

A Shiny new app for policy makers: Using simulation to test which factors most improve child well-being

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Whare Wānanga o Tāmaki Makaurau

1/24

COMPASS Seminar Series
17 March 2017



**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**
HIKINA WHAKATUTUKI

▣ Background

- ▣ Knowledge translation
- ▣ Knowledge Lab of the early life-course
 - Model development

▣ What is microsimulation?

- ▣ A simple example

▣ A Shiny app for policy

- ▣ Demonstration
- ▣ Policy scenarios: Obesity, Education, Mental health

Background - Knowledge translation

- ❑ Knowledge translation: How to do?
 - ❑ ‘Push system’
Researchers create knowledge; policy makers use it (or not)
 - ❑ ‘Pull system’
Policy makers seek out or request information to fit their purpose
 - ❑ Emphasises divide between researches and policy makers, across which knowledge is pushed and pulled
 - Knowledge brokers may be employed to ‘translate’
 - ❑ Co-production of knowledge through policy-research partnerships
 - Shown to improve knowledge translation

Background - Goal

- ❑ Our goal:
 - ❑ Collaborate with policy makers to produce a policy tool in which knowledge is embedded, but which can be interrogated by policy makers, and can be updated as per the needs of policy makers

- ❑ Knowledge Laboratory of the early life course
 - ❑ Identify key determinants of child and adolescent outcomes (to age 21)
 - ❑ Integrate estimates from systematic reviews/meta analyses into working microsimulation model of early life course (built upon earlier MELC model)
 - ❑ Make available for use by policy makers (and others) as a ‘knowledge laboratory’ to test policy scenarios
 - ❑ Web deployment to aid uptake (<https://compassnz.shinyapps.io/knowlabshiny>)

Knowledge Lab - End user engagement



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- ❑ Important role of policy reference “End User” group
 - Use their expertise to determine what they’d like modelled policy-relevant scenarios

