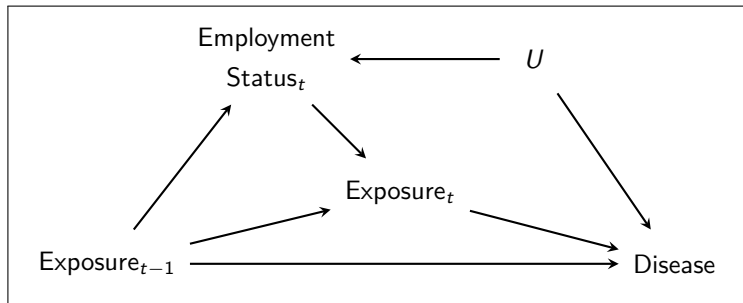


HWSE path analysis

Replicating (?) the analysis in Garcia et al. (2017)

June 3, 2021

From Erika Garcia's paper¹



The presence of the healthy worker survivor effect (HWSE) implies the presence of the following three conditions:

1. Leaving work predicts (future) exposure
2. Leaving work is associated with the disease
3. Prior exposure predicts predicts leaving work

Analytic population

- ▶ Restricted to
 - ▶ Those alive and under age 75 on January 1, 1985
 - ▶ Hired in or after 1938
 - ▶ Missing no more than half of their work history
- ▶ Leaving work and cancer incidence
 - ▶ FU spans 1985–1994 (includes SEER)
- ▶ MWF exposure and leaving work
 - ▶ FU spans 3 years after hire through 1994, death, or leaving work

An important change!

- ▶ Among those with `yrou09_new < yout15`, use `yrou09_new` as the leaving work variable

Characteristics

	Cancer follow-up		Employment follow-up	
Study population size (person-years)	31,471	(291,699)	31,471	(635,563)
Race				
White	20,589	(65%)	20,589	(65%)
Black	5,966	(19%)	5,966	(19%)
Unknown	4,916	(16%)	4,916	(16%)
Sex				
Male	27,246	(87%)	27,246	(87%)
Female	4,225	(13%)	4,225	(13%)
Plant ^b				
Plant 1	6,817	(22%)	6,813	(22%)
Plant 2	13,337	(42%)	13,340	(42%)
Plant 3	11,317	(36%)	11,318	(36%)
Ever exposed to MWFs				
Straight	18,340	(58%)	18,184	(58%)
Soluble	28,148	(89%)	28,028	(89%)
Synthetic	11,790	(37%)	11,657	(37%)
Left work	20,607	(65%)	20,607	(65%)
Deceased by end of follow-up	3,048	(10%)	449	(1%)

Cancers in men

	All cancers		Prostate	
Study population size (person-years)	1,353	(10,905)	383	(3,444)
Year of birth	1926	(1921, 1933)	1924	(1920, 1929)
Year of hire	1954	(1949, 1966)	1953	(1949, 1963)
Race				
White	797	(59%)	205	(54%)
Black	307	(23%)	122	(32%)
Unknown	249	(18%)	56	(15%)
Deceased by end of follow-up	638	(47%)	69	(18%)
Left work	1,258	(93%)	363	(95%)
Age at leaving work (years)*	55	(41, 61)	58	(49, 63)

Cancers in men

	Lung		Colorectal	
Study population size (person-years)	330	(2,251)	183	(1,512)
Year of birth	1925	(1920, 1932)	1925	(1921, 1932)
Year of hire	1953	(1949, 1965)	1953	(1949, 1966)
Race				
White	180	(55%)	112	(61%)
Black	73	(22%)	39	(21%)
Unknown	77	(23%)	32	(17%)
Deceased by end of follow-up	269	(82%)	71	(39%)
Left work	326	(99%)	174	(95%)
Age at leaving work (years)*	53	(39, 60)	56	(40, 62)

Cancers in women

	All cancers	
Study population size (person-years)	207	(1,704)
Year of birth	1930	(1921, 1943)
Year of hire	1968	(1953, 1976)
Race		
White	128	(62%)
Black	42	(20%)
Unknown	37	(18%)
Deceased by end of follow-up	81	(39%)
Left work	165	(80%)
Age at leaving work (years)*	52	(42, 59)

