

Loneliness and social isolation dynamics around the onset of long-term health conditions

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Preliminary work – Please do not cite



Background

Loneliness and social isolation exacerbate LTHC burden

- Having a chronic debilitating health condition can shape the social aspects of our lives

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- Being lonely and socially isolated can exacerbate the LTHC burden
 - Being lonely and socially isolated predicts poorer quality of life (Rizal et al., 2025; Majmudar et al., 2022), higher mortality and morbidity (e.g., Valtorta et al., 2016; Holt-Lunstad et al., 2015), and higher costs (e.g., Engel et al., 2025), even after controlling for health and socioeconomic factors

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- Understanding how social isolation and loneliness (SIL) evolve around the onset of an LTHC can be useful to better design the timing and type of intervention to address them

Growing longitudinal evidence, but...

- Growing interest in the public health literature in how SIL evolves around the onset of health conditions:
 - Examples: chronic pain (Bloomberg et al., 2025), cancer (Park and Kim, 2022), stroke (Willroth et al., 2024), diabetes (Kristensen et al., 2024), heart attack (Dhand et al., 2018), mobility loss (Augustsson et al., 2026), dementia (Hackett et al., 2019)
 - Findings: SIL often already elevated (and rising) pre-onset; post-onset worsening is larger and more persistent for functionally limiting conditions (stroke, dementia, mobility loss) than for other conditions (heart attack or diabetes)
 - Mostly older populations (SHARE, ELSA, etc.), disease-specific, and no mental health condition onset

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 - Mostly older populations (SHARE, ELSA, etc.), disease-specific, and no mental health condition onset
- In economics, studies examine the effects of health shocks on employment, income, household finance, and life satisfaction (e.g., Polidano and Vu, 2015; Di Meo and Eryilmaz, 2025)
 - Loneliness and social isolation (themselves) are important indicators that can (potentially) be intervened on to reduce the health & economic burden

This paper

- Describing how loneliness and social isolation evolve around the onset of LTHC and exploring what may explain these patterns

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- Long panel with up to 20+ years of observations (for some people), involving a broader age range (15+)
- Broad conditions: any, mental health-related and non-mental health (“other”) conditions
- Australian evidence, relevant for the “local” context

How we approach this

Data and onset definition

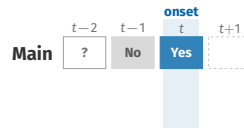
Data: HILDA Waves 3–24 (2003–2024); 25,539 people aged 15+, with a total of 226,902 person-year observations

Conditions: *“Do you have any long-term health condition, impairment or disability that restricts you in your everyday activities, and has lasted or is likely to last, for 6 months or more?”*

- Grouped into any, mental health-related, and non-mental health → different “events”
- Often used as a measure of disability (Polidano and Vu, 2015; Aitken et al., 2020)

Alternatives: Any illness or injury in the past 12 months (life event question); self-reported doctor or nurse diagnoses (4 waves: 9, 13, 17, 21)

Onset: first reported condition immediately after no reported condition (requires 2 consecutive waves with non-missing LTCH items)



? = can be missing

For each condition, we have 2 groups: onset and never-onset cohorts

Condition types (showcard). **MH (2):** nervous or emotional condition requiring treatment; mental illness requiring help or supervision. **Non-MH (15):** sight; hearing; speech; blackouts or fits; slow at learning or understanding; limited use of arms or fingers; difficulty gripping; limited use of feet or legs; restricted physical activity; disfigurement or deformity; shortness of breath; chronic or recurring pain; effects of head injury, stroke or brain damage; condition still restricting despite treatment; other (e.g. arthritis, asthma, heart disease, dementia).

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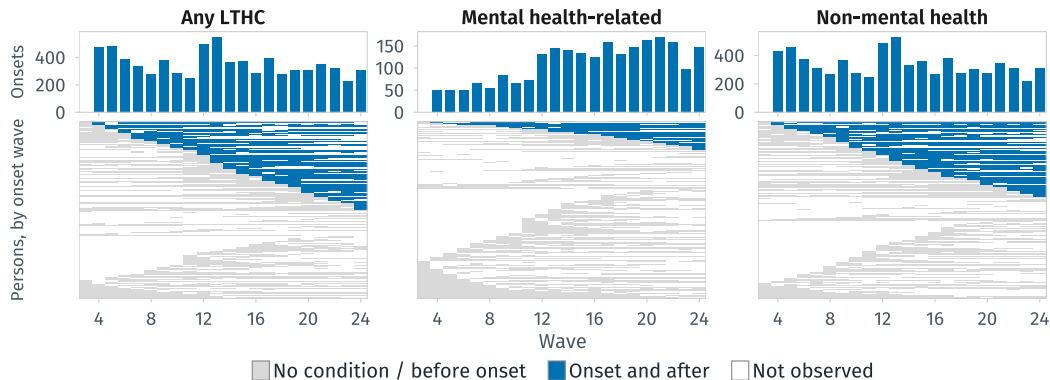
	t−2	t−1	onset t	t+1	
Main	?	No	Yes		
Looser	?	?	Yes		any first report
Stricter	No	No	Yes	Yes	0011

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What does the panel look like?



