

Brain Tumors in Chemical Workers

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Experimental Brain Carcinogens

2- Acetylaminofluorene	(Vasquez, 1945)
Acrylonitrile	(Maltoni et al., 1977)
1-Aryl-3,3-Dialkyltriazenes	(Druckrey, 1973)
Azoethane (prenatal)	(Zulch and Menzel, 1973)
Azoxyethane (prenatal)	(Zulch and Menzel, 1973)
Azoxymethane	(Druckrey, 1973)
Butylnitrosourea	(Takizawa and Nishihara, 1971)
Cycasin	(Hirono et al., 1968)
1,2-Diethylhydrazine	(Druckrey, 1973)
Diethylnitrosamine (prenatal)	(Druckrey, 1973)
Diethyl Sulfate (prenatal)	(Druckrey et al., 1970)
Dimethyl Sulfate (prenatal)	(Druckrey et al., 1970)
Elaiomycin	(Schoental, 1969)
Ethyl methanesulphonate	(Swann and Magee, 1969)
Ethylnitrosobiuret (prenatal)	(Zulch and Menzel, 1973)
Ethylnitrosourea (prenatal)	(Ivankovic, 1973)
1-Methyl-2-Benzyl-Hydrazine (prenatal)	(Druckrey, 1973)
Methyl methanesulphonate	(Magee, 1973)
Methylnitrosourea (prenatal)	(Alexandrov, 1969)
Methylnitrosourethane (intraplacental)	(Napalkov, 1973)
Procarbazine (prenatal)	(Ivankovic, 1973)
Propane Sultone	(Ulland et al., 1971)
Propylene Imine	(Ulland et al., 1971)
Pyrrolizidine Alkaloids	(Schoental and Cavanagh, 1972)
Vinyl Chloride	(Maltoni, 1976)

Epidemiological Studies:
Clues to Human Brain Cancer Etiology

Aluminum Workers	(Milham, 1976)
Anti-Convulsant Use	(Clemmesen, 1974)
Autoworkers-Pattern Makers	(Robinson et al., 1980)
Farm/Rural Residents	(Choi et al., 1970)
Geographic Clustering-(Kentucky) (Rhône Valley)	(Brooks, 1972) (Trouillas et al., 1975)
Halomethanes in Drinking Water	(Cantor et al., 1978)
Lead Smelter Workers	(Cooper, 1976)
Machinists	(DeCoufle, 1978)
Petrochemical Workers	(Thomas et al., 1980)
Rubber Workers	(Mancuso et al., 1968)
Toxoplasmosis	(Schuman et al., 1967)
Vinyl Chloride Workers	(Tabershaw and Gaffey, 1974)

[Tables from Maxweller et al., 1976]

1 Study cohort members: interval between initial exposure to vinyl chloride (VC) and death.

2 Non-cohort cases who had worked in VC polymerization areas.

3 Non-cohort cases who never worked in VC polymerization areas.

Case Number	Histologic Diagnosis	Age at Death (years)	Latency (years)
1	Chondrosarcoma multiforme	49	25
2	Chondrosarcoma multiforme	43	17
3	Chondrosarcoma multiforme	53	20
4	Chondrosarcoma multiforme	54	15
5	Chondrosarcoma multiforme	56	24
6	Chondrosarcoma multiforme	43	20
7	Chondrosarcoma multiforme	42	20
8	Chondrosarcoma multiforme	58	21
9	Chondrosarcoma multiforme	65	19
10	Chondrosarcoma multiforme	33	3

Table 7

Brain Cancer Cases Histologically Diagnosed Among Workers Exposed to Vinyl Chloride

* Significant at $p < 0.05$.

** Significant at $p < 0.01$.

Cancer Morbidity	EXP.	SNR	EXP.	SNR
All malignant neoplasms	23.5	21	16.9	18.4
Brain and CNS cancer	0.9	3	0.6	3
Respiratory system cancer	12	11	7.7	5.7
Biliary and liver cancer	0.6	7	0.4	7
Lymphatic and hematopoietic system cancer	2.5	3	1.7	1.7

Table 4

Cancer Mortality by Latency Among Workers Exposed to Vinyl Chloride

Cancer Mortality

EXP. 11-Year Latency

SNR 11-Year Latency

EXP. 11-Year Latency

SNR 11-Year Latency

EXP. 11-Year Latency

SNR 11-Year Latency

EXP. 11-Year Latency

SNR 11-Year Latency

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[Tables from Infante, 1976]

Observed and Expected Cancer Deaths and Standardized Mortality Ratios for Residents 45 Years and Older in Balance of Counties, by Sex: 1958-73

CNS

(191-192)

Balance of County	Obs./Exp. SMR	Obs./Exp. SMR	Obs./Exp. SMR	Obs./Exp. SMR	Obs./Exp. SMR	Obs./Exp. SMR	Obs./Exp. SMR
Ashtabula	19/21.42	89	11/13.29	83	30/34.68	87	
Lake	32/34.78	92	19/21.41	89	51/56.19	91	
Location	50/50.89	98	39/31.95	122	89/82.84	107	

