

Inquiry into the Obesity Epidemic in Australia

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Submission to Parliament of Australia Senate Committee: Inquiry into the Obesity Epidemic in Australia, on behalf of the International Health Economics Association (iHEA) Economics of Obesity Special Interest Group (EOSIG)

Dear Senate Committee Members

Thank you for the opportunity to contribute to the Senate Inquiry into the Obesity Epidemic in Australia. This submission was prepared by a working group, as part of the activities of the International Health Economics Association's (iHEA) Economics of Obesity Special Interest Group (EOSIG).

Who we are

The sheer magnitude of the obesity crisis means that society's scarce resources should be directed towards the most effective and cost-effective obesity prevention and treatment strategies. The iHEA EOSIG brings together health economists from all over the world who are working in the field of obesity, to enhance the understanding of the prevention and treatment of obesity from an economics perspective.

The views expressed are those of the members of the EOSIG working group, and not necessarily those of iHEA. A full list of the members of the working group writing on behalf of the EOSIG is provided at the end of this document.

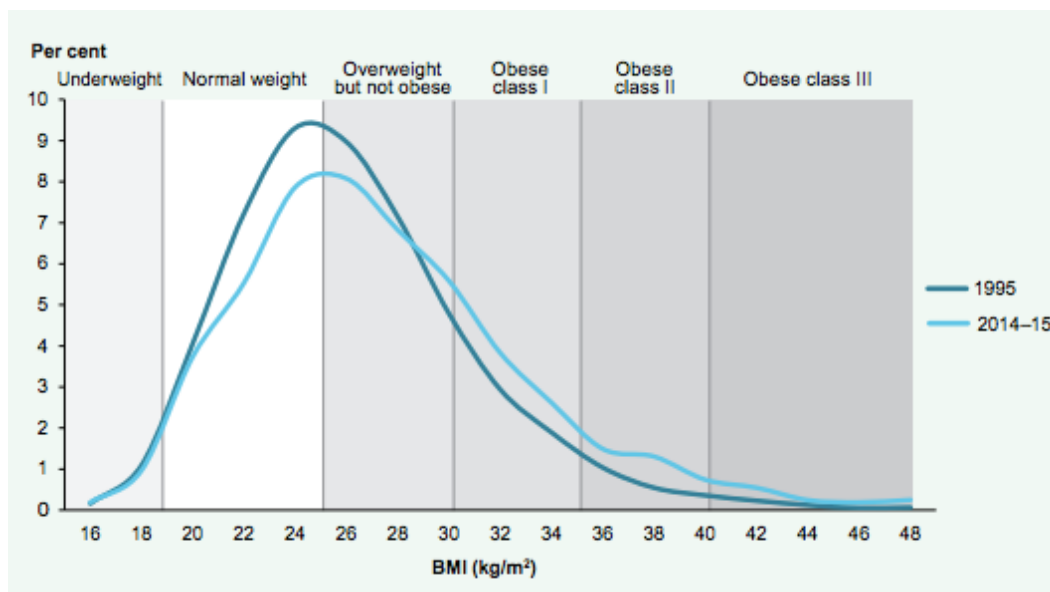
Response to the Terms of Reference:

The prevalence of overweight and obesity among children in Australia and changes in these rates over time

Australia is one of the most overweight and obese countries in the world

- The **majority (63%) of Australian adults are either overweight or obese** (1-3). Approximately one-third (35%) of Australians are in the normal weight range (1-3).
- This equates to 11 million Australians aged over 18 years, of whom, nearly half are obese (1-3). Australian men have higher rates of overweight and obesity than women (71% vs 56% respectively) (3).
- Australia is now the **fifth most obese country** amongst members of the Organisation for Economic Co-Operation and Development (3). Whilst the proportion of Australians with a healthy body weight has decreased over the past two decades, the proportion of Australians who are classified as obese has increased (Figure 1) (3).
- The majority of Australians in 2014-15 were **significantly more likely to be obese than Australian's of the same age in 1995** (3). Further, the proportion of those classified as severely obese nearly **doubled** between 1995-2015, from 4.9% to 9.4% (3).

Figure 1: Distribution of BMI in Australians aged 18 years and over, 1995 and 2014-15



