WORK & MENTAL HEALTH: Capturing Natural Experiments From Large Longitudinal Datasets

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Vision: healthy and sustainable work for all

We seek to:

- Advance the scientific and public understanding of work as a social determinant of health, and
- Help shape policy & practice to better protect people from the harmful effects of work, while fostering its health-promoting qualities

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WORK & MENTAL HEALTH
...A GROWING CONCERN

1 in 5 Australians will have a mental illness in their lives

• Depression and anxiety most common
• Depression and anxiety - leading cause of non-fatal burden of disease

2007 Australian National Survey of Mental Health & Wellbeing

• 14.7% of workers - history of MDE
• 12% of men and 18% of women

As much as 20% of working age population affected by a mental health problem (OECD 2012)

Suicide the 10th leading cause of death for males.
For every completed suicide, it is estimated that as many as 30 people attempt.
NEED FOR INTERVENTION RESEARCH

• Great need for ‘solutions-oriented’ intervention research

• ‘Gold standard’ -- experimental designs
  - Random assignment or allocation to different ‘intervention’ or ‘treatment’ conditions
  - Highest causal inference, ability to attribute observed effects to intervention and not something else
  - Researcher manipulates exposure

• Ideally, individuals in different conditions are ‘exchangeable’ but for the manipulated exposure or treatment
WORKPLACE MENTAL HEALTH
CLUSTER-RANDOMISED TRIAL IN VICTORIA POLICE

- Intervention development & feasibility studies: two projects over 3 years 2011-2013
- Fed into a CRT in 24 police stations (12 per arm), funded for 3 years from 2013-2016
Integrated intervention activities

- Baseline survey feedback
- 360 degree leadership capability assessment
- CHW Supportive Leadership Development & Coaching Program
- Healthy Minds at Work for Leaders
- Stress & workload management training (2 x 2 hour seminars)
- Station peer support program

Target groups

- Station command (S/Sgts)
- Leadership group (Sergeants)
- Troops (all other ranks in a station)

Proximal outcomes

- Workplace mental health literacy and associated behaviours
- Working conditions (supervisor support, job demands/control)

Distal outcomes

- Perceived job stress
- Mental health
- Work productivity and performance
VICTORIA POLICE CRT

- Intervention development & feasibility studies over 3 years:
  - $300K and $200K

- CRT funded by a 3 year ‘Partnership’ grant with partner contributions matched in value by Australian govt (NHMRC):
  - $450K in partner cash and in-kind (Worksafe/ISCR and VicHealth)
  - $450K from NHMRC

- Now at year 2.5 and still in implementation phase...
CHALLENGES OF INTERVENTION STUDIES

• Expensive, difficult to get funded
• Long timelines, high effort/person-time... but low publication yield
• Attrition, generalisability limitations
• Susceptible to disruptions outside of researcher control
  - Organisational change/restructures/retrenchments
  - Macro-economic change (e.g., Global Financial Crisis of 2007-2009)
• Limitations on what can be tested (potentially harmful conditions)
NATURAL EXPERIMENTS

• Longitudinal studies with observations over time offer the possibility of capturing ‘natural experiments’

• Definition: events, interventions, or policies that are not under the control of researchers ... but which are amenable to research using the (unplanned) variation in exposure that they generate to analyse their impact

NATURAL EXPERIMENTS

• Key features:
  – The intervention is not undertaken for research purposes (‘naturally’ occurring), researchers do not assign or control exposure
  – The variation in exposure and outcomes is analysed using methods that attempt to make causal inferences
  – Treat assignment of subjects to intervention or comparison ‘as if’ random
  – In short... involves the application of experimental thinking to non-experimental studies

NATURAL EXPERIMENTS

• Still... secondary analyses on observational data, and...
  
  - Non-random assignment of exposure
  
  - Limited exchangeability of exposed/non-exposed
  
  - Susceptible to bias

• But... if can use existing data (e.g., national panel studies), then efficient (cost), powerful (sample size), generalisable (pop-based), and numerous ‘natural experiments’ could be studied
NATURAL EXPERIMENTS

• Analytic methods:
  - Interrupted time series, difference-in-difference, propensity score matching, regression discontinuity, instrumental variables, others...