Observed and Expected Cancer Deaths and Standardized Mortality Ratios for Residents 45 Years and Older in Towns Constituted by Sex: 1958-73

CNS

(191-192)

Communities	Obs./Exp. SMR	Obs./Exp. SMR	Obs./Exp. SMR	Obs./Exp. SMR	Obs./Exp. SMR	Obs./Exp. SMR	Obs./Exp. SMR
Ashtabula	76.09	101	6.4.74	127	11/11.64	112	
Portsmouth	12/4.36	282	2.14	64	14.7.40	189	
Axon Lake	21.08	119	1.05	93	3.2.73	110	
N. Ridgeville	6/1.43	420	2.087	210	8.2.50	248	
Community comp.					38/24.07	158	

[Table from Clemmesen, 1974]

* < 0.05, † < 0.01, Obs. uncorrected, Exp. uncorrected.

	1943-47	1948-52	1953-57	1958-62	1963-67	Obs. Exp.
Stomach and pharynx	0.1	0.4	0.2	0.2	0.1	0.1
Liver	1.1	2.4	2.4	0.4	0.4	0.4
Esophageal system	1.1	0.4	0.4	0.4	0.4	0.4
Rectum and sigmoid system	0.1	0.1	0.1	0.1	0.1	0.1
Colon and rectum system	0.1	0.1	0.1	0.1	0.1	0.1
Other organs	0.1	0.1	0.1	0.1	0.1	0.1
Connective tissue	0.1	0.1	0.1	0.1	0.1	0.1
Lymph and blood systems	0.1	0.1	0.1	0.1	0.1	0.1
All neoplasms	2.0	2.9	2.9	1.0	1.0	1.0

Cancer among men

	1943-47	1948-52	1953-57	1958-62	1963-67	Obs. Exp.
Stomach and pharynx	0.1	0.4	0.2	0.2	0.1	0.1
Liver	1.1	2.4	2.4	0.4	0.4	0.4
Esophageal system	1.1	0.4	0.4	0.4	0.4	0.4
Rectum and sigmoid system	0.1	0.1	0.1	0.1	0.1	0.1
Colon and rectum system	0.1	0.1	0.1	0.1	0.1	0.1
Other organs	0.1	0.1	0.1	0.1	0.1	0.1
Connective tissue	0.1	0.1	0.1	0.1	0.1	0.1
Lymph and blood systems	0.1	0.1	0.1	0.1	0.1	0.1
All neoplasms	2.0	2.9	2.9	1.0	1.0	1.0

TABLE II—CANCER AMONG EMPLOYEES TREATED WITH ANTICOLONYLAXES FOR MORE THAN TEN YEARS

* < 0.05, † < 0.01, Obs. uncorrected, Exp. uncorrected.

	1943-47	1948-52	1953-57	1958-62	1963-67	Obs. Exp.
Stomach and pharynx	0.1	0.4	0.2	0.2	0.1	0.1
Liver	1.1	2.4	2.4	0.4	0.4	0.4
Esophageal system	1.1	0.4	0.4	0.4	0.4	0.4
Rectum and sigmoid system	0.1	0.1	0.1	0.1	0.1	0.1
Colon and rectum system	0.1	0.1	0.1	0.1	0.1	0.1
Other organs	0.1	0.1	0.1	0.1	0.1	0.1
Connective tissue	0.1	0.1	0.1	0.1	0.1	0.1
Lymph and blood systems	0.1	0.1	0.1	0.1	0.1	0.1
All neoplasms	2.0	2.9	2.9	1.0	1.0	1.0

TABLE I—CANCER AMONG EMPLOYEES TREATED WITH ANTICOLONYLAXES FOR LESS THAN TEN YEARS

Table 4
Observed and Expected Deaths Among Deceased National
Pattern Makers' League Members by Predominant Work
Between 1940-1960**

