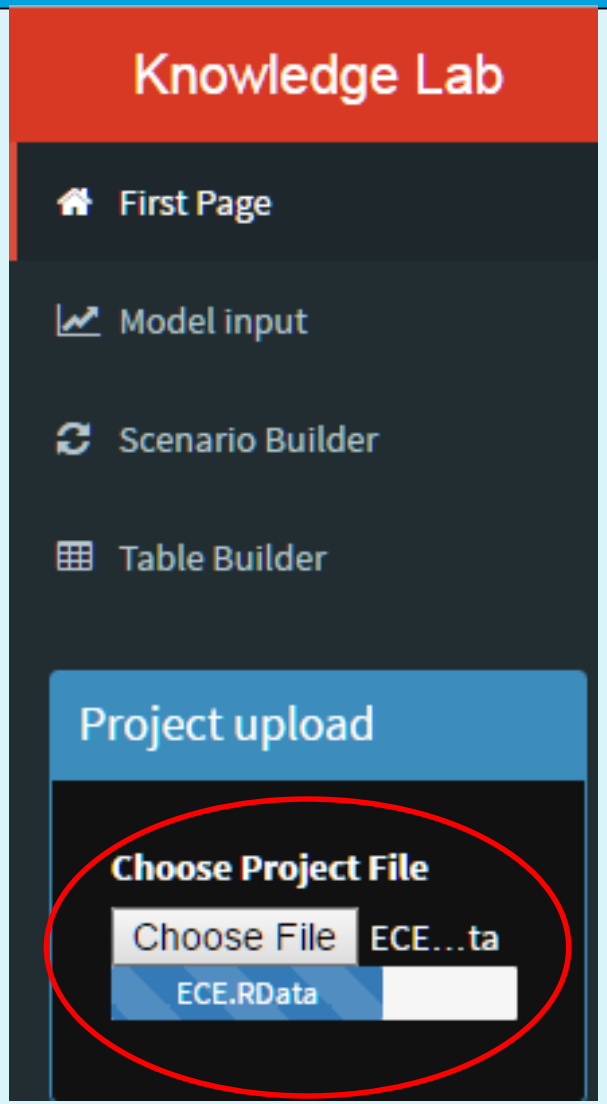
- But… School qualifications do change from 62% to 70% among those who previously had not attended ECE

Demonstration - Saving projects



Demonstration
- Uploading projects



THANKS!!

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- Thanks to
  - Nichola Shackleton, Kevin Chang, Jessica McLay, Martin von Randow, Roy Lay-Yee, Pater Davis, Oliver Mannion, Janet Pearson
  - All members of end user group since 2011 (MELC)
    - MOH: Martin Tobias, Pat Tuohy, Jackie Fawcett
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    - MSD: Evan Thompson, Christina Connolly, many others
    - MOJ: Robert Lynn, Maragaret McArthur
    - TPK: Nathaniel Pihama
    - OCC: Kathleen Logan, Donna Provoost
    - SuPERU: Jeremy Robertson, Alex Collier

Quality Assessment

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- Did they test for publication bias?
- Did they adjust estimates for publication bias?
- Did they run sensitivity analyses?
- Did they undertake moderator analysis (did effect sizes differ by characteristics of sample)?
- Did they assess quality of included studies?
- Were estimates based on high quality studies, or cross-sectional studies only?