• Fixed effects regression relatively new to epi (adapted from econometrics): Not included in these 3 reviews


FIXED EFFECTS REGRESSION

• Emulates experimental design by:
  
  ▪ Optimising exchangeability:
    - Looks at within person change in exposure in relation to outcome
    - Each study participant is their own control/reference
  
  ▪ Eliminating both measured and unmeasured time-invariant confounding
    - Examples: sex, early childhood experiences, disease history, race, ethnicity...
    - Mean centring: mean (over time) of measurements for each individual is subtracted from all the individual’s measurements, thus eliminating time invariant terms

FE REGRESSION: LIMITATIONS

• Because only uses within-individual variation, can lack precision (e.g., compared to random effects)
• No parameters for time-invariant covariates
• Only observations where exposures vary contribute to the FE estimates...
  — so not applicable to investigation of exp-outcome in individuals who do not change exposure status over time
• Do not control for other important biases, such as time-varying confounding and reverse causation
## THREE WORK & MENTAL HEALTH EXAMPLES FROM OUR RECENT RESEARCH

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>FOCUS</th>
<th>ANALYTIC APPROACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job/task</td>
<td>Job control</td>
<td>Fixed effects longit regression</td>
</tr>
<tr>
<td>Form of employment</td>
<td>Temporary employment</td>
<td>Fixed effects longit regression</td>
</tr>
<tr>
<td>Labour market/macroeconomic</td>
<td>GFC &amp; psychosocial stressors</td>
<td>Time series</td>
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EXAMPLE 1: JOB/TASK LEVEL

Job control and mental health
JOB CONTROL & MENTAL HEALTH

- Deteriorating job control predicts poor mental health
- Impact of improvement in job control on mental health less well understood (limited trial evidence), but of great policy significance

Research question:
Are improvements in job control associated with improvements in mental health?
JOB CONTROL & MENTAL HEALTH

• Data source: Household Income & Labour Dynamics in Australia panel survey (HILDA)
  – Large, nationally representative sample with annual waves of data collection since 2001
  - Face-to-face interviews combined with self-completion questionnaires
  - Initial/wave 1 household response rate 66%.
    o 87% at wave 2 and >90% thereafter
JOB CONTROL & MENTAL HEALTH

• 10 annual waves used in this analysis (2001—2010)
• Outcome: SF-36 Mental Health Component Summary (MCS)
  – 100-point scale (higher score, better MH)
  – Analytic sample mean 49.3, SD 9.4 (N = 13,545 persons, n = 61,106 obs, pooled over all waves)
JOB CONTROL MEASURES

• Job control (alpha 0.40) derived from two equally-weighted subscales

  - Decision authority (sum of scale/3, alpha = 0.83):
    “I have lots of freedom to decide how I do my work”
    “I have a lot of say about what happens in my job”
    “I have a lot of freedom to decide when I do my job”

  - Skill discretion (sum of scale/2, alpha = 0.65):
    “My job often requires me to learn new skills”
    “I use many of my skills and abilities in my current job”

• Treated continuously and in quintiles (lowest quintile as reference category)
**FIXED-EFFECTS LONGITUDINAL REGRESSION ANALYSIS**

- Uses each person as their own comparison/control
  - Maximises exchangeability, removes time-invariant confounding
- Compares mental health at different levels of job control within persons
- Model beta coefficients ~represent the grand mean of within-person means
- To illustrate with hypothetical data...
EXPOSURE-OUTCOME TEMPORAL RELATION

• Contemporaneous association between psychosocial working conditions and scaled measure of MH is plausible

• Exposure and outcome related over the same year/wave based on evidence from a Dutch panel study of four annual waves showing that changes in job stressors were most strongly associated with changes in mental health over a one year time frame (de Langhe et al, 2002)

JOB CONTROL CHANGE

Quintile, T1          Quintile, T2
1 (Low)               1 (Low)
2                     2
3                     3
4                     4
5 (High)              5 (High)
TRANSITIONS BETWEEN QUINTILES OF JOB CONTROL BETWEEN CONSECUTIVE HILDA WAVES, 2001 TO 2010

Starting from lowest Q, time T

Starting from middle Q, time T

Starting from highest Q, time T

Quintile distribution at time T+1

9896 observations  9851 obs  9718 obs
TRANSITIONS BETWEEN QUINTILES OF JOB CONTROL BETWEEN CONSECUTIVE HILDA WAVES, 2001 TO 2010

