Where there is no control group

Coarsened exact matching to improve causal inference in evaluations of BCC and social marketing programs

Rebecca Firestone

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PSI makes it easier for people in the developing world to lead healthier lives and plan the families they desire by marketing affordable products and services.
Does it work?
Assessing if it works and hopefully how

Social Marketing & BCC → Exposure to intervention → Behavioral Factors:
- Opportunity
- Ability
- Motivation → Behavior Change → Health Outcomes
Assessing if it works and hopefully how

Social Marketing & BCC → Exposure to intervention → Behavioral Factors
- Opportunity
- Ability
- Motivation → Behavior Change → Health Outcomes
In an ideal world, we would do a randomized evaluation.
Then there’s what usually happens…

![Diagram showing flow between Total Population, Target Population, Reached, received program, Reached, didn’t receive program, Not reached, and Evaluation?](image-url)
When implementation and evaluation don’t mix

- We don’t know who will be reached by program activities
- We don’t know how many people will be reached
- Program in the field before we can do a baseline
- We don’t know how much “dose” of the program might be needed to foster changes in outcomes
A possible solution?

- Endline evaluation with statistical matching
- Get a representative sample of the population
- Ask about program exposure and about outcomes of interest
- Match to create statistically equivalent groups of exposed and non-exposed cases
- Test for a difference in outcomes in matched sub-sample
Coarsened exact matching

- Match on coarsened, i.e. categorized, bins of the exact values of matching variables
- Subsequent estimation of treatment effects in matched sub-sample
How does CEM work?

- Assigns each case into one of a set of strata in which members are exactly matched on a set of coarsened variables
- Matched members assigned a weight specific to that stratum and representative of the proportion of all members present in the stratum
- Use L1 distance measure to assess the extent of imbalance btw exposed and unexposed cases
- Trade-off between balance and sample size
HIV prevention with transgender women in Thailand
Sisters

The purpose of the program is to promote safer sex among transgender women through peer education and drop-in center activities in eastern Thailand
Evaluation Methodology

- Time-location survey in Pattaya in 2011 (n=308)
- Coarsened exact matching to compare exposed/non-exposed (n=238)
  - Matched on
    - Duration of residence in Pattaya
    - Monthly income
    - Occupation: work in entertainment venue, work as a freelance sex worker
    - Number of transgender friends
  - L1 = 1.735E-17

- Multiple logistic regression
  - Outcomes
    - Consistent condom use with commercial partner in past 3 mos
    - Consistent condom and lubricant use with commercial partner in past 3 mos
    - HIV test in past 6 mos
  - Measures of exposure
    - Receipt of any Sisters services in the past 12 months
    - Attendance at the Sisters drop-in center (DIC)
    - Interaction with a Sisters outreach worker
    - Receipt of a home visit
# Estimated treatment effects – condoms and lube

<table>
<thead>
<tr>
<th></th>
<th>Full sample (n=308)</th>
<th>Matched sample (n=238)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR, 95% CI</td>
<td>Adjusted OR, 95% CI</td>
</tr>
<tr>
<td><strong>Commercial partner</strong> (full sample n=289, matched sample n=233)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistent condom/water-based lubricant use in past 3 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any service</td>
<td>1.23 (0.67-2.27)</td>
<td>2.37 (1.28-4.41)</td>
</tr>
<tr>
<td>Drop-in center</td>
<td>0.79 (0.46-1.35)</td>
<td>0.70 (0.40-1.22)</td>
</tr>
<tr>
<td>Outreach</td>
<td>1.59 (0.91-2.78)</td>
<td><strong>1.75 (0.95-3.21)</strong></td>
</tr>
<tr>
<td>Home visit</td>
<td>1.16 (0.57-2.36)</td>
<td>0.98 (0.46-2.08)</td>
</tr>
</tbody>
</table>
## Estimated treatment effects – HIV testing

<table>
<thead>
<tr>
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<th>Full sample (n=308)</th>
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<tbody>
<tr>
<td></td>
<td>OR, 95% CI</td>
<td>Adjusted OR, 95% CI</td>
</tr>
<tr>
<td>Received an HIV test in the past 6 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any service</td>
<td>3.32 (1.90-5.76)</td>
<td>2.45 (1.36-4.39)</td>
</tr>
<tr>
<td>Drop-in center</td>
<td>3.17 (1.95-5.14)</td>
<td>2.83 (1.72-4.65)</td>
</tr>
<tr>
<td>Outreach</td>
<td>2.24 (1.37-3.65)</td>
<td>1.64 (0.96-2.80)</td>
</tr>
<tr>
<td>Home visit</td>
<td>2.11 (1.13-3.94)</td>
<td>1.59 (0.81-3.13)</td>
</tr>
</tbody>
</table>
Reducing concurrent partnerships in Botswana
**Botswana’s Concurrent Partnerships Campaign**