Top: persons by wave of onset. Bottom: the subsample of persons displayed by panelView (Mou et al., 2023), sorted by onset wave.

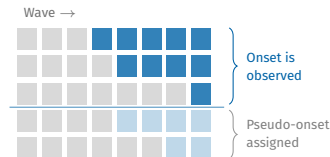
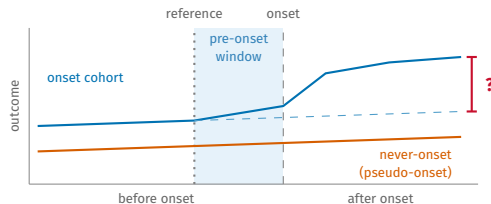
Panel: Waves 3–24, respondents aged 15+ who answered the LTHC question. **Excluded:** those who report any LTHC in Waves 1–3; respondents with missing covariates, loneliness or social isolation at the first wave they are observed in the panel (“panel entry”); and person-waves where either loneliness or social isolation is missing.

Outcomes

- **Loneliness:** scoring 5 or more on a 1–7 scale (“strongly disagree” to “strongly agree”) for “I often feel very lonely”.
- **Social isolation:** living alone and getting together socially with friends/relatives outside the household less than once a week.
- **Alternatives:** multi-item classification (Australian Institute of Health and Welfare, 2026; Manera et al., 2022); continuous score (1–7); lack of social support
- **Additional “relevant” outcomes**
 - Part of SI: living alone and frequency of social contact; partnership and marriage (relationship)
 - Health and functioning: SF-36 social functioning and physical functioning scales (0–100), overall SF-6D HRQoL/health utility (0–1)

Illustrative approach

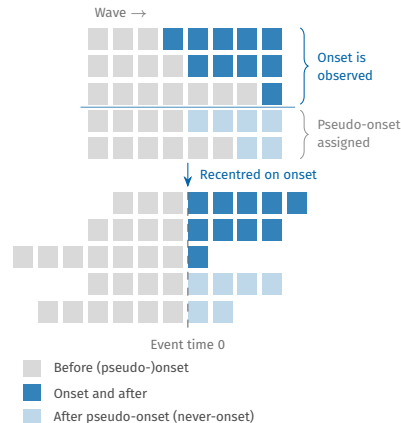
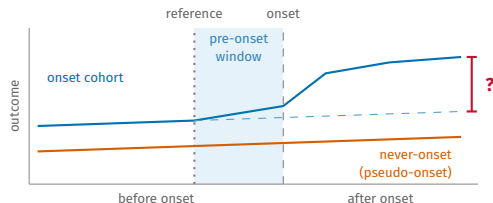
- Onset is reported in different waves; some people never report it (conditional on participating in the survey)
- Comparing onset cohort vs never-onset cohort trends in outcomes:
 - Method: recentre time around onset; assign pseudo-onset waves to the pool of the never-onset cohort (similar to Gao et al., 2025)
 - Age-sex adjusted outcomes



- Before (pseudo-)onset
- Onset and after
- After pseudo-onset (never-onset)

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Difference-in-differences event study approach

- Event study specification

$$Y_{it} = \alpha_i + \lambda_t + \sum_{k=-8, k \neq -5}^8 \beta_k D_{it}^k + \varepsilon_{it}$$

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- Estimated using the CS-DiD approach (Callaway and Sant'Anna, 2021), allowing the not-yet-onset cohort as comparison, with IPW adjustment for age and sex
 - Window of 8 waves before and after onset, with $k = -5$ as a reference period given outcomes may change before onset (Bloomberg et al., 2025)
 - Building blocks: many 2×2 DiDs for each onset cohort g and time t
 - Pair-balanced approach: individuals must be observed in both the reference period and the “target” period (Rios-Avila et al., 2025); aggregated into event-time coefficients (β_k)
 - Summarised as the at-onset estimate (β_0) and the post-onset average (Di Meo and Eryilmaz, 2025)

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- Heterogeneity analysis by age, sex, education and remoteness of residence
- **Robustness:** conventional TWFE, Sun–Abraham (Sun and Abraham, 2021); changing the reference period, balanced panel; no IPW adjustment, balanced sample around onset, etc.

