Cost-effectiveness of Childhood Obesity Interventions: CHOICES

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CHOICES First Results

Five papers published in the July 2015 issue of the *American Journal of Preventive Medicine*

- Long et al. Cost effectiveness of a sugar-sweetened beverage excise tax in the U.S.
- Sonneville et al. BMI and healthcare cost impact of eliminating tax subsidy for advertising unhealthy food to youth.
- Wright et al. Modeling the cost effectiveness of child care policy changes in the U.S.
- Barrett et al. Cost effectiveness of an elementary school active physical education policy.
<table>
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<th>CHOICES Authors</th>
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<tr>
<td>- Steven Gortmaker</td>
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<td>- Angie Cradock</td>
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Session Agenda

- CHOICES Project Goals
- CHOICES Process
- Cost-effectiveness
- Results
- Implementation and Equity Considerations
- Research and Policy Implications
CHOICES Project Goals

- Reversing childhood obesity epidemic will require sustained effort from all levels of government and civil society

- Decades of research on intervention effectiveness, extremely limited research on cost-effectiveness

- To identify best value to society, decision-makers need to integrate best evidence on:
  - Effectiveness
  - Population Reach
  - Cost
CHOICES Project Goals

Childhood Obesity Intervention Cost-Effectiveness Study (CHOICES)

- Generate cost-effectiveness estimates for 40 of the most relevant childhood obesity interventions in the United States
- Engage policymakers and the general public to focus action on most cost-effective strategies
CHOICES Process

1. Selection and recruitment of stakeholder group
2. Selection of interventions
3. Specification of intervention, implementation scenarios and costs
4. Intervention effects
5. Modeling short-term and 10-year cost-effectiveness
6. Performing uncertainty and sensitivity analyses
7. Implementation and Equity Considerations
1. CHOICES Stakeholder Group

- Recruited stakeholders to represent:
  - U.S. policymakers
  - Policy researchers
  - Programmatic experts

- Stakeholders provided:
  - Advice concerning specification of interventions
  - Identification of data sources
  - Technical analyses
  - Identification of implementation and equity considerations
2. Selection of Interventions

- Currently evaluating over 40 interventions

- Initial 4 interventions selected to represent broad range of nationally-scalable strategies using mix of policy and programs

1. Excise tax of $0.01 per ounce of sugar-sweetened beverages (SSB)
2. Elimination of tax deductibility of TV advertising of nutritionally-poor foods to children (TV AD)
3. State policy requiring 50% of existing PE time to be moderate to vigorous physical activity (Active PE)
4. State policy to make early childcare settings healthier targeting physical activity time, improving nutrition and reducing screen time (ECE)
3. Specification of Interventions and Costs

- Hypothetical national implementation modeled using logic pathways from implementation and dissemination to outcomes:

- Costs estimated using published guidelines and adapting economic protocol from the Assessing Cost-Effectiveness (ACE) study

- Ten-year costs based on length of exposure for the closed cohort
  - TV AD and SSB assumed to be implemented for 10 years
  - ECE implemented for children 3-5, with maximum of 3 years
4. Intervention Effects

- Intervention effects on BMI estimated using an evidence review process evaluating study quality in agreement with Cochrane and GRADE approach

- Evidence reviews conducted based on logic models linking interventions to behavioral changes and shifts in energy balance

- All four interventions had direct evidence linking behavior change to BMI
Active PE Intervention Effect:

- Active PE increase of 6.24% of class time in MVPA from published meta-analysis of school PE MVPA interventions (Lonsdale et al. *Prev Med* 2013)

- Increase in minutes of MVPA/day to BMI from two studies, including RCT (Kriemler et al. *BMJ* 2010; Mitchell et al. *Obesity* 2013)
  - Each additional 1 minute of MVPA/day leads to 0.023 BMI unit reduction
  - Effect similar to 0.018 calculated using energy balance model from Hall et al.
5. Modeling Cost-effectiveness

