

Supplementary Material

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Article Title: Modelled distributional cost-effectiveness analysis of childhood obesity interventions: A demonstration.

Authors: Anagha Killedar, Thomas Lung, Rachael W Taylor, Alison Hayes

Corresponding Author: Anagha Killedar

The University of Sydney, Faculty of Medicine and Health, School of Public Health, Menzies Centre for Health Policy and Economics, NSW 2006, Australia

anagha.killedar@sydney.edu.au

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Appendix 1: Intervention Details

A summary of each of the three interventions evaluated is presented in the table below.

	High Five For Kids	POI-Sleep	POI-Combo
Intervention content	Treatment intervention targeting television viewing and fast food and sugar sweetened beverage intake	Guidance around health infant sleep	Sleep intervention plus guidance around nutrition, physical activity and breastfeeding
Year trial started	2006	2009	2009
Target group	Children with existing overweight and obesity.	Infants	Infants
Intervention modality	Pediatric practices – motivational interviewing run by clinicians - 4 in-practice sessions - 2 telephone calls	<i>Standard intervention (first six months):</i> - 1 group session - 1 home session <i>Optional components (6months to two years)</i> - 4 levels of intervention by request from caregiver	Sleep intervention plus 8 contacts conducted through home visits and GP sessions
Age at study randomisation	2 to 6 years (mean 5 years)	Antenatal	Antenatal
Duration of intervention	1 year	2 years	2 years
Age at follow-up (results used in this study)	Mean age 6 years	Mean age 5 years	Mean age 5 years
Cost per child	2011 USD 196	2018 AUD 184	2018 AUD 601

Appendix 2: Description of the New Zealand Deprivation Index 2013

The SEP measure in POI uses the New Zealand Deprivation Index 2013 which combines nine variables from the 2013 census relating to communication (no access to the internet at home), income (receiving a means tested benefit or living below income thresholds), unemployment, qualifications, home ownership, single parent families, living space, and transport access. A deprivation score is provided for each meshblock which is a geographical unit defined by Statistics New Zealand containing about 60-110 people. The score reflects the extent of material and social deprivation and is used to construct deciles from 1 (least deprived) to 10 (most deprived). This is further categorised into three groups where deciles 1-3 are categorised to High SEP, 4-7 to middle SEP and 8-10 to low SEP.

Appendix 3: Internal validation of the EQ-EPOCH model

In internal validation of the EQ-EPOCH model, mean BMI trajectories and prevalence of overweight and obesity at age 17 years simulated by the model were compared with the actual values from the Kindergarten cohort of the Longitudinal Study of Australian Children. These results are presented below.