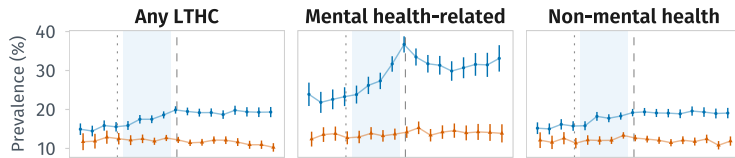
What we found

Who reports onset

At panel entry	Any LTHC		Mental health-related		Non-mental health	
	Onset	Never-onset	Onset	Never-onset	Onset	Never-onset
Age (years)	38	29	32	33	39	29
Female	54%	51%	62%	51%	54%	52%
Married	61%	50%	50%	54%	62%	50%
Below high school	42%	39%	51%	40%	41%	40%
Employed	65%	69%	53%	66%	65%	68%
Income (AU\$)	41,493	51,023	40,102	48,196	40,949	51,009
Lonely	17%	15%	25%	16%	17%	16%
Socially isolated	2.1%	1.2%	1.7%	1.6%	2.2%	1.2%
Age at onset	45	–	39	–	45	–
Persons	7,434	13,942	2,335	22,184	7,117	14,624

Measured at panel entry. Means for age and income, percentages otherwise. Income: equivalised household income. Never-onset: people who never report the condition while observed.

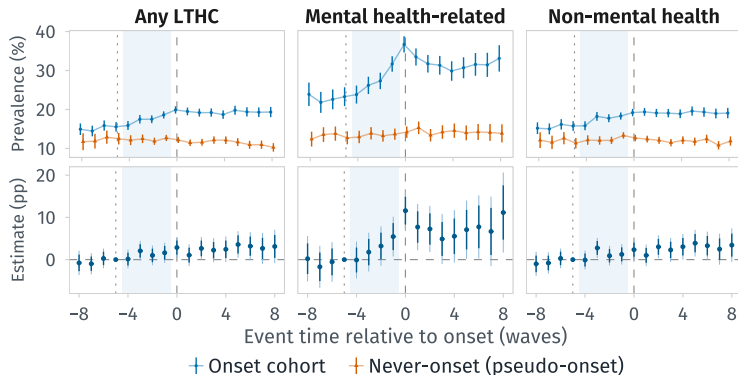
Loneliness rises before onset and stays elevated afterwards



+ Onset cohort + Never-onset (pseudo-onset)

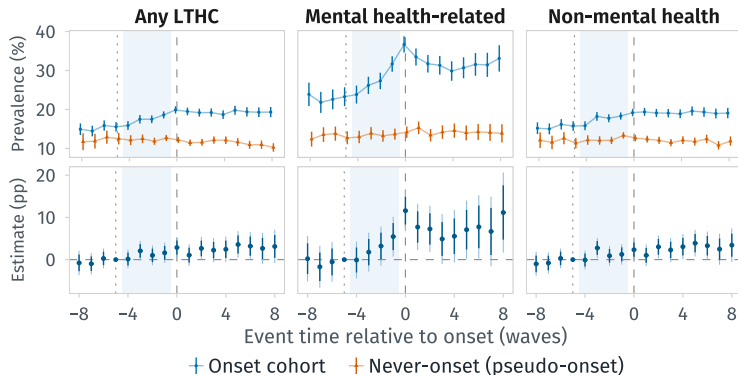
Top: adjusted prevalence; never-onset people assigned pseudo-onset waves. Bottom: CS-DiD estimates with 95% pointwise (dark) and simultaneous (light) CIs. Dotted line: reference period ($k = -5$); shaded: pre-onset window.

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Loneliness rises before onset and stays elevated afterwards



Loneliness was already higher before onset was reported.

They are trending similarly but then increase approaching the onset wave.

+2.9 pp

at onset, any condition

+11.6 pp

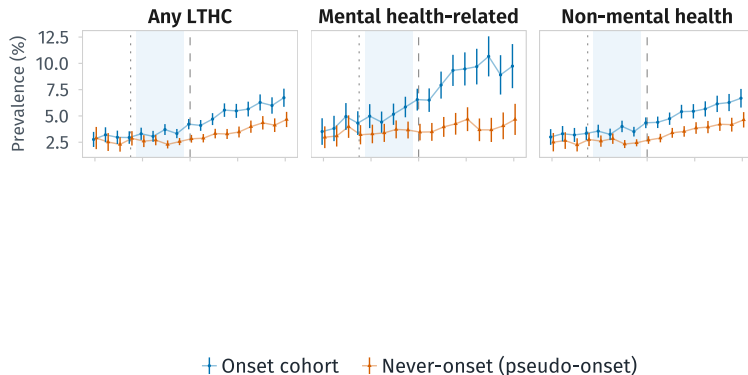
at onset, mental health-related

MH: 5.5 pp higher one wave before.