- Markov closed-cohort simulation model of the 2015 U.S. population ≥ 2 years of age developed in excel and replicated in JAVA programming language

- Model simulated health and healthcare cost experience of the cohort over 10 years (2015-2025)

- **Short-term Outcomes:** Effects of interventions on BMI compared to natural history

- **Long-term Outcomes:** BMI-mediated reductions in incidence of 9 diseases:
  - stroke, ischemic heart disease, hypertensive heart disease, diabetes mellitus, osteoarthritis, post-menopausal breast cancer, colon cancer, endometrial cancer, and kidney cancer
5. Modeling Cost-effectiveness

- Reductions in annual healthcare costs due to reductions in obesity were estimated based on published analyses of data from the Medical Expenditure Panel Survey (Finkelstein and Trogdon. AJPH 2008)

- For youth (8-19), obesity is associated with an excess $236 (2014 dollars) in annual healthcare expenditures

- Excess healthcare costs due to obesity increase with age
  - The lifetime excess healthcare costs associated with obesity from 18-75 are estimated to be $68,500 (2014 dollars)
5. Modeling Cost-effectiveness

- Model estimated difference in life-expectancy and disability-adjusted life expectancy of cohort under no intervention and intervention scenarios.

- Quality-adjusted Life Years (QALYs) gained estimated based on shift in overweight and obesity prevalence using published estimate of relationship between BMI and HRQoL by age and sex (Muennig AJPH 2006)
  - We did not estimate changes in HRQoL for children and adolescents.

- Assumed full effect on BMI after 1 year with maintenance of effect for the duration of the 10 year period.

- All results in 2014 U.S. dollars with future outcomes discounted at 3% annually.
5. Modeling Cost-effectiveness

- The primary outcome of cost-effectiveness analysis is the incremental cost-effectiveness ratio (ICER)

\[ \frac{\text{Net increase in cost}}{\text{Net gain in health effect}} \]

- All ICERs are comparative
5. Modeling Cost-effectiveness

<table>
<thead>
<tr>
<th>Difference in Cost</th>
<th>Difference in Effectiveness</th>
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<tbody>
<tr>
<td>Higher costs</td>
<td>Higher costs</td>
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<tr>
<td>Worse outcome</td>
<td>Better outcome</td>
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<tr>
<td>Lower costs</td>
<td>Lower costs</td>
</tr>
<tr>
<td>Worse outcome</td>
<td>Better outcome</td>
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6. Uncertainty and Sensitivity Analyses

- Probabilistic sensitivity analyses were used by sampling all parameter values from predetermined distributions based on evidence on reach, effectiveness and cost. Scenario analyses used to test different logic pathways and extreme assumptions.

- Sampled 10,000 iterations of the model to estimate effects on BMI and cost.

- Simulated 1,000,000 iterations of the model to capture uncertainty around BMI effect on disease incidence, healthcare costs, mortality, DALYs and QALYs.
7. Implementation and Equity Considerations

- Quantitative cost-effectiveness analyses do not capture all important considerations for choosing obesity prevention interventions.

- With stakeholder consultation, evaluated the following qualitative considerations for each intervention:
  - Quality of evidence
  - Equity
  - Acceptability
  - Feasibility
  - Sustainability
  - Side effects
  - Social and policy norms
### Results