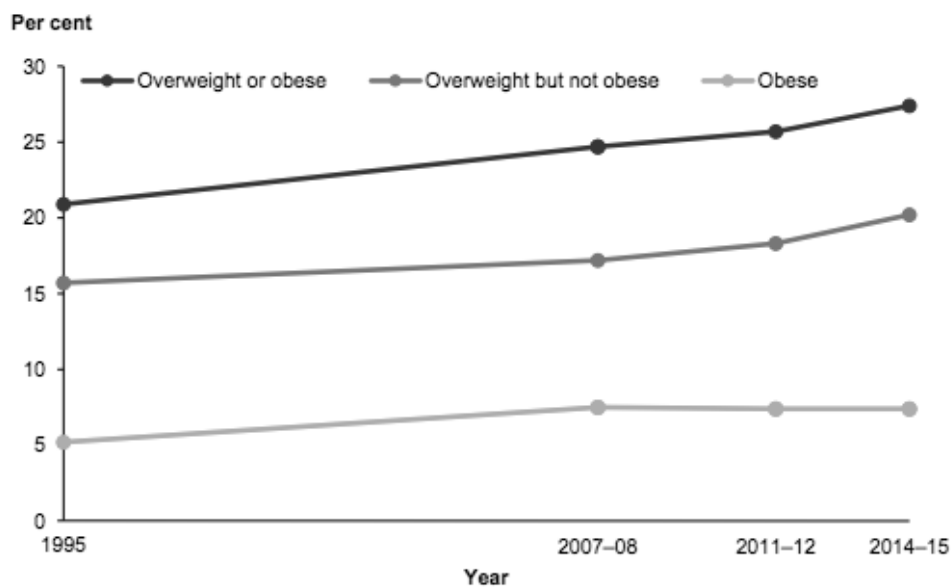
Source: Australian Institute of Health and Welfare (3)

Prevalence of overweight and obesity in children and adolescents

- **Over one-quarter (28%) of Australian children aged 5-17 years are overweight or obese**, having risen from 21% a decade prior (1, 2).
- Approximately **1 in 5 (21%) Australian children aged 2-4 years are overweight or obese**.

- Approximately **4 in 10 (37%) Australian young people aged 15-24 years are overweight or obese** (2-4).
- For both children and young people, similar proportions of boys and girls were obese. For boys the highest prevalence of obesity was seen between the ages of 16-17 years (8.2%) and for girls between the ages of 5-7 years (12%)(3).
- Figure 2 depicts the trends in overweight and obesity for Australian children aged 5-17 years over the period 1995 to 2014-15. Evidence suggests there may be a plateauing of overweight and obesity in children in high income English speaking countries worldwide (and including Australia), albeit at **unacceptably high levels** (5, 6).

Figure 2: Proportion of overweight and obese Australian children (5-17 years), 1995 to 2014-15



Source: Australian Institute of Health and Welfare (4)

Increased prevalence of overweight and obesity in Australians with a lower socioeconomic position

- Evidence suggests that social determinants, such as a lower socioeconomic position, negatively impact a person’s health status (3). This is true of overweight and obesity, which is more prevalent in Australians with lower SEP.
- Obesity is more prevalent in children with lower SEP. Over **one-third (34.7%) of children in the lowest socioeconomic areas** are classified as either overweight or obese (2).
- Specifically, over one-third (33%) of boys aged 2-17 years from a lower socioeconomic area were overweight or obese compared to 22% of boys from the highest socioeconomic area (3). This disparity is worse for girls from a lower socioeconomic area. Over one-third (38%) of girls aged 2-17 years were overweight or obese compared to 24% of girls from the highest socioeconomic areas (1, 3).

Increased prevalence of overweight and obesity in regional and remote Australia

- Relative to their metropolitan peers, children and adolescents living in regional and remote Australia were more likely to be overweight or obese (2-4). Boys and girls living in outer regional/remote areas were, **1.3 and 1.5 times respectively, as likely to be overweight or obese** relative to their metropolitan peers (2-4).

Indigenous Australians at a greater risk of overweight or obesity

- Indigenous adults aged over 18 years are 1.2 times more likely to be overweight or obese and 1.6 times more likely to be obese relative to their non-Indigenous adult peers (7).
- **Indigenous children are also more likely to be overweight or obese relative to their non-Indigenous peers** (2-4). Almost one-third (30%) of Aboriginal and Torres Strait Islander children aged 2-14 years are overweight or obese (7). Over one-third (36%) of Aboriginal and Torres Strait Islander adolescents aged 15-17 years are classified as overweight or obese (7).

Intergenerational transmission of childhood overweight and obesity

- Evidence suggests that **parental body mass index is a strong determinant of offspring weight** (8, 9), with a stronger relationship between maternal and child weight than the father-offspring counterpart (9-13). Offspring with obese mothers are at significantly higher risk of obesity than children from non-obese mothers (9, 14-17).
- Using data from the Household Income and Labour Dynamics in Australia (HILDA) survey, the intergenerational link between maternal obesity and childhood obesity was estimated. Findings suggest that **having an obese mother increases the likelihood of being an obese adolescent by 9.2% relative to having a mother who is not obese**.
- To put it into context, these estimates fall somewhere in the middle of comparable international studies. Using English data, Whitaker et al. (9) estimate a 4.36% increase in the probability of offspring obesity, and Costa-Font and Gil (18) find a 4.2% to 4.6% increase in the probability of youth obesity using Spanish data. These studies represent the lower-bound international estimates of the intergenerational transmission of obesity. Classen (15) and Coate (17) estimate increased probabilities of 31.7% and 20%, respectively, in their US studies of the intergenerational transmission of obesity from mothers to offspring.
- In Australia, there is evidence of a relationship between low socioeconomic status (SES) and the intergenerational persistence of obesity. The intergenerational transmission of obesity is substantially stronger at the lowest quartile of equivalised household income. Furthermore, maternal obesity increases the likelihood of adolescent obesity by 12.7% for families from low SES neighbourhoods. As youths with obese mothers from high socioeconomic status neighbourhoods face an increased obesity probability of only 4.5%, these results indicate that **the intergenerational persistence of obesity is almost three times as strong for low SES households relative to high SES households**. However, the marginal effect of maternal obesity on the likelihood of youth obesity does not appear to vary by maternal education level.

