Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Proposed Changes in the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields	)	ET Docket No. 03-137
	)	
To: The Commission	)	

PETITION OF THE AMERICAN ASSOCIATION FOR JUSTICE FOR RECONSIDERATION OF PINNA CLASSIFICATION

I. Introduction:

Despite a stated intent of "clarify[ing] evaluation procedures and references to determine compliance," in its March 27, 2013 Order, the Federal Communications Commission (FCC) has relied on biased sources and incomplete science in deciding to re-examine the standards limiting radiofrequency (RF) energy emitted by cell phones. Rather than ameliorate uncertainty surrounding human exposure to RF radiation, the order paradoxically creates a regime that is less safe than when the standard was first set in 1996. In deciding to re-classify the ear ("pinna") as an extremity and raise the level of allowable radiation emission, the FCC ignores mounting data indicating a link between long-term radiation exposure and cancer, instead, relying on definitions that are no longer current given the substantial changes in wireless technology over the past decade. With this petition, the American Association for Justice (AAJ) opposes the FCC

reclassification and recommends that the Commission undertake more rigorous research into the long terms effects arising from cell phone radiation exposure before revising its policy.

Today, the FCC continues to define a mobile device as being "generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structures and the body of the user."[1] Yet, given the increasingly compact size of most cell phone models and standard mobile usage where personal devices are typically held directly against one's ear, the FCC definition is clearly outdated.

Since the release of the original 2003 Notice by the FCC outlining the proposed changes, the number of mobile phone calls per day, the length of each call, and the amount of time people spend using mobile phones have all increased.[2] This petition urges the Commission to reevaluate its reliance on decade-old data promulgated by an organization populated by industry insiders. The Commission must also review recent scientific studies which demonstrate a connection between radiation exposure and the incidence of cancer. The FCC should not approve a re-classification of the pinna as an extremity. Such a reclassification may decrease the incentives for cell phone manufacturers to design and produce safer products.

II. The FCC Has Not Performed Appropriate Due Diligence in Issuing the Order

In a 2005 DC Circuit case where the U.S. Chamber of Commerce petitioned for review of Securities and Exchange Commission (SEC) rulemaking, the court conducted a "consideration of costs" analysis in determining whether the agency's actions was consistent with the public

---

[1] Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, Federal Communications Commission Office of Engineering and Technology, available at http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65b.pdf.

[2] Letter from the American Academy of Pediatrics to the FCC Commissioner, available at http://citizensforsafetechnology.org/uploads/scribd/AAP_07-12-12%20FCC%20cell%20phone%20radiation%20ltr.pdf.

interest.[3] The court considered two factors: (1) the ability of the SEC to develop new data or to consider existing empirical data in undertaking the rulemaking and (2) whether the SEC considered the costs of the conditions it was imposing.[4] While the Court in *Chamber of Commerce v. Securities and Exchange Commission* ultimately held that the SEC did not exceed its statutory authority, in the current case, the ready availability of scientific studies and the potentially devastating public health risks associated with the FCC Order both point to a different conclusion. Here, a cost-benefit analysis clearly indicates that the FCC does *not* possess the adequate authority to promulgate its Order and the proposed reclassification of the pinna as an extremity should not be implemented.

A. Consideration of Empirical Data

The rationale of the FCC in adopting the extremity classification of the pinna is based on the determination of the IEEE which makes the argument that because the tissue composition of the pinna is similar to the other extremities, the ear should be classified accordingly and subject to the higher SAR threshold of 4W/kg.[5] Notably, the IEEE report itself admits calculations showing that the absorption of RF energy has a minimal impact on pinna temperature was subject to "limited experimental measurements" and that the "temperature effect on human pinna would *vary significantly* [emphasis added] from model to model of mobile phones because of differences in the heat generated by various devices."[6]

---

[3] *Chamber of Commerce v. Securities and Exchange Commission*, 412 F.3d 133 (D.C. Cir. 2005).
[4] *Id.*
[5] IEEE Stud C95.1-2005, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 Ghz*, Rationale for applying the peak special-average SAR values for the extremities to the pinna: "The pinna consist of skin, cartilage, fat, nerves, blood vessels and muscle tissue, a composition similar to that of the extremities...Temperature increased in the pinna from heat generated in the device and from RF absorption are not harmful even if imposed on an initial pinna temperature that is close to body core temperature."
[6] *Id.*

There are several problems with FCC's reliance on the determinations of the IEEE. First, the IEEE study was released in 2006 and the speed with which cell phone manufacturers innovate means that both mobile phone and wireless technology have undergone substantial changes. Data based on devices used nearly a decade ago should not be relied upon to determine current RF energy standards and in the past few years, a number of American and international health and scientific bodies have contributed to the debate over cell phone radiation and its possible link to cancer. The International Agency for Research on Cancer (IARC), part of the United Nations' World Health Organization, said in June 2011 that a family of frequencies that includes mobile phone emissions is "possibly carcinogenic to humans."[7] The National Cancer Institute has stated that although studies have not demonstrated that RF energy from cell phone definitely causes cancer, more research is needed because cell phone technology and cell phone use are changing rapidly. These studies and others clearly demonstrate the need for further research into this area and highlight the importance of reassessing the FCC's order to determine if it is protective of human health.

Secondly, despite sharing tissue composition similar to that of extremities, the IEEE study fails to address a significant difference between the pinna and the extremities of the human body such as the hand, feet, wrists, and ankles: the former's proximity to the brain. While the pinna may function as a barrier between RF radiation and the brain, it is composed of permeable cartilage and RF radiation, like sound waves, are guided from the projecting part of the ear which lies outside the head, to the inner ear canal before ultimately reaching the brain. To compare the

[7] D.L. Davis, et al., Swedish Review Strengthens Grounds for Concluding that Radiation From Cellular and Cordless Phones is a Probable Human Carcinogen, Pathophysiology (2013), available at http://dx/doi/org/10/1016/j.pathophys.2013.001

pinna and the body's extremities is an over simplification and an inaccurate analogy in regards to the effect of exposure to RF radiation.

Finally, the FCC Order makes no mention of the fact that the IEEE is not an unbiased entity, but is composed of industry insiders. In fact, the members of IEEE SCC-28 Subcommittee 4, the entity in charge of the report relied on by the FCC, include former employees of wireless communication giants such as Motorola and Nokia as well as defense contractors like Raytheon and BAE Systems. The words of the Order itself indicate a dangerous adherence to the status quo as the FCC reasons that "[t]he same devices that were approved before [the reclassification of the pinna] will continue to be approved, and the same devices that could not receive approval before this specification will not receive approval after this specification."[8] Instead of moving towards a safer standard, the FCC appears content to rely on decade-old data to justify its current action, ignoring the mounting evidence of adverse health effects caused by cell phone radiation exposure.

B. The Costs of Rule Implementation

The second prong of the *U.S. Chamber v. SEC* ruling considers the potential costs of the agency rulemaking.[9] There, the court considered efficiency, competition, and capital formation as negative outcomes from the proposed rule's redefinition of a company's board composition.[10] Here, a much greater urgency is warranted as potential costs arising from the FCC Order must take into account the latency period between cell phone usage and the presentation of symptoms attributable to radiation as well as the disparate impact of radiation on children.

---

[8] First Report and Order, Further Notice of Proposed Rulemaking and Notice Inquiry, Federal Communications Commission ET Docket No. 13-84, available at http://www.cavellmertz.com/uploads/N_311_fcc-13-39a1.pdf.
[9] See *Chamber of Commerce* at 143.
[10] *Id.*

1. Latency

Diseases like brain cancer are known to exhibit a long latency period.[11] For example, the survivors of the atomic bombs that fell at the end of World War II did not demonstrate any increased rate of malignant cancers of the brain until four decades later.[12] Moreover, carcinogens such as tobacco were not firmly identified as increasing the risk of cancer until more than ten years after first usage.[13] The effects of long-term cell phone radiation exposure will likely follow this pattern as a Swiss personal monitoring study found that mobile phone use currently accounts for one-third of total exposures to wireless and microwave radiation.[14] With more than 5.9 billion reported mobile phone users worldwide, the impact of cell phone radiation taken in the aggregate, constitutes an environmental carcinogen whose risk still remains in the discovery process. Without further data, the FCC should not preemptively change the definition of the pinna to allow an increase in the level of radiation exposure.

