High Visibility Studies in Environmental Cancer: Cellular Telephones and Brain Cancer

Peter D. Inskip
Division of Cancer Epidemiology & Genetics
National Cancer Institute

The New England Journal of Medicine

VOLUME 344 JANUARY 11, 2001 NUMBER 2

CELLULAR-TELEPHONE USE AND BRAIN TUMORS

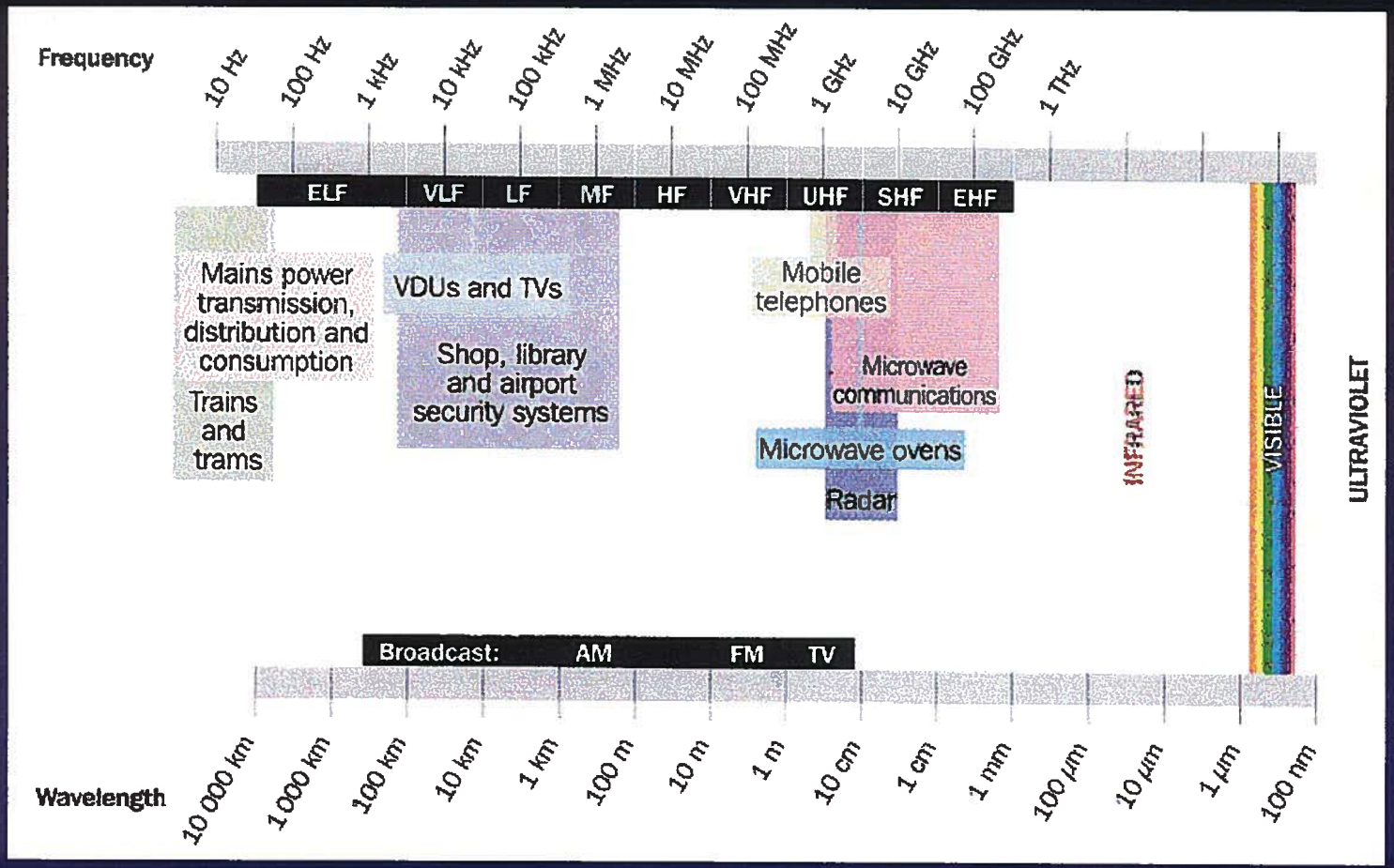
PETER D. INSKIP, SC.D., ROBERT E. TARONE, PH.D., ELIZABETH E. HATCH, PH.D., TIMOTHY C. WILCOSKY, PH.D., WILLIAM R. SHAPIRO, M.D., ROBERT G. SELKER, M.D., HOWARD A. FINE, M.D., PETER M. BLACK, M.D., JAY S. LOEFFLER, M.D., AND MARTHA S. LINET, M.D.