- This evidence, suggesting that obesity immobility in Australia is strongest for the most disadvantaged households, should be considered when designing targeted policy interventions. The intergenerational relationship of obesity, coupled with rapidly increasing female obesity in Australia (19), could result in an increase in obesity rates for subsequent generations.

The short and long-term economic burden of obesity, particularly related to obesity in children in Australia

Health care costs in childhood

- Black et al. (2018) examines the health care costs caused by (not merely correlated with) obesity in Australia (20). It used data on approximately 3,500 children from the Longitudinal Study of Australian Children (LSAC) (a representative sample of Australian children), linked to their Medicare (MBS & PBS) records.
- Compared to healthy weight children, **overweight and obesity among 6 to 13 year olds** is estimated to cause an additional **\$43 million** (in 2015 AUD) in annual non-hospital costs incurred by Medicare Australia (medicines and medical care)(20). The additional annual cost per child caused by **obesity** is **\$103**, and caused by **overweight** (but not obesity) is **\$63** (20).
- A majority of these costs are due to more frequent GP visits (and accompanying bulk-billing incentive expenses). The total health care costs caused by overweight and obesity are likely to be even greater once hospital and out-of-pocket expenses are considered (20).
- The costs caused by obesity are higher than suggested by earlier studies, which have examined the association between childhood obesity and health care costs in Australia (21, 22).
- Causal estimates for pre-schoolers or older adolescents are unavailable. However, Hayes et al. (23) showed that among pre-schoolers from socioeconomically disadvantaged areas of Sydney, the Government-funded health care costs (including hospital and non-hospital) associated with **obesity among 2-4 year olds** is **1.62 times** that of children of healthy weight over 3 years. The largest component of these costs are for hospital treatment.
- Extrapolating this estimate to the wider Australian population suggests that compared to healthy weight children, obesity among 2-4 year olds is associated with an additional **\$17 million** (in 2016 AUD) in annual Government-funded health care costs. The annual excess cost per child with obesity, compared to healthy weight, is **\$367** (24).

Costs to child's human capital development

- Cognitive, social and emotional skills are all important predictors of economic success and wellbeing in adulthood (25). By affecting human capital development, obesity can lead to future economic losses for the individual and society (26).
- Determining such costs is complicated by *confounding* factors (e.g. kids from socioeconomically disadvantaged backgrounds are more likely to have both obesity and difficulties in skill development), and *simultaneity bias* (e.g. kids with emotional problems may be more likely to overeat and gain weight). Recent studies have accounted for these estimation issues using advanced econometric techniques.

- Children with obesity suffer from weight stigma and bullying. After accounting for confounding and selection bias, compared to healthy weight children, obesity among 6 to 13 year olds in Australia causes substantially more **emotional problems** (both genders) and **peer problems** (especially for boys) (27). Similar findings have been reported in the United States (28).
- Obesity may reduce cognitive achievement as a result of ill health or sleep problems affecting concentration or school attendance, or through stigma or discrimination, which can lead to reduced self-esteem and anxiety (26). After accounting for confounding and selection bias, compared to healthy weight children, obesity among 8 to 13 year olds in Australia is associated with lower levels of **academic achievement** (measured by NAPLAN performance in grade 3, 5 and 7), particularly for boys (26). Similarly, studies from the United States (29, 30) and England (31) have shown that obesity is associated with poorer academic performance among children and adolescents.
- These important economic consequences are over-and-above any health-related consequences in childhood, and are not currently accounted for in economic evaluations of childhood obesity interventions. Even existing health-related utility measures may not fully reflect the health benefits of obesity interventions in children (32-34). Together, this implies that current economic evaluations are likely to underestimate the benefits of childhood obesity interventions.

The potential long-term economic consequences of obesity include:

- a) Losses to the individual from reduced educational attainment, employment, wages and household income.
- b) Loss of Government tax revenue due to adverse labour market consequences and subsequent loss of societal welfare due to less public expenditure.
- c) Costs to employers due to loss of productivity (from absences and sickness).
- d) Health care costs (incurred by Governments and individuals).

Childhood and adolescent obesity may have long-term economic consequences via two key pathways:

1. Lower levels of cognitive, social and emotional skill development (including lower self-esteem) during childhood, which can affect educational attainment, labour market opportunities and household income.
2. A greater risk of obesity in adulthood, which can lead to greater health care costs and labour market penalties (e.g. through discrimination and health limitations) and production losses (e.g. due to sickness).