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



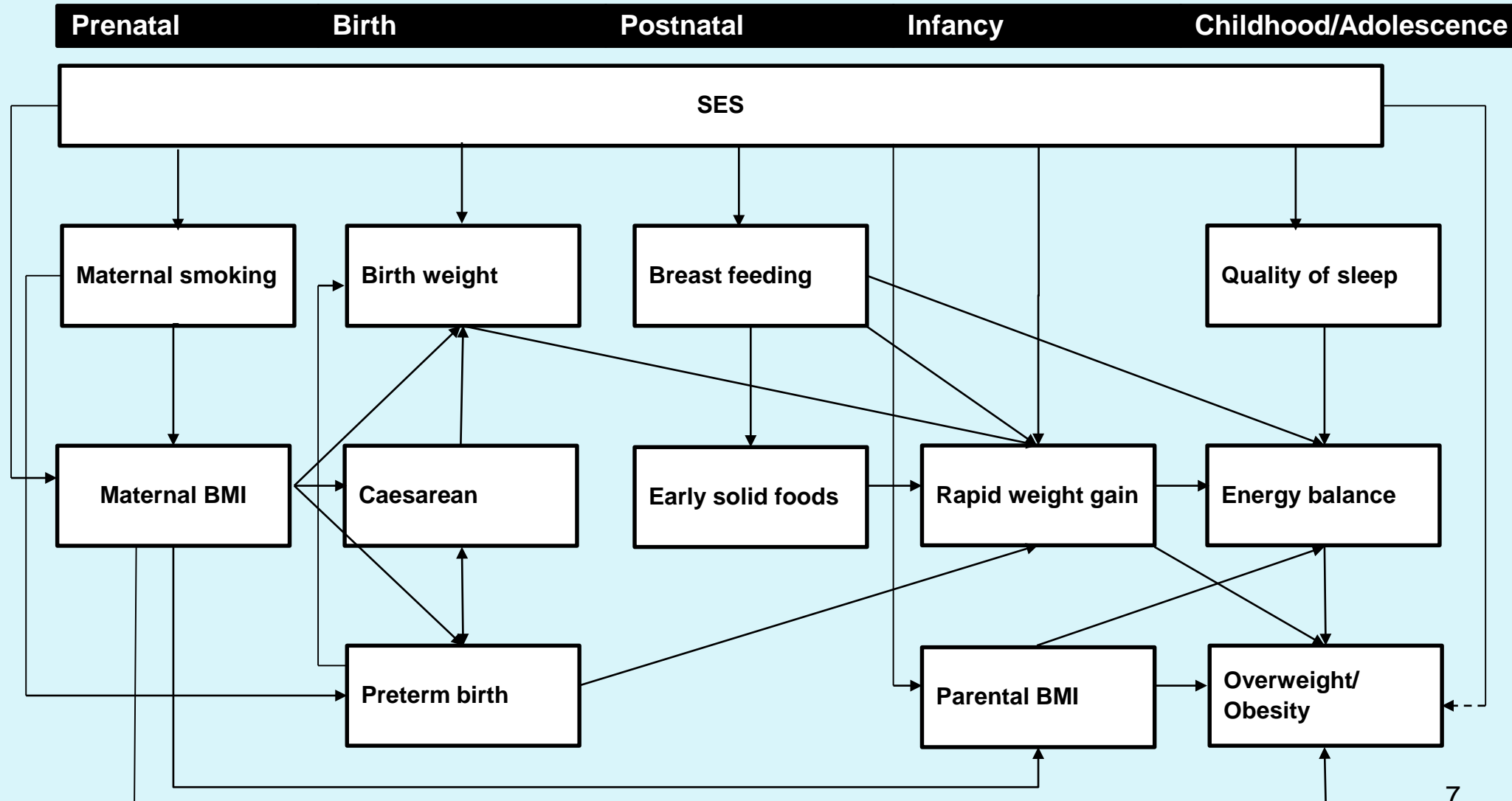
▣ Focus on three outcomes

- ▣ Obesity
- ▣ Education
- ▣ Mental Health

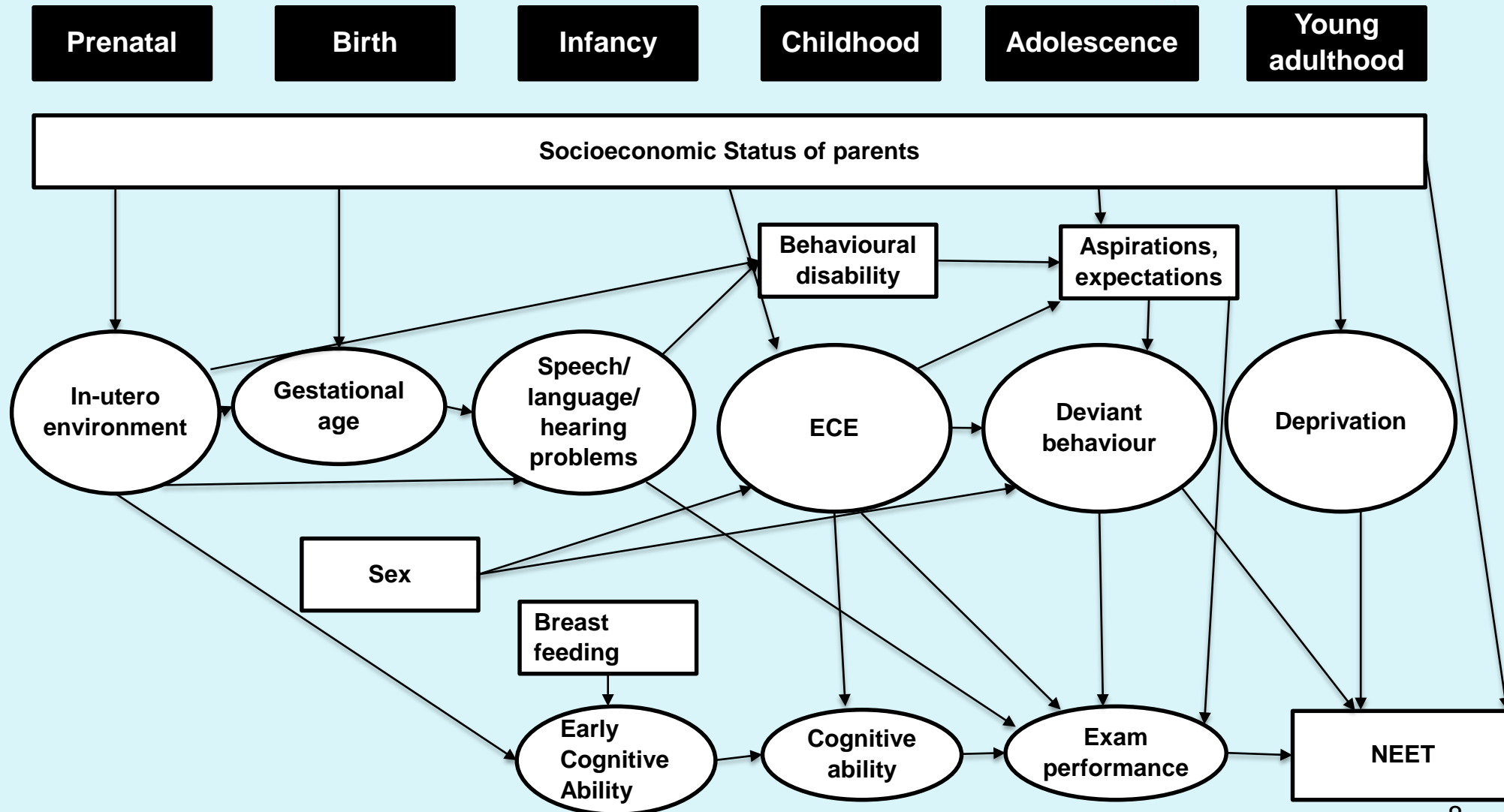
▣ For each outcome

- ▣ 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
- ▣ Build (upon) a computer simulation model to quantify the underlying determinants of obesity, education and mental health