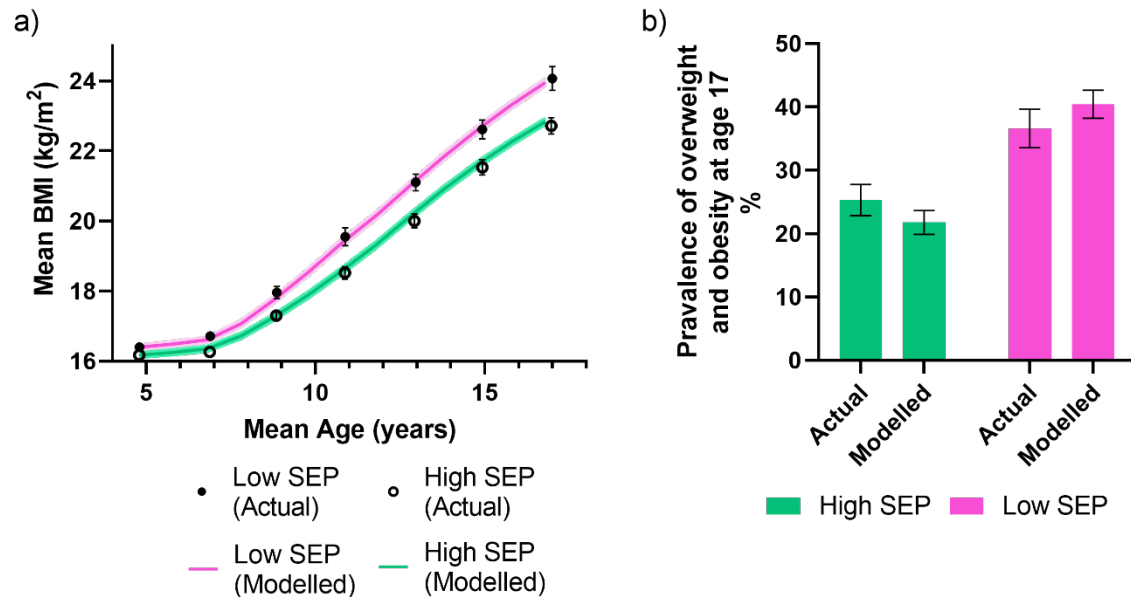


Figure. Internal validation of the EQ-EPOCH model. Actual and modelled outcomes at age 17 years for high and low SEP groups: a) mean BMI trajectories b) prevalence of overweight and obesity.

Appendix 4: Healthcare costs

The weight and age specific healthcare costs incorporated into the EQ-EPOCH model were derived using a top-down approach using data from Australian national statistics and published literature.

Briefly, the annual healthcare expenditure for the Australian government for three age groups (5-9 years, 10-14 years and 15-19 years) was determined from national statistics on hospital expenditure for the year 2012-13 (1) and Medicare costs, which includes non-hospital general practitioner and specialist consultations and pharmaceutical costs, for the year 2017-18 (2, 3). The hospital expenditure data were inflated to 2017-18 values using the total health price index (4).

The mean annual healthcare costs for children with healthy weight and overweight and obesity combined were then estimated from the overall cost by accounting for the prevalence of overweight and obesity in each age group (5) and the relative difference between children with healthy weight and overweight and obesity in health funder incurred costs estimated in the literature (6).

For example, in 5-9 year old children the mean annual healthcare costs combining hospital and Medicare data were \$749.67. The prevalence of overweight and obesity was 0.317 and the relative difference in cost of overweight and obesity compared to healthy weight was 1.1292. Therefore, if x =cost for a 5-9 year old child with healthy weight then,

$$0.683x + 0.317 \times 1.129x = 749.67$$

And

$$x = \$720.17$$

Therefore, the cost incurred for a child with overweight or obesity is

$$720.17 \times 1.129 = \$813.22$$

The mean costs estimated for each age group and weight status are presented below:

Age group (years)	Mean annual healthcare costs (\$AUD pp): Healthy Weight	Mean annual healthcare costs (\$AUD pp): Overweight and Obesity
5-9	720.17	813.22
10-14	772.57	872.39
15-19	1244.62	1405.42

References

1. Australian Institute of Health and Welfare. Australian health expenditure—demographics and diseases. Canberra: AIHW, 2017.
2. The Department of Health. Annual Medicare Statistics - Financial Year 1984-85 to 2017-18. Canberra: The Department of Health, 2018.
3. Tan EJ, Taylor RW, Taylor BJ, et al. Cost-Effectiveness of a Novel Sleep Intervention in Infancy to Prevent Overweight in Childhood. *Obesity*. 2020; 28: 2201-08.
4. Australian Institute of Health and Welfare. Health expenditure Australia 2017–18. Canberra: AIHW, 2019.
5. Australian Bureau of Statistics. National Health Survey: First Results, 2014-15. In: Australian Bureau of Statistics, ed. Canberra, 2015.
6. Au N. The Health Care Cost Implications of Overweight and Obesity during Childhood. *Health Services Research*. 2012; 47: 655-76.

Appendix 5: Utility decrements

The weight status specific utilities and decrements incorporated into the EQ-EPOCH model have been derived from a recent systematic review:

Brown V, Tan EJ, Hayes AJ, Petrou S, Moodie ML. Utility values for childhood obesity interventions: a systematic review and meta-analysis of the evidence for use in economic evaluation. *Obes Rev.* 2018;19(7):905-16.

These values are presented below:

Healthy Weight Utility	0.850
Decrement for Overweight (including obesity)	0.015
Overweight (including obesity) utility	0.835

Appendix 6: Calculating an uneven distribution of opportunity costs

In sensitivity analysis 2, we tested the effect of assuming that opportunity costs were unevenly distributed across SEP quintiles. As studies quantifying this distribution in Australia were not available, we used the proportions estimated for England. The table below presents these proportions, and the opportunity costs for the point estimate by SEP quintile. These opportunity costs are presented in QALYs, assuming a \$50 000 per QALY gained cost-effectiveness threshold, and represent a per-person value.