Long term economic consequences of childhood obesity

- There is little evidence on the long-term economic consequences of childhood obesity in Australia, primarily due to a lack of quality data that follows children into adulthood (and is linked to their adult health care utilisation and economic circumstances).
- Evidence from Britain and the U.S. find that childhood and adolescent obesity is associated with significantly lower levels of future household income in adulthood for women, but not men (35, 36). This is linked to a lower likelihood of marriage and a lower level of spousal income among women who marry, rather than reduced labour market opportunities.

Economic consequences of adult obesity

- A large literature has shown that obesity in adulthood is associated with considerably higher health care costs. Recent evidence from the United States suggests that the health care costs *caused* by adult obesity are even higher than the costs *associated* with adult obesity (37).
- Although causal estimates are unavailable for Australia, the annual health care costs related to overweight and obesity among 30+ year olds is estimated to be **\$10.7 billion** (in 2005 AUD)(38). Another Australian study showed that medical costs increase with BMI. Compared to those of normal weight, health expenses of adults aged 45+ years with a BMI 30 to 35 (**obese type I**) are 19% higher and expenses of those with BMI > 35 (**obese type II/III**) are 51% higher (39). Health care costs are higher not only through related chronic diseases, but also because the cost of recovery from acute health shocks is higher (39).
- In Australia (and several other OECD countries), obesity in adulthood leads to adverse labour market outcomes, including **lower levels of employment, lower wages** and more **absences from work** due to illness (40). These findings account for the complex interrelationship between obesity and labour market outcomes; while on one hand, obesity may affect employment outcomes and productivity, on the other hand, work patterns and socioeconomic status can affect weight and the risk of chronic diseases.
- The adverse labour market outcomes imply that obesity leads to economic **production losses**. However, the quantification of the production losses is complex (e.g some losses can be absorbed by extra workers)(40).
- If causal estimates of the consequences of obesity in adulthood were available in Australia, it would be possible (under certain assumptions) to model the expected long-term cost (in \$) of obesity in childhood. Studies in Germany have made progress towards achieving this (although without causal estimates)(41, 42).

The effectiveness of evidence-based measures and interventions to prevent and reverse childhood obesity, including experiences from overseas jurisdictions

- The World Health Organisation (WHO) Ending Childhood Obesity (ECHO) report (43) identified six key areas of action requiring government leadership and stakeholder engagement across the **critical periods of the childhood life-course (pre-conception, pregnancy, early childhood, older childhood and adolescence)**.
- Whole-of-population **and** targeted interventions (in high-risk individuals) are required, spanning **systemic, environmental and individual drivers and moderators of obesity**.
- Significant challenges exist in establishing the effectiveness of policies and programs to reduce childhood overweight and obesity, and government commitment to on-going research agendas is required.
- Throughout the world, several measures to battle obesity and more specifically childhood obesity have been adopted but without significant results so far:
 - Since the 1980s' till the present the prevalence of obese adults tripled in England from less than 10% to slightly above 25%. During the same period of time 10 reports have been published addressing the problem and presenting policies and strategies to curb its increasing trend. There has been a cross-sectorial approach to tackle the problem and efforts to improve delivery of services. Results so far

have been meagre, the modest results observed for children hide growing inequalities whereby children living in the most deprived areas are twice as likely to be obese than those living in the least deprived areas. Changes in behaviours linked to specific policy interventions are yet to be seen (44). Evidence from the UK has shown that interventions implemented in school settings alone are unlikely to impact on the childhood obesity problem (45). Instead, wider support across multiple sectors and environments is required.

- With 30% of its children overweight and 12% obese, Portugal introduced a “soda tax” in February 2017 for drinks with 50gr-80gr of sugar per litre and more than 80gr of sugar per litre. Consumption of soft drinks was around 40% in Portuguese adolescents. The tax represented an increase of between 25-30% in the final price. No results are yet available for its impact on obesity trends but there was a reduction in the sales of drinks in the highest group from 63% in 2016 to 38% in 2017. In the group of 50gr-80gr of sugar per litre, an inversed trend was observed: there was an increase in sales from 6% to 28%. Changes in consumption are not only due to the tax but also to changes introduced by the manufacturers in the total content of sugar added to soft drinks (46).
- In Mexico, obesity is a highly prevalent health problem in all regions, groups and genders. In 2005 some programmes were put in place, such as the Mexican national beverage guidelines, the school guidelines for healthy foods, the regulation of food and beverage marketing to children, and so on, and children were seen as an important group to be targeted. A tax on sugar sweetened beverages was introduced in 2014. Nevertheless, tangible results are yet to be seen (47). Evidence from Latin America favours the use of evidence in the development and support of policies to address obesity and change population behaviours (48). However, it is worth noting that the impact of policies is driven by the context where they are implemented and country specific evaluations of measures adopted so far are of paramount importance to inform future decisions.