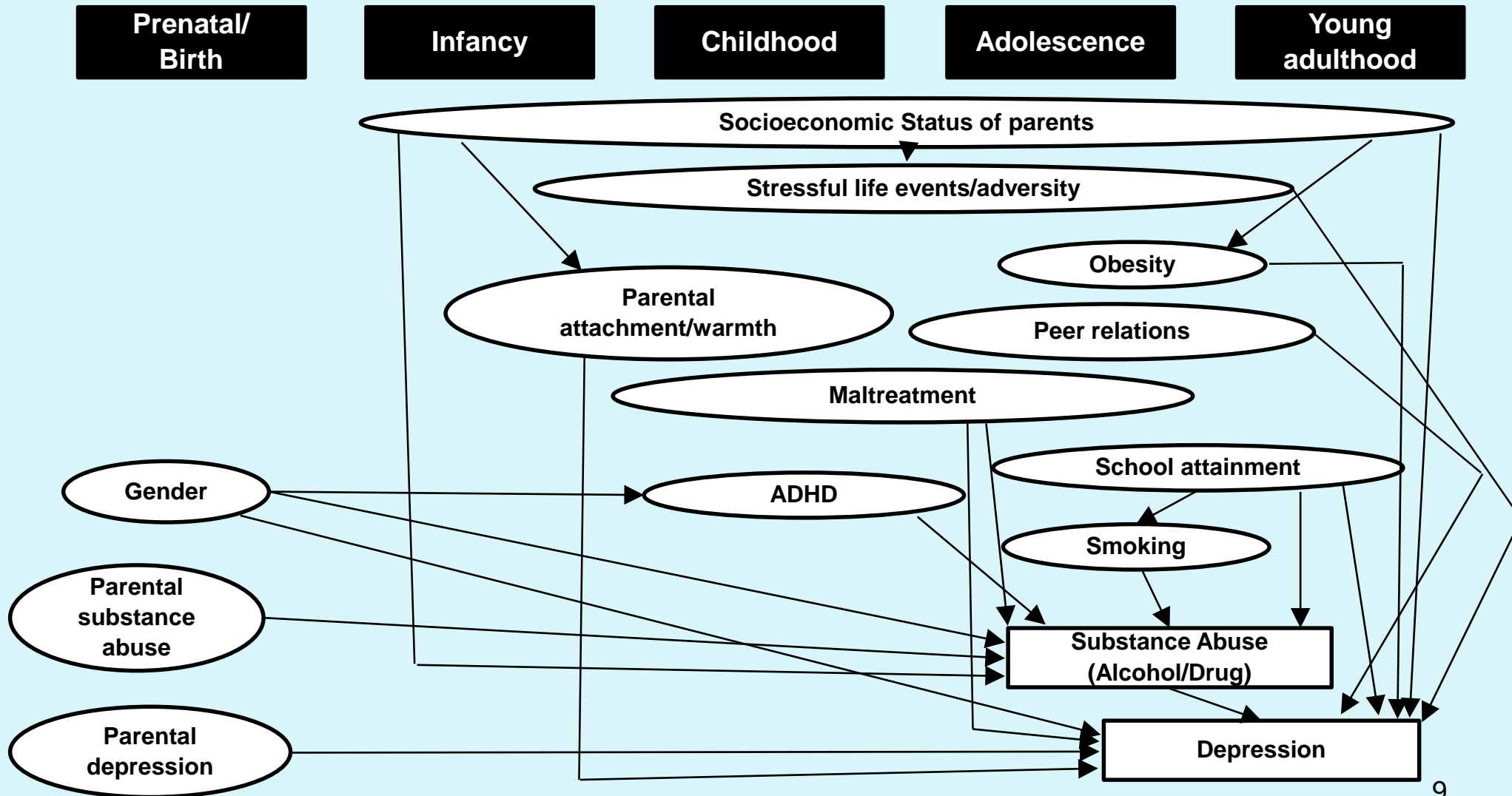
Obesity - Conceptual framework



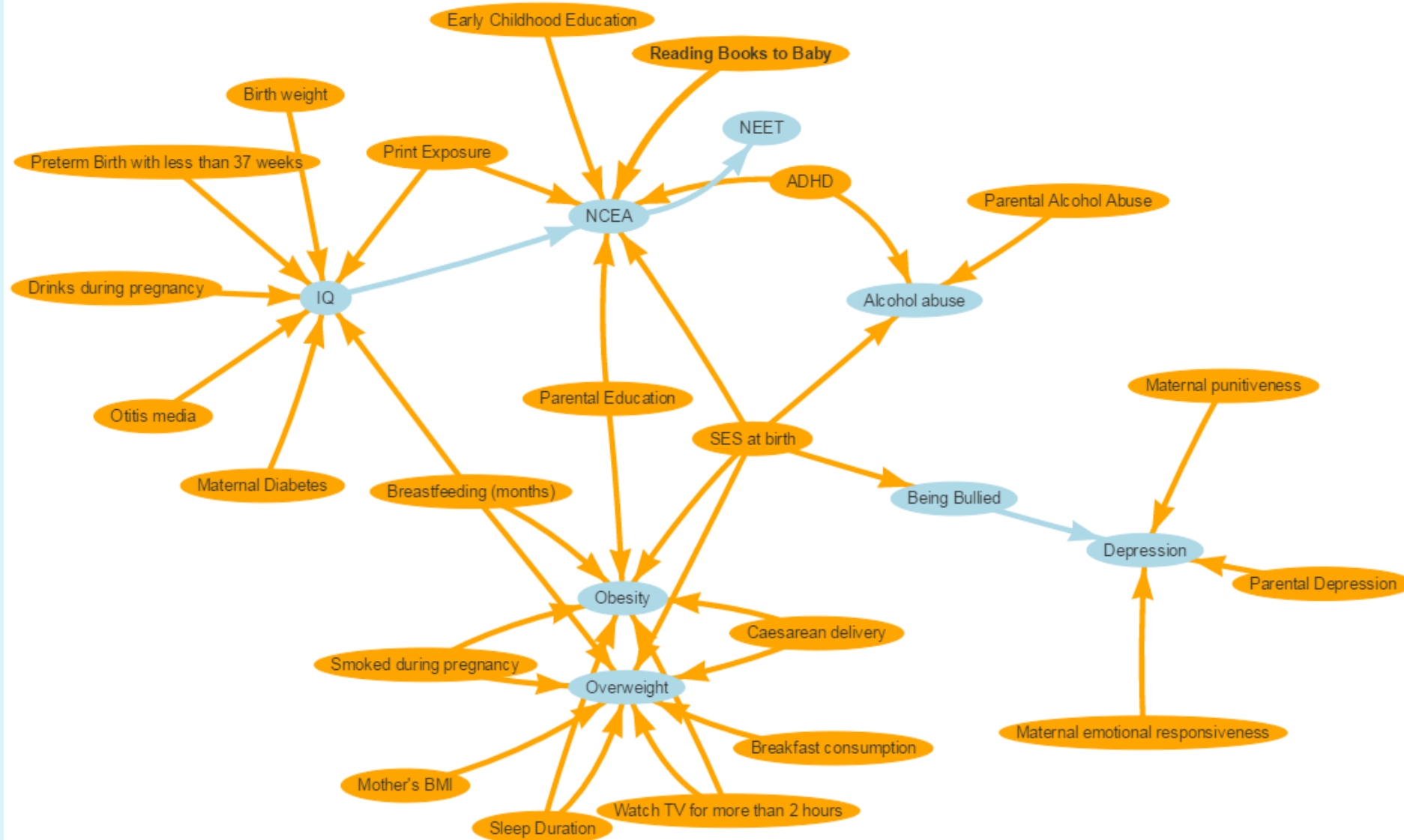
Education - Conceptual framework



Mental health - Conceptual framework



Knowledge Lab - Conceptual framework(s)



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%)
 - ❑ 38/68 reported whether magnitude of risk factor estimates differed for Māori vs non-Māori

Literature comparing effect sizes for Māori vs non-Māori



- ❑ 103 interactions reported (from the 38 papers)
- ❑ 63 reported that associations differed between Māori and non-Māori
 - ❑ Involving obesity (deprivation, rurality) – accounted for
 - ❑ Involving depression (family dysfunction) – not included
 - ❑ Involving alcohol (proximity to outlets) – not included
- ❑ 40 reported that associations did not differ between Māori and non-Māori

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

- Start with a real (or realistic synthetic) sample of people
- Apply statistically-derived rules to reproduce patterns via a stochastic process
- In so doing, create 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)



- 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

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

- 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
- $A_v = 10.2/20$ attended ECE
- $A_v = 13.2/20$ left school with qualifications

A simple worked example

- 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



- For 5 runs & 20 units,
- $A_v = 16/20$ attended ECE
- $A_v = 14.8/20$ 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

SHINY

- Data visualisation using R



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Secure | https://shinyapps.stats.govt.nz/tkpie/

Iwi cultural well-being from Te Kupenga 2013

- English
- Te reo

Select region / rohe

...

Select iwi

Kāti Māmoe

Select measure

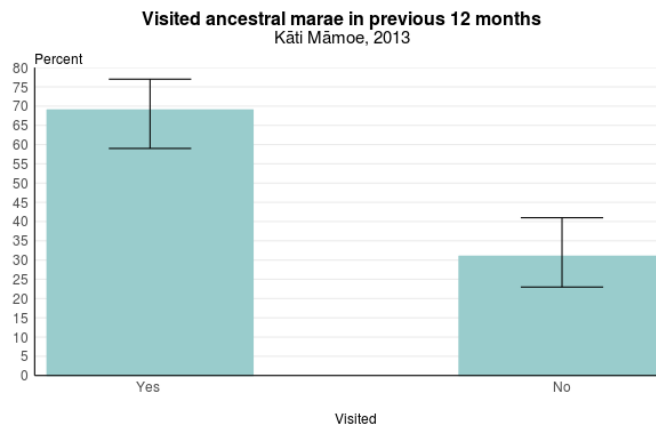
Visited ancestral marae in previous 12 months

Compare to estimate for Total Māori?

- No, just look at this iwi
- Yes

Download tables and graphs

Graph Table



Source: Statistics New Zealand

Explanatory notes

