Injection drug use, low income, & severe food insecurity in HIV-HCV co-infected individuals in Canada: a mediation analysis

HIV ENDGAME II: Stopping the Syndemics that Drive HIV
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Presenter Disclosure

• **Presenter:** Taylor McLinden

• **Relationships with commercial interests:**
  • None to declare
Rationale

- **Food insecurity (FI):**
  - Common issue in HIV-hepatitis C virus (HCV) co-infected [1]
  - FI in HIV-HCV co-infected (Canada): 59% (2012-2014) [2]
    - Much higher than general Canadian population (8%) [3]
  - Co-infected: majority of food insecure experienced severe FI [2]
    - Most extreme: “disrupted eating patterns & reduced food intake”

- **FI**: Limited or uncertain -
  - **Availability** of nutritionally adequate & safe foods or
  - **Ability** to acquire acceptable foods in socially acceptable ways [4]

- **General population**: low income as primary risk factor for FI [5,6]

- FI is **context-specific**: general population vs. sub-groups of population
Rationale

• 20% of HIV-positive: HIV-HCV co-infected [7]
  • Vulnerable sub-set of HIV-positive population [8-10]
    • High prevalence of injection drug use (IDU)
    • High prevalence of severe FI [2]

• FI is associated with:
  • Sub-optimal HIV treatment adherence [11]
  • Incomplete HIV viral load suppression [12]
  • Lower CD4 cell counts [13]
  • Higher rates of mortality [14]

• Due to consequences of FI:
  • Important to study:
    • Mechanisms
    • Pathways: risk factors → mediators → outcome
Objective

- **Given:**
  - Importance of low income
  - High prevalence of IDU & severe FI (in co-infected)

- **Objective:**
  - **Mediation** analysis:
    - Pathways: IDU $\rightarrow$ low income $\rightarrow$ severe FI
      - Temporally-ordered longitudinal cohort data
      - HIV-HCV co-infected in Canada

- Potential insights into interventions:
  - Reduce severe FI & consequences of being severely food insecure
Methods

- **Data sources:**
  
  - **Food Security & HIV-HCV Study:**
    
    - Canadian Co-infection Cohort (CCC) \(^{[15]}\)
    - Multi-centre study of co-infected in care
    - 17 HIV clinics, 6 provinces
    - Questionnaires & blood samples (every 6 months)

  - FI-related:
    
    - Integrated in CCC: Nov 2012 - May 2015 \(^{[3]}\)
    - Additional questionnaire
      - Household Food Security Survey Module (HFSSM)
Methods

• **Measurements:**
  
  • **Temporal-ordering:** exposure [visit 1] → mediator [visit 2] → outcome [visit 3]

• **Exposure:** self-reported IDU *(in the past 6 months)*
  • none vs. any IDU

• **Mediator:** average personal monthly income *(over the past 6 months)*
  • Dichotomized at StatsCan “low income measure before tax” *(LIM-BT)*[^16]
  • $1,847 / month (single-person household)
  • Above vs. below the LIM-BT

• **Outcome:** severe food insecurity *(in the past 6 months)*
  • 10-item adult scale: Household Food Security Survey Module *(HFSSM)*[^17]
  • # of affirmative (✓) responses:
    • ≥ 6 affirmative responses: severely food insecure
Conceptual framework

**IDU** [visit 1] → **Low income** [visit 2] → **Severe FI** [visit 3]

**Time-fixed confounders**

**Time-varying confounders**
Conceptual framework

IDU [visit 1] $\rightarrow$ Low income [visit 2] $\rightarrow$ Severe FI [visit 3]
Methods

• **Measurements:**
  
  • **Time-fixed confounders [visit 1]:**
    • Education at enrolment, sex, ethnicity, country of origin
  
  • **Time-varying confounders [visit 1] of IDU → FI:**
    • Age, living situation, unstable housing, illicit substances by non-injection, issues with usual activities (EQ-5D), moderate / severe anxiety or depression (EQ-5D), significant liver fibrosis (APRI > 1.5), HIV viral suppression (≤ 50 copies/mL), HCV treatment status, & low income
  
  • **Time-varying confounders [visit 2] of low income → FI:**
    • All of the above (excluding low income) & monetary / non-monetary dietary support, use of nutritionist
Methods

- Data analyses:
  - Estimate an **overall effect**: association via all pathways
  - Estimate a **controlled direct effect**: \(^{18}\)
    - Association via pathways except that of low income
Methods

• Data analyses:
  • Direct **regression adjustment** for visit 2 confounders
    • Blocks some of IDU’s association with FI
  • Alternative to direct adjustment:
    • **Inverse probability weighting**
  • Log-linear **marginal structural models**
    • Risk ratios (RRs)
    • Robust standard errors (for repeated measures)
# Results

- **N = 725** co-infected participants: 17 centres, 6 provinces

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<thead>
<tr>
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<th>Study visit (2012 – 2015)</th>
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<tbody>
<tr>
<td></td>
<td>Visit 1 (N = 725)</td>
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<tr>
<td></td>
<td>Visit 2 (N = 608)</td>
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<tr>
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<td>Visit 3 (N = 475)</td>
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<tr>
<td>Number of participants / total with factor measured (%)</td>
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<tr>
<td>Injection drug use (IDU): exposure (in the past 6 months)</td>
<td>230 / 698 (33%)</td>
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<td>Below LIM-BT (&lt;$1,847 CAD/month): mediator (over the past 6 months)</td>
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<tr>
<td>Severe food insecurity (FI): outcome (in the past 6 months)</td>
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Results

Modeled relationship

<table>
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<tr>
<th>Risk Ratio [RR] (95% CI)</th>
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<tr>
<td><strong>Adjusted overall association</strong> (via all pathways)</td>
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<tr>
<td><strong>Controlled direct effect</strong> (all pathways except that of low income)</td>
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- Overall association (RR = **1.61**) ≈ controlled direct effect (RR = **1.54**)
- Minimal association through low income pathway
- Therefore: IDU associated with severe FI primarily through pathways other than low income
Discussion

- Potentially acting **directly**: IDU $\rightarrow$ severe FI
  - Biologic impact on: appetite & metabolism \[^{19}\]
    - Disrupting food intake patterns

- Potentially acting **indirectly**: IDU $\rightarrow$ time-varying confounders [visit 2]
  - e.g., IDU $\rightarrow$ depressive symptoms $\rightarrow$ FI \[^{19}\]
Limitations

- Unable to model exposure as multi-category indicator of IDU:
  - Frequency, duration, or drug-type

- LIM-BT varies by household size:
  - Single-person: $1,847 CAD / month
  - 49% live alone (however: no data on household size)

- Unknown: how much of association is through other mediators?
  - e.g., depression / unstable housing

- Observational: residual confounding
  - Unmeasured factors / imperfect measurement

- Numerous self-reported factors: misclassification
Conclusions

• Evidence:
  • (1) IDU: independently associated with severe FI (overall)
  • (2) Association between IDU \(\rightarrow\) severe FI may be primarily through pathways other than low income

• Recommendation:
  • Given high prevalence of IDU & severe FI in this co-infected population, interventions aimed at injection drug users (e.g., substance abuse treatments) may mitigate severe FI

• Future research:
  • Does incorporation of food supports in harm reduction programming reduce severe FI?
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