

ONLINE APPENDIX

R script for calculating estimated relative risks under selection bias causal structure (figure 1a) over a range of input parameters:

```
get.RRu = function(
  pU,                # prevalence of unmeasured confounder (U)
  pHF.0,             # prevalence of heart failure (HF) among normal weight
  RR.HF.Obesity,     # RR for effect of obesity on HF
  RR.HF.U.0,         # RR for effect of U on HF among normal weight
  RR.HF.U.1,         # RR for effect of U on HF among obese
  RR.M.U,            # RR for effect of U on M among HF patients
  RR.M.Obesity       # RR for effect of obesity on M
)
{
  pHF.00 = pHF.0/(1+pU*(RR.HF.U.0-1)) # prevalence of HF among normal weight without U
  pHF.01 = pHF.00*RR.HF.U.0           # prevalence of HF among normal weight with U
  pHF.1 = pHF.0*RR.HF.Obesity          # prevalence of HF among obese
  pHF.10 = pHF.1/(1+pU*(RR.HF.U.1-1)) # prevalence of HF among obese without U
  pHF.11 = pHF.10*RR.HF.U.1           # prevalence of HF among obese with U
  pU.HF.0 = pHF.01*pU/pHF.0           # prevalence of U among HF patients without U
  pU.HF.1 = pHF.11*pU/pHF.1           # prevalence of U among HF patients with U
  relative.bias = (1+pU.HF.1*(RR.M.U-1))/(1+pU.HF.0*(RR.M.U-1))
                                     # relative bias of RR for effect of obesity on M
                                     # among HF patients, without adjustment for U;
                                     # see VanderWeele, 2010, page 550
  return(RR.M.Obesity*relative.bias)  # observed RR = true RR * relative bias
}

make.tables = function(
  pU = c(0.05, 0.1, 0.2, 0.3, 0.4, 0.5),
  pHF.0 = 0.03,
  RR.HF.Obesity = 2,
  RR.HF.U.0 = c(2, 5),
  RR.HF.U.1 = c(0.67, 1, 1.5),
  RR.M.U = c(2, 5),
  RR.M.Obesity = c(1.25, 1.5, 2)
)
{
  output = matrix(NA, length(RR.M.U)*length(RR.HF.U.1), length(pU)+2)
  dimnames(output) = list(rep("", length(RR.M.U)*length(RR.HF.U.1)), c("RR.M.U", "RR.HF.U.1", pU))
  output[, 1] = rep(RR.M.U, length(RR.HF.U.1))
  output[, 2] = rep(RR.HF.U.1, rep(length(RR.M.U), length(RR.HF.U.1)))
  for(g in 1:length(RR.HF.U.0)) {
    for(h in 1:length(RR.M.Obesity)) {
      for(i in 1:length(RR.HF.U.1)) {
        for(j in 1:length(RR.M.U)) {
          for(k in 1:length(pU)) {
```

```

        row = length(RR.M.U)*(i-1) + j
        output[row, k+2] = get.RRu(
            pU = pU[k],
            pHF.0 = pHF.0,
            RR.HF.Obesity = RR.HF.Obesity,
            RR.HF.U.0 = RR.HF.U.0[g],
            RR.HF.U.1 = RR.HF.U.1[i],
            RR.M.U = RR.M.U[j],
            RR.M.Obesity = RR.M.Obesity[h])
    }
}

cat("\nRR for effect of obesity on mortality in HF patients: ", RR.M.Obesity[h])
cat("\nRR.HF.U.0 for effect of U on HF in normal weight patients: ", RR.HF.U.0[g])
cat("\n      Prevalence of U in population without HF\n")
print(round(output, 2))
}
}

make.tables()
# table focusing on cited illustration
make.tables(RR.M.Obesity=1.25, RR.HF.U.0=5, RR.HF.U.1=1, RR.M.U=2:5)

```

Estimated relative risks under selection bias

Estimated relative risks (RRs) for effect of obesity on mortality among patients with heart failure (HF), if data were generated under the selection bias causal structure (figure 1a), and analyzed without adjustment for the unmeasured confounder (U).