2. Disparate Effects of Radiation on Children

A second cause for concern is the impact of cell phone radiation on children. Today, cell phone usage begins at a much younger age than in past decades as mobile devices are relied upon for communication, entertainment, and even use as navigational tools. However, studies indicate that radiation may have a disparate impact on the youngest cell phone users as "[h]igh resolution computerized models based on real human imaging data suggest that the higher conductivity and higher permittivity in children's brain tissues, together with their thinner skulls

---

[11] *See* The Cell Phone Problem, Environmental and Human Health, Inc, Concerning the latency period of brain tumors: "Data from ionizing radiation studies indicate a brain tumor latency time of between 20 and 55 years." available at http://www.ehhi.org/reports/cellphones/cell_phone_report_EHHI_Feb2012.pdf.
[12] *See* Davis at 2.
[13] *Id.*
[14] *Id.* at 3.

and small heads, will lead to higher SARs in their brains from microwave frequencies when compared to adults."[15]

In a December 2012 letter to then Representative Dennis Kucinich supporting H.R. 6358, the *Cell Phone Right to Know Act*, the American Academy of Pediatrics argued that "[t]he differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults. It is essential that any new standards for cell phone or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes."[16] Yet, not only does the FCC make no distinction between the levels of cell phone radiation advisable for children and for adults, the agency takes the opposite approach in its Order, reclassifying the pinna and effectively making cell phones less safe for the segment of the population most at risk for future harm.

III. Conclusion

Nearly half of the world's mobile phone users are under the age of 30 and live in developing countries.[17] Moreover, even as the Davis study cautions that brain cancer is the "tip of the iceberg," the rest of the body is also showing effects other than cancers.[18] In the United States alone, the Central Brain Tumor Registry of the United States estimates that about 10,000 people will develop glioma, or tumor of the brain this year. Given the growing evidence of harm arising from human exposure to radiofrequency emissions, the FCC Order reclassifying the pinna as an extremity is a rash decision which will put future generations at risk of an invisible

---

[15] *Id.* at 4.
[16] Letter from the American Academy of Pediatrics to Dennis Kucinich, available at http://ehtrust.org/wp-content/uploads/2012/12/aap_support_letter_cell_phone_right_to_know_act.pdf.
[17] *See* Davis at 4.
[18] *Id.* at 1.

but menacing carcinogen. AAJ urges the FCC to ensure public safety by withdrawing its Order and committing to more robust exploration in this area.

Respectfully Submitted,
By: /s/ Ivanna Yang

Ivanna Yang
American Association for Justice
777 6th Street, NW
Washington, DC 20001
(202) 944-2806

July 1, 2013

Int. J. Epidemiol. Advance Access published May 8, 2013

Published by Oxford University Press on behalf of the International Epidemiological Association
© The Author 2013; all rights reserved.
International Journal of Epidemiology 2013;1–11
doi:10.1093/ije/dyt072

Mobile phone use and risk of brain neoplasms and other cancers: prospective study

Victoria S Benson,[1]* Kirstin Pirie,[1] Joachim Schüz,[2] Gillian K Reeves,[1] Valerie Beral[1] and Jane Green[1] for the Million Women Study Collaborators[†]

[1]Cancer Epidemiology Unit, University of Oxford, UK, [2]International Agency for Research on Cancer (IARC), Section of Environment and Radiation, Lyon, France

*Corresponding author. Cancer Epidemiology Unit, University of Oxford, Richard Doll Building, Roosevelt Drive, Oxford OX3 7LF, UK. E-mail: vicky.benson@ceu.ox.ac.uk

[†]The members of Million Women Study Collaborators are listed in the Supplementary Appendix at *IJE* online

Accepted 28 March 2013

Background Results from some retrospective studies suggest a possible increased risk of glioma and acoustic neuroma in users of mobile phones.

Methods The relation between mobile phone use and incidence of intracranial central nervous system (CNS) tumours and other cancers was examined in 791 710 middle-aged women in a UK prospective cohort, the Million Women Study. Cox regression models were used to estimate adjusted relative risks (RRs) and 95% confidence intervals (CIs). Women reported mobile phone use in 1999 to 2005 and again in 2009.

Results During 7 years' follow-up, 51 680 incident invasive cancers and 1 261 incident intracranial CNS tumours occurred. Risk among ever vs never users of mobile phones was not increased for all intracranial CNS tumours (RR = 1.01, 95% CI = 0.90–1.14, $P = 0.82$), for specified CNS tumour types nor for cancer at 18 other specified sites. For long-term users compared with never users, there was no appreciable association for glioma (10+ years: RR = 0.78, 95% CI = 0.55–1.10, $P = 0.16$) or meningioma (10+ years: RR = 1.10, 95% CI = 0.66–1.84, $P = 0.71$). For acoustic neuroma, there was an increase in risk with long term use vs never use (10+ years: RR = 2.46, 95% CI = 1.07–5.64, $P = 0.03$), the risk increasing with duration of use (trend among users, $P = 0.03$).

Conclusions In this large prospective study, mobile phone use was not associated with increased incidence of glioma, meningioma or non-CNS cancers.

Keywords Acoustic neuroma, glioma, meningioma, cellular phone, neoplasms, prospective studies

Introduction

A Working Group within the International Agency for Research on Cancer (IARC) monograph programme on the evaluation of carcinogenic risks to humans has recently classified radio frequency electromagnetic fields, such as those emitted by mobile telephones, as 'possibly carcinogenic to humans' (Group 2B), based on limited evidence from epidemiological studies for an association between use of mobile phones and the risk of glioma and acoustic neuroma (but not of meningioma).[1] The only certain biological effect of the

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

non-ionizing radio-frequency radiation emitted by mobile phones is a small rise in tissue temperature of the brain and adjacent organs,[2] and there is only weak evidence for related potential mechanisms of carcinogenesis.[1]

The majority of epidemiological studies reviewed by IARC compared retrospectively reported use of mobile phones by patients with a diagnosed brain tumour with use reported by people who did not have a brain tumour. In some instances, proxy respondents, often relatives of the patient, were interviewed when those with brain tumours had died, or were too ill to respond. Recall of past mobile phone use could potentially differ between those with and without brain tumours, particularly if the reporting of past use was not by the patients themselves.[3] The only published study where information on mobile phone use was recorded prospectively, i.e. before the diagnosis of a brain tumour, reported no increase in the risk of any tumour of the brain or of other cancers.[4,5] Where information on mobile phone use is collected prospectively, recall of use should not differ between those who subsequently develop brain tumours and those who do not (except, perhaps, if a brain tumour was diagnosed soon after data collection, and early symptoms of the disease affected the person's recall of past events).

We report here on the relation between prospectively recorded information on use of mobile phones and the incidence of intracranial central nervous system (CNS) tumours and of other cancers (both overall and at 18 separate sites) in a large UK cohort of middle-aged women. For comparison, we also report results for incidence of hospitalization for stroke and ischaemic heart disease.

Materials and Methods

Study design, data collection and follow-up

During the period 1996–2001, 1.3 million middle-aged women were recruited through the UK National Health Service (NHS) Breast Screening Programme into the Million Women Study (see Supplementary data at *IJE* online), completing a postal questionnaire about sociodemographic, medical and lifestyle factors. The study population is resurveyed approximately every 3–4 years. Full details of the study design and methods are described elsewhere[6,7] and all questionnaires can be viewed at http://www.millionwomenstudy.org. Questions on mobile phone use were asked in 1999–2005, and again in 2009.

