Systems Approaches to Obesity Prevention: What does this actually mean?

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Global Obesity Centre
Deakin University

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Outline

• Pre-systems thinking approaches to obesity prevention
  – G1 Package Testing, G2 Capacity Building
  – Signs of systems change

• Systems thinking and tools

• First at-scale application (G3) – Healthy Together Victoria
  – Promise, progress, demise, lessons, parallel & subsequent approaches

• New Zealand context
  – Healthy Families NZ
  – Regional efforts
  – Indigenous approaches
  – Research programs

• Future directions
Most short term
Some successful, some not
Overall reduces BMI
Very few sustained

Waters et al Cochrane Library 2011
## Cochrane 2011 meta-analysis

### Pre-school children

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Mean</th>
<th>SD</th>
<th>Total</th>
<th>Control Mean</th>
<th>SD</th>
<th>Total</th>
<th>Weight</th>
<th>Std. Mean Difference IV, Random, 95% CI</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>L.1.1 0-5 years</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Mo-Suwan 1998 (1)</td>
<td>-0.35</td>
<td>1.23</td>
<td>82</td>
<td>-0.44</td>
<td>1.06</td>
<td>88</td>
<td>2.1%</td>
<td>-0.10 [-0.21, 0.00]</td>
<td>1998</td>
</tr>
<tr>
<td>Mo-Suwan 1998 (2)</td>
<td>0.07</td>
<td>0.05</td>
<td>65</td>
<td>-0.33</td>
<td>0.59</td>
<td>57</td>
<td>1.7%</td>
<td>-0.30 [-0.66, 0.06]</td>
<td>1998</td>
</tr>
<tr>
<td>Harvey-Karlo 2003 (3)</td>
<td>0.27</td>
<td>0.52</td>
<td>17</td>
<td>0.51</td>
<td>0.7</td>
<td>20</td>
<td>9.7%</td>
<td>-0.91 [-1.59, -0.23]</td>
<td>2005</td>
</tr>
<tr>
<td>Dennison 2004</td>
<td>0.26</td>
<td>1.64</td>
<td>43</td>
<td>0.12</td>
<td>1.75</td>
<td>34</td>
<td>1.3%</td>
<td>-0.21 [-0.66, 0.24]</td>
<td>2004</td>
</tr>
<tr>
<td>Fergithon 2005</td>
<td>0.05</td>
<td>0.87</td>
<td>174</td>
<td>0.14</td>
<td>0.68</td>
<td>185</td>
<td>2.7%</td>
<td>-0.15 [-0.54, 0.24]</td>
<td>2005</td>
</tr>
<tr>
<td>Kooij 2006</td>
<td>0.09</td>
<td>0.92</td>
<td>432</td>
<td>-0.02</td>
<td>0.90</td>
<td>434</td>
<td>0.8%</td>
<td>-0.21 [-0.65, 0.23]</td>
<td>2000</td>
</tr>
<tr>
<td>Fitzgibbon 2006</td>
<td>0.11</td>
<td>1.54</td>
<td>198</td>
<td>0.13</td>
<td>1.5</td>
<td>187</td>
<td>2.7%</td>
<td>-0.01 [-0.21, 0.19]</td>
<td>2006</td>
</tr>
<tr>
<td>Cellier 2009 (4)</td>
<td>-0.15</td>
<td>0.23</td>
<td>49</td>
<td>0.11</td>
<td>0.23</td>
<td>134</td>
<td>1.8%</td>
<td>-1.13 [-1.47, -0.78]</td>
<td>2009</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>862</td>
<td>953</td>
<td>15.9%</td>
<td>-0.26 [-0.53, 0.00]</td>
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</tbody>
</table>

**Heterogeneity:** $\tau^2 = 0.11$; $\chi^2 = 42.80$, df $= 7$ ($p < 0.000001$); $I^2 = 89$

*Test for overall effect: $Z = 1.24$ ($p = 0.22$)*

### Adolescents

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Mean</th>
<th>SD</th>
<th>Total</th>
<th>Control Mean</th>
<th>SD</th>
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<th>Weight</th>
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<tbody>
<tr>
<td>L.1.3 13-18 years</td>
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<td></td>
</tr>
<tr>
<td>Neumark-Stzainer 2003 (23)</td>
<td>-0.96</td>
<td>3.22</td>
<td>84</td>
<td>0.75</td>
<td>2.59</td>
<td>106</td>
<td>2.1%</td>
<td>-0.39 [-0.88, -0.00]</td>
<td>2003</td>
</tr>
<tr>
<td>Williamson 2006</td>
<td>0.73</td>
<td>2.8</td>
<td>18</td>
<td>1.2</td>
<td>3.05</td>
<td>22</td>
<td>0.9%</td>
<td>-0.16 [-0.78, 0.47]</td>
<td>2006</td>
</tr>
<tr>
<td>Singh 2009 (24)</td>
<td>0.5</td>
<td>1.57</td>
<td>312</td>
<td>0.5</td>
<td>1.55</td>
<td>308</td>
<td>2.9%</td>
<td>0.00 [-0.18, 0.18]</td>
<td>2009</td>
</tr>
<tr>
<td>Pedra 2009 (23)</td>
<td>0.3</td>
<td>1.56</td>
<td>19</td>
<td>0.0</td>
<td>1.63</td>
<td>16</td>
<td>0.7%</td>
<td>-0.16 [-0.53, 0.24]</td>
<td>2009</td>
</tr>
<tr>
<td>Singh 2009 (24)</td>
<td>0.4</td>
<td>1.22</td>
<td>275</td>
<td>0.4</td>
<td>1.33</td>
<td>214</td>
<td>2.8%</td>
<td>0.00 [-0.27, 0.27]</td>
<td>2009</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>706</td>
<td>586</td>
<td>9.4%</td>
<td>-0.17 [-0.41, 0.08]</td>
<td></td>
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</tr>
</tbody>
</table>