Results shown across variations of:

- prevalence of U in the population without HF
- RR for effect of omitted confounder (U) on HF among normal weight patients (RR.HF.U.0)
- RR for effect of U on HF among obese patients (RR.HF.U.1)
- RR for effect of obesity on mortality among HF patients
- RR for effect of U on mortality among HF patients (RR.M.U)

RR for effect of obesity on mortality in HF patients: 1.25

RR.HF.U.0 for effect of U on HF in normal weight patients: 2

RR.M.U	RR.HF.U.1	Prevalence of U in population without HF					
		0.05	0.1	0.2	0.3	0.4	0.5
2	0.67	1.18	1.13	1.07	1.05	1.04	1.05
5	0.67	1.03	0.92	0.84	0.83	0.85	0.89
2	1.00	1.2	1.16	1.12	1.11	1.11	1.12
5	1.00	1.09	1.01	0.96	0.97	0.99	1.02
2	1.50	1.22	1.21	1.19	1.19	1.19	1.2
5	1.50	1.17	1.14	1.12	1.13	1.14	1.16

RR for effect of obesity on mortality in HF patients: 1.5

RR.HF.U.0 for effect of U on HF in normal weight patients: 2

RR.M.U	R.HF.U.1	Prevalence of U in population without HF					
		0.05	0.1	0.2	0.3	0.4	0.5
2	0.67	1.42	1.36	1.29	1.26	1.25	1.26
5	0.67	1.23	1.11	1.01	1	1.02	1.07
2	1	1.44	1.4	1.35	1.33	1.34	1.35
5	1	1.3	1.22	1.16	1.16	1.19	1.23
2	1.5	1.47	1.45	1.43	1.43	1.43	1.44
5	1.5	1.4	1.36	1.34	1.35	1.37	1.39

RR for effect of obesity on mortality in HF patients: 2

RR.HF.U.0 for effect of U on HF in normal weight patients: 2

RR.M.U	R.HF.U.1	Prevalence of U in population without HF					
		0.05	0.1	0.2	0.3	0.4	0.5
2	0.67	1.89	1.81	1.72	1.67	1.67	1.68
5	0.67	1.65	1.48	1.35	1.33	1.36	1.42
2	1	1.92	1.86	1.8	1.78	1.78	1.8
5	1	1.74	1.62	1.54	1.55	1.58	1.64
2	1.5	1.96	1.93	1.91	1.9	1.91	1.92
5	1.5	1.87	1.82	1.79	1.8	1.83	1.85

RR for effect of obesity on mortality in HF patients: 1.25

RR.HF.U.0 for effect of U on HF in normal weight patients: 5

RR.M.U	R.HF.U.1	Prevalence of U in population without HF					
		0.05	0.1	0.2	0.3	0.4	0.5
2	0.67	1.07	0.98	0.92	0.91	0.92	0.96
5	0.67	0.77	0.66	0.61	0.63	0.69	0.75
2	1	1.09	1.01	0.96	0.97	0.99	1.02
5	1	0.82	0.72	0.7	0.74	0.8	0.87
2	1.5	1.11	1.05	1.02	1.03	1.06	1.09
5	1.5	0.88	0.81	0.81	0.86	0.92	0.98

RR for effect of obesity on mortality in HF patients: 1.5**RR.HF.U.0 for effect of U on HF in normal weight patients: 5**

RR.M.U	R.HF.U.1	Prevalence of U in population without HF					
		0.05	0.1	0.2	0.3	0.4	0.5
2	0.67	1.28	1.18	1.1	1.09	1.11	1.15
5	0.67	0.93	0.79	0.73	0.76	0.82	0.9
2	1	1.3	1.22	1.16	1.16	1.19	1.23
5	1	0.98	0.86	0.84	0.89	0.96	1.04
2	1.5	1.33	1.26	1.23	1.24	1.27	1.31
5	1.5	1.06	0.97	0.97	1.03	1.1	1.18

RR for effect of obesity on mortality in HF patients: 2**RR.HF.U.0 for effect of U on HF in normal weight patients: 5**

RR.M.U	R.HF.U.1	Prevalence of U in population without HF					
		0.05	0.1	0.2	0.3	0.4	0.5
2	0.67	1.71	1.58	1.47	1.45	1.48	1.53
5	0.67	1.24	1.05	0.98	1.02	1.1	1.2
2	1	1.74	1.62	1.54	1.55	1.58	1.64
5	1	1.31	1.15	1.12	1.18	1.28	1.38
2	1.5	1.78	1.68	1.64	1.65	1.7	1.75
5	1.5	1.41	1.29	1.3	1.38	1.47	1.57

RR for effect of obesity on mortality in HF patients: 1.25**RR.HF.U.0 for effect of U on HF in normal weight patients: 5**

RR.M.U	R.HF.U.1	Prevalence of U in population without HF					
		0.05	0.1	0.2	0.3	0.4	0.5
2	1	1.09	1.01	0.96	0.97	0.99	1.02
3	1	0.97	0.88	0.83	0.85	0.89	0.94
4	1	0.88	0.78	0.75	0.78	0.83	0.89
5	1	0.82	0.72	0.7	0.74	0.8	0.87