All: remains relatively higher after onset.

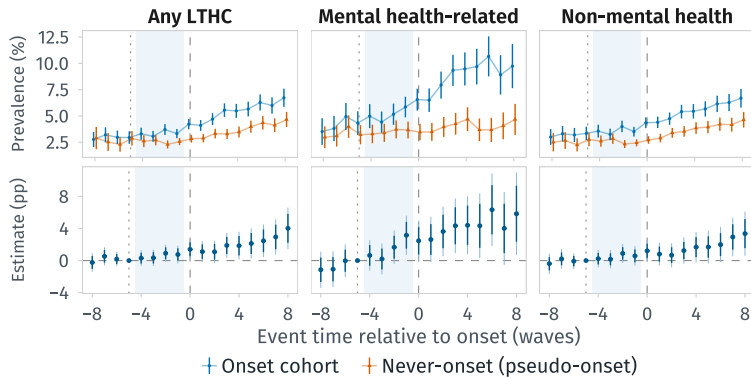
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Social isolation (mostly) builds up after onset



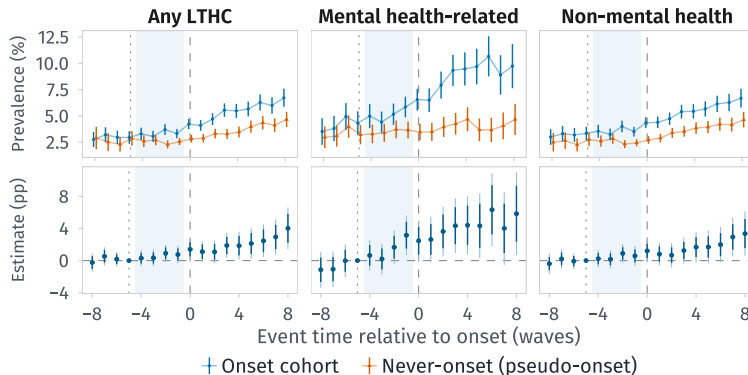
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Social isolation (mostly) builds up after onset



Relatively similar level of social isolation before onset was reported.

Trending higher (mainly) at and after onset.

+2.1 pp

post-onset average, any condition

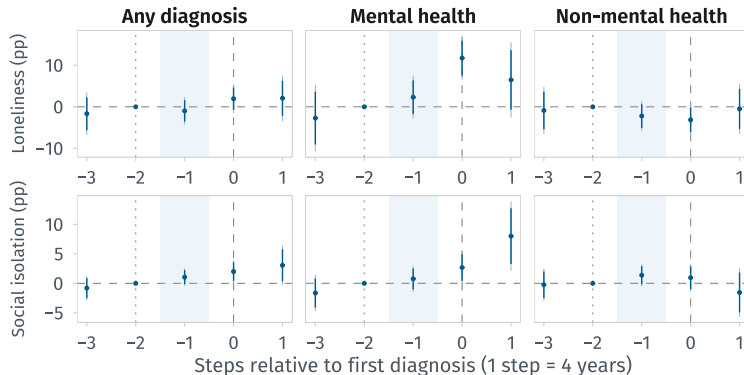
+4.2 pp

post-onset average, mental health-related

MH: already rising in the two waves before onset (+3.2 pp at $k = -1$).

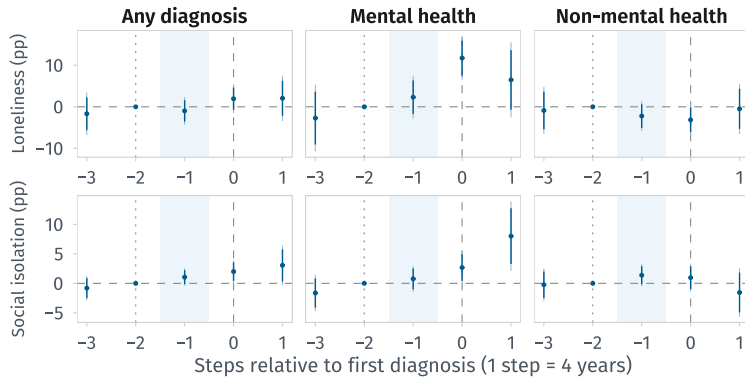
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A (broadly) similar pattern using reported diagnoses



CS-DiD on the four diagnosis waves (1 step = 4 years). Reference: two steps before the first reported diagnosis.