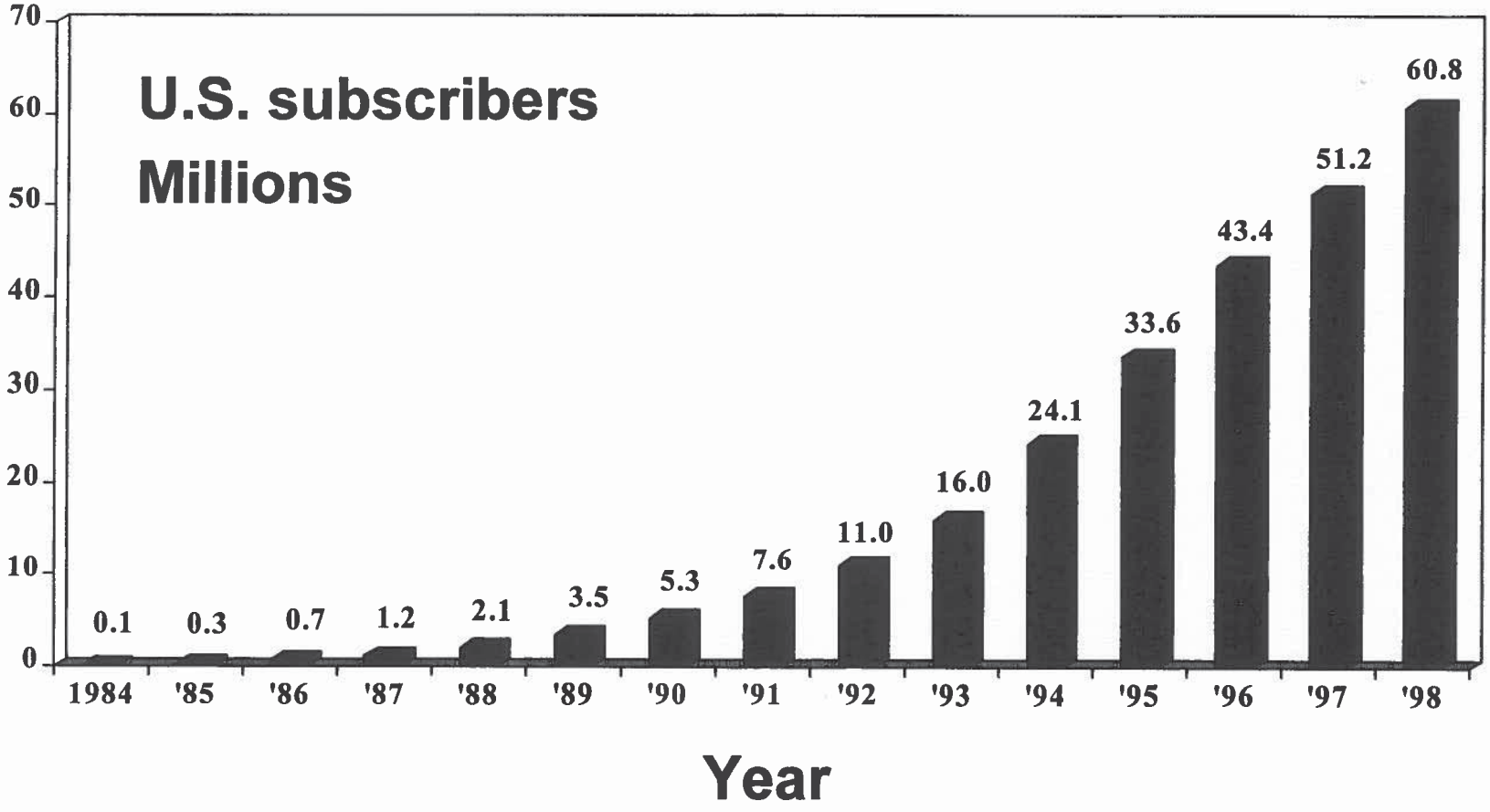
Background

- Issue comes to widespread public attention in January of 1993
- Congressional hearings in February 1993
- NCI adds a cellular-phone component to a planned case-control study
- Data collection for NCI study begins in 1994

NCI Study of Brain Tumors in Adults
Other Possible Risk Factors Under Study

Category	Examples
Occupation	solvents, lead, EMF
Medical history	allergies, head injury, radiation
Reproductive hx	pregnancies, hormone use
Family history	cancer
Genetic	metabolic & DNA repair genes
Diet	nitrates & nitrites, fruits & vegetables
Other	electrical appliances, hair dyes


Frequency
10 Hz
100 Hz
1 kHz
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
1 GHz
10 GHz
100 GHz
1 THz
ELF
VLF
LF
MF
HF
VHF
UHF
SHF
EHF
Mains power transmission, distribution and consumption
Trains and trams
VDUs and TVs
Shop, library and airport security systems
Mobile telephones
Microwave communications
Microwave ovens
Radar
INFRARED
VISIBLE
ULTRAVIOLET
Broadcast:
AM
FM
TV
Wavelength
10 000 km
1 000 km
100 km
10 km
1 km
100 m
10 m
1 m
10 cm
1 cm
1 mm
100 μm
10 μm
1 μm
100 nm


U.S. subscribers
Millions
70
60
50
40
30
20
10
0
0.1
0.3
0.7
1.2
2.1
3.5
5.3
7.6
11.0
16.0
24.1
33.6
43.4
51.2
60.8
1984
'85
'86
'87
'88
'89
'90
'91
'92
'93
'94
'95
'96
'97
'98
Year

Methods

- Hospital-based, case-control study
- 3 hospitals (Phoenix, Boston, Pittsburgh)