The cost-effectiveness of policies and programs to improve diets and prevent childhood obesity

- As well as having an understanding of the effectiveness of obesity interventions, it is important to have **an understanding of their cost-effectiveness** (i.e. the “value for money” such interventions provide).
- Economic evaluation of obesity interventions provides important information to inform resource allocation decisions.
- Given that no single intervention is likely to reduce rates of overweight and obesity, and that a suite of measures is likely required, information on the cost-effectiveness of interventions for **prevention AND treatment** across **individual, program AND policy** levels is required. This reflects the need to address the systemic, environmental, behavioural *and* physiological determinants of obesity (49).
- **Limited evidence currently exists on the cost-effectiveness of interventions for obesity** (50, 51).

- A better understanding of the potential costs and benefits of obesity intervention in children and adolescents is required:
 - within the childhood timeframe, taking into account the costs and benefits of obesity intervention during the child and adolescent years; and
 - across the lifetime, taking into account the costs and benefits that accrue over the life course (predominantly from the prevention of chronic diseases for which overweight and obesity are a risk factor, but which do not normally present until later in life). At present, the long-term economic modelling of childhood obesity interventions are relatively limited by the lack of evidence of sustainability of intervention effect across the life course.
- Limited economic evaluations have been undertaken alongside randomised controlled trials, to estimate the more immediate (i.e. occurring within the childhood timeframe) costs and benefits of obesity intervention programs. For instance, Hayes et al. (52) found that the *Healthy Beginnings* trial (a home visiting intervention delivered by specially trained community nurses in the first two years of life) demonstrated a significant reduction in BMI at age 2 years and was cost-effective (with an incremental cost-effectiveness ratio of \$4,320 per BMI unit avoided).
- Two large-scale bodies of work have been undertaken to date to determine the cost-effectiveness of obesity interventions in the Australian population, the Assessing Cost-Effectiveness in Obesity (**ACE-Obesity**) study (53) and the National Health and Medical Research Council (NHMRC) funded **CRE in Obesity Policy and Food Systems**.
 - ACE-Obesity examined the cost-effectiveness of thirteen obesity prevention or treatment interventions in children and adolescents (54). In terms of prevention interventions, **restricting television advertising of foods high in fat, salt and sugar to children** was found to be highly cost-effective (55), followed by a **multi-faceted school-based programme with an active physical education component**. **Laparoscopic adjustable gastric banding** was estimated to be cost-effective as a treatment intervention in severely obese adolescents (56).
 - The CRE in Obesity Policy and Food Systems is due for completion in late 2018, but has already examined the cost-effectiveness of several policy-level obesity prevention interventions to which Australian children and adolescents would be exposed.
 - An intervention **restricting television advertising of foods high in fat, salt and sugar to children** was modelled using the most up-to-date evidence and was found to be “**dominant**” (i.e. **both cost-saving and health-promoting**) (57), with **approximately 1.5 times greater health benefits and healthcare cost-savings for children with low socioeconomic position** as compared to children with high socioeconomic position.
 - A **20% tax on sugar-sweetened beverages (SSBs)** was found to be “**dominant**” (i.e. **both cost-saving and health-promoting**) (58), with the most health benefits and healthcare cost-savings accruing to the most disadvantaged socioeconomic groups in Australia.

- **A package size cap on single-serve SSBs >375 mL** was found to be **“dominant” (i.e. both cost-saving and health-promoting)** (59). The intervention would result in the greatest health benefits and healthcare cost-savings if implemented on a mandatory basis, with effective Government support.
- **A product reformulation intervention to reduce energy content of packaged SSBs** was found to be **“dominant” (i.e. both cost-saving and health-promoting)** (59), and likely to offer excellent “value for money” as an obesity prevention measure in Australia. The intervention would result in the greatest health benefits and healthcare cost-savings if implemented on a mandatory basis, with effective Government support.
- **The ‘Health Star Rating’ (HSR) front of package labelling intervention** was found to be **cost-effective** (60). The intervention would result in the greatest health benefits and healthcare cost-savings if implemented on a mandatory basis, with effective Government support.
- **Limited evidence currently exists on the cost-effectiveness of combinations of interventions** likely required to reduce rates of obesity and chronic disease in the Australian population. Cobiac et al. (61) modelled the potential impact for the Australian population of five policy options to address the growing burden of dietary-related diseases (taxes on saturated fat, salt, sugar and SSBs and a subsidy on fruit and vegetables), noting the potentially large health benefits and healthcare cost-savings of combining food taxes and subsidies. Limited evidence exists on the combinations of other obesity-related interventions (e.g. dietary and/or physical activity) that may prove cost-effective.