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Population Reach (millions)</th>
<th>First year intervention cost $U.S. millions (UI)</th>
<th>Per Person BMI unit reduction (UI)</th>
<th>Cost per unit BMI reduction $U.S. (UI)</th>
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</thead>
<tbody>
<tr>
<td>Sugar-sweetened beverage (SSB) tax all ages</td>
<td>313</td>
<td>$51 ($36, $66)</td>
<td>0.08 (0.03, 0.20) (adult)</td>
<td>$3.16 ($1.24, $8.14)</td>
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<td>SSB Tax ages 2-19 years only</td>
<td>74</td>
<td>$51 ($36, $66)</td>
<td>0.16 (0.06, 0.37) (ages 2-19 years)</td>
<td>$8.54 ($3.33, $24.2)</td>
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<tr>
<td>Reduce tax subsidy of TV advertising</td>
<td>74</td>
<td>$1.1 ($0.69; $1.42)</td>
<td>0.028 (0.011, 0.046)</td>
<td>$1.16 ($0.51, $2.63)</td>
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<td>Early care and education policy changes</td>
<td>3.7</td>
<td>$4.8 (-$6.0; $12.6)</td>
<td>0.02 (0.01, 0.04)</td>
<td>$57.80 (a, $138)</td>
</tr>
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<td>Active PE policy</td>
<td>17.6</td>
<td>$71 ($51; $96)</td>
<td>0.02 (0.003, 0.05)</td>
<td>$401 ($148, $3,100)</td>
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*aNegative ICERs are not reported because they cannot be interpreted.*
### Results

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Healthcare costs U.S. $ millions (UI)</th>
<th>Net costs U.S. $ millions (UI)</th>
<th>QALYs gained (UI)</th>
<th>Net cost saved per $ spent (UI)</th>
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</thead>
<tbody>
<tr>
<td>Sugar-sweetened beverage (SSB) tax all ages</td>
<td>-$23,600 (-$54,900, -$9,330)</td>
<td>-$23,200 (-$54,500, -$8,800)</td>
<td>871,000 (342,000; 2,030,000)</td>
<td>$55 ($21, $140)</td>
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<tr>
<td>Reduce tax subsidy of TV advertising</td>
<td>-$352 (-$581, -$138)</td>
<td>-$343 (-$572, -$129)</td>
<td>4,540 (1,750, 7,500)</td>
<td>$38 ($14, $74)</td>
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<tr>
<td>Early care and education policy changes</td>
<td>-$52 (-$134, -$14)</td>
<td>-$43.2 (-$133, $4.24)</td>
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<td>$6 (-$52, $66)</td>
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<tr>
<td>Active PE policy</td>
<td>-$61 (-$153, -$8)</td>
<td>$175 ($63, $277)</td>
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Limitations

- None of the modeled interventions has been scaled nationally in the U.S.
- Although all of the interventions have strong evidence linking behavior change to BMI, modeled effects require assumptions using logic pathways.
- Modeled health benefits through BMI change underestimate total health benefit of each intervention:
  - Effect of SSB intake on diabetes and CVD risk independent of BMI not modeled
  - Non-BMI health effects of increased physical activity not modeled
Equity Considerations

- **SSB Tax**: regressive, but health benefits may accrue more to lower-income population

- **TV AD**: potential to reduce inequality; minority children watch more TV

- **ECE**: potential to reduce disparities in childcare centers, but may increase disparities in family-based care if implementation varies by income

- **Active PE**: potential for negative effect as only impacts schools with PE can implement
Implications

Wide Variation Among Modeled Interventions

- Impact, reach, cost and cost-effectiveness varies widely across 4 modeled interventions

- SSB Tax would reach entire population and have largest per capita effect on BMI

- Removing tax subsidy for TV advertising of nutritionally-poor foods would reach all children, but have smaller effects than SSB Tax

- Setting-specific interventions have smaller reach and higher cost, but potentially lower political barriers
Implications

What is a good value for BMI Unit Reduction?

- Short-term cost per BMI unit reduced varied widely, ranging from $1.16 to $401

- There is no established willingness-to-pay threshold for BMI reductions
  - Clinical interventions that are currently covered by insurers cost $1,000-$2,000 per BMI unit reduction

- Three of the interventions would be cost-saving to society, suggesting that they should be pursued based on quantitative analysis
Conclusion

- All four evaluated interventions show good cost-effectiveness for reducing BMI

- SSB tax would lead to substantial near-term reductions in disease and healthcare costs due to obesity

- **Key Questions:**
  - How can cost-effectiveness models inform policymaking at the federal, state, and local levels?
  - How do we change the policy conversation from identifying what works to what offers the best value to society?
Thank you

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