- 782 cases (489 glioma, 197 meningioma, 96 acoustic neuroma)
- 799 matched controls
- Interview about use of cellular phones
- Data collection from 1994 to 1998

Cell-Phone Use and Risk of Glioma

Phone Use	Controls	Cases	RR	95% CI
never	440	285	1.0	
ever	358	201	1.0	0.7 - 1.4
regular*	172	85	0.8	0.6 - 1.2

* Two or more calls per week

Cell-Phone Use and Risk of Glioma

Average Daily Use (min)	Controls	Cases	RR	95% CI
never/rarely	625	398	1.0	
< 3	53	27	0.9	0.5 - 1.6
3 to < 15	64	37	1.0	0.6 - 1.6
>= 15	51	20	0.5	0.3 - 1.0
>=60	24	12	0.7	0.3 - 1.7

Cell-Phone Use and Risk of Glioma

Duration of Regular Use (yr)	Controls	Cases	RR	95% CI
never/rarely	625	398	1.0	
< 0.5	56	24	0.6	0.3 - 1.1
0.5 to < 3.0	55	31	0.9	0.5 - 1.6
>= 3.0	60	30	0.9	0.5 - 1.5
>= 5	31	11	0.6	0.3 - 1.4

Cell-Phone Use and Risk of Glioma

Cumulative Use (hr)	Controls	Cases	RR	95% CI
never/rarely	625	398	1.0	
< 13	55	26	0.8	0.4 - 1.4
13 to 100	58	26	0.7	0.4 - 1.3
> 100	54	32	0.9	0.5 - 1.6
> 500	27	11	0.5	0.2 - 1.3

Cell-Phone Use and Risk of Glioma:
Laterality of Tumor and Phone Use

	Phone Use*		
Tumor	Left	Right	P-value**
Left	8	18	0.77
Right	10	17	

* Use for >= 6 months before tumor diagnosis

** Test for independence

Main Findings

- No association between incidence of brain cancer and level of use of cell phone
- Laterality of cancer independent of laterality of phone use