<table>
<thead>
<tr>
<th>Job control quintiles, n observations at T</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Low</td>
<td>5,395</td>
<td>2,715</td>
<td>1,009</td>
<td>543</td>
<td>234</td>
<td>9,896</td>
</tr>
<tr>
<td>2</td>
<td>2,721</td>
<td>4,713</td>
<td>2,692</td>
<td>1,509</td>
<td>489</td>
<td>12,124</td>
</tr>
<tr>
<td>3</td>
<td>956</td>
<td>2,809</td>
<td>2,971</td>
<td>2,285</td>
<td>830</td>
<td>9,851</td>
</tr>
<tr>
<td>4</td>
<td>486</td>
<td>1,489</td>
<td>2,475</td>
<td>3,667</td>
<td>2,020</td>
<td>10,137</td>
</tr>
<tr>
<td>5 - High</td>
<td>180</td>
<td>531</td>
<td>923</td>
<td>2,181</td>
<td>3,903</td>
<td>7,718</td>
</tr>
<tr>
<td>Total</td>
<td>9,738</td>
<td>12,257</td>
<td>10,070</td>
<td>10,185</td>
<td>7,476</td>
<td>49,726</td>
</tr>
</tbody>
</table>
JOB CONTROL & MENTAL HEALTH: FIXED EFFECTS MODELS
ADJUSTED FOR AGE GROUP, CHANGE IN JOB AND SURVEY YEAR

![Diagram showing beta coefficients for different quintiles of job control]

- **Job Control quintile, categorical**
  - (Q1 lowest = Reference)

- Beta Coefficients:
  - Quintile 2: 0.37
  - Quintile 3: 0.76
  - Quintile 4: 1.18
  - Quintile 5 (Highest): 1.55

- Beta Coefficients for continuous measures:
  - Job Control (raw, continuous): 0.44
  - Job Control (quintiles, continuous): 0.39
JOB CONTROL SUBSCALES:
FE MODELS ADJUSTED FOR AGE GROUP, CHANGE IN JOB AND SURVEY YEAR

• Mental health improved with both increasing skill discretion and decision authority:
  - SD: 0.16 [95%CI 0.10, 0.23]
  - DA: 0.35 [95%CI 0.29, 0.42]

• For DA in particular: evidence of a step-wise increase when quintiles modeled as categorical variable

• Contrasts with recent Finnish study showing a negative association with DA and positive with SD (Joensuu 2012)
DISCUSSION

- Job control usually stable over time within person, but can change substantially year to year.
- Improving job control within-persons associated with improved mental health.
- Stronger evidence of a causal relationship than previous observational studies.
  - Within-person analysis and evidence of dose-response.
- Supports the case for improving job control to improve mental health as an element of workplace mental health prevention and control intervention strategy.
DISCUSSION

• Small effect size?
• Results generalize only to people who experienced change in job control—but across the working population
• Small effect size at population-level can be important (Rose)
• FE coefficient does not represent full relationship between job control and mental health
  - e.g., those staying at low or high control
• Does not fully consider sequence, direction, and duration of job control status over contributed waves
EXAMPLE 2: EMPLOYMENT ARRANGEMENT LEVEL

Temporary employment and mental health
### FORMS OF EMPLOYMENT IN AUSTRALIA

- Employment arrangement: The form and terms of employment

<table>
<thead>
<tr>
<th>Form of Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Permanent FT</td>
</tr>
<tr>
<td>2. Permanent PT</td>
</tr>
<tr>
<td>3. Casual FT</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>4. Self employed – own account</td>
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</tbody>
</table>

Dominant form of ‘precarious’ employ in Aus is ‘Casual’
BACKGROUND

• Casual employment in Australia (20-25% of LF)
  - no paid sick or annual leave, no formal commitment to hours
• Health & safety concerns about casual/temporary employment
  - Poor job security
  - Poor working conditions
• Safety hazards, health hazards, psychosocial stressors
  - Weak OH&S protections
  - Less OH&S training, weak regulatory oversight
BACKGROUND

- Many studies link precarious employment to poorer health...
  - But null and even converse relationships observed

- Why mixed findings?
  - Definitional variation
  - Paucity of prospective studies
  - Confounding (e.g., by health selection)
  - Variation in contextual influences, such as labour and social welfare protections
BACKGROUND

• Qual research suggests impacts vary by working life stage
  - May be good, bad, or indifferent (Clarke et al, 2007)

• Reconsidered theory: Relationship likely mediated by balance of neg and pos aspects in relation to the costs of the (still) dominant alternative of Permanent employment (De Cuyper et al, 2008)


RESEARCH QUESTIONS

• RQ1: Are there differences in mental health in temporary versus Permanent employment within workers who experience both forms of employment?