The estimates for the Total Māori population are for the usually resident Māori population of New Zealand, living in occupied private dwellings on 2013 Census night, aged 15 years and over, and who identified themselves as having Māori ethnicity or Māori descent.

The estimates for the Kāti Māmoe population are for the usually resident Māori population of New Zealand, living in occupied private dwellings on 2013 Census night, aged 15 years and over, who identified themselves as having Māori descent and who gave Kāti Māmoe as their iwi or one of several iwi.

The confidence intervals give the range in which we are 95 percent confident that the true population value falls.

We produced Kāti Māmoe estimates using small domain estimation. See [Iwi estimates using Small Domain Estimation](#) for technical details.

Feedback

You can provide feedback [here](#).

Your feedback will help us develop and refine this tool - in order to better meet the needs of our customers.

Demonstration - First Page



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Knowledge Lab



User guide

First Page

Model input

Scenario Builder

Table Builder

Project upload

Choose Project File

Browse... No

Scenarios Run

Select Scenario for comparison:

ECE

Name the Project:

CompassSeminar1

Save Project

Latest Update:

2017-03-15

KNOWLEDGE LAB (A knowledge laboratory of the early life-course)

Knowledge Lab is a microsimulation model of New Zealand children's development from birth to age 21. Micro-simulation is a technique that creates a virtual world which mimics the real world, with the population of 'virtual' individuals looking very much like the population of real individuals – in our case, children developing from birth through to early adulthood. A key feature of microsimulation is that allows virtual experiments to be carried out, where the effects of changing aspects of children's lives can be simulated, and the results quantified. What if we could reduce child bullying? What if fewer children had ear infections? What if we could improve the diet and activity of children? How would children's lives improve as a result of these changes? These are the sorts of questions Knowledge Lab has been set up to answer.