Other Studies of Cell Phones and Brain Cancer

Study	Country	Cases	Association?
Muscat et al. (2000)	USA	469	No
Johansen et al. (2001)*	Denmark	127	No
Hardell et al. (1999)	Sweden	136	No

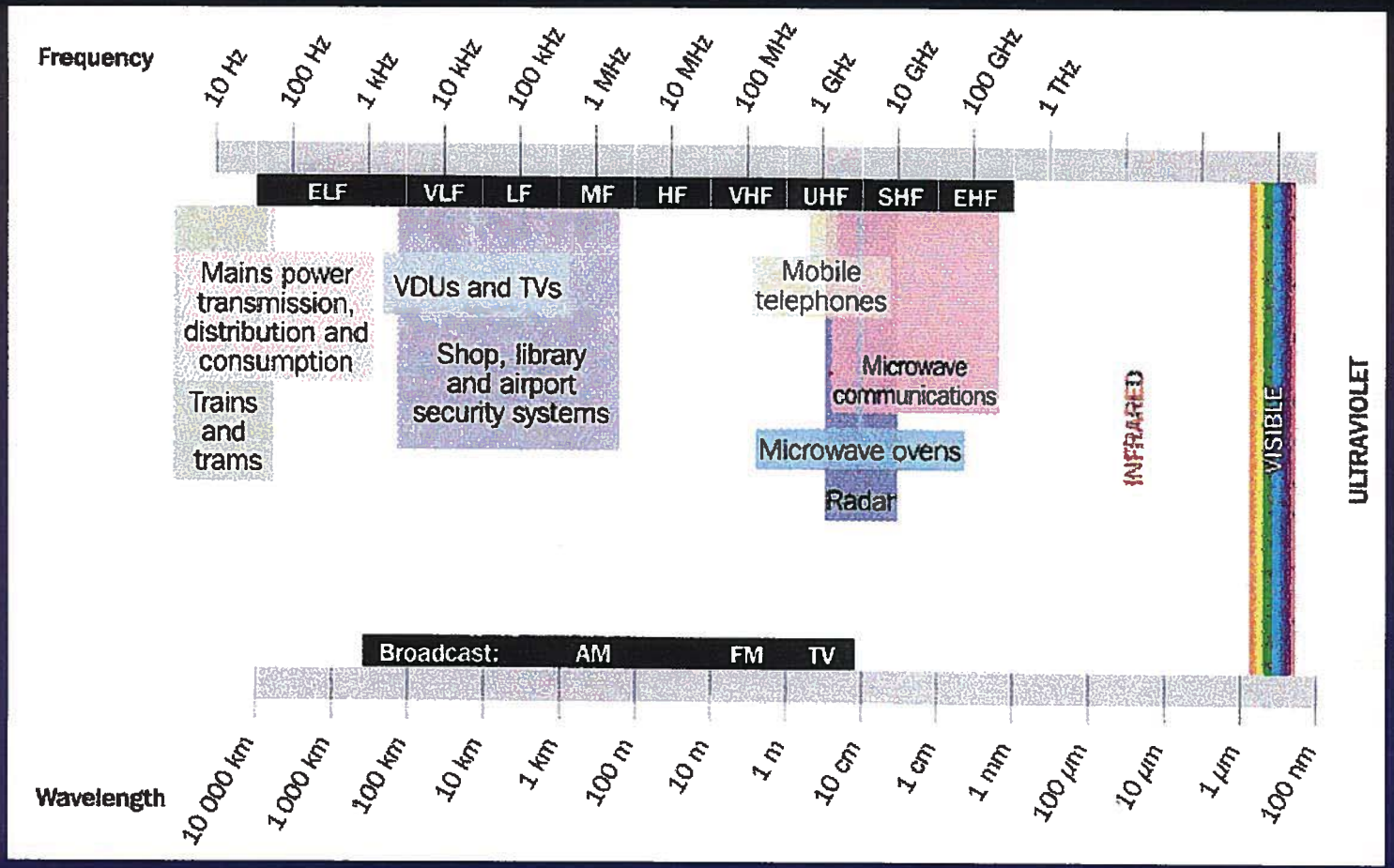
* Cohort study

Strengths

- Incident, histologically-confirmed cases
- High participation rates
- Interview setting and quality
- Large sample size
- Use of imaging and surgical reports to determine tumor location