**Campaign team**
- National AIDS Coordinating Agency
- Natl Prevention Technical Advisory Cmte
- PSI

**Campaign strategy**
- Teaser campaign – get people talking
- Phase 1 – address risk perceptions, knowledge, awareness of CP
- Phase 2 – assess consequences, personalize risk

**Mechanisms**
- Social mobilisation – reach key influencers and leaders
- Mass media – TV, radio, print, billboards, combis
- Interpersonal communication – CBOs, FBOs, door-to-door, bars/shebeens
Evaluation Methodology

- National two-stage cluster sampling survey (n=1237)
  - Stage 1
    - PPS sampling of enumeration areas (EAs) from census sampling frame
    - EAs in high exposure areas prospectively matched to EAs in low exposure areas, based on geography and availability/coverage of radios and televisions
  - Stage 2
    - Households within selected EAs selected using simple random sampling
    - One eligible individual in each household randomly interviewed.

- Coarsened exact matching to compare exposed/non-exposed
  - Matching on radio and/or television access and or ownership, and place of residence
    - L1 (Global Imbalance measure) = 0.059

- Multiple logistic regression on sub-sample (n=1138)
  - Two exposure variables
    - Exposure to at least one national campaign
    - Exposure to specific campaigns
  - Stratification by gender
Did campaign exposure reduce concurrent partnerships or increase HIV risk reduction behaviors?

- No evidence the campaign influenced concurrent partnerships
- Campaign was associated with HIV risk reduction behaviors

<table>
<thead>
<tr>
<th>Program exposure effects (vs. no exposure) on behaviors and behavioral factors</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effects for concurrency</strong></td>
<td></td>
</tr>
<tr>
<td>Concurrency point prevalence</td>
<td>1.3 (0.8, 2.1)</td>
</tr>
<tr>
<td>Concurrency cumulative prevalence</td>
<td>1.1 (0.8, 1.6)</td>
</tr>
<tr>
<td>Peer pressure not to engage in CP</td>
<td>1.7 (1.1, 2.7)</td>
</tr>
<tr>
<td>Negative attitude to having variety of partners</td>
<td>1.6 (1.1, 2.3)</td>
</tr>
<tr>
<td><strong>Effects for HIV risk reduction</strong></td>
<td></td>
</tr>
<tr>
<td>Consistent condom use</td>
<td>1.3 (1.01, 1.7)</td>
</tr>
<tr>
<td>Tested for HIV</td>
<td>1.6 (1.1, 2.4)</td>
</tr>
<tr>
<td>Condom use self-efficacy</td>
<td>1.4 (1.02, 1.8)</td>
</tr>
<tr>
<td>Perceived HIV risk</td>
<td>1.5 (1.1, 2.0)</td>
</tr>
</tbody>
</table>
## Campaign effects concentrated in men

<table>
<thead>
<tr>
<th>Program exposure effects (vs. no exposure) by gender</th>
<th>Men AOR (95% CI) (^a)</th>
<th>Women AOR (95% CI) (^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effects for concurrency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative attitude to having variety of partners</td>
<td>2.0 (1.3, 3.1)</td>
<td>0.9 (0.4, 1.7)</td>
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<tr>
<td>Effects for HIV risk reduction</td>
<td></td>
<td></td>
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<tr>
<td>Consistent condom use</td>
<td>1.7 (1.1, 2.6)</td>
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<tr>
<td>Condom use self-efficacy</td>
<td>1.6 (1.02, 2.4)</td>
<td>1.2 (0.8, 1.9)</td>
</tr>
<tr>
<td>Perceived HIV risk</td>
<td>3.0 (1.9, 4.6)</td>
<td>0.8 (0.5, 1.2)</td>
</tr>
</tbody>
</table>

\(^a\) Adjusted for baseline variables.
What we’ve learned so far
What we like about endline matching with CEM

- Identifying what to match on helps everyone understand the program better
- Not as data-intensive as other matching techniques
- Few assumptions go into the matching procedure
- Straightforward for field research teams to conceptualize and implement
- Results are only as good as the conceptual model
Limitations

- For CEM
  - Need to be *extremely thoughtful* about variables to match on
  - How do we assess dose-response?

- For statistical matching
  - If you haven’t measured it, you can’t account for it
  - Does the matched sample really reflect the target pop?

- For this specific design
  - We’re documenting differences, not changes
  - Can’t be fit for purpose for every program model