Combining Systematic Reviews with Modeling to Inform Public Health Decision-Making

Case Study of the Childhood Obesity Intervention Cost-Effectiveness Study

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Study funded by JPB Foundation
Childhood Obesity Intervention Cost-Effectiveness Study (CHOICES)

• Case study of the adaptation, integration, and application of evidence synthesis methods for public health decision making.

• In a common framework, evaluating about 40 population-level childhood obesity prevention strategies
  • Conducting systematic reviews of intervention effectiveness
  • Evidence review tightly coupled to decision modeling
  • Explicit attention to generalizability

• Modeling scenarios will estimate population-level health impact (e.g. number of obese children, lives saved, DALYs) and cost-effectiveness of each strategy at a national scale, for a common time horizon, and under a consistent set of alternative assumptions regarding key unknown factors.

• Goal is to provide information to policymakers seeking solutions to the country’s childhood obesity problem
• Systematic review (SR) is limited to intervention effectiveness on behavior, bodyweight, or Body mass index (BMI) and behavior effect on bodyweight or BMI
Limits of traditional systematic reviews

- Often inclusion criteria for systematic reviews are narrowly drawn, with an emphasis on maximizing internal validity.

- It is also not uncommon for these systematic reviews to conclude that the ‘evidence is insufficient’ for making recommendations

- **Upshot:** the output of SR is sometimes of limited value to decision makers (esp. in domain of public health) and may be ignoring some useful information.

- **Example:** Initiatives to systematically gather and evaluate evidence regarding community preventive services have stopped with recommendations flowing directly from systematic reviews (e.g. CDC Guide to Community Preventive Services, and AHRQ’s recent comparative effectiveness review of childhood obesity interventions)
Principles guiding CHOICES methodology development

• We don’t want to throw away useful information about the intervention’s effectiveness
• We don’t want to conclude “not enough evidence available”
• We want to be smart about adapting evidence to the national scale
• We want to be consistent about all assumptions in the model that are not intervention-specific
CHOICES methodology features

• Evidence typology values generalizability as well as internal validity
• Broad inclusion criteria
• Use of **logic models** to map “evidence pathways”
• attention to **external validity** of studies and the contextual factors relevant to the implementation or adoption of particular strategies so that these can be incorporated into modeling scenarios

• Remaining challenge: **How to synthesize evidence along multiple pathways?**
| Level 1: | Meta-analyses or Systematic Reviews of experimental and/or quasi-experimental studies with a pretest-posttest and control or comparison group. |
| Level 2: | A Single Experimental or Quasi-Experimental Study with a pretest-posttest and control or comparison group. |
| Level 3: | Meta-analyses or Systematic Reviews of Observational Studies (with no intervention or manipulation) that analyze change in the exposure predicting change in the outcome (“change in change”). |
| Level 4: | A Single Observational Study (no intervention or manipulation) that analyzes change in the exposure predicting change in the outcome (“change in change”). |
| Level 5: | Meta-Analyses or Systematic Reviews with less “robust” designs (including cross-sectional) using direct evidence and found in the peer-reviewed literature. |
| Level 6: | Single studies with a less “robust” design (including cross-sectional) or pilot studies with no control group results, found published in the peer-reviewed literature. |
| Level 7: | Lowest level of evidence, including indirect evidence that is not peer-reviewed (i.e. Effectiveness Analyses, Indirect (or assumed) evidence, Parallel Evidence, Theory and Program Logic, Informed Opinion, Gray Literature) |
External validity assessment

• Ultimately, the model is used to *transfer observed effect* from study populations to a national scale for the United States.

• The CHOICES systematic review process extracts information from studies regarding the generalizability of their findings.

• Although not purely quantitative, the attention to features of the study population and features of interventions’ implementation (such as resource intensity and uniqueness of study sites) is systematic.

• Assessment of factors affecting generalizability is standardized and designed to ensure consistency across the interventions that will be compared with modeling.

• Uncertainty about the generalizability of findings regarding interventions’ potential population-level reach or individual-level effect are can then at least be addressed in sensitivity analysis
Logic model

- General Logic Model showing evidence pathways
- Red = intervention-specific
- Blue = common approach
Example: Sugar Sweetened Beverage Excise Tax Policy

- Direct evidence **pathway 1**: SSB consumption change on body-mass index (BMI) (1 serving/day over 4 years = 1 pound)

- Indirect evidence **pathway 2+4+5**: SSB change → changes energy intake → energy intake changes BMI (1 serving/day over 4 years = 14 pounds)
Summary points

• Methodology driven by a decision-analytic perspective that is obligated to suggest the best course of action given current information.

• Underlying assumption: more information is better

• Augmenting traditional systematic review (and meta-analysis) with modeling enables information from a wider range of studies to be combined along evidence pathways and translated to salient health outcomes such as BMI change, change in obesity prevalence, disease incidence reduction, survival gains, DALYs, and cost-effectiveness.

• Not only does modeling provide a solution for linking evidence from groups of studies focused on different parts of a long causal chain, it also allows for speculative assumptions based on theory or expert opinion where stronger evidence is lacking or ‘threshold detection’ (i.e. how good would intervention have to be?).
Key remaining challenge: integrating evidence pathways

- Often modelers that do systematic review of literature, then just take information from the “strongest” individual study for their base case.

- In CHOICES, we have not found a quantitative way to combine evidence along two or more different pathways to BMI change. Instead, the pathway with the “strongest” evidence is selected as a base case, and other evidence pathways are considered in alternative scenarios. When the choice of evidence pathway leads to different conclusions, there is no clear way to determine how much ‘weight’ to put on each result.

- Moreover, even when considering each pathway individually, the identification of the best pathway to serve as the base case is not always straightforward since the choice is based both on the design of studies along each pathway (evidence typology level) and the directness of the pathway.

- A large number of studies with strong design and fewer ‘steps’ between the intervention and BMI change is preferable. In some cases, studies with better designs may lie along less direct pathways. The relative importance of design and directness is difficult to quantify, making the evaluation of evidence tricky.
5 Level I studies along pathway E, 4 Level II studies along pathway D1, 1 Level I study along pathway A.