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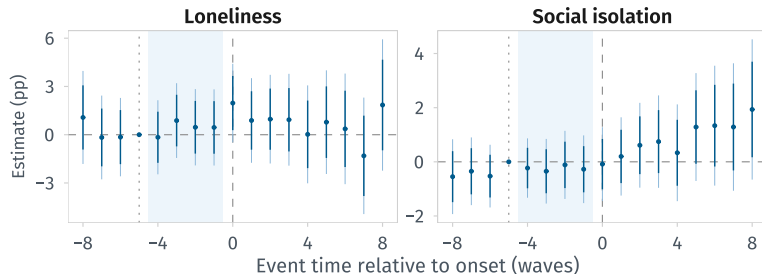
Doctor or nurse-diagnosed conditions, asked in four waves only.

Similar pattern to LTHC onset:

- Loneliness peaked at onset and receding afterward
- Social isolation grows over time
- Bigger changes around MH diagnoses
- No increase around non-MH diagnoses (loneliness slightly lower at diagnosis)

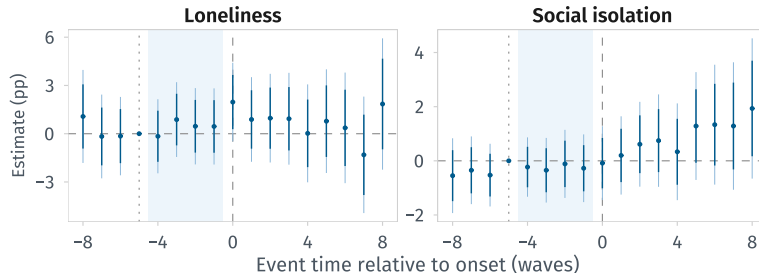
CS-DiD on the four diagnosis waves (1 step = 4 years). Reference: two steps before the first reported diagnosis.

A slight jump in loneliness at the first reported injury or serious illness



Onset: first report of a serious illness or injury in the past 12 months (life event question), same onset rule; 6,093 people. CS-DiD estimates with 95% pointwise (dark) and simultaneous (light) CIs.

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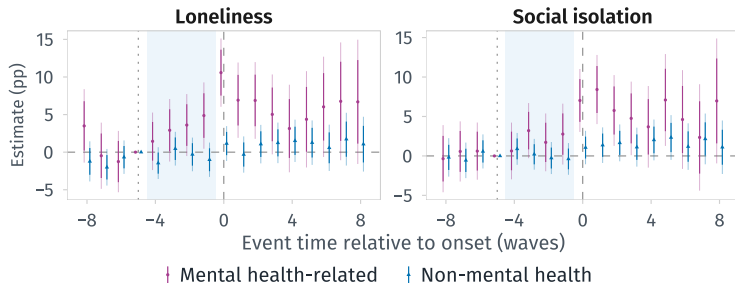


Loneliness jumps at the first reported illness or injury and then goes back towards zero after that.

Social isolation tends to grow over time, but none of the event-time estimates are statistically significant (simultaneous CIs).

Onset: first report of a serious illness or injury in the past 12 months (life event question), same onset rule; 6,093 people. CS-DiD estimates with 95% pointwise (dark) and simultaneous (light) CIs.

Alternative outcomes

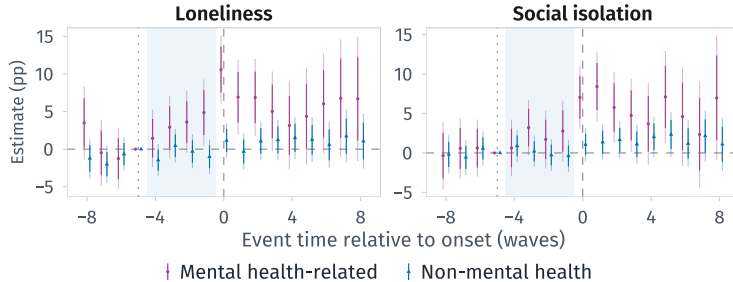


Multi-item classifications following Manera et al. (2022). Each item/statement is scored 1 (strongly disagree) to 7 (strongly agree).

Lonely (median ≥ 5): “People don’t come to visit me as often as I would like”; “I often need help from other people but can’t get it”; “I often feel very lonely”.

Socially isolated (median ≤ 4): “There is someone who can always cheer me up when I’m down”; “I enjoy the time I spend with the people who are important to me”; “When something’s on my mind, just talking with the people I know can make me feel better”; “When I need someone to help me out, I can usually find someone”.