Summary and Recommendations

- The existing evidence suggests that childhood obesity causes a considerable economic burden in Australia, which is borne by the children, their families and governments.
- This indicates that investment in effective interventions to prevent childhood obesity are likely to result in substantial short and long-term economic benefits (above and beyond health benefits) in Australia. Investment in intervention needs to be sustained, as the obesity problem is relatively intractable and unresponsive to short scale interventions which fade over time. Investment in intervention also needs to reflect the complex, multi-level nature of the problem of obesity, and address both systemic, environmental and individual drivers of overweight and obesity across the entire life course.
- Given the higher prevalence of obesity among children from lower socioeconomic backgrounds, the impact of obesity on a child's long-term health and human capital development may perpetuate socioeconomic inequalities in Australia. Understanding how obesity interventions affect and assist children from low socioeconomic backgrounds should be an important focus.
- We call for a comprehensive research agenda on obesity in Australia and its economic costs and consequences, reflecting government recognition that obesity prevention is a national priority area.
 - The long-term economic consequences of childhood obesity in Australia have not been quantified. International evidence and studies on the consequences of adult obesity in Australia indicate that the long-term costs of childhood obesity are likely to be considerable. Investment in high quality longitudinal survey data, linked to administrative records and high quality economic research is needed to determine the long-term costs caused by childhood obesity.
 - More research is required into the effectiveness and cost-effectiveness of the complex, multi-level, multi-sectoral obesity interventions needed to reduce the prevalence of obesity. This research needs to be designed in explicit recognition that actions are systemic in nature, and so research needs to adopt a whole systems approach and move from highly controlled studies, appreciating the linear and non-linear relationships between different interventions (62).
 - Childhood obesity is unlike many other childhood health conditions due to the associated weight stigma and discrimination, which can result in a range of short- and long-term economic disadvantages for the child. We need greater research into how we can comprehensively measure the health, social and economic benefits of reducing childhood obesity over a child's life such that they can be captured in economic evaluations of obesity interventions.
- We highlight the importance of long term cross-party political commitment to tackling the issue of obesity in Australia. This is particularly important when considering that the largest share of the benefits of prevention of obesity in childhood and adolescence is unlikely to be experienced for many years (i.e. until children reach middle age, the common age of onset for many chronic diseases for which overweight and obesity are risk factors). Research outcomes, timelines and funding should reflect this long term commitment.

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REFERENCES

1. Australian Bureau of Statistics. 4364.00.55.001 – National Health Survey, 2014-15. Canberra: ABS 2015 [cited 2018 Jun 16]. Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/PrimaryMainFeatures/4364.0.55.001?OpenDocument>.
2. Australian Institute of Health and Welfare. Australia's Health 2016. Canberra: AIHW 2016 [cited 2018 Jun 16]. Australia's health series no. 15. cat. no. AUS 199]. Available from: <https://www.aihw.gov.au/getmedia/9844cefb-7745-4dd8-9ee2-f4d1c3d6a727/19787-AH16.pdf.aspx?inline=true>.
3. Australian Institute of Health and Welfare. Australia's Health 2018. Canberra: AIHW 2018 [cited 2018 Jun 16]. Australia's health series no. 16. AUS 221]. Available from: <https://www.aihw.gov.au/getmedia/4b395076-f554-4818-9150-64ffe2fc3039/aihw-aus-221-chapter-4-10.pdf.aspx>.
4. Australian Institute of Health and Welfare. A picture of overweight and obesity in Australia 2017 [Internet]. Canberra: AIHW 2017 [cited 2018 Jun 16]. cat. no.PHE 216.]. Available from: <https://www.aihw.gov.au/getmedia/172fba28-785e-4a08-ab37-2da3bbae40b8/aihw-phe-216.pdf.aspx?inline=true>.
5. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet*. 2014;384(9945):766-81.
6. Abarca-Gómez L, Abdeen ZA, Hamid ZA, Abu-Rmeileh NM, Acosta-Cazares B, Acuin C, et al. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *The Lancet*. 2017;390(10113):2627-42.
7. Australian Bureau of Statistics. 4727.0.55.001 – Australian Aboriginal and Torres Strait Islander Health Survey: Updated Results, Australia, 2012-13. Canberra: ABS 2014 [cited 2018 Jun 16]. Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4727.0.55.001main+features12012-13>.
8. Abrevaya J, Tang H. Body mass index in families: spousal correlation, endogeneity, and intergenerational transmission. *Empirical Economics*. 2011;41(3):841-64.
9. Whitaker KL, Jarvis MJ, Beeken RJ, Boniface D, Wardle J. Comparing maternal and paternal intergenerational transmission of obesity risk in a large population-based sample. *The American Journal of Clinical Nutrition*. 2010;91(6):1560-7.
10. Coutinho R, David RJ, Collins Jr JW. Relation of parental birth weights to infant birth weight among African Americans and whites in Illinois: a transgenerational study. *American Journal of Epidemiology*. 1997;146(10):804-9.
11. Emanuel I, Filakti H, Alberman E, Evans SJ. Intergenerational studies of human birthweight from the 1958 birth cohort. 1. Evidence for a multigenerational effect. *BJOG: An International Journal of Obstetrics & Gynaecology*. 1992;99(1):67-74.
12. Jääskeläinen A, Pussinen J, Nuutinen O, Schwab U, Pirkola J, Kolehmainen M, et al. Intergenerational transmission of overweight among Finnish adolescents and their parents: a 16-year follow-up study. *International Journal of Obesity*. 2011;35(10):1289.
13. Murrin CM, Kelly GE, Tremblay RE, Kelleher CC. Body mass index and height over three generations: evidence from the Lifeways cross-generational cohort study. *BMC Public Health*. 2012;12(1):81.
14. Anderson PM, Butcher KF, Levine PB. Maternal employment and overweight children. *Journal of Health Economics*. 2003;22(3):477-504.
15. Classen TJ. Measures of the intergenerational transmission of body mass index between mothers and their children in the United States, 1981–2004. *Economics & Human Biology*. 2010;8(1):30-43.
16. Classen T, Hokayem C. Childhood influences on youth obesity. *Economics & Human Biology*. 2005;3(2):165-87.