The overall opportunity costs (in QALYs) were calculated as the incremental cost (in \$AUD) divided by \$50000 – i.e. the average QALYs per person that could have been gained by spending the money elsewhere in the health system. The average opportunity costs in QALYs per person in each SEP quintile is calculated by weighting the overall opportunity cost by the proportion of opportunity cost gained in a quintile. E.g. for H54K quintile 1, the opportunity cost is $0.264 \times 5 \times 0.00048 = 0.00063$. SEP-specific opportunity costs were calculated for the point estimate and each bootstrapped sample in STATA.

		Socioeconomic Quintile				
	Overall	1	2	3	4	5
Proportion of opportunity cost (%)	-	26.4	21.9	21.8	16.0	13.9
Opportunity cost for H54K (QALYs)	0.00048	0.00063	0.00052	0.00052	0.00038	0.00033
Opportunity cost for POI-Sleep (QALYs)	0.00282	0.00373	0.00309	0.00308	0.00226	0.00196
Opportunity cost for POI-Combo (QALYs)	0.01171	0.01545	0.01282	0.01276	0.00937	0.00814

Appendix 7: Unstratified intervention effects

In sensitivity analysis 3, we tested the effect of applying unstratified intervention effects instead of SEP-specific effect sizes to the LSAC K cohort for before simulation. These effect sizes have been identified from publications presenting trial results of the interventions tested in this study. The unstratified effect sizes, 95% confidence intervals and the source from which they were identified are presented below:

	Effect size (95% CI) Intervention - Control	Source
High Five For Kids	-0.21 (-0.50 to 0.07)	Taveras EM, Gortmaker SL, Hohman KH, Horan CM, Kleinman KP, Mitchell K, et al. Randomized controlled trial to improve primary care to prevent and manage childhood obesity: the High Five for Kids study. Arch Pediatr Adolesc Med. 2011;165(8):714-22.
POI-Sleep	-0.22 (-0.56 to 0.12)	Taylor RW, Gray AR, Heath AM, Galland BC, Lawrence J, Sayers R, et al. Sleep, nutrition, and physical activity interventions to prevent obesity in infancy: follow-up of the Prevention of Overweight in Infancy (POI) randomized controlled trial at ages 3.5 and 5 y. Am J Clin Nutr. 2018;108(2):228-36.
POI- Combined	-0.11 (-0.45 to 0.24)	

Appendix 8: Quantified results for base case and sensitivity analyses

Incremental and overall results for the point estimate of base case and sensitivity analyses are presented in the table below.

SA1 = Sensitivity analysis 1 (Marginal productivity estimate)

SA2 = Sensitivity analysis 2 (Uneven opportunity costs)

SA3 = Sensitivity analysis 3 (Unstratified effect size)

	Base case	SA 1	SA2	SA3
High Five for Kids				
Incremental healthcare costs (AUD)	-52.20	-52.20	-52.20	-18.10
Incremental healthcare + intervention costs (AUD)	23.81	23.81	23.81	57.91
Incremental QALYs	0.007	0.007	0.007	0.003
Opportunity Costs (QALYs)	0.0005	0.0008	0.0005	0.001
Net Health Benefit (QALYs) ¹	0.007	0.007	0.007	0.001
Equity Impact (QALYs) ²	0.020	0.020	0.020	-0.002
POI-Sleep				
Incremental healthcare costs	-43.09	-43.09	-43.09	-44.61
Incremental healthcare + intervention costs (AUD)	141.25	141.25	141.25	139.73
Incremental QALYs	0.006	0.006	0.006	0.006
Opportunity Costs (QALYs)	0.003	0.005	0.003	0.003
Net Health Benefit ¹	0.003	0.001	0.003	0.003
Equity Impact (QALYs) ²	0.002	0.002	0.001	0.001
POI-combo				
Incremental healthcare costs	-16.12	-16.12	-16.12	-21.95
Incremental healthcare + intervention costs (AUD)	585.33	585.33	585.33	579.50
Incremental QALYs	0.002	0.002	0.002	0.003
Opportunity Costs (QALYs)	0.012	0.021	0.012	0.012
Net Health Benefit ¹	-0.009	-0.019	-0.009	-0.009
Equity Impact (QALYs) ²	-0.005	-0.005	-0.014	0.001

¹A positive net health benefit means a population level increase in QALYs whereas a negative benefit refers to a net health loss

²A positive equity impact refers to a reduction in inequalities in QALYs whereas a negative equity impact refers to a widening of inequalities in QALYs.