All study participants have a unique NHS number, and are followed via record linkage (using this number and other personal details) to the NHS Central Register. Cancer registrations (including non-invasive tumours of the CNS, and those of uncertain behaviour) and deaths are routinely notified to the study investigators; this information includes the date of each such event, with tumour site and morphology coded using the 10th revision of the International Classification of Diseases (ICD-10),[8] and the third edition of the International Classification of diseases for Oncology (ICD-O).[9]

Information on incident vascular disease during follow-up was obtained through linkage to Hospital Episodes Statistics (HES) in England and to Scottish Morbidity Records (SMR); these agencies provided dates and ICD-10 diagnosis codes for inpatient and day-patient hospital admissions.

All study participants gave written consent to taking part in the study, and ethical approval was provided by the Oxford and Anglia Multi-Centre Research Ethics Committee. Access to hospital admissions data was approved by the Information Centre for Health and Social Care (England) and the Information Services Division (Scotland).

Exposure variables

Women in the study have been asked twice about mobile phone use. In a survey conducted between 1999 and 2005 (to which about 65% of women recruited in 1996–2001 replied), women were asked: 'About how often do you use a mobile phone?', and given three options to respond: 'never', 'less than once a day', 'every day'; and 'For how long have you used one?' (participants were asked to provide total years of use). The responses to these questions provided baseline exposure data for analyses. In 2009, study participants were asked 'How much do you talk on a mobile phone?' (average minutes per week) and 'How long have you used a mobile phone?' (in years). This information is currently available for a random sample of 31 110 women who had also responded to the questions on mobile phone use at baseline, and although it was not used to define exposure status for analyses, it allowed assessment of the repeatability of use of mobile phones reported earlier. Of the women who reported at baseline that they had used a mobile phone, 77% of those reporting ever use (13 437/17 647) and 92% of those reporting daily use (1702/1852) also reported use for at least 1 minute per week at follow up, an average of 8.8 years later. In women reporting use at both surveys, duration of use reported at the later survey was consistent, on average, with that estimated to have accrued by that time on the basis of duration reported at baseline, assuming continued use between surveys. Approximately half (49%) of those who reported no phone use at baseline reported using a mobile phone in 2009.

Outcomes

The main outcomes examined here are registered cancers or non-invasive tumours occurring after the date that the baseline questionnaire was completed. Results are reported for incident intracranial tumours of the CNS: ICD-10 C70, C71, C72.1-5, C75.1-3, D32.0, D33.0-3, D35.2-4, D42.0, D43.0-3 and D44.3-5; and where possible, CNS tumours were further classed

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

by site and morphology as glioma (ICD-O 9380-9481), meningioma (ICD-O 9530-9539), pituitary tumours (C75.1, D35.2, and D44.3) and acoustic neuroma (D33.3, ICD-O 9560). Results are also reported for all invasive cancer (C00-C97, excluding non-melanoma skin cancer C44), and separately for 18 invasive cancer sites, 16 of which had accrued over 500 incident cases during follow-up and 2 others (eye and thyroid) for comparison with reports by others. The 18 cancer sites were defined as follows: 'other head and neck' (ICD-10 C00-14, C30-32, i.e. excluding CNS, eye and thyroid), oesophagus (C15), stomach (C16), colon (C18), rectum (C19-20), pancreas (C25), lung (C34), melanoma (C43), breast (C50), endometrium (C54), ovary (C56), kidney (C64), bladder (C67), eye (C69), thyroid (C73), non-Hodgkin lymphoma (C82-85), myeloma (C90) and leukaemia (C91-95).

Incident vascular disease endpoints were defined as first hospital admission with a primary diagnosis of stroke (ICD-10 I60-69) or ischaemic heart disease (ICD-10 I20-25).

Statistical analyses

Potentially eligible for these analyses were 866 525 women who responded to the study survey conducted between 1999 and 2005. Of these, 14 387 were excluded because they completed a version of the survey which did not include the question on mobile phone use, and 11 981 because they did not answer the question asked on mobile phone use. Analyses also excluded 48 531 women with a CNS tumour or any other invasive cancer [other than non-melanoma skin cancer (C44)] registered before baseline, and 6 women who reported having the inherited disorder neurofibromatosis (Q85.0) (which is associated with a high risk of neurological tumours).

Analyses for vascular disease additionally excluded women with a history of vascular disease (diagnosis of and/or treatment for heart disease or for stroke before baseline, either self-reported or identified from hospital admission data).

Cox regression models (taking attained age as the underlying time variable) were used to obtain adjusted relative risks (RRs) and 95% confidence intervals (CIs) for each of the endpoints of interest in relation to mobile phone use. Duration of use of a mobile phone was treated as a time-dependent variable, incrementing duration for each year of follow-up.

Eligible women contributed woman-years from the date they answered the baseline questions about mobile phone use until the date of diagnosis with the tumour or disease of interest, date of death or the end of follow-up, whichever was earliest. In analyses of cancer and CNS tumour outcomes, censoring was done at first cancer or CNS tumour diagnosis at any site: for stroke and ischaemic heart disease censoring was done at first diagnosis of either condition. The last date of follow-up for analyses of tumour incidence was 31 December 2009 for all 10 regions (corresponding to 10 cancer registries), except for the North West (Mersey) region and Scotland, where it was 31 December 2008 (as registrations were incomplete after that date). For vascular disease incidence, hospital admissions data were available in England until 31 March 2008 and in Scotland until 31 December 2008, with follow-up ending on these dates.

All analyses were stratified by quintiles of socioeconomic status (based on the Townsend deprivation index[10]), geographical region of residence (10 regions corresponding to the areas covered by the cancer registries) and age at baseline (<53, 53–55, 56-58, . . . , 78–80, 80+ years). Analyses were additionally adjusted for height (<160, 160–164.9, ⩾165 cm), body mass index (<25, 25–29.9, ⩾30 kg/m^2), smoking (never, past, current 1–14 cigarettes per day, current ⩾15 cigarettes per day), alcohol intake (none, <10, ⩾10 g per day), duration of strenuous exercise (<0.5 h, 0.5–1 h, ⩾1 h per week) and use of menopausal hormone therapy (never, past, current). For each adjustment and stratification variable, missing values were assigned to a separate category. For analyses of CNS tumours, sensitivity analyses were carried out excluding the first 3 years of follow-up (because pre-clinical disease may affect reporting of mobile phone use, or may cause women to change their mobile phone use) and, separately, excluding women who completed the baseline questionnaire in 1999 or 2000, because the prevalence of use of mobile phones increased rapidly over the next few years; non-users who completed the baseline questionnaire in 1999–2000 were more likely than non-users reporting in 2001–05 to have started to use a mobile phone over the follow-up period to 2009.

Where summary estimates are given combining our results with those from the Danish prospective study of mobile phone use,[4,5,11] study-specific results were combined using the method of inverse variance least squares.

National trends in the incidence of acoustic neuroma (ICD-10 code D33.3) in England were examined for the years from 1998 to 2008 by calculating annual age-standardized incidence rates per 100 000 men and women aged 20–79 years, using data on tumour incidence and population estimates from the Office for National Statistics.[12] All analyses were performed using Stata version 12.0.

Results

Baseline data were collected between 1999 and 2005, and during that period reported mobile phone use increased rapidly. The proportion of study respondents who reported at baseline that they had used a mobile phone rose from 34% of those completing the questionnaire in 1999 to 79% of those completing the questionnaire in 2005, and the proportion reporting

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

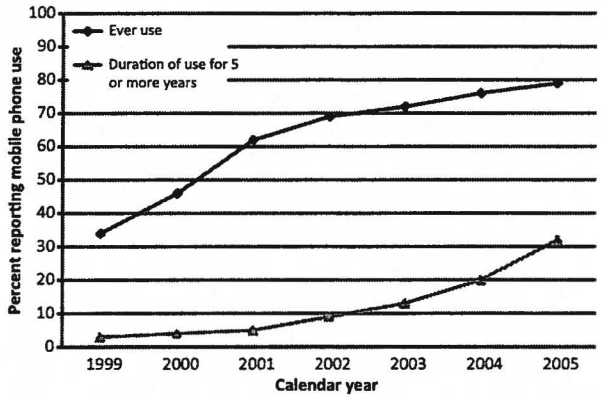

Figure 1 Reported use of mobile phones by calendar year

use for a duration of 5 or more years rose from 3% in 1999 to 32% in 2005 (Figure 1).