Alternative outcomes



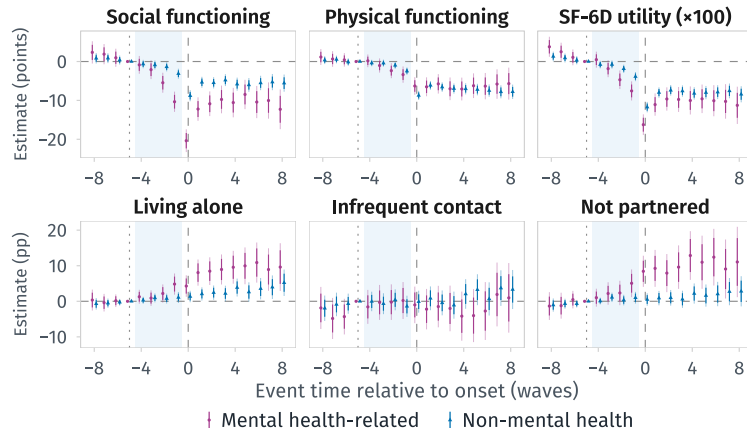
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Patterns in loneliness and social isolation around MH LTHC onset now both look more similar to the main loneliness results.

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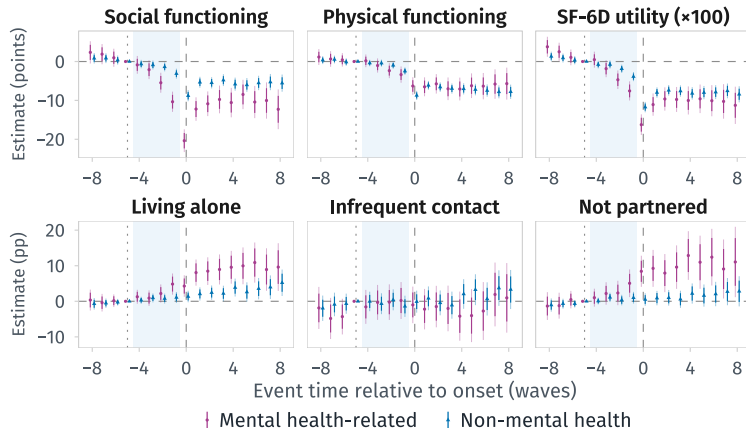
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What changes alongside



95% pointwise (solid) and simultaneous (faint) CIs. Not partnered: people married or partnered at panel entry. Functioning 0–100; SF-6D utility (0–1) shown $\times 100$.

What changes alongside



Health and functioning

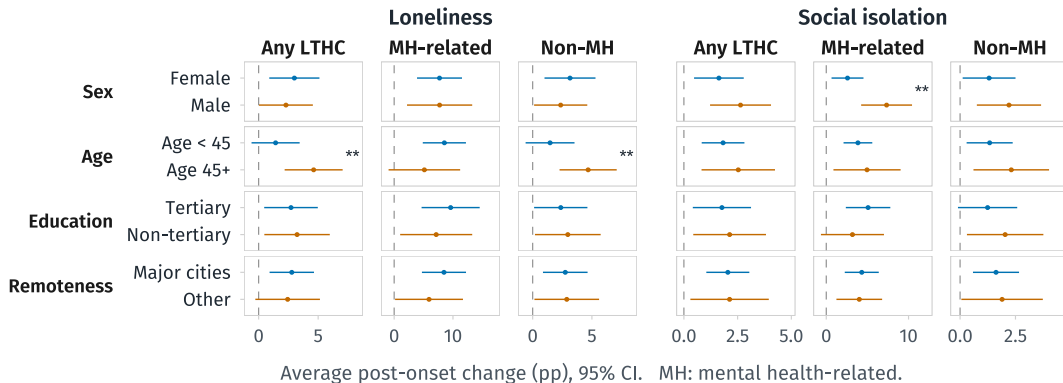
Social functioning (e.g. health limiting social activities), physical functioning (e.g. climbing stairs, walking) and SF-6D health utility track closely with the loneliness trajectory.

Relationship and contact

Living alone increases over time and more people are no longer partnered (mostly divorce or separation, around MH onset); contact frequency (getting together socially less than once a week) changes little.