• RQ2: Are transitions from stable Permanent to temporary employment associated with changes in mental health (within workers who experience both)?

• RQ3: Are the relationships noted in RQ1 and RQ2 modified by age or sex?
RESEARCH QUESTIONS

• Compare Permanent/On-going employment to two categories of increasing *temporariness* or *precariousness*:
  - Casual (the most precarious or temporary compared to Permanent)
  - Fixed-term contract (an intermediate category of precariousness compared to Permanent)
METHODS: DATA SOURCE

- HILDA again...
  - Ten annual waves of nationally representative data 2001—2010
  - Source population: 81,114 obs from 15,580 employed persons aged 15-64 years
• Wave 1 (2001) snapshot of participants working for profit or pay:

Casual & Labour Hire combined as “Temporary”
METHODS -- ANALYSIS

- Fixed-effects longitudinal linear regression
- Outcome = SF-36 Mental Component Summary
  - Working pop mean 48.5 (9.9), all persons, all waves

- RQ1: *State* of Casual vs Permanent, FT Contract vs Permanent

- RQ2: *Transitions* from stable Permanent (2 conseq waves) to Casual, or to FT Contract

- RQ3: Tested for effect modification by sex and age
Time (years)

- Mental Health
- Employment contract

1 = permanent
0 = casual/LH

1 = permanent
0 = fixed term

Graph showing the trend over time for mental health and employment contract types.
RQ 1: STATE COMPARISON

- Multivariate adj for education and survey wave (time)
- Interactions between employment arrangement and sex/age not significant
RQ 2: TRANSITION MODELS

- Transition from stable to Casual employment
- Multivariate analysis
- Overall and stratified by age / sex
RESULTS RQ2 (and RQ3)

• FOR TRANSITION from PERMANENT to FIXED-TERM CONTRACT:
  - No main effects (multivar beta -0.04, p = 0.86)
  - No significant interactions between employment arrgt and sex or age
RESULTS ROBUST: SENSITIVITY ANALYSES

- Additional adjustment for occupational skill level
- Additional adjustment for income
- Additional adjustment for change in job
- Restriction of RQ2/transition analyses to participants who experienced transitions of interest only once during their period of observation (85-90% of each category)
DISCUSSION

- No evidence of *within person net differences* in MH in either of two *states* of precarious employ compared to Permanent (RQ1)
  - No evidence of effect modification by age or sex (RQ3)

- No evidence of overall of *within person changes* in MH following transitions from ‘stable’ Permanent to either of two forms of precarious employ *over the short term* (RQ2)
  - Evidence of effect modification by age, with a small improvement in MH for the oldest age group (RQ3)
DISCUSSION

• Fixed effects regression optimises causal inference, but generalises only to those who experience change in states or transitions of interest

• Flint et al, 2013 applied FE regression to employment transitions using self-reported assessment of employment security and saw a small difference in GHQ, but no difference with transitions

Flint, E., et al. (2013). "Do labour market status transitions predict changes in psychological well-being?" J Epidemiol Community Health 67(9): 796-802
DISCUSSION: Limitations

- Measurement once annually
- Possible longer-term or cumulative effects of transitions?
- No data on why persons are in particular forms of employment
  - voluntary vs involuntary?
- Self-employ not included because more heterogeneous WRT precariousness
  - results still generalise to 85% of the labour force
INTERPRETATION: Optimistic

• Macro perspective: findings may be particular to Australia’s labour and social welfare protections
  – Casual ‘loading’ of +15-25% of hourly rate
  – Aus minimum wage of ~$16/hour
  – Legislated employer super contributions of 9%
  – Nondependence on employers for healthcare/insurance

• Operate as labour market-level effect modifiers?