2. Leaving work and cancer incidence

- ▶ Exposure: Employment status (binary)
- ▶ Conditioning set:
 - ▶ Age
(index time for Cox model)
 - ▶ Cumulative MWF exposure
(lagged 1 year)
 - ▶ Year of hire
(P-spline, $df = 3$)
 - ▶ Calendar year
(P-spline, $df = 3$)
 - ▶ Duration of employment
 - ▶ Race
(unknown as white)
 - ▶ Plant
 - ▶ Sex
- ▶ If cancer incidence date was the same year as leaving work, it was considered to have occurred after leaving work
- ▶ If cancer incidence date was after date of death, it was assumed to have been on the day of death

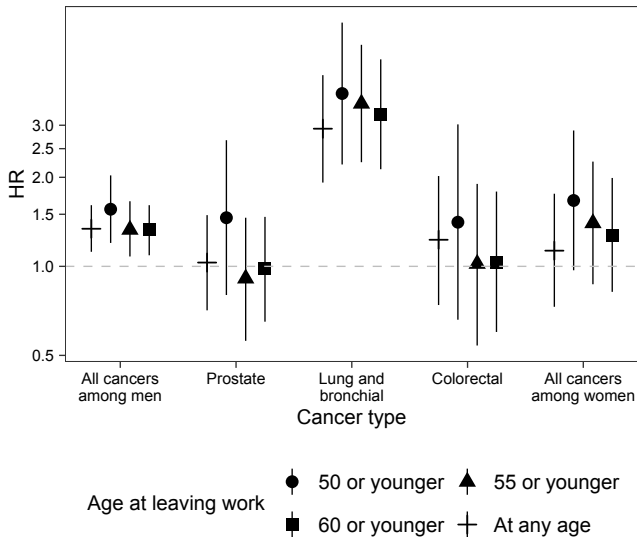
2. Leaving work by age 50 and cancer incidence

$$\begin{aligned}\log h(t \mid a, x) = & \log h_0(t) \\ & + a \cdot \mathbb{1}[t < 51] \cdot \beta_1 + a \cdot \mathbb{1}[t \geq 51] \cdot \beta_2 \\ & + x \begin{pmatrix} \beta_3 & \cdots & \beta_p \end{pmatrix}^\top\end{aligned}$$

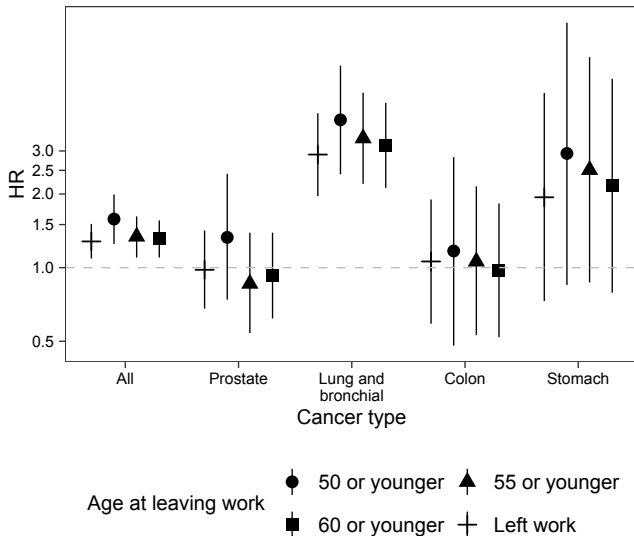
where a is the indicator of having left work, t is age, and x is a vector of covariates

- ▶ Coefficients β_1 and β_2 may be thought of as interaction effects of employment status and age

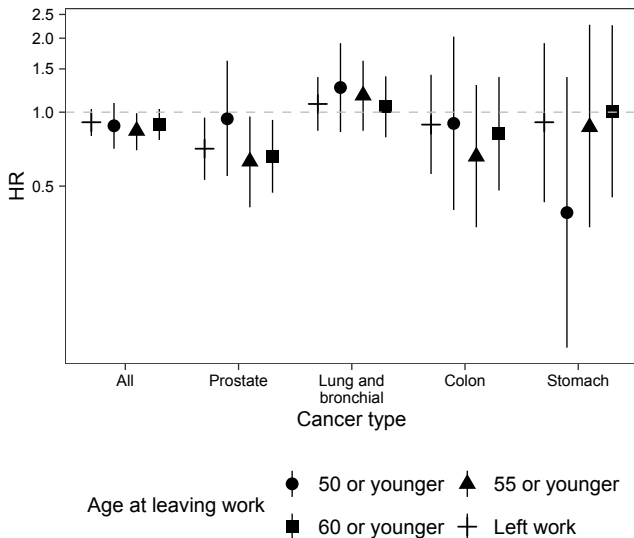
2. Leaving work and cancer incidence



2. Leaving work and cancer incidence (what I did most recently, but new YOUT and FU until 75)



2. Leaving work and cancer incidence (lagged employment status)



3. Prior exposure and leaving work

- ▶ Exposure: Cumulative exposure lagged 1 year
- ▶ Conditioning set:
 - ▶ Age
(index time for Cox model)
 - ▶ Calendar year
(P-spline $df = 3$)
 - ▶ Race
(unknown as white)
 - ▶ Plant