In total, 791 710 women with a mean age at baseline of 59.5 years (standard deviation 4.9) were included in analyses of tumour incidence. During an average of 7 years' follow-up, 51 680 incident invasive cancers and 562 incident non-invasive intracranial CNS tumours occurred; neoplasms were diagnosed on average 4.2 years after baseline report of mobile phone use. Table 1 shows the characteristics of the study population, woman-years of follow-up, average years of follow-up per woman and the number of women with intracranial CNS tumours and incident cancer according to never and ever use of a mobile phone as reported at baseline for these analyses. Table 1 also includes details of diagnoses for the 16 665 women who were admitted to hospital with stroke or ischaemic heart disease during follow-up. Mobile phone users were slightly younger, lived in more affluent areas and were more likely to do strenuous exercise, to be a current user of menopausal hormone therapy and to have taken oral contraceptives than never users of a mobile phone; they also drank more alcohol on average but were less likely to be current smokers than never users.

Intracranial CNS tumours

During follow-up, 1261 intracranial CNS tumours were reported, including 571 gliomas, 251 meningiomas, 110 pituitary tumours and 96 acoustic neuromas (the remaining 233 tumours were predominantly of unspecified type). Table 2 shows relative risks for incident intracranial CNS tumours and other cancers by ever use, daily use and duration of use of a mobile phone. The relative risk for ever use of a mobile phone for incidence of all intracranial CNS tumours taken together was 1.01, 95% CI 0.90–1.14, $P=0.82$. For specific CNS tumour types, relative risks were 0.91, 0.76–1.08, $P=0.29$; 1.05, 0.81–1.38, $P=0.70$; 1.52, 0.99–2.33, $P=0.06$; and 1.44, 0.91–2.28, $P=0.12$ for glioma, meningioma, pituitary tumours and acoustic neuroma, respectively.

Further details of the relationship between use of mobile phones and incidence of intracranial CNS tumours are shown in Table 3. Relative risks did not vary much between less than daily and daily users, for all CNS tumours taken together or for each CNS tumour type separately. Duration of use of a mobile phone for 5 or more years was associated with an increased risk of acoustic neuroma (RR for 5+ years of use *vs.* never use, 1.88, 95% CI 1.14–3.11, $P=0.01$; test for trend across categories <5, 5–9 and 10+ years of use, $P=0.03$). For pituitary tumours, the RR was increased in short-term mobile phone users with duration less than 5 years (RR=2.31, 95% CI 1.31–4.06, $P=0.004$) but there was no evidence for a trend in risk with increasing duration of use ($P=0.23$). Excluding the first 3 years of follow-up, or excluding women who answered questions about their use of mobile phones in 1999/2000, did not materially change the findings (Table 3).

National incidence data showed no overall increase in the incidence of acoustic neuroma (ICD-10 D33.3) in either men or women at ages 20–79 years in England from 1998 to 2008 (Figure 2). Trends were similar in men and women, but confidence intervals were wide, as in each year there were only about 160 acoustic neuromas registered in men and 170 in women.

Other cancers

Risk of all invasive cancers combined was slightly reduced in mobile phone users compared with never users: ever vs never use, RR=0.97, 95% CI 0.95–0.99, $P<0.001$). No significant associations were seen between mobile phone use and risk of cancers of the eye and thyroid, or of other head and neck cancers (Table 2). Nor was ever use of a mobile phone significantly associated with increased risk of invasive cancer at the 15 other sites examined. A significantly reduced risk was found for lung cancer in ever vs never users (RR 0.89, 95% CI 0.84–0.95, $P=0.001$).

Vascular disease

During follow-up, 4073 women had a first hospital admission for stroke and 12 592 had a first admission for ischaemic heart disease. As shown in Table 2, ever use of a mobile phone was associated with a reduced risk of stroke (RR for ever vs never use, 0.88, 95% CI 0.82–0.94, $P<0.001$), but not with risk of admission for ischaemic heart disease (RR 1.04, 95% CI 1.00–1.08, $P=0.06$).

Discussion

In this large prospective study of middle-aged UK women, use of mobile phones was not associated

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

Table 1 Characteristics of the study population by reported mobile phone use at baseline, and details of follow-up

	Mobile phone use	
	Never (n = 294 484)	Ever (n = 497 226)
Characteristics at baseline		
Mean age, years (SD)	60.3 (5.1)	59.0 (4.8)
Socioeconomic group (% in upper third)	29.6	35.7
Mean height, cm (SD)	162.0 (6.7)	162.4 (6.6)
Mean body mass index, kg/m^2 (SD)	26.0 (4.6)	26.2 (4.6)
Strenuous physical activity >one h per week (%)	52.4	58.1
Alcohol intake, ⩾70 g/week (%)	21.3	29.6
Current smoker (%)	14.4	11.0
Current use of hormone replacement therapy (%)	25.7	29.3
Ever used oral contraceptives (%)	53.3	65.5
Ever had a full term pregnancy (%)	87.4	89.6
Follow-up for cancer		
Women-years of follow-up (millions)	2.3	3.5
Average years of follow-up per woman	7.7	7.1
Incident cancers (n)	21 549	30 131
Incident intracranial central nervous system tumours (n)	507	754
Follow-up for vascular disease[a]		
Women-years of follow-up (millions)	1.7	2.6
Average years of follow-up per woman	6.2	5.7
Incident stroke (n)	1993	2080
Incident ischaemic heart disease (n)	5401	7191

[a]Shorter follow-up time for vascular disease than for cancer (see text).

with an increased risk of glioma, meningioma, total cancer or cancer at 18 other specific sites. We found an increased risk of acoustic neuroma in women who had used a mobile phone for 5 years or longer, with risk increasing with increasing duration of exposure.

Possible carcinogenic effects of non-ionizing radiofrequency electromagnetic fields from handheld mobile phones have been of concern for many years, with their widespread and rapidly increasing use since the late 1990s.[13] Based on estimates of site-specific radiofrequency field dose,[14] interest has focused on risk of tumours of the head and neck, and in particular on those of the brain and cranial nerves, including glioma, meningioma and acoustic neuroma. It has also been suggested that there may be an increase in risk of leukaemia,[15,16] through exposure of bone marrow, and of malignant melanoma.[17]

In May 2011, an IARC Working Group concluded that there is 'limited evidence in humans' for the carcinogenicity of radiofrequency electromagnetic fields, based on associations between glioma and acoustic neuroma and exposure to these fields from wireless phones.[1] For meningioma and for non-CNS cancers, the IARC Working Group found the available evidence to be 'insufficient to reach a conclusion on the potential association with mobile phone use'. The epidemiological evidence, which has been extensively reviewed,[1,18–25] came largely from retrospective case-control studies, notably the INTERPHONE multicentre study[26-28] and studies from the Hardell group in Sweden.[29-31] Potential limitations of studies that collect exposure information retrospectively are well known, and are particularly pertinent for brain tumours, which may impair cognitive functioning and are often rapidly fatal. Some studies used proxy respondents to report the patient's past exposure. The INTERPHONE study of glioma risk, for example, used proxy reports of mobile phone use for 13% of cases.[26] It is not clear how proxies would affect accuracy of exposure information; the Hardell group reported similar results for living (no proxies)[32] and dead (100% proxies)[33] cases of malignant brain tumours.