**Heterogeneity:** $\tau^2 = 0.01$; $\chi^2 = 13.55$, df $= 4$ ($p = 0.010$); $I^2 = 70$

*Test for overall effect: $Z = 1.33$ ($p = 0.18$)*

Waters et al Cochrane Library 2011
<table>
<thead>
<tr>
<th>Location</th>
<th>Age Range</th>
<th>Years</th>
<th>Effect</th>
<th>Factors</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geelong</td>
<td>&lt;5s</td>
<td>2004-’08</td>
<td>↓ 1.8% (2y/o) &amp; 2.7% (3.5y/o) over 3 y</td>
<td>$100k for 12,000 children, Δ behaviours and environments, Δ state prevalence</td>
<td>(de Silva-Sanigorski Am J Clin Nutr 2010)</td>
</tr>
<tr>
<td>Colac</td>
<td>4-12y</td>
<td>2002-’06</td>
<td>↓ ~1kg, 3cm waist over 3 y</td>
<td>Greater effect in lower SES children, No Δ ‘safety measures’</td>
<td>(Sanigorski et al Int J Obesity 2008)</td>
</tr>
<tr>
<td>(E Geelong)</td>
<td>13-18y</td>
<td>2004-’08</td>
<td>↓ 5.8% prevalence over 3 y</td>
<td>Δ community capacity, Δ in school environments, No Δ behaviours</td>
<td>(Millar et al Obes Rev 2011)</td>
</tr>
</tbody>
</table>
Pacific OPIC study outcomes

% overweight/obese

Baseline
Follow-up

Australia
Fiji - Indigenous
Fiji - Indian
New Zealand
Tonga

*
Investment during & after a 3y intervention program in Colac (vs comparison region)

Swinburn et al Ped Obesity 2014
Changes in overweight & obesity prevalence

Swinburn et al Ped Obesity 2014
Other Australian community-based interventions

• ‘Scale-up’ to 5 communities
  – Bogged down in individual contracting procedures by Vic govt
  – Little scope for local ownership and innovation
  – Shorter time-scale and not effective in reducing obesity

• Metropolitan, multi-cultural intervention
  – Added complexities
  – Relatively ineffective in reducing obesity
Pre-systems thinking approaches

- Interventions were systems building blocks
- Organisational argy-bargy: an important sign of systems change
- Quasi-experimental designs & standard epi tools were used
- Low cost interventions eg policies, training
- ‘Obesity prevention virus’ spreading along networks
- Limitations
  - Not sufficiently effective in non-white communities (indigenous & migrant)
  - Not culturally-centred
  - Govt-managed ‘scale-up’ inadequate
- Systems: at-scale, aligned with cultural perspectives, sustainable
What does a systems approach mean?

- Considering the whole as well as the parts
- Connections, networks, interdependence
- Rules and boundaries
- Dynamics:
  - Feedback loops, delays, non-linear effects, tipping points
- Complexity, adaptability, self-organising
- Patterns and emergence
Agent-based Modeling
“bottom up”
Actors & rules

System Dynamics
“top down”
Stocks & flows

Network Analysis
Nodes &
ties among them
Adding the dynamics

Table 1. The Ecological Model

Ecological model

Causal loop diagram
"And that's why we need a computer."
What does it mean for evaluation?

• **Intervention characteristics:**
  – Complex, at-scale, adaptable, evolutionary
  – Designed and implemented locally
  – Heterogeneous in type and dose

• **Evaluation design**
  – Null hypothesis testing may not be possible
  – Explaining heterogeneity may be better
  – Answering ‘how’ questions
  – Monitoring vs surveys

• **Use of system tools**
Healthy Together Victoria

Comprehensive health promotion initiative targeting 14 local government areas

Including:
- 938 early childhood centres
- 520 schools
- 4,409 workplaces and
- over 1.3 million Victorians
- 150 new positions in LGAs

