Partners in health?

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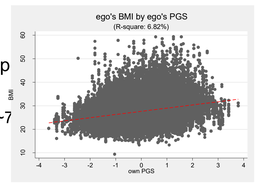
Problem / Question

- Is health behavior 'contagious'? (Christiakis & Fowler, 2007)
- Partners are similar in health and lifestyle. But do partner's have a causal social influence on each others BMI?
- Hard to prove partner effects even in longitudinal studies due to homophily (assortative mating), unmeasured confounders, and reverse causality
- How genes may help to test role of partner:
  - A. Does a partner's genetic makeup influence ego's BMI (net of own genetic predisposition)? (**Social Genetic Effects**)
  - B. Can the partner's genes be used as instruments to test social influence (**Mendelian Randomization**)?

Health and Retirement Study

SAMPLE

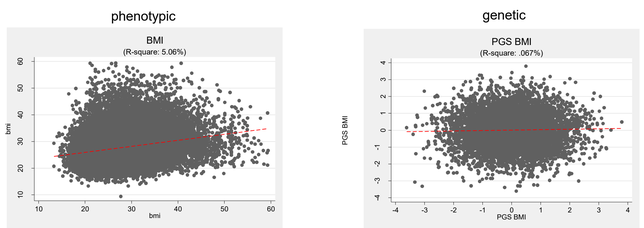
- Baseline 1992, follow-up every 2 years (till 2016 included)
  - Birth cohorts 1910-1985, average age 65 (min 27, max 99)
  - Average relationship length ~34 years
- Sample restrictions:
  - Americans of European descent
  - Excluded same-sex couples
  - Listwise deletion
- On average ~7 observations per individual/couple
- *N* = 50.491 observations, 6.719 individuals, 3.337 coup



Main variables (for both partners in a dyad):

- weighted PGS for BMI (Yengo et al., 2018 GIANT), R^2=~7
- first 10 principal components
- BMI ((lagged for the partner), sex, education,
- age + age^2 (lagged for the partner)
- Interactions of age + age^2 with ego's sex, both education levels and ego's PGS,
- years in relationship, year of interview dummies

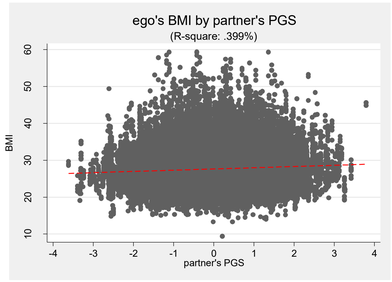
Partner similarity in sample



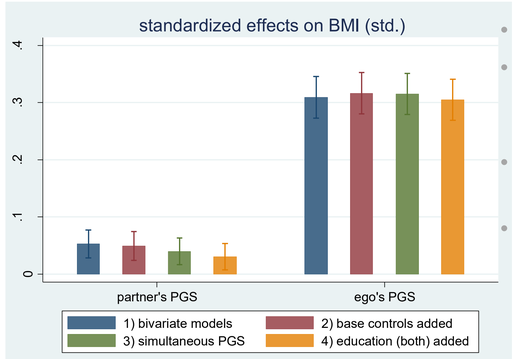
References

- Christakis, N.A. and J.H. Fowler, The Spread of Obesity in a Large Social Network over 32 Years. New England Journal of Medicine, 2007. 357(4): p. 370-379
- O'Malley, A.J., et al., Estimating peer effects in longitudinal dyadic data using instrumental variables. Biometrics, 2014. 70(3): p. 506-515.
- Yengo, L., et al., Meta-analysis of genome-wide association studies for height and body mass index in ~700,000 individuals of European ancestry. bioRxiv, 2018.

I) Social Genetic Effects (SGE)



II) SGE: Results



Main findings:

ego's BMI predicted by both partner PGS for BMI

Partner's effect about 1/6 of ego's

Effect decreases somewhat but remains in subsequent models

SGE moderation?

- Spousal genetic influence on ego's BMI is moderated by
  - gender (no)
  - spousal education (yes, increases effect)*
  - ego's own education (yes, increases effect)
  - spousal age + age squared (no)
  - relationship duration (yes, increases effect)*
- No epistatic effects: No interaction with ego's PGS

* remain in fully interacted models and also when including similar interactions with own BMI

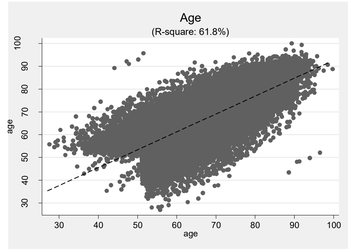
III) SGE: Partner's genes matter?

- The partner's matters, also his/her genetic-makeup
- Partner's SGE remain even controlling for ego's PGS
- Extends previous SGE findings (school friends, siblings) to long-term relationships
- SGE larger if
  - spouse is better educated (power in relationship?)
  - longer lasting relationships (converge?)
- Future work: update PGS; explore other health behaviors

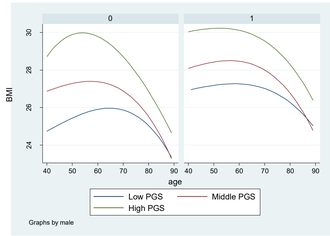
I) Causal social influence?

- Peer effects hard to identify: homophily, confounding, reverse causality. Previous research: longitudinal models
- Alternatively use MR, but standard MR not a solution
  - Does not solve gene-based homophily
  - New problems: pleiotropy; population stratification
- Credible MR(?):
  - gene-expression (by age + age^2) as instruments (O'Malley et al., 2014)
  - And fixed effects at couple/individual level

Age variation withn couples

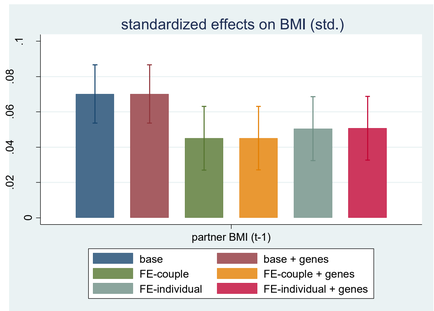


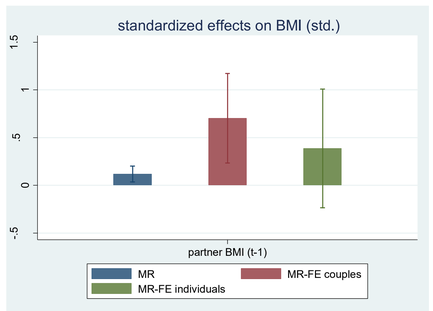
Effects of PGS BMI depend on age



II: Effects of partner's BMI (*t*-1)

- We replicate and extend previous work:
  - longitudinal dyadic models with lagged partner's BMI
  - new controls for own genetic predisposition + gene expression by age
  - MR using gene-expression with individual/couple fixed effects





III) Credible MR?

- MR models also point to causal social influence processes but work-in-progress…
- Effect estimate have wide s.e.'s; lack of power
- Pleiotropy really controlled for?
  - Models also control for education * age interactions
  - Effects remain using PGS with different threshold (only genome-wide significant SNPs)