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

Table 2 Relative risks (RRs) and 95% confidence intervals (CIs) for various outcomes in mobile phone users compared with never users

Outcome	Total cases	Ever use of a mobile phone		Daily use of a mobile phone		Duration of use 10+ years	
		n cases	RR (95% CI)	*n* cases	RR (95% CI)	*n* cases	RR (95% CI)
Neoplasms (ICD-10 codes)							
All invasive neoplasms (C00-97)	51 680	30 131	0.97 (0.95-0.99)	3684	0.95 (0.91-0.98)	4120	0.97 (0.93-1.00)
Head and neck neoplasms							
Intracranial central nervous system tumours[a]							
All	1261	754	1.01 (0.90-1.14)	90	1.00 (0.80-1.26)	103	1.02 (0.81-1.27)
Glioma (ICD-O 9380-9481)	571	334	0.91 (0.76-1.08)	36	0.80 (0.56-1.14)	40	0.78 (0.55-1.10)
Meningioma (ICD-O 9530-9539)	251	149	1.05 (0.81-1.38)	19	1.11 (0.67-1.85)	20	1.10 (0.66-1.84)
Pituitary (ICD-10 C75.1, D35.2, D44.3)	110	77	1.52 (0.99-2.33)	9	1.45 (0.68-3.10)	11	1.61 (0.78-3.35)
Acoustic neuroma (ICD-10 D33.3, ICD-O 9560)	96	67	1.44 (0.91-2.28)	8	1.37 (0.61-3.07)	8	2.46 (1.07-5.64)
Other/unspecified	233	127	0.93 (0.71-1.21)	18	1.19 (0.71-1.99)	24	1.03 (0.65-1.65)
Other head and neck							
Eye (C69)	87	52	1.01 (0.64-1.60)	5	0.75 (0.29-1.97)	5	0.82 (0.31-2.19)
Thyroid (C73)	345	216	1.07 (0.85-1.35)	21	0.85 (0.53-1.37)	32	1.06 (0.71-1.61)
Other (C00-14, 30-32)	719	417	0.98 (0.84-1.15)	46	0.79 (0.58-1.09)	57	1.00 (0.74-1.35)
Other neoplasms							
Oesophagus (C15)	666	355	0.90 (0.77-1.06)	30	0.61 (0.42-0.90)	52	1.02 (0.75-1.39)
Stomach (C16)	566	290	0.84 (0.70-1.00)	32	0.75 (0.52-1.10)	40	0.96 (0.68-1.36)
Colon (C18)	3803	2152	0.95 (0.89-1.02)	236	0.93 (0.81-1.07)	323	0.95 (0.84-1.08)
Rectum (C19-20)	1826	1056	0.95 (0.86-1.05)	124	0.94 (0.77-1.14)	146	0.92 (0.76-1.10)
Pancreas (C25)	1240	713	1.09 (0.96-1.22)	70	0.94 (0.72-1.21)	103	1.04 (0.83-1.30)
Lung (C34)	4162	2148	0.89 (0.84-0.95)	342	0.99 (0.88-1.11)	293	0.88 (0.78-1.00)
Melanoma (C43)	2116	1336	1.06 (0.96-1.16)	160	1.06 (0.89-1.26)	191	1.09 (0.92-1.29)
Breast (C50)	19 828	12 069	0.99 (0.96-1.02)	1514	0.97 (0.92-1.03)	1608	1.02 (0.96-1.08)
Endometrium (C54)[b]	3313	1924	0.97 (0.90-1.05)	219	0.92 (0.79-1.06)	234	0.86 (0.74-0.99)
Ovary (C56)[b]	2587	1503	0.97 (0.90-1.06)	157	0.85 (0.72-1.01)	199	0.97 (0.83-1.14)
Kidney (C64)	979	584	1.05 (0.92-1.20)	83	1.19 (0.93-1.52)	92	1.16 (0.91-1.48)
Bladder (C67)	730	394	0.90 (0.77-1.05)	42	0.79 (0.57-1.10)	65	1.10 (0.83-1.46)
Non-Hodgkin lymphoma (C82-85)	2058	1184	0.97 (0.88-1.06)	134	0.94 (0.78-1.13)	176	0.99 (0.83-1.17)
Multiple myeloma (C90)	742	427	0.98 (0.84-1.14)	50	1.01 (0.74-1.37)	59	0.87 (0.65-1.17)
Leukaemia (C91-95)	860	478	0.91 (0.79-1.05)	53	0.88 (0.66-1.19)	67	0.92 (0.70-1.21)
Vascular Disease (ICD-10 codes)							
Stroke (I60-69)	4073	2080	0.88 (0.82-0.94)	263	0.94 (0.83-1.07)	137	0.84 (0.70-1.00)
Ischaemic heart disease (I20-25)	12 592	7191	1.04 (1.00-1.08)	1055	1.25 (1.17-1.34)	477	1.01 (0.92-1.11)

[a]ICD-10 codes C70,C71,C72.1-5, C75.1-3, D32.0, D33.0-3, D35.2-4, D42.0, D43.0-3, D44.3-5.
[b]Women who have reported having had hysterectomy or bilateral oophorectomy were excluded from the analyses, as appropriate.

Consistent with the findings from the only other study with prospective recording of exposure,[5] we found no increase in the risk of glioma in mobile phone users. Combining results from the two prospective studies gives a RR of 0.98 (95% CI 0.83–1.15, $P=0.76$) for 10 or more years of use of a mobile phone, inconsistent with the findings from the Hardell group (RR 2.5, 95% CI 1.8–3.3 in mobile phone users of more than 10 years).[31] An increased risk for glioma (RR 1.40, 95% CI 1.03–1.89) in INTERPHONE was seen only in people with the highest decile of reported call time; the lack of a dose-response relationship and the likelihood of recall bias have meant that the authors[27] and others[19]

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

Table 3 Relative risks (RRs) and 95% confidence intervals (CIs) for incident intracranial central nervous system (CNS) tumours and for specified glioma, meningioma, pituitary tumours and acoustic neuroma in relation to mobile phone use

	All intracranial CNS tumours		Glioma		Meningioma		Pituitary tumours		Acoustic neuroma	
Mobile phone use	*n* cases	RR (95% CI)	*n* cases	RR (95% CI)	*n* cases	RR (95% CI)	*n* cases	RR (95% CI)	*n* cases	RR (95% CI)
All women										
Never	507	Ref	237	Ref	102	Ref	33	Ref	29	Ref
Ever	754	1.01 (0.90-1.14)	334	0.91 (0.76-1.08)	149	1.05 (0.81-1.38)	77	1.52 (0.99-2.33)	67	1.44 (0.91-2.28)
Frequency of use										
<Daily use	664	1.02 (0.90-1.15)	298	0.92 (0.77-1.10)	130	1.05 (0.80-1.37)	68	1.53 (0.99-2.36)	59	1.45 (0.91-2.31)
Daily use	90	1.00 (0.80-1.26)	36	0.80 (0.56-1.14)	19	1.11 (0.67-1.85)	9	1.45 (0.68-3.10)	8	1.37 (0.61-3.07)
Duration of use										
<5 years	203	1.00 (0.84-1.20)	89	0.93 (0.71-1.21)	41	0.88 (0.60-1.31)	29	2.31 (1.31-4.06)	19	1.00 (0.54-1.82)
5-9 years	406	1.02 (0.89-1.17)	185	0.92 (0.75-1.13)	82	1.21 (0.89-1.65)	30	1.08 (0.64-1.82)	38	1.80 (1.08-3.03)
10+ years	103	1.02 (0.81-1.27)	40	0.78 (0.55-1.10)	20	1.10 (0.66-1.84)	11	1.61 (0.78-3.35)	8	2.46 (1.07-5.64)
Excluding the first 3 years of follow-up										
Never	335		153		63		24		11	
Ever	466	0.99 (0.85-1.14)	203	0.89 (0.71-1.11)	86	1.01 (0.72-1.42)	45	1.27 (0.75-2.14)	31	1.96 (0.96-4.02)
Duration of use										
<5 years	47	1.28 (0.92-1.77)	16	1.00 (0.58-1.71)	11	1.44 (0.70-2.93)	7	2.28 (0.93-5.62)	4	1.80 (0.55-5.90)
5-9 years	305	0.97 (0.82-1.14)	141	0.92 (0.72-1.17)	55	1.01 (0.69-1.47)	26	1.11 (0.62-1.99)	20	1.89 (0.87-4.08)
10+ years	91	0.96 (0.75-1.23)	35	0.75 (0.51-1.10)	18	1.01 (0.58-1.76)	9	1.36 (0.61-3.05)	6	3.11 (1.08-8.95)
Excluding women reporting mobile phone use in 1999-2000, as many may have subsequently changed use (see text and Figure 1)										
Never	295		151		49		18		17	
Ever	574	0.98 (0.84-1.13)	261	0.83 (0.68-1.02)	103	1.07 (0.75-1.52)	60	1.67 (0.97-2.86)	53	1.40 (0.80-2.44)
Duration of use										
<5 years	147	0.91 (0.74-1.13)	66	0.77 (0.57-1.06)	25	0.82 (0.49-1.38)	21	2.38 (1.19-4.74)	15	0.95 (0.46-1.94)
5-9 years	324	1.01 (0.85-1.18)	148	0.86 (0.68-1.09)	64	1.32 (0.89-1.94)	25	1.21 (0.65-2.27)	31	1.78 (0.96-3.29)
10+ years	67	0.96 (0.72-1.26)	29	0.75 (0.49-1.13)	9	0.85 (0.41-1.78)	7	1.77 (0.70-4.44)	5	1.98 (0.70-5.59)