3. Prior exposure and leaving work (men)

MWF exposure	n	Adjusted HR	(95% CI)
Cumulative straight			
0	7996	1.00	
> 0 to 0.39	3375	1.14	(1.09, 1.19)
> 0.39 to 2.04	3375	1.08	(1.03, 1.13)
> 2.04	3375	1.09	(1.05, 1.14)
Cumulative soluble			
0 to 1.27	4442	1.00	
> 1.27 to 4.7	4560	1.10	(1.06, 1.15)
> 4.7 to 14.6	4559	1.09	(1.04, 1.14)
> 14.6	4560	1.23	(1.17, 1.29)
Cumulative synthetic			
0	12488	1.00	
> 0 to 0.262	1878	0.87	(0.82, 0.93)
> 0.262 to 1.51	1877	0.91	(0.86, 0.97)
> 1.51	1878	1.09	(1.03, 1.15)

3. Prior exposure and leaving work (women)

MWF exposure	n	Adjusted HR	(95% CI)
Cumulative straight			
0	1130	1.00	
> 0 to 0.185	452	1.05	(0.93, 1.18)
> 0.185 to 0.962	452	0.99	(0.87, 1.13)
> 0.962	452	1.15	(1.02, 1.3)
Cumulative soluble			
0 to 0.11	612	1.00	
> 0.11 to 1.55	625	1.04	(0.92, 1.17)
> 1.55 to 4.2	624	1.17	(1.03, 1.33)
> 4.2	625	1.22	(1.07, 1.4)
Cumulative synthetic			
0	1599	1.00	
> 0 to 0.172	296	1.09	(0.94, 1.27)
> 0.172 to 0.855	295	1.03	(0.88, 1.2)
> 0.855	296	1.17	(1.01, 1.35)

3. Prior exposure and leaving work (what I did most recently)

MWF exposure	n	Adjusted HR	(95% CI)
Cumulative straight			
0	6956	1.00	
> 0 to 0.314	2493	1.04	(0.99, 1.1)
> 0.314 to 1.66	2492	0.94	(0.89, 0.99)
> 1.66	2492	0.96	(0.91, 1.01)
Cumulative soluble			
0 to 0.05	2555	1.00	
> 0.05 to 2.7	3842	0.84	(0.8, 0.89)
> 2.7 to 12.2	4018	0.73	(0.69, 0.78)
> 12.2	4018	0.73	(0.69, 0.78)
Cumulative synthetic			
0	9812	1.00	
> 0 to 0.187	1541	0.91	(0.85, 0.97)
> 0.187 to 1.14	1540	0.90	(0.85, 0.97)
> 1.14	1540	0.92	(0.86, 0.98)

3. Prior exposure and leaving work (what I did most recently, but new YOUT and FU until 75)

MWF exposure	n	Adjusted HR	(95% CI)
Cumulative straight			
0	11882	1.00	
> 0 to 0.403	4792	1.12	(1.08, 1.17)
> 0.403 to 2.07	4791	1.06	(1.02, 1.1)
> 2.07	4791	1.09	(1.05, 1.13)
Cumulative soluble			
0 to 0.05	3342	1.00	
> 0.05 to 3.97	7638	1.13	(1.08, 1.18)
> 3.97 to 16.3	7638	1.13	(1.09, 1.18)
> 16.3	7638	1.21	(1.15, 1.27)
Cumulative synthetic			
0	18542	1.00	
> 0 to 0.261	2572	0.90	(0.86, 0.95)
> 0.261 to 1.48	2571	0.94	(0.9, 0.99)
> 1.48	2571	1.09	(1.04, 1.15)

Citations

1. Garcia E, Picciotto S, Costello S, Bradshaw PT, Eisen EA. Assessment of the healthy worker survivor effect in cancer studies of the united autoworkers-general motors cohort. *Occupational and environmental medicine*. 2017;74(4):294-300.