Cause	8th Revision ICDA	Predominantly Wood			Predominantly Metal		
		Obs.	Exp.	PMR	Obs.	Exp.	PMR
All malignant neoplasms	(140-209)	205	180.9	113	73	71.7	102
Digestive System	(150-159)	63	49.5	127	25	19.3	130
Esophagus	(150)	4	4.0	100	1	1.6	62
Stomach	(151)	5	8.1	62	4	3.1	129
Colon	(153)	30	18.4	163	13	7.1	183
Rectum	(154)	9	5.3	170	1	2.0	50
Gall Bladder	(156)	2	1.5	133	3	0.6	500
Other Digestive System	(152, 155, 157-159)	13	12.2	107	3	4.9	61
Nose, Nasal Sinuses	(160)	0	0.3	0	0	0.1	0
Lung	(162)	48	56.3	85	23	23.2	99
Skin	(171-172)	5	2.5	200	0	1.0	0
Urinary Bladder	(188)	11	7.3	151	3	2.7	111
Kidney	(189)	5	3.9	128	3	1.6	188
Lymphatic and Hematopoietic System	(200-209)	24	16.1	149	7	6.4	109
Hodgkin's Disease	(201)	0	0.9	0	0	0.4	0
Other Lymphomas	(200-202)	7	4.7	149	2	1.9	105
Multiple Myeloma	(203)	3	2.5	120	1	1.0	100
Leukemia	(204-207)	14	7.0	200*	1	2.7	37
Other Lymphatic and Hematopoietic	(208-209)	0	0.9	0	3	0.3	1000
Other Malignant Neoplasms		49	45.0	109	12	17.4	69
Brain Tumors, Both Malignant and Unspecified	(191-192, 238)	(7)	(4.0)	175	(5)	(1.7)	294
Diseases of Circulatory System	(390-458)	520	524.2	99	201	194.8	103
Diseases of Respiratory System	(460-519)	62	71.6	87	27	26.4	102
All Accidents and Violence	(800-999)	33	38.3	86	10	17.4	57
All Other Causes		86	91.0	95	35	35.7	98
All Causes		906	906	100	346	346	100

* $p < 0.05$

** 5 members could not be classified

[Table from Robinson et al., 1980]

Table 5. — Mortality for Selected Cancer Sites in Texas OCAW Members by Race and Industrial Category.

Site (8th Revision, ICD)	White Males - Industrial Category												Nonwhite Males - Industrial Category											
	All Categories			1			2			3			4			All Categories			1			2		
	O*	E†	PMR‡	O	E	PMR	O	E	PMR	O	E	PMR	O	E	PMR	O	E	PMR	O	E	PMR	O	E	PMR
Digestive organs & peritoneum (150-159)	140	171.3	1.07	9	15.3	0.59	111	89.3	1.24§	9	13.7	0.66	5	7.0	0.72	34	27.6	1.23	30	21.7	1.30	30	21.7	1.30
Respiratory system (160-163)	188	150.8	1.25	21	15.6	1.35	134	102.6	1.31§	18	17.6	1.02	9	8.3	1.08	35	24.9	1.40§	27	19.5	1.39	27	19.5	1.39
Skin (172-173)	19	18.8	1.78§	1	1.0	—	14	7.2	1.94§	3	1.4	—	0	0.6	—	7	8.5	—	2	0.4	—	2	0.4	—
Genitourinary organs (185-189)	42	40.2	1.04	3	4.6	—	28	27.2	1.03	6	4.5	1.34	4	2.1	—	7	8.3	0.84	6	6.6	0.91	6	6.6	0.91
Brain & central nervous system (191, 192)	31	21.3	1.46§	2	2.2	—	25	14.2	1.76§	4	2.7	—	0	1.2	—	1	1.4	—	1	1.0	—	1	1.0	—
Lymphatic & hematopoietic tissue (200-209)	63	54.4	1.16	4	5.5	0.72	44	36.3	1.21	8	7.1	1.13	2	3.0	—	7	6.3	1.11	4	4.8	0.84	4	4.8	0.84

*O = Observed deaths

†E = Expected deaths based on proportionate mortality for U.S. males

‡PMR = Statistically significant at the 0.05 level

— Not calculated

Table 9. — Mortality for Selected Cancer Sites in White Male OCAW Members Employed at Plant A by Length of Union Membership.

Site (8th Revision, ICD)	Length of Membership					
	< 10 Years (N = 107)			10-19 Years (N = 177)		
	O*	E†	PMR‡	O	E	PMR
Stomach (151)	3	1.4	—	1	2.2	—
Brain & central nervous system (191, 192)	0	0.8	—	5	1.5	3.32§
				4	1.1	—

*O = Observed deaths

†E = Expected deaths based on proportionate mortality for U.S. white males

‡PMR = Statistically significant at the 0.05 level

— Not calculated

[Tables from Thomas et al., 1980]

Texas Petrochemical Plant
PMR Mortality Study
Causes of Death: 08/27/49 - 01/01/79

	No.	Per cent	1975 Texas	1975 Galveston County
Cancer -(All Types)	111	24.0		20.4 (City)
Oral Cancer	1	0.9	2.39	3.9
Digestive	34	30.6	25.7	26.5
Respiratory	27	24.3	26.69	25.2
Genital	6	5.4	11.6	10.2
Urinary	6	5.4	3.99	4.59
Bone, Skin Breast	5	4.5	10.26	6.88
Lymphatic	13	11.7	9.9	12.78
Neoplasms Brain	10	9.0	2.16	2.62
Misc. & Unspecified	9	8.0	9.9	
				1975 Galveston City
Cardiac	180	39.5		36.6
Respiratory	10	21.9		2.5
Digestive	5	1.09		1.4
Liver	9	1.9		2.2
Genito-Urinary	6	1.3		1.7
Trauma	64	14.0		8.8
Cerebro-Vascular	27	5.9		13.0
Miscellaneous	8	1.7	} -----	13.2
Unknown	35	7.69		
	455			

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