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

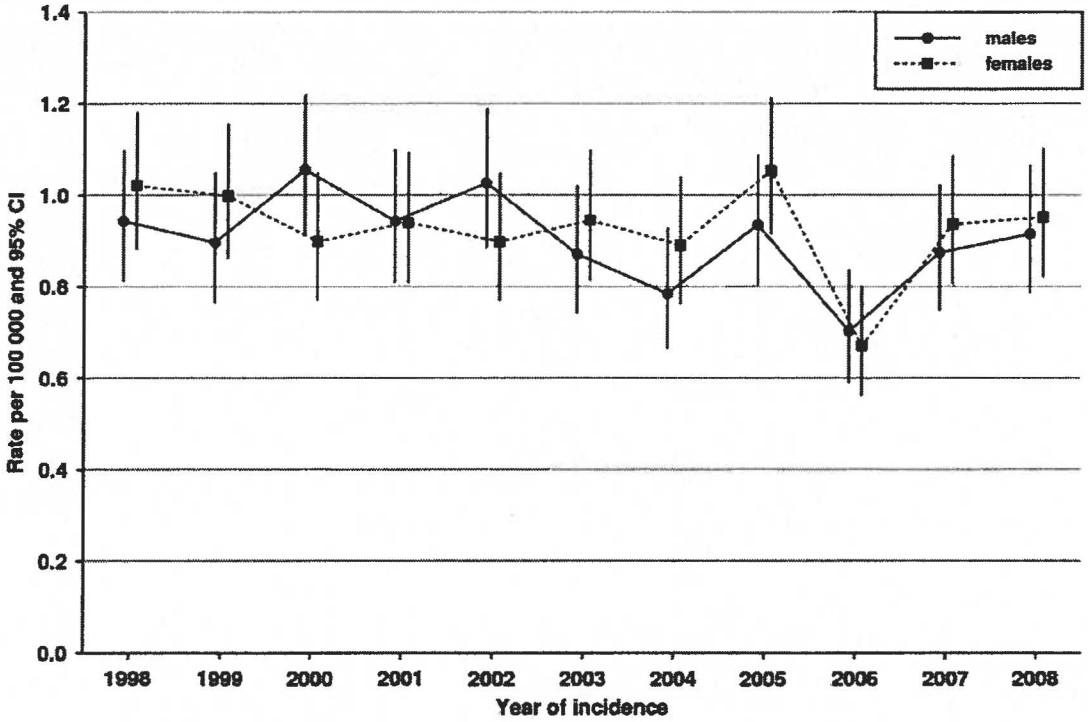

Figure 2 Annual incidence rates for acoustic neuroma (ICD-10 D33.3), for men and women aged 20–79 years, England, 1998 to 2008[12]

have cautioned against regarding this finding as strong evidence for a causal relationship. Also there has been no observable increase in glioma incidence during the past decade or so.[34,35]

For meningioma, our results and those from the Danish prospective study show no increase in the risk related to mobile phone use, with a combined RR of 0.97 (95% CI, 0.72–1.32, $P=0.86$) for 10 or more years of use. Studies with retrospective reporting of exposure have also found little evidence for increased risk of meningioma in mobile phone users.[27,30]

In contrast to the findings from the Danish prospective study,[11] we did find a trend of increasing risk for acoustic neuroma with increasing duration of mobile phone use. Acoustic neuroma is rare; there were relatively few incident acoustic neuromas in mobile phone users in either study (96 in our study and 261 in the Danish study), and confidence intervals surrounding each risk estimate are large. Combining results from the two studies gives a summary RR of 1.16 (95% CI 0.75–1.81, $P=0.50$) for mobile phone use for at least 10 years. With retrospective reporting of exposure, the INTERPHONE study found little evidence for increased risk of acoustic neuroma in mobile phone users. As in the analyses for glioma, their elevated odds ratio was found for acoustic neuroma only in those in the top decile of reported call time; and, again, no dose-response relationship was seen.[28] The Hardell group reported a relative risk of 2.9 (95% CI 1.6–5.5) for acoustic neuroma associated with the use of mobile phones for more than 10 years.[30] Acoustic neuroma often causes hearing loss: in the INTERPHONE study, 79% of acoustic neuroma patients reported having hearing problems before diagnosis, with 25% having had these symptoms for more than 5 years before diagnosis.[28] Given the media coverage of possible relationships between mobile phone use and brain tumours, it is possible that some of the observed associations are due to differential diagnosis, as long-term mobile phone users may have been selectively investigated for symptoms of hearing loss.

The rapidly increasing prevalence of mobile phone use in our cohort, from 34% in women reporting in 1999 to 79% in those reporting in 2005, is consistent with the steep increase in numbers of mobile phone subscriptions in the UK from the early 1990s to 2003[13] and mirrors similar increases in the rest of the world.[36] There is, however, little to suggest an increase in the incidence of acoustic neuroma in England between 1998 and 2008 (Figure 2).

We found a raised relative risk for pituitary tumours in ever users of mobile phones vs never users

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

(RR = 1.52, 95% CI 0.99–2.33, $P = 0.06$), but no evidence for a trend with increasing duration of use. Previous studies of incident pituitary tumours and mobile phone use have found no increase in risk.[37,38]

We found no evidence for increased incidence of other cancers in relation to use of a mobile phone, including cancers of the head and neck, all cancers, or cancer at 15 other specific sites, including malignant melanoma, leukaemia, multiple myeloma and non-Hodgkin lymphoma. These results are consistent with the limited published data for non-CNS tumours.[4,15–18,39] As found in the Danish cohort, mobile phone users in our study had a slightly lower incidence of lung cancer and all cancer than non-users; in the Million Women Study, mobile phone users were less likely than non-users to be current smokers at baseline, and it is possible that the slightly reduced risk of lung cancer reflects some residual confounding with smoking.

Mobile phone use was also not consistently associated with increased incidence of stroke or of ischaemic heart disease. The analyses of vascular disease risk were included largely for comparison with those for cancer. Although a case report of an indirect (mechanical) association between using a mobile phone and risk of cerebral ischaemia has been published,[40] we are not aware of any substantial hypothetical or reported direct associations between mobile phone use and vascular disease.