• These and related entitlements and protections key policy levers to minimise health & social impacts of temporary employment?
INTERPRETATION: Not So Optimistic

• “Improvement” for older workers more likely recovery from stressful jobs?
  – Qual study support (Clarke 2007, Keuskamp 2013)

• Reflects a narrowing of contrasts b/w permanent and precarious due to erosion of conditions of permanent employment?
  – Last two decades in Australia: steady reduction in employment regulations and protections (Burgess et al, 2008)

• Other adverse outcomes possible: association with increased risk of injury in other Aus studies

FUTURE DIRECTIONS

• Importance of working life course stage in understanding the influence of psychosocial work environment on health

• Need to consider balance of negative and positive influences of work on MH, both in terms of theory and design/analysis


Available open access in *AJE Editor’s Choice* at [http://aje.oxfordjournals.org/content/by/tag/choice](http://aje.oxfordjournals.org/content/by/tag/choice)
OTHER FIXED EFFECTS ANALYSES IN HILDA


CLOSING COMMENTS: NATURAL EXPTS

• Natural experiments offer a valuable and efficient complement to experimental studies
  – Especially in the face of feasibility, ethical, or other challenges
  – Adds value to use of routinely-collected surveillance and other data, panel studies and other longitudinal cohorts, etc.
  – Can’t replace intervention trials, but can inform their design and contribute substantially to policy & practice evidence base
CLOSING COMMENTS: FE REGRESSION

- When within-individual repeated measures data are available...
- Fixed effects regression is a causally robust analytic strategy for natural experiments
- Optimises exchangeability and eliminates time-invariant confounding
- Its application in epidemiology is likely to grow
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Thank you

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EXAMPLE 3: MACRO-ECONOMIC LEVEL

The Global Financial Crisis, psychosocial working conditions, and suicide
BACKGROUND

• Unemployment an established risk factor for mental illness and suicide (Milner et al, 2013)
• But... the majority of suicide cases occur among the employed
• Studies of the impact of economic shocks often focus on unemployment...
• But what’s happening in the employed population?
• Changes in psychosocial working conditions over GFC?

BACKGROUND

• XC surveys in 2005 & 2009 in the Northern Ireland Civil Service found psychosocial stressor exposures were significantly worse during the GFC period than prior to it


• What about in Australia? (HILDA again...)

Job Control Trends, HILDA data 2001-2013 (19,467 persons, 100,610 obs)
Job Security Trends, HILDA data 2001-2013 (19,478 persons, 100,755 obs)
CHANGE IN SUICIDE RATES OVER GFC?

• Some evidence of country-specific increases in suicide, but in the general population...

• Not known whether GFC-related increases occurred more in the employed, unemployed, or those who were otherwise without work at the time of death
Was the GFC period (2007, 2008, 2009) associated with changes in suicide rates by LF status?
– compared to years prior to the GFC (2001-2006)
STUDY DESIGN AND DATA SOURCES

• Retrospective mortality study (time series) using:
  – National Coroners Information System (NCIS), ~16,000 suicide cases with LF status (numerators)
  – Population data from the Australian Bureau of Statistics (ABS) (denominators)
    • Labour Force, Australia, Feb 2014
    • Persons Not in the Labour Force (NILF), Australia, Sep 2012
ISSUES WITH DIFFERING DEFINITIONS

- ABS LF surveys define UE as:
  - “looking for work in the 4 weeks prior to the monthly labour market survey”
  - classify discouraged UE job seekers (>4 weeks) as ‘NILF’

- UE status in NCIS based on Coronial record
  - broader and more varied definition includes ‘UE’ for >4 weeks
THUS...

- Economically inactive/unemployed combined in our analysis

Unemployed (in population/suicide data) + Economically inactive (15-64 years)

... excluding those with a specified reason for being out of the labour force, such as being ill, retired, injured, studying or looking after children at the time of death)
Age-adjusted suicide rates among the employed and economically inactive by sex, 2001 to 2010

- Rates (IRR) in econ inactive increased by up to 20% over 2007 & 2008
- Rates (IRR) in employed increased by up to 7%, only in 2007
- GFC was associated with a very small transient rise in suicide rate among employed, and a transient increase in economically inactive
- Not clear that increases GFC-attributable, but consistent with ‘mild’ exposure to the GFC in Australia
DISCUSSION

• Results possibly masking widening disparity by occupational status/skill level differences during the GFC?
  – Lower occupational status groups more susceptible to GFC impacts (UK study by Roberts et al., 2013)?
  – Greater changes in job insecurity?
DISCUSSION

- Highlights need to target entire working-age population in suicide prevention activities

Thank you

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