To construct Knowledge Lab, we first identified key determinants of child and adolescent outcomes, in association with policy representative from the New Zealand Ministries of Health, Education, Social Development and Justice, as well as Te Puni Kōkiri, the Social Policy Evaluation and Research Unit (SuPERU), and the Children's Commission. We then integrated estimates from systematic reviews and meta-analyses for the impact of these determinants into a working micro-simulation model of the early life-course, building on an earlier microsimulation model we had developed: [Modelling the Early life-course](#).

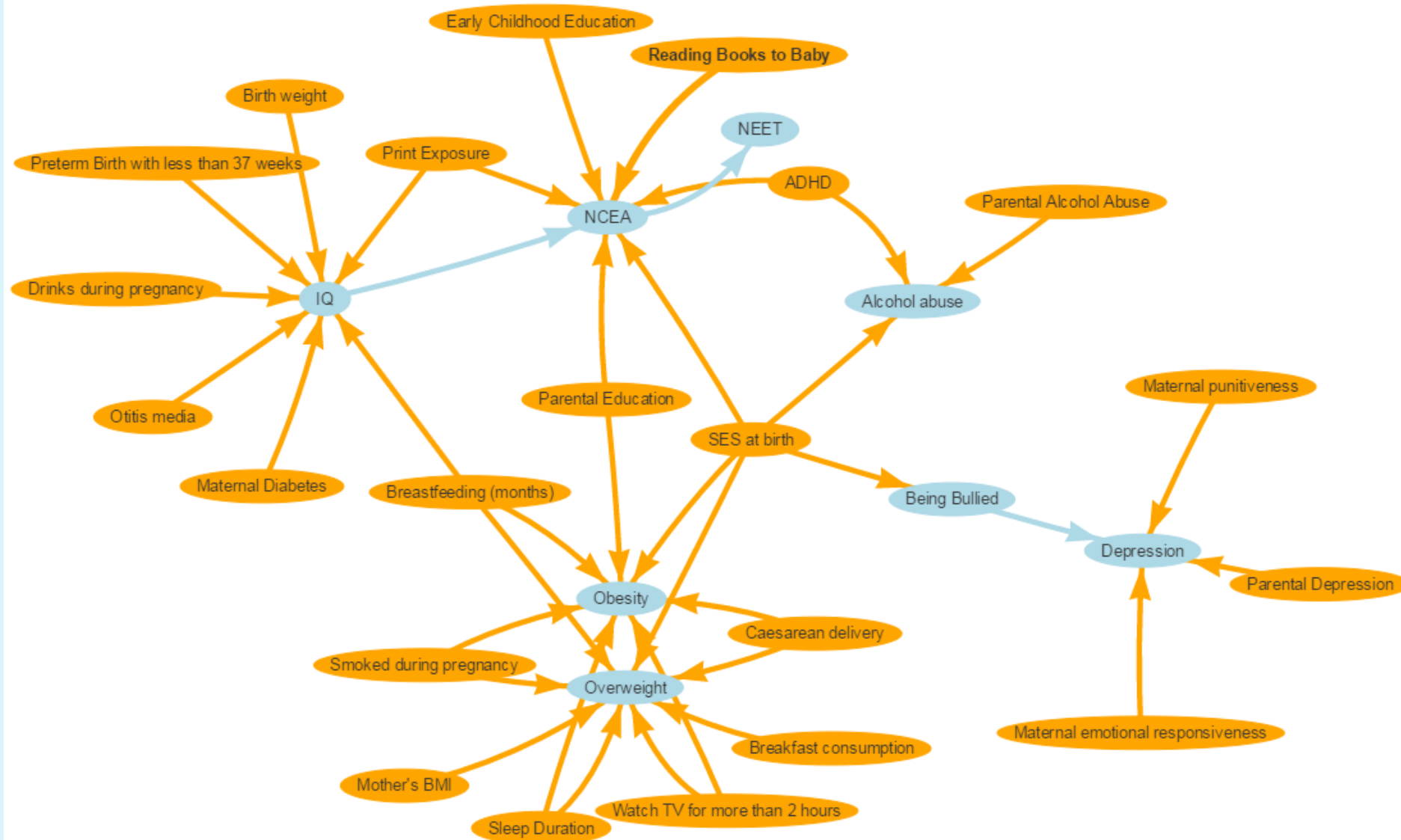
Steps in this process have involved (i) identifying published systematic reviews and meta analyses relating to key outcomes for children and adolescents (to age 21); (ii) integrating estimates from these studies into, and thus enhancing, an existing micro-simulation model of the early life-course; (iii) validating the enhanced model, and thus published estimates, by comparing simulated results to published New Zealand benchmarks; and (iv) using the validated enhanced model to test the impact of various policies on key child and adolescent outcomes.

The end product is an expert decision-support tool that is available for use by the public policy community. This tool have been developed as an interactive web application using Shiny R package and R programming language. Thus, the Shiny app can be shared as a web page, which allows the user to run across a number of different platforms, and does not require any specialist software to be installed.