The main strengths of this study lie in the prospective collection of information on use of mobile phones, and the inclusion of large numbers who had used mobile phones for more than 5 years, and many for more than 10 years. As a prospective study with individual participant information on amount of mobile phone use and on possible confounders, this study was prone neither to the shortcomings of retrospective reporting of exposure nor to the limitations of the Danish prospective study, which was based on follow-up of subscription holders and had limited adjustment for other risk factors.[10] In previous analyses we have shown associations between height, body mass index and use of hormone therapy for menopause and risk of CNS tumours.[7,41,42] Obesity, physical activity, smoking and alcohol consumption are associated with risk of cancers at other sites. Some of these factors are related to reported mobile phone use and so could potentially confound associations between phone use and cancer risk, but we adjusted for these. Thus, with virtually complete follow-up, we were able to compare risks for a wide range of cancer outcomes in users and non-users of mobile phones, in an analysis free from recall bias and adjusted for potential confounding factors.

The main limitation of the study is that mobile phone use was reported at baseline and may have changed subsequently. Almost all women who reported daily use of mobile phones at baseline were still using a mobile phone at least once a week when asked again 8.8 years later. However, some women who reported not using a mobile phone at baseline began use subsequently; and this might dilute our estimates of relative risk towards the null. Our data suggest that, as expected, this problem is likely to be greatest among women who reported their baseline use of mobile phones in 1999 and 2000, before use became widespread; however, excluding these women did not materially alter our results. We did not have details of handedness of phone use, nor information on tumour laterality. Despite the large study size, the numbers of incident intracranial CNS tumours were still relatively small, especially for rarer tumours such as acoustic neuroma.

In conclusion, in this large prospective study we found no increase in the risk of glioma or meningioma, consistent with findings from the only other prospective study. We did find an increase in the risk of acoustic neuroma among those who had used mobile phones for 5 years or longer; but risk for acoustic neuroma in long-term mobile phone users was not significantly increased when our results were combined with those from the only other published prospective study. In relation to previous studies,[1] our results weaken the evidence for an association between mobile phone use and risk of glioma, but leaves open the possibility of an increased risk of acoustic neuroma in long-term users of mobile phones.

Supplementary Data

Supplementary data are available at *IJE* online.

Funding

This study was funded by Cancer Research UK (www.cancerresearchuk.org) (grant C570/A11692), the Medical Research Council (www.mrc.ac.uk) (grant G0700474 ID no. 81793) and the UK National Health Service Breast Screening Programme (www.cancerscreening.nhs.uk/breastscreen) (grant C4023/A7506). The funders had no role in study design, data collection and analysis, decision to publish or preparation of the manuscript.

Acknowledgements

We would like to thank all of the women who participated in the study, and staff from participating NHS Breast Cancer Screening Centres.

Conflict of interest: None declared.

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

KEY MESSAGES

- Results from some retrospective studies suggest a possible increased risk of glioma and acoustic neuroma in users of mobile phones. Interpretation of these findings is debated.
- In this large UK cohort study with prospective recording of mobile phone use, we found no association of phone use, including use for 10 or more years, with risk of incident glioma or meningioma, or of invasive cancer overall and at 18 specified sites.
- Risk of acoustic neuroma was increased in women with 5 or more years' mobile phone use, the risk increasing with increasing duration of use.
- Interpretation of the increased risk of acoustic neuroma is not straightforward. Acoustic neuroma registration rates in the UK have not changed over the period of rapidly increasing use of mobile telephones.

References

[1] Baan R, Grosse Y, Lauby-Secretan B *et al.* Carcinogenicity of radio frequency electromagnetic fields. *Lancet Oncol* 2011;**12**:624–26.

[2] Wainwright P. Thermal effects of radiation from cellular telephones. *Phys Med Biol* 2000;**45**:2363–72.

[3] Vrijheid M, Armstrong BK, Bédard D *et al.* Recall bias in the assessment of exposure to mobile phones. *J Expo Sci Environ Epidemiol* 2009;**19**:369–81.

[4] Schüz J, Jacobsen R, Olsen JH, Boice J, McLaughlin JK, Johansen C. Cellular telephone use and cancer risk: Update of a nationwide Danish cohort. *J Natl Cancer Inst* 2006;**98**:1707–13.

[5] Frei P, Poulsen AH, Johansen C, Olsen JH, Steding-Jessen M, Schüz J. Use of mobile phones and risk of brain tumours: update of Danish cohort study. *BMJ* 2011;**343**:d6387.

[6] Beral V, Million Women Study Collaborators. Breast cancer and hormone-replacement therapy in the Million Women Study. *Lancet* 2003;**362**:419–27.

[7] Benson VS, Pirie K, Green J *et al.* Hormone replacement therapy and incidence of central nervous system tumours in the million women study. *Int J Cancer* 2010;**127**: 1692–98.

[8] World Health Organization. *International Statistical Classification of Diseases and Related Health Problems, 10th Revision*. Geneva: World Health Organization, 1992.

[9] Fritz A, Percy C, Jack A *et al. International Classification of Diseases for Oncology*. 3rd edn. Geneva: World Health Organization, 2000.

[10] Townsend P, Phillimore P, Beattie A. *Health and Deprivation: Inequality and the North*. London: Croom Helm, 1988.

[11] Schüz J, Steding-Jessen M, Hansen S *et al.* Long-term mobile phone use and the risk of vestibular schwannoma: A Danish nationwide cohort study. *Am J Epidemiol* 2011; **174**:416–22.

[12] Office for National Statistics. Cancer Statistics Registrations and Population Estimates for UK. http://www.ons.gov.uk/ons/ (22 January 2012, date last accessed).

[13] Shepard A. Use of ICT among households and individuals. In Avery V, Chamberlain E, Summerfield C, Zealey L (eds). *Focus on the Digital Age*. Norwich, UK: Office for National Statistics, 2011.

[14] Cardis E, Deltour I, Mann S *et al.* Distribution of RF energy emitted by mobile phones in anatomical structures of the brain. *Phys Med Biol* 2008;**53**:2771–83.

[15] Kaufman DW, Anderson TE, Issaragrisil S. Risk factors for leukemia in Thailand. *Ann Hematol* 2009;**88**:1079–88.

[16] Cooke R, Laing S, Swerdlow AJ. A case-control study of risk of leukaemia in relation to mobile phone use. *Br J Cancer* 2010;**103**:1729–35.

[17] Hardell L, Carlberg M, Hansson Mild K, Eriksson M. Case-control study on the use of mobile and cordless phones and the risk for malignant melanoma in the head and neck region. *Pathophysiology* 2011;**18**:325–33.

[18] Ahlbom A, Feychting M, Green A, Kheifets L, Savitz DA, Swerdlow AJ. Epidemiologic evidence on mobile phones and tumor risk: A review. *Epidemiology* 2009;**20**:639–52.

[19] Swerdlow A, Feychting M, Green AC, Kheifets L, Savitz DA. Mobile phones, brain tumours and the Interphone Study: Where are we now? *Environ Health Perspect* 2011;**119**:1534–38.

[20] Levis AG, Minicuci N, Ricci P, Gennaro V, Garbisa S. Mobile phones and head tumours. The discrepancies in cause-effect relationships in the epidemiological studies – How do they arise? *Enviro Health* 2011;**10**:59.

[21] Kan P, Simonsen SE, Lyon JL, Kestle JRW. Cellular phone use and brain tumor: A meta-analysis. *J Neurooncol* 2008;**86**:71–78.

[22] Khurana VG, Teo C, Kundi M, Hardell L, Carlberg M. Cell phones and brain tumors: a review including the long-term epidemiologic data. *Surg Neurol* 2009;**72**:205–14.

[23] Myung SK, Ju W, McDonnell DD *et al.* Mobile phone use and risk of tumors: A meta-analysis. *J Clin Oncol* 2009;**27**: 5565–72.

[24] Lahkola A, Tokola K, Auvinen A. Meta-analysis of mobile phone use and intracranial tumors. *Scand J Work Environ Health* 2006;**32**:171–77.