Limitations

- Small number of long-term, heavy users
- Allowance for short induction period only
- Cannot rule out small risks
- Reliance on interviews to assess cell phone use
- Changes in cellular technology


Frequency
10 Hz
100 Hz
1 kHz
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
1 GHz
10 GHz
100 GHz
1 THz
ELF
VLF
LF
MF
HF
VHF
UHF
SHF
EHF
Mains power transmission, distribution and consumption
Trains and trams
VDUs and TVs
Shop, library and airport security systems
Mobile telephones
Microwave communications
Microwave ovens
Radar
INFRARED
VISIBLE
ULTRAVIOLET
Broadcast:
AM
FM
TV
Wavelength
10 000 km
1 000 km
100 km
10 km
1 km
100 m
10 m
1 m
10 cm
1 cm
1 mm
100 μm
10 μm
1 μm
100 nm

Summary

- NCI study is the largest to date concerning use of cell phones and risk of brain tumors
- No evidence of increased risk
- Similar findings in three other recent studies
- Longer-term risks still to be evaluated
  - studies are in progress to do this
- What does cause brain tumors?

External Advisory Panel

Member	Specialty
Jon Samet (chair)	Epidemiology
Stuart Allen	Radiofrequency radiation
Ted Colton	Biostatistics
Carol Kruchko	Brain tumor research advocacy
Paul McKeever	Pathology
Jack Siemiatycki	Epidemiology/industrial hygiene
Margaret Wrensch	Epidemiology

Study Investigators

National Cancer Institute
- Peter Inskip
- Martha Linet
- Robert Tarone
- Elizabeth Hatch