A systems approach to chronic disease prevention
Healthy Together Victoria

- Investment in a systems-based approach through local government
- Injection of capacity into 12 sites (~120 FTE)
- 2 years planning, 3 years intervention, change in govt, prevention defunded
- ‘Prevention virus’ spreading after 3 years
- Non-HTV sites stimulated by HTV activity started their own action
- Little engagement with primary care
- Weak evaluation
- Communities now getting activated
SYSTEMS SCIENCE: APPROACHES AND TOOLS
Group Model Building

- Uses system dynamics to develop a causal map/diagram
- Community driven participatory research—core modeling team
- Start with ‘Changes over time’ with ‘Hopes and fears’
Example: Portland Victoria
37 variables / relationships to start quantifying the model

CLD v4 – nutrition: food prepared in ECEs
Networks, ‘Knowledge’ and ‘Engagement’

• What flows over networks to stimulate change (community action to prevent obesity)?
• Retrospective analysis from 2 successful programs
• ‘Knowledge’
  – Knowing & understanding the problem, how to intervene, how to contribute, what is being done, how to mobilise resources
• ‘Engagement’
  – Level of participation, dialogue/mutual learning, flexibility, influence/power, leadership, passion, trust
Knowledge

The problem of overweight
What level to intervene / determinants
How to intervene / sustainability
Your role / what others are doing
Available resources
Engagement 1

Degree of engagement

1. Not engaged
2. Engaged a little
3. Somewhat engaged
4. Quite engaged
5. Very engaged

Not at all capable
Not very capable
Somewhat capable
Capable
Very capable

Flexibility

Dialogue and mutual learning
Engagement 2

- **Degree of influence / power**: Neutral
- **Leadership / passion**: Strongly Agree
- **Mutual trust**: Neutral

Scale:
- 1: Strongly disagree
- 2: Disagree
- 3: Neutral
- 4: Agree
- 5: Strongly Agree
Types of social network analyses

Sociometric

Ego-centric
Ego networks with affiliations, directions, strength

- 19 participants
- 288 connections wrt childhood obesity
- 17 primary affiliations
- 18 median connections
Heterophily – discussions in same or different organisations

Discussion topics

- Sleep
- Screen time
- Overweight
- Growth & dev
- Active play, movt
- Food / nurtition
## Collective Impact Cascade

<table>
<thead>
<tr>
<th>Stage</th>
<th>Authorising</th>
<th>Conceptualising</th>
<th>Validating/formulating</th>
<th>Actioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who is involved</td>
<td>CEO level</td>
<td>Managers &amp; leaders (Steering Group)</td>
<td>Staff, parents, volunteers</td>
<td>Those with the remit, interest &amp; capacity</td>
</tr>
<tr>
<td>Systems tools</td>
<td>Presentations on systems nature of problem &amp; solutions</td>
<td>Group Model Building workshops</td>
<td>Critique of Causal Loop Diagrams &amp; systems solutions</td>
<td>Communications aligning actions to system objectives</td>
</tr>
</tbody>
</table>

### Common agenda
Ensure shared understanding of the problem and vision for change is agreed for each stage of the cascade.

### Shared measurements
Ensure consistent data on problems (child obesity, behaviours) and solutions (eg policy implementation, settings’ food environments) are collected.

### Mutually reinforcing activities
Ensure participant activities are differentiated yet coordinated through a mutually reinforcing plan of action relevant for each stage of the cascade.

### Continuous communications
Ensure consistent and open communication across the many players to build trust, assure mutual objectives, and create common motivation.

### Backbone organisation
Ensure an organization with appropriate staff & skills serves as the backbone for the initiative and coordinates participating organizations and agencies.
Healthy Families NZ

- Other national and regional activities eg
  - Fruit in schools
  - Healthy Auckland Together, Healthy Christchurch
  - Project Energize
• Regional PH service provides backbone support
• All major Auckland organisations participating
• 1 year – joining up, learning about each other, developing plans, obtaining mandates etc
• Injected $$ = 3 Healthy Families NZ sites, ARPHS
• Challenges
  – Undertaking systems change across the region using existing resources
  – Measuring the impacts of the efforts

http://www.healthyaucklandtogether.org.nz/
Indigenous approaches to obesity prevention
The FoodBack System

Information

Central database

Community members

Short feedback loops

Healthier community food places

Change agents

Long feedback loops

**Information and short feedback loops** = Food data, pictures, location data, best practice stories, comments

**Long feedback loop** = Analyses, badges, best practice benchmarks
Strengths of systems approaches

1. Engagement
   - Creating joint understandings of the problems and solutions
   - Group Model Building

2. Truer picture of the problem
   - Embracing the complexity
   - Using the dynamics
   - More tools for understanding and evaluations

3. Levels of intervention
   - Variables
   - Relationships
   - Rules, goals
Conclusions

• Shift to systems thinking is a step change for obesity prevention
• Still understanding how to communicate it, apply it, and measure it
• Need to exploit the spread of the ‘prevention virus’ and ‘community bootstrap’ processes
• Need systems tools as well as linear null hypothesis testing tools (G1-G3)
• Population monitoring data is essential
• Pool our lessons and create preventions systems for NZ