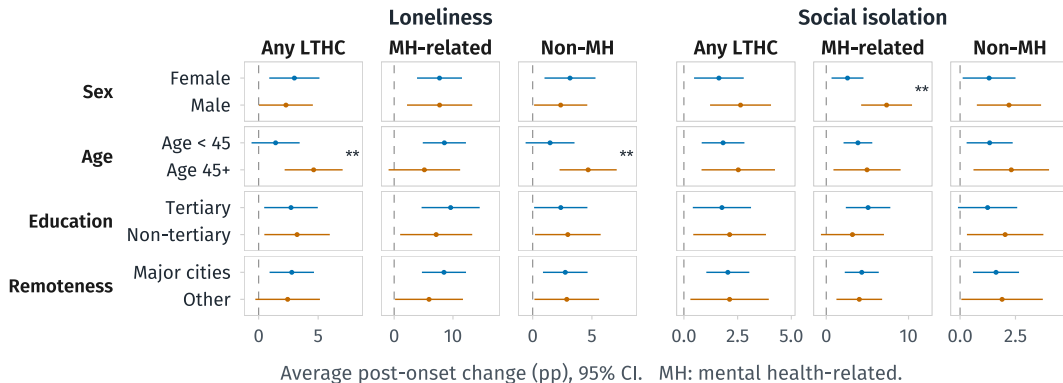
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Which groups experience bigger/smaller changes?



Average post-onset change with 95% CI by baseline subgroup. **: Wald test of the subgroup difference, $p < 0.05$. Education: people aged 25 and over.

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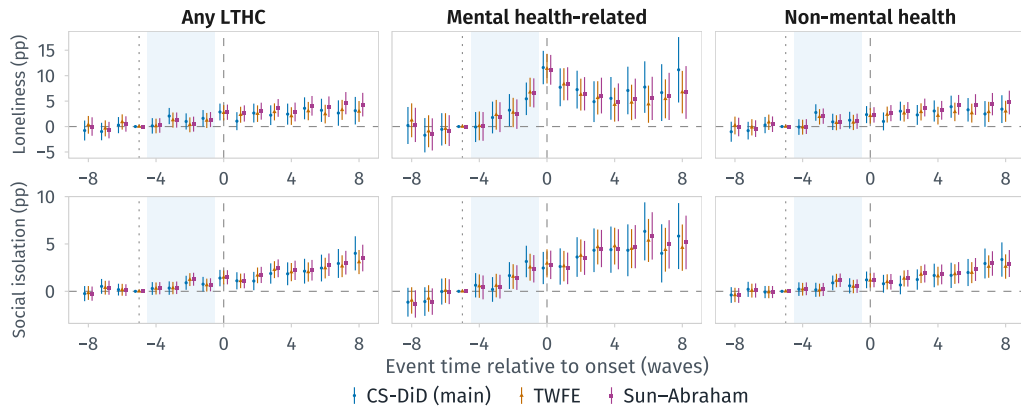


A bit of difference by sex (social isolation around MH onset) and age (loneliness around any and non-MH onset).

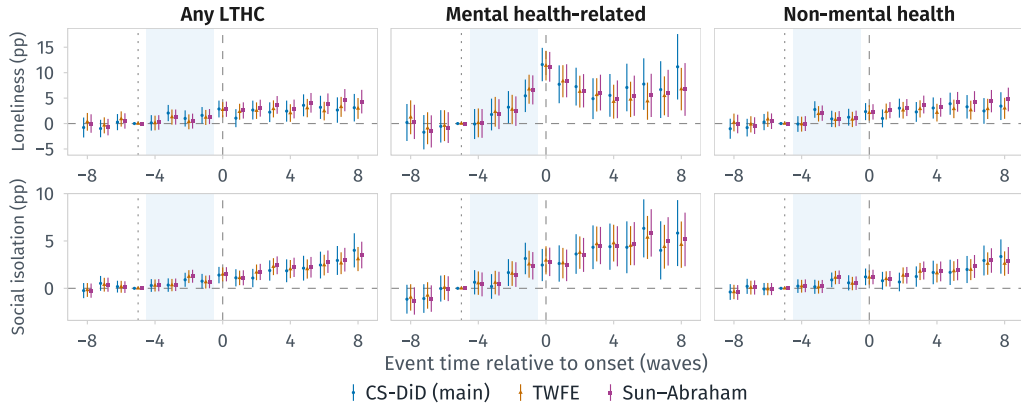
Average post-onset change with 95% CI by baseline subgroup. **: Wald test of the subgroup difference, $p < 0.05$. Education: people aged 25 and over.

Are the main results robust?

Does the estimator matter?