St. Joseph's Hospital & Medical Center
- William R. Shapiro

Brigham & Women's Hosp.
- Howard Fine
- Peter Black
- Jay Loeffler

Western Pennsylvania Hosp
- Robert Selker

Research Triangle Institute:
- Timothy Wilcosky

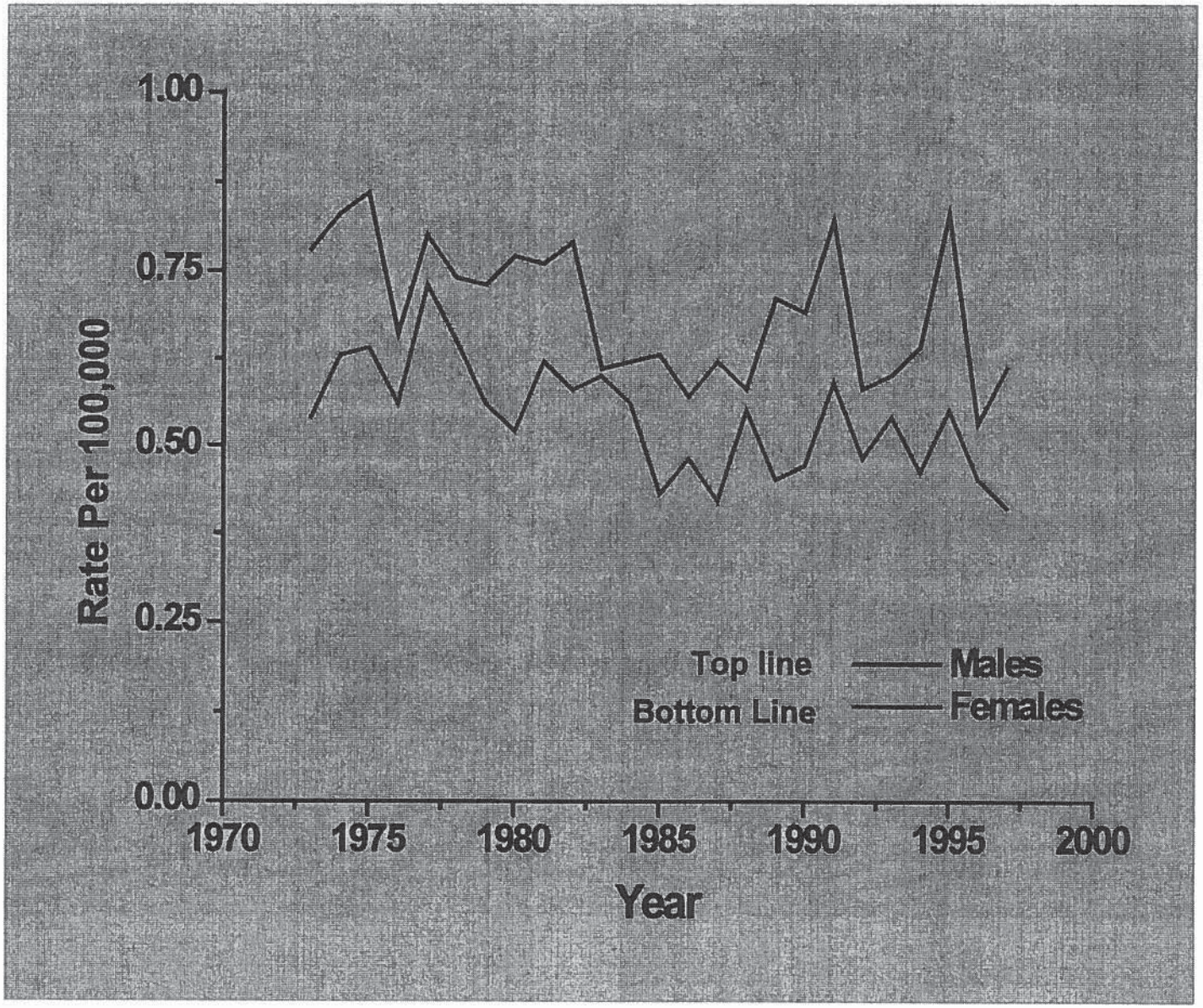
The Possible Role of Radiofrequency Radiation in the Development of Uveal Melanoma