17. Coate D. The Relationship Between Diet, Parent's Fatness, and Obesity in Children and Adolescents. National Bureau of Economic Research Cambridge, Mass., USA; 1983.
18. Costa-Font J, Gil J. Intergenerational and socioeconomic gradients of child obesity. *Social Science & Medicine*. 2013;93:29-37.
19. Hayes A, Lung T, Bauman A, Howard K. Modelling obesity trends in Australia: unravelling the past and predicting the future. *International Journal of Obesity*. 2017;41(1):178.
20. Black N, Hughes R, Jones AM. The health care costs of childhood obesity in Australia: an instrumental variables approach. revision under peer-review at *Economics & Human Biology*. 2018.
21. Au N. The health care cost implications of overweight and obesity during childhood. *Health Services Research*. 2012;47(2):655-76.
22. Clifford SA, Gold L, Mensah FK, Jansen PW, Lucas N, Nicholson JM, et al. Health-care costs of underweight, overweight and obesity: Australian population-based study. *Journal of Paediatrics and Child Health*. 2015;51(12):1199-206.
23. Hayes A, Chevalier A, D'Souza M, Baur L, Wen LM, Simpson J. Early childhood obesity: Association with healthcare expenditure in Australia. *Obesity*. 2016;24(8):1752-8.
24. Brown V, Moodie M, Baur L, Wen LM, Hayes A. The high cost of obesity in Australian pre-schoolers. *Australian and New Zealand Journal of Public Health*. 2017;41(3):323-4.
25. Heckman James J, Stixrud J, Urzua S. The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior. *Journal of Labor Economics*. 2006;24(3):411-82.
26. Black N, Johnston DW, Peeters A. Childhood Obesity and Cognitive Achievement. *Health Economics*. 2015;24(9):1082-100.
27. Black N, Kassenboehmer SC. Getting Weighed Down: The Effect of Childhood Obesity on the Development of Socioemotional Skills. *Journal of Human Capital*. 2017;11(2):263-95.
28. Sabia JJ, Rees DI. Body weight, mental health capital, and academic achievement. *Review of Economics of the Household*. 2015:1-32.
29. Sabia JJ. The effect of body weight on adolescent academic performance. *Southern Economic Journal*. 2007:871-900.
30. Averett SL, Stifel DC. Race and gender differences in the cognitive effects of childhood overweight. *Applied Economics Letters*. 2010;17(17):1673-9.
31. von Hinke Kessler Scholder S, Smith GD, Lawlor DA, Propper C, Windmeijer F. The effect of fat mass on educational attainment: Examining the sensitivity to different identification strategies. *Economics & Human Biology*. 2012;10(4):405-18.
32. Brown V, Tan E, Hayes A, Petrou S, Moodie M. Utility values for childhood obesity interventions: a systematic review and meta-analysis of the evidence for use in economic evaluation. *Obesity Reviews*. 2018.
33. Eminson K, Canaway A, Adab P, Lancashire E, Pallan M, Frew E. How does age affect the relationship between weight and health utility during the middle years of childhood? *Quality of Life Research*. 2018;27(6):1455-62.
34. Canaway A, Frew E. Is utility-based quality of life in children aged 6–7 years affected by Body Mass Index (BMI)? *International Journal of Obesity*. 2014;38(8):1146.
35. Black N, Kung CS, Peeters A. For richer, for poorer: the relationship between adolescent obesity and future household economic prosperity. *Preventive Medicine*. 2018;111:142-50.
36. Averett S, Korenman S. The economic reality of the beauty myth. *Journal of Human Resources*. 1996;31(2):304-30.
37. Cawley J, Meyerhoefer C. The medical care costs of obesity: an instrumental variables approach. *Journal of Health Economics*. 2012;31(1):219-30.
38. Colagiuri S, Lee CM, Colagiuri R, Magliano D, Shaw JE, Zimmet PZ, et al. The cost of overweight and obesity in Australia. *Med J Aust*. 2010;192(5):260-4.
39. Buchmueller TC, Johar M. Obesity and health expenditures: evidence from Australia. *Economics & Human Biology*. 2015;17:42-58.