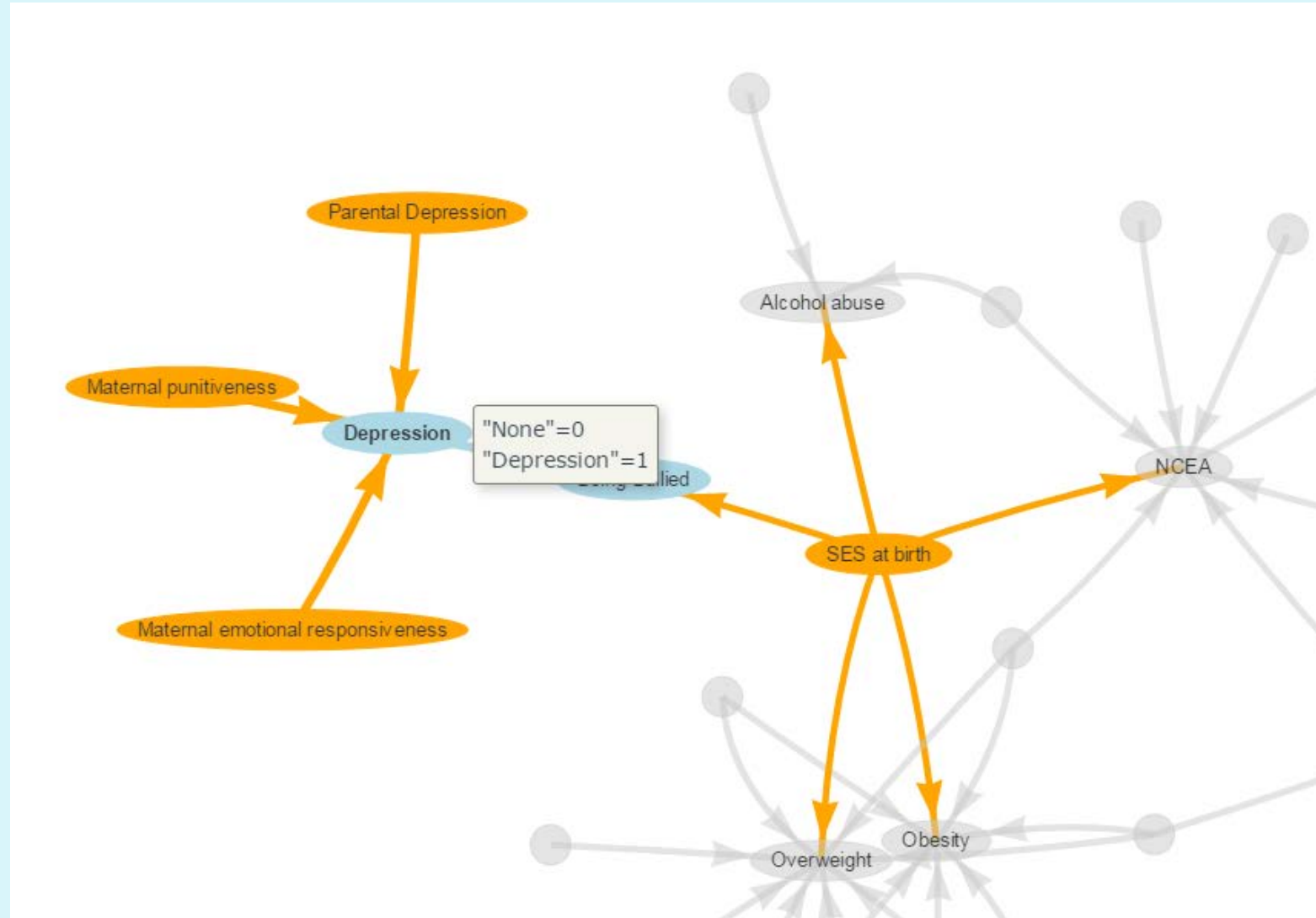


Getting Started
(User Guide)