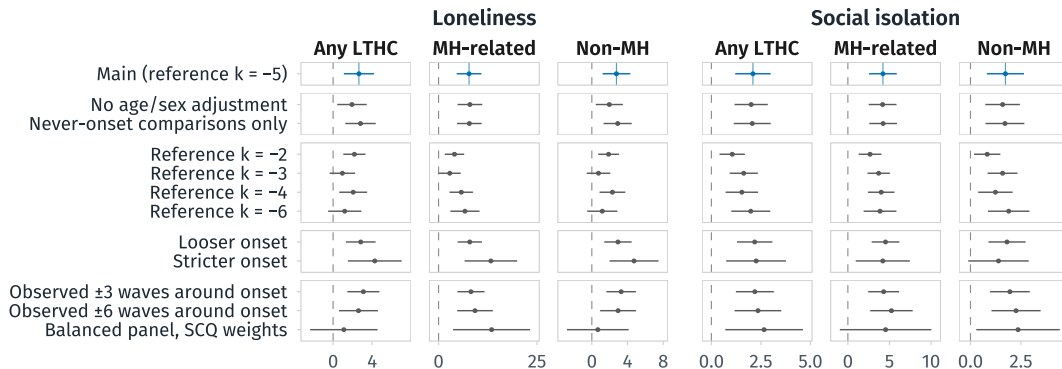


Does the estimator matter?



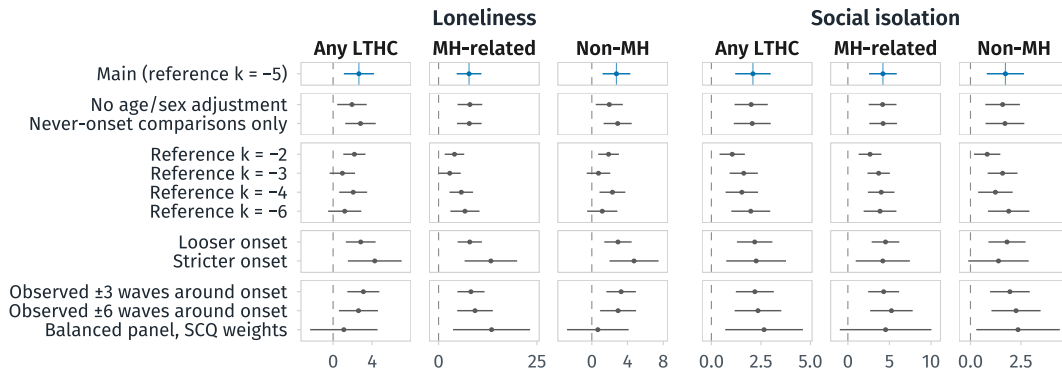
The overall pattern is similar across different estimators; TWFE produces smaller estimates for loneliness, most visibly the post-onset average around mental health-related onset (6.4 vs 7.7 pp).

How robust are the post-onset averages?



Post-onset average (k = 0–8), pp, 95% CI. Blue: main estimate. MH: mental health-related.

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Post-onset average (k = 0-8), pp, 95% CI. Blue: main estimate. MH: mental health-related.

Loneliness results, esp. for any and non-MH LTHC, are particularly sensitive to the choice of reference period.

Discussion

Take away

- Social isolation and loneliness (as defined here) develop differently around the onset of LTHC.
 - Loneliness is already higher before onset & peaks at onset; social isolation grows over time.
 - Big Q: Can tackling SIL reduce LTHC incidence in the future?

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 - Big Q: Can tackling SIL reduce LTHC incidence in the future?
- Onset of mental health-related conditions is more strongly associated with both outcomes
 - Support more attention to social connection interventions around mental health conditions?

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- Social isolation and loneliness (as defined here) develop differently around the onset of LTHC.
 - Loneliness is already higher before onset & peaks at onset; social isolation grows over time.
 - Big Q: Can tackling SIL reduce LTHC incidence in the future?
- Onset of mental health-related conditions is more strongly associated with both outcomes
 - Support more attention to social connection interventions around mental health conditions?
- Changes in social isolation appear to be driven by increased living alone, while loneliness tracks closely with health and functioning indices
 - Transition out of a relationship → living alone?

Take away

- Social isolation and loneliness (as defined here) develop differently around the onset of LTHC.
 - Loneliness is already higher before onset & peaks at onset; social isolation grows over time.
 - Big Q: Can tackling SIL reduce LTHC incidence in the future?
- Onset of mental health-related conditions is more strongly associated with both outcomes
 - Support more attention to social connection interventions around mental health conditions?
- Changes in social isolation appear to be driven by increased living alone, while loneliness tracks closely with health and functioning indices
 - Transition out of a relationship → living alone?
- Separate responses to loneliness and social isolation within LTHC management/care
 - Assessed separately; priority for loneliness early on and more relational support (for social isolation) later?

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- Single-item loneliness could be quite noisy; only MH onset shows significant changes in multi-item scale
- Many things can happen around the onset of LTHC, hard to attribute these changes to the condition itself

Thank you!

I welcome your questions and feedback.

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for Better Health Project