40. Devaux M, Sassi F. The Labour Market Impacts of Obesity, Smoking, Alcohol Use and Related Chronic Diseases. 2015.
41. Sonntag D, Ali S, Lehnert T, Konnopka A, Riedel-Heller S, König HH. Estimating the lifetime cost of childhood obesity in Germany: Results of a Markov Model. *Pediatric Obesity*. 2015;10(6):416-22.
42. Sonntag D, Ali S, De Bock F. Lifetime indirect cost of childhood overweight and obesity: A decision analytic model. *Obesity*. 2016;24(1):200-6.
43. World Health Organisation. Report of the Commission on Ending Childhood Obesity. Geneva: WHO; 2017.
44. Jebb SA, Aveyard P, Hawkes C. The evolution of policy and actions to tackle obesity in England. *Obesity Reviews*. 2013;14:42-59.
45. Adab P, Pallan MJ, Lancashire ER, Hemming K, Frew E, Barrett T, et al. Effectiveness of a childhood obesity prevention programme delivered through schools, targeting 6 and 7 year olds: cluster randomised controlled trial (WAVES study). *BMJ*. 2018;360.
46. Goiana-da-Silva F, Nunes AM, Miraldo M, Bento A, Breda J, Araújo FF. Using Pricing Policies to Promote Public Health: The Sugar Sweetened Beverages Taxation Experience in Portugal. *Acta Medica Portuguesa*. 2018;31(4):191-5.
47. Barquera S, Campos I, Rivera JA. Mexico attempts to tackle obesity: the process, results, push backs and future challenges. *Obesity Reviews*. 2013;14:69-78.
48. Pérez-Escamilla R, Lutter C, Rabadan-Diehl C, Rubinstein A, Calvillo A, Corvalán C, et al. Prevention of childhood obesity and food policies in Latin America: from research to practice. *Obesity Reviews*. 2017;18:28-38.
49. Swinburn BA, Sacks G, Hall KD, McPherson K, Finegood DT, Moodie ML, et al. The global obesity pandemic: shaped by global drivers and local environments. *The Lancet*. 2011;378(9793):804-14.
50. Döring N, Mayer S, Rasmussen F, Sonntag D. Economic evaluation of obesity prevention in early childhood: methods, limitations and recommendations. *International Journal of Environmental Research and Public Health*. 2016;13(9):911.
51. Lehnert T, Sonntag D, Konnopka A, Riedel-Heller S, König HH. The long-term cost-effectiveness of obesity prevention interventions: systematic literature review. *Obesity Reviews*. 2012;13(6):537-53.
52. Hayes A, Lung T, Wen LM, Baur L, Rissel C, Howard K. Economic evaluation of “healthy beginnings” an early childhood intervention to prevent obesity. *Obesity*. 2014;22(7):1709-15.
53. Carter R, Moodie M, Markwick A, Magnus A, Vos T, Swinburn B, et al. Assessing Cost-Effectiveness in Obesity (ACE-Obesity): an overview of the ACE approach, economic methods and cost results. *BMC Public Health*. 2009;9(1):419.
54. Haby M, Vos T, Carter R, Moodie M, Markwick A, Magnus A, et al. A new approach to assessing the health benefit from obesity interventions in children and adolescents: the assessing cost-effectiveness in obesity project. *International Journal of Obesity*. 2006;30(10):1463.
55. Magnus A, Haby M, Carter R, Swinburn B. The cost-effectiveness of removing television advertising of high-fat and/or high-sugar food and beverages to Australian children. *International Journal of Obesity*. 2009;33(10):1094.
56. Ananthapavan J, Moodie M, Haby M, Carter R. Assessing cost-effectiveness in obesity: laparoscopic adjustable gastric banding for severely obese adolescents. *Surgery for Obesity and Related Diseases*. 2010;6(4):377-85.
57. Brown V, Ananthapavan J, Veerman L, Sacks G, Lal A, Peeters A, et al. The Potential Cost-Effectiveness and Equity Impacts of Restricting Television Advertising of Unhealthy Food and Beverages to Australian Children. *Nutrients*. 2018;10(5):622.
58. Lal A, Mantilla-Herrera AM, Veerman L, Backholer K, Sacks G, Moodie M, et al. Modelled health benefits of a sugar-sweetened beverage tax across different socioeconomic groups in Australia: A cost-effectiveness and equity analysis. *PLoS Medicine*. 2017;14(6):e1002326.

59. Crino M, Herrera AMM, Ananthapavan J, Wu JH, Neal B, Lee YY, et al. Modelled Cost-Effectiveness of a Package Size Cap and a Kilojoule Reduction Intervention to Reduce Energy Intake from Sugar-Sweetened Beverages in Australia. *Nutrients*. 2017;9(9):983.
60. Mantilla Herrera AM, Crino M, Erskine HE, Sacks G, Ananthapavan J, Mhurchu CN, et al. Cost-Effectiveness of Product Reformulation in Response to the Health Star Rating Food Labelling System in Australia. *Nutrients*. 2018;10(5):614.
61. Cobiac LJ, Tam K, Veerman L, Blakely T. Taxes and subsidies for improving diet and population health in Australia: a cost-effectiveness modelling study. *PLoS Medicine*. 2017;14(2):e1002232.
62. Frew E, Ng SW, Coast J, Hollingsworth B, Smith R. How Can Economics Help Tackle Obesity? *Obesity*. 2018;26(7):1112-3.