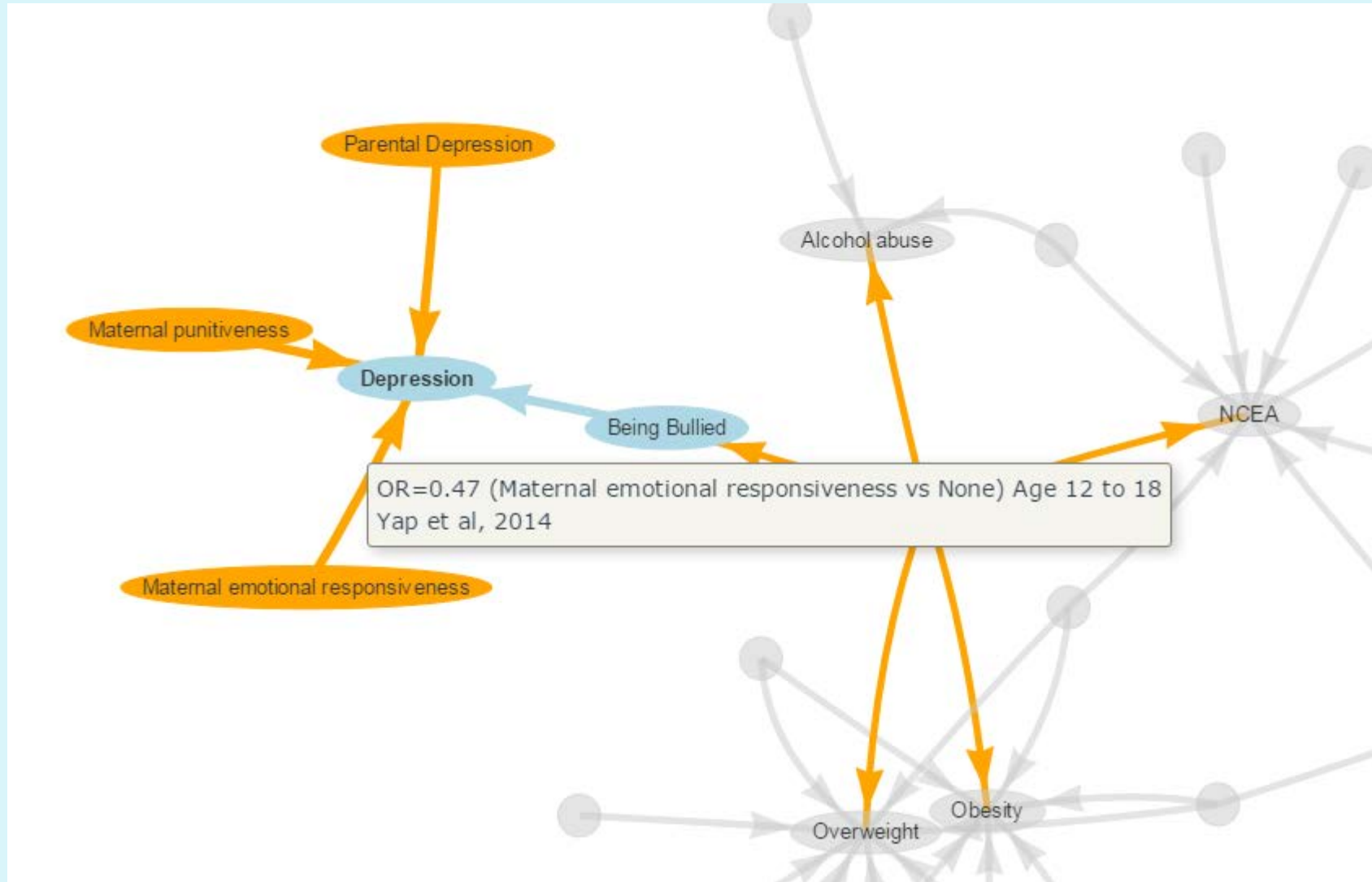
Demonstration - Model inputs




Demonstration - Model inputs



Demonstration - Model inputs



Demonstration - Model inputs



The screenshot shows a web browser window displaying a ScienceDirect article. The browser tabs include 'Knowledge Lab', 'Parental factors associat...', and 'www.sciencedirect.com/science/article/pii/S0165032713008057'. The ScienceDirect logo is at the top left, with navigation links for Journals, Books, Register, and Sign in. The article title is 'Parental factors associated with depression and anxiety in young people: A systematic review and meta-analysis' from the 'Journal of Affective Disorders', Volume 156, 1 March 2014, Pages 8–23. The authors listed are Marie Bee Hui Yap^{a, b}, Pamela Doreen Pilkington^{a, b}, Siobhan Mary Ryan^{a, b}, and Anthony Francis Jorm^{a, b}. The abstract section is visible, starting with 'Background' and 'There is a burgeoning and varied literature examining the associations between parental factors and depression or anxiety disorders in young people. However, there is hitherto no systematic review of this complex literature with a focus on the 12–18 years age range, when the first onset for these disorders peaks. Furthermore, to facilitate the application of the evidence in prevention, a focus on modifiable factors is required.' The 'Abstract' section is partially visible, starting with 'Methods' and 'Employing the PRISMA method, we conducted a systematic review of parental factors associated with depression and anxiety disorders in young people which parents can potentially modify.' The 'Results' section is also partially visible, starting with 'We identified 181 articles altogether, with 140 examining depression, 17 examining anxiety problems, and 24 examining both outcomes. Stouffer's method of combining p was used to determine whether associations between variables were reliable, and'. On the right side, there are sections for 'Recommended articles', 'Citing articles (30)', and 'Related book content'. The 'Metrics' section shows 29 citations, including 2 news outlets, 1 blog, and 6 Tweetsters. The page footer includes the URL 'www.sciencedirect.com/science/article/pii/S0165032713008288' and a 'Feedback' button.

Demonstration - Scenario builder



First Page

Model input

Scenario Builder

Table Builder

Project upload

Choose Project File

Browse... Cor

Upload complete

Scenarios Run

Select Scenario for comparison:

ECE

Name the Project:

Save Project

Latest Update:
2017-03-15

Contact email:

Variable

STEP 1: Name your scenario

Scenario1

STEP 2: Select Variable to Examine

ADHD

STEP 4 (optional): Select Subgroup for subgroup formula:

None

Insert () And Or Reset

Subgroup formula:

STEP 5: Click after every variable adjustment

Add Scenario

STEP 6 (optional): Choose number of Runs:

10

Scenario simulation log:

Step 7:

Run Scenario

Setting the Scenario

STEP 3: Variable Adjustment

Level	ADHD
No (%)	
Yes (%)	

Base value for the Variable:

ADHD

Var	Year	Mean
No	Childhood	97.6
Yes	Childhood	2.4

Demonstration - Scenario builder



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First Page

Model input

Scenario Builder

Table Builder

Project upload

Choose Project File

Browse... Cor

Upload complete

Scenarios Run

Select Scenario for comparison:

ECE

Name the Project:

Save Project

Latest Update:
2017-03-15

Contact email:

Variable

STEP 1: Name your scenario

Obesity

STEP 2: Select Variable to Examine

Breakfast consumption

STEP 4 (optional): Select Subgroup for subgroup formula:

None

Insert () And Or Reset

Subgroup formula:

STEP 5: Click after every variable adjustment

Add Scenario

STEP 6 (optional): Choose number of Runs:

10

Scenario simulation log:

Breastfeeding (months) has been added inserted in the scenario.
Breakfast consumption has been added inserted in the scenario.

