

Table 2.2. Cohort studies of ethylene oxide and breast cancer

Reference, location	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	Relative risk (95% CI)	Adjustments and comments
Hagmar <i>et al.</i> (1991, 1995) Sweden	2170 workers employed for ≥ 12 months in 1964–85 at 2 plants where medical equipment sterilized with ethylene oxide, followed for cancer incidence to 1990		Breast	All cohort members	5	SIR 0.46 (0.15–1.08)	
Norman <i>et al.</i> (1995), USA	1132 workers employed during 1974–80 at a sterilizing plant that used ethylene oxide, followed for cancer incidence to 1957		Breast	All cohort members	12	1.72* (0.99–3.00)	*Expected numbers from SEER rates for 1978–81
				All cohort members	12	1.57** (0.90–2.75)	**Expected numbers from SEER rates for 1981–85
Kardos <i>et al.</i> (2003) Hungary	299 women employed on a hospital ward using ethylene oxide sterilizer in 1976–93, followed 1987–99		Breast	All cohort members	3	4.38 deaths expected from all causes	Deaths in the cohort ascertained from a different source from the reference rates; one or more breast cancer cases may have been part of a cluster that prompted the study.

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Steenland <i>et al.</i> (2003) USA	7576 women worked for ≥ 1 year at 13 plants, followed for breast cancer incidence to 1998	Exposure data over time based on a large number of measurements coupled with data of historical process changes, to quantitatively estimate cumulative exposure to ethylene oxide.	Breast	All cohort members	319	SIR 0.87* (0.77–0.97)	*Recognized to be an underestimate because of incomplete ascertainment of cases **Odds ratios calculated by Cox regression in a nested case–control analysis ***Analysis restricted to subset of 5139 women with data on potential confounders from interviews; adjusted for parity, breast cancer in first-degree relative	
			Breast excluding carcinoma <i>in situ</i>	All cohort members	299	0.94 ([0.84–1.05])		
			Breast	<i>Exposures in ppm–days with 15-year lag</i>				
				0	81	1.00** (lagged out)		
				< 647	45	1.07 (0.72–1.59)		
				647–2026	46	1.00 (0.67–1.50)		
				2027–4919	46	1.24 (0.85–1.90)		
				4920–14 620	45	1.17 (0.78–1.78)		
			Breast	<i>Exposures in ppm–days with 15-year lag</i>				
				0	81	1.00*** (lagged out)		
< 647	45	1.06 (0.66–1.71)						
647–2026	46	0.99 (0.61–1.60)						
	2027–4919	46	1.24 (0.76–2.00)					
	4920–14 620	45	1.42 (0.88–2.29)					
	> 14 620	48	1.87 (1.12–3.10)					

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Coggon <i>et al.</i> (2004) United Kingdom	1011 women potentially exposed to ethylene oxide in sterilization units at 8 hospitals during 1964–86, followed to 31 December 2000		Breast	All cohort members	11	0.84 (0.42–1.51)	Update of Gardner <i>et al.</i> (1989)
				Continual	5	0.70 (NR)	
				Unknown	6	1.16 (NR)	
Steenland <i>et al.</i> (2004) USA	18 235 workers at 14 industrial plants that used ethylene oxide for sterilization since 1943		Breast	All cohort members	103	SMR 0.99 (0.84–1.17)	At least one cancer occurred in a man.
				All female cohort members	NR	0.99 (0.81–1.20)	

ICD, International Classification of Diseases; NR, not reported; SEER, Surveillance, Epidemiology and End Results; SIR, standardized incidence ratio; SMR, standardized mortality ratio; TWA, time-weighted average