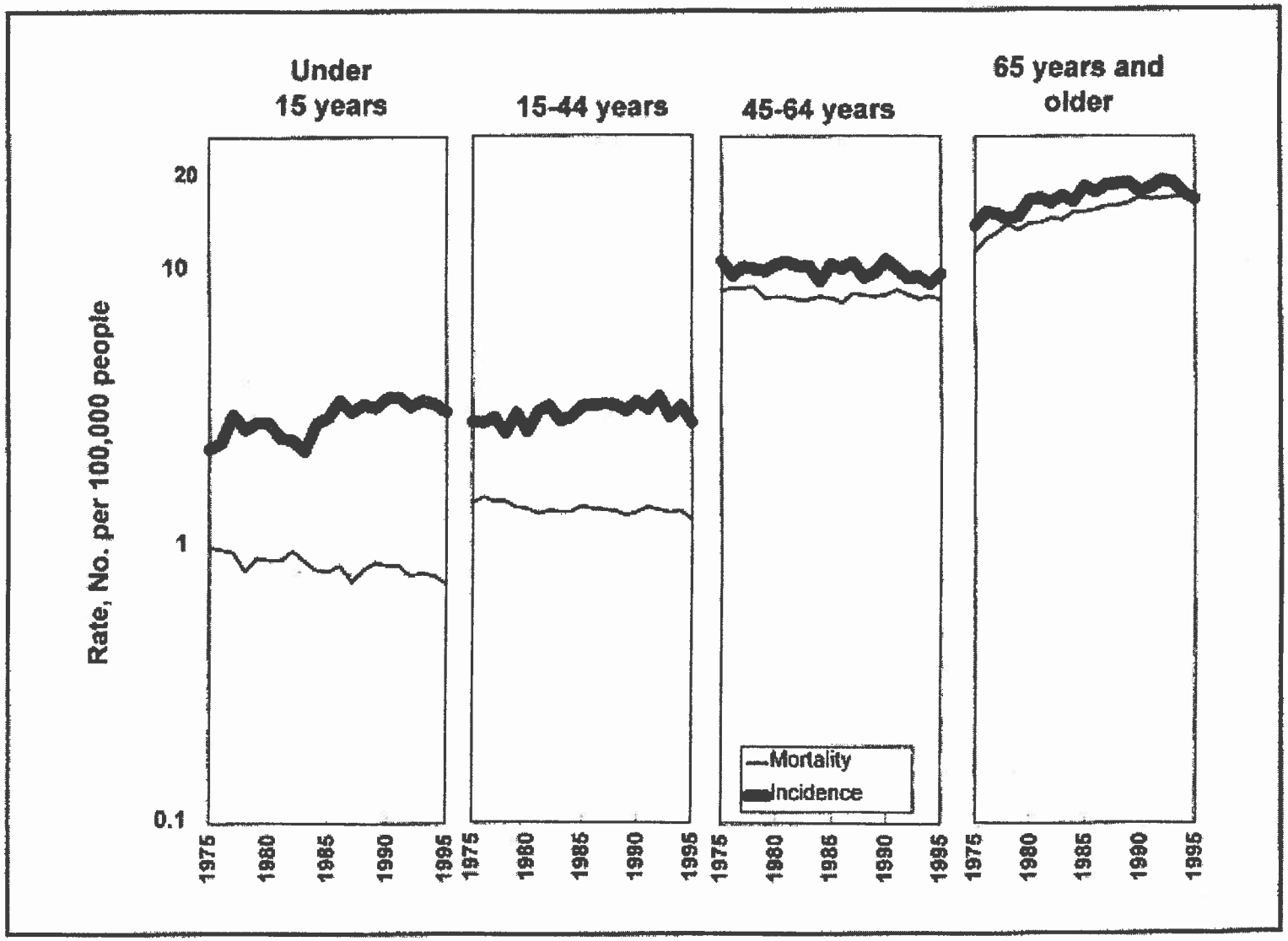
Andreas Stang,[1] *Gerasimos Anastassiou,*[2] *Wolfgang Ahrens,*[1,3] *Katja Bromen,*[1] *Norbert Bornfeld,*[2] *and Karl-Heinz Jöckel*[1]

There are few epidemiologic studies dealing with electromagnetic radiation and uveal melanoma. The majority of these studies are exploratory and are based on job and industry titles only. We conducted a hospital-based and population-based case-control study of uveal melanoma and occupational exposures to different sources of electromagnetic radiation, including radiofrequency radiation. We then pooled these results. We interviewed a total of 118 female and male cases with uveal melanoma and 475 controls matching on sex, age, and study regions. Exposure to radiofrequency-transmitting devices was rated as (a) no radiofrequency radiation exposure, (b) possible exposure to mobile phones, or (c) probable/certain exposure to mobile phones. Exposures were rated independently by two of the authors who did not know case or control status. We used conditional logistic regression to calculate odds ratios (ORs) and 95% confidence intervals (95% CIs). We found an elevated risk for exposure to radiofrequency-transmitting devices (exposure to radio sets, OR = 3.0, 95% CI = 1.4–6.3; probable/certain exposure to mobile phones, OR = 4.2, 95% CI = 1.2–14.5). Other sources of electromagnetic radiation such as high-voltage lines, electrical machines, complex electrical environments, visual display terminals, or radar units were not associated with uveal melanoma. This is the first study describing an association between radiofrequency radiation exposure and uveal melanoma. Several methodologic limitations prevent our results from providing clear evidence on the hypothesized association. (Epidemiology 2001;12:7–12)

Keywords: uveal melanoma, eye neoplasms, radio waves, electromagnetic fields, case-control studies, Germany.

Incidence Rate of Ocular Melanoma (SEER)




Under 15 years
15-44 years
45-64 years
65 years and older
Rate, No. per 100,000 people
20
10
1
0.1
1975
1980
1985
1990
1995
Mortality
Incidence