Step 7:

Run Scenario

Setting the Scenario

STEP 3: Variable Adjustment

Level	Breakfast consumption
No (%)	9.00
Yes (%)	91.00

Base value for the Variable:

Breakfast consumption

Var	Year	Mean
No	Childhood	18.2
Yes	Childhood	81.8

Demonstration - Table builder

First Page
Model input
Scenario Builder
Table Builder
Project upload
Choose Project File
Browse... Cor
Upload complete
Scenarios Run
Select Scenario for comparison:
obesity
Name the Project:
Save Project
Latest Update:
2017-03-15
Contact email:

Variable

STEP 1: Select Summary Measure
Percentage

STEP 2: Choose variable:
Overweight

Select a level to compare in plot:
Overweight

STEP 3 (optional): Select ByGroup:
None

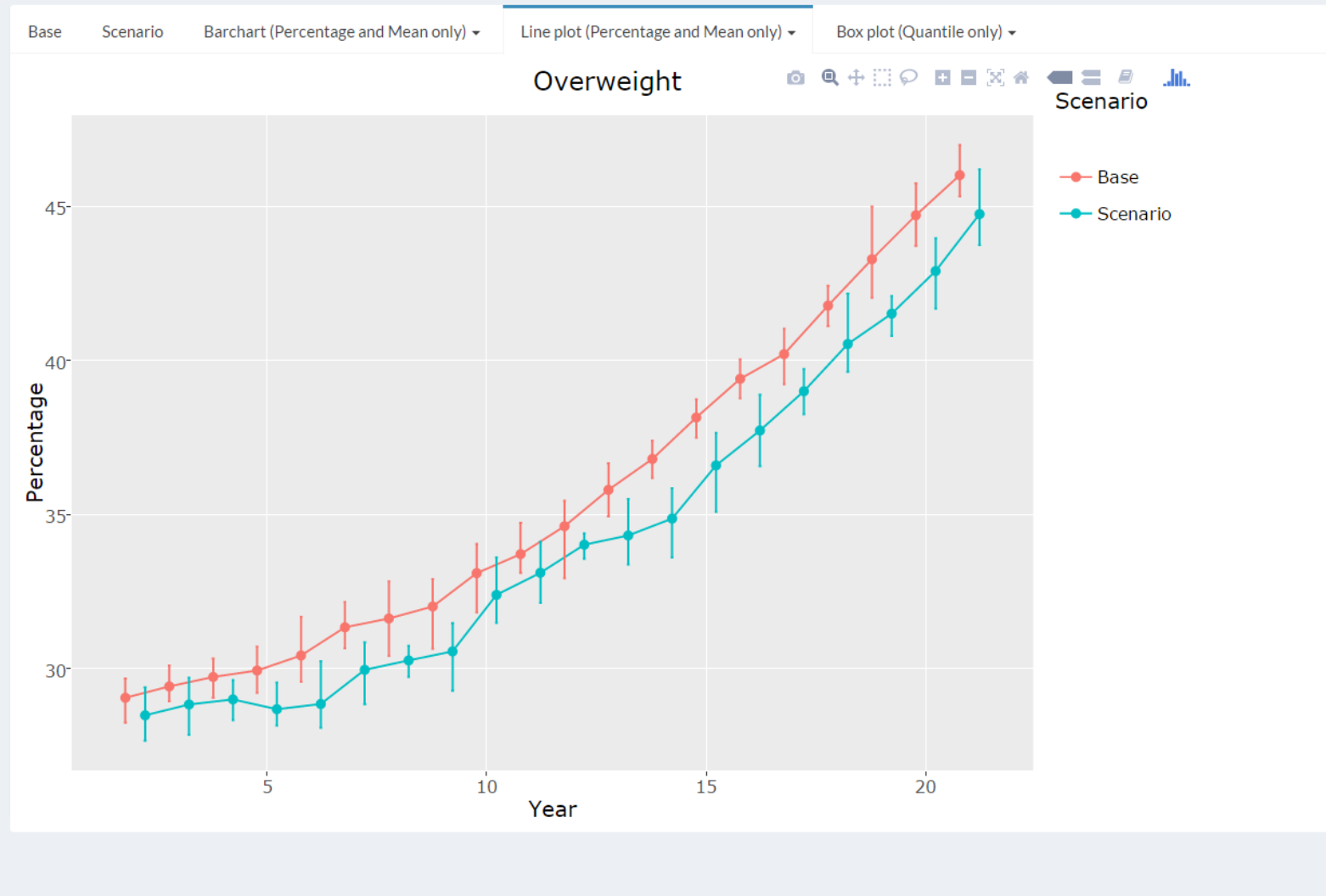
STEP 4 (optional): Select Subgroup for subgroup formula:
None
Insert () And Or Reset

Subgroup formula:

STEP 5 (optional): Apply subgroup to:
Scenario population (After scenario testing)

STEP 6 (optional):
 Confidence Interval

STEP 7 (optional):
Download Table Download Plot



THANK YOU!!



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<https://compassnz.shinyapps.io/knowlabshiny>