[25] Hardell L, Carlberg M, Hansson MK. Epidemiological evidence for an association between use of wireless phones and tumour diseases. *Pathophysiology* 2009;**16**:113–22.

[26] Cardis E, Richardson L, Deltour I *et al.* The INTERPHONE study: Design, epidemiological methods, and description of the study population. *Eur J Epidemiol* 2007;**22**: 647–64.

[27] Cardis E. Brain tumour risk in relation to mobile telephone use: Results of the INTERPHONE international case-control study. *Int J Epidemiol* 2010;**39**:675–94.

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

[28] The INTERPHONE Study Group. Acoustic neuroma risk in relation to mobile telephone use: Results of the INTERPHONE international case-control study. *Cancer Epidemiol* 2011;**35**:453–64.
[29] Hardell L, Carlberg M, Hansson M. Pooled analysis of two case-control studies on the use of cellular and cordless telephones and the risk of benign brain tumours diagnosed during 1997-2003. *Inter J Oncol* 2006;**28**: 509–18.
[30] Hardell L, Carlberg M. Mobile phones, cordless phones and the risk for brain tumours. *Int J Oncol* 2009; **35**:5–17.
[31] Hardell L, Carlberg M, Mild KH. Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects. *Int J Oncol* 2011;**38**:1465–74.
[32] Hardell L, Carlberg M, Mild KH. Mobile phone use and risk for malignant brain tumours: A case-control study of deceased cases and controls. *Neuroepidemiol* 2010;**35**: 109–14.
[33] Hardell L, Carlberg M, Mild KH. Pooled analysis of two case-control studies on use of cellular and cordless telephones and the risk for malignant brain tumours diagnosed in 1997-2003. *Int Arch Occup Environ Health* 2006; **79**:630–39.
[34] Deltour I, Auvinen A, Feychting M *et al*. Mobile phone use and incidence of glioma in the Nordic countries 1979-2008. *Epidemiology* 2012;**23**:301–07.
[35] Little MP, Rajaraman P, Curtis RE *et al*. Mobile phone use and glioma risk: comparison of epidemiological study results with incidence trends in the United States. *BMJ* 2012;**344**:e1147.
[36] International Telecommunication Union (ITU). World Telecommunication/ICT Indicators Database 2011. http://www.itu.int/ITU-D/ict/publications/world/world.html (12 September 2011, date last accessed).
[37] Schoemaker ML, Swerdlow AJ. Risk of pituitary tumors in cellular phone users: a case control-study. *Epidemiology* 2009;**20**:348–54.
[38] Takebayashi T, Varsier N, Kikuchi Y, Wake K, Taki M, Watanabe S. Mobile phone use, exposure to radiofrequency electromagnetic field, and brain tumour: a case-control study. *Br J Cancer* 2008;**98**:652–59.
[39] Söderqvist F, Carlberg M, Hardell L. Use of wireless phones and the risk of salivary gland tumours: a case-control study. *Eur J Cancer Prev* 2012;**21**:576–79.
[40] Zuber M, Meder JF, Mas JL. Carotid artery dissection due to elongated styloid process. *Neurology* 1999;**53**: 1886–87.
[41] Benson VS, Green J, Pirie K, Beral V. Cigarette smoking and risk of acoustic neuromas and pituitary tumours in the Million Women Study. *Br J Cancer* 2010;**102**:1654–56.
[42] Benson VS, Pirie K, Green J, Casabonne D, Beral V. Million Women Study Collaborators. Lifestyle factors and primary glioma and meningioma tumours in the Million Women Study cohort. *Br J Cancer* 2008;**99**:185–90.

Downloaded from http://ije.oxfordjournals.org/ at Medicinska biblioteket on May 12, 2013

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

AAP Headquarters
141 Northwest Point Blvd
Elk Grove Village, IL 60007-1019
Phone: 847/434-4000
Fax: 847/434-8000
E-mail: kidsdocs@aap.org
www.aap.org

Reply to
Department of Federal Affairs
Homer Building, Suite 400 N
601 13th St NW
Washington, DC 20005
Phone: 202/347-8600
Fax: 202/393-6137
E-mail: kids1st@aap.org

Executive Committee

President
Robert W. Block, MD, FAAP

President-Elect
Thomas K. McInerny, MD, FAAP

Immediate Past President
O. Marion Burton, MD, FAAP

Executive Director/CEO
Errol R. Alden, MD, FAAP

Board of Directors

District I
Carole E. Allen, MD, FAAP
Arlington, MA

District II
Danielle Laraque, MD, FAAP
Brooklyn, NY

District III
Sandra Gibson Hassink, MD, FAAP
Wilmington, DE

District IV
Francis E. Rushton, Jr, MD, FAAP
Beaufort, SC

District V
Marilyn J. Bull, MD, FAAP
Indianapolis, IN

District VI
Michael V. Severson, MD, FAAP
Shakopee, MN

District VII
Kenneth E. Matthews, MD, FAAP
College Station, TX

District VIII
Kyle Yasuda, MD, FAAP
Seattle, WA

District IX
Myles B. Abbott, MD, FAAP
Berkeley, CA

District X
Sara H. Goza, MD, FAAP
Fayetteville, GA

July 12, 2012

The Honorable Julius Genachowski
Commissioner
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

Dear Chairman Genachowski:

The American Academy of Pediatrics (AAP), a non-profit professional organization of 60,000 primary care pediatricians, pediatric medical sub-specialists, and pediatric surgical specialists dedicated to the health, safety and well-being of infants, children, adolescents, and young adults strongly supports the proposal for a formal inquiry into radiation standards for cell phones and other wireless products. The Academy encourages the Federal Communications Commission (FCC) to vote to move forward with this inquiry in an expeditious manner.

The FCC has not assessed the standard for cell phone radiation since 1996. According to industry groups, approximately 44 million people had mobile phones when the standard was set; today, there are more than 300 million mobile phones in use in the United States. While the prevalence of wireless phones and other devices has sky-rocketed, the behaviors around cell phone uses have changed as well. The number of mobile phone calls per day, the length of each cell phone call, and the amount of time people use mobile phones has increased, while cell phone and wireless technology has undergone substantial changes. Many more people, especially adolescents and young adults, now use cell phones as their only phone line and they begin using wireless phones at much younger ages.

The FCC standard for maximum radiation-exposure levels are based on the heat emitted by mobile phones. These guidelines specify exposure limits for hand-held wireless devices in terms of the Specific Absorption Rate (SAR), which measures the rate the body absorbs radiofrequency (RF). The current allowable SAR limit is 1.6 watts per kilogram (W/kg), as averaged over one gram of tissue. Although wireless devices sold in the United States must ensure that they do not exceed the maximum allowable SAR limit when operating at the device's highest possible power level, concerns have been raised that long-term RF exposure at this level affects the brain and other tissues and may be connected to types of brain cancer, including glioma and meningioma.

In the past few years, a number of American and international health and scientific bodies have contributed to the debate over cell phone radiation and its possible link to cancer. The International Agency for Research on Cancer (IARC), part of the

United Nations' World Health Organization, said in June 2011 that a family of frequencies that includes mobile-phone emissions is "possibly carcinogenic to humans." The National Cancer Institute has stated that although studies have not demonstrated that RF energy from cell phones definitively causes cancer, more research is needed because cell phone technology and cell phone use are changing rapidly. While a definitive link between cell phone radiation and brain cancer has not been established, these studies and others clearly demonstrate the need for further research into this area and highlight the importance of reassessing the current SAR to determine if it is protective of human health.

The AAP believes the inquiry to reassess the radiation standard presents an opportunity to review its impacts on children's health and well-being. In the past, such standards have generally been based on the impact of exposure on an adult male. Children, however, are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. In fact, according to IARC, when used by children, the average RF energy deposition is two times higher in the brain and 10 times higher in the bone marrow of the skull, compared with mobile phone use by adults. While the Academy appreciates that the FCC is considering investigating whether the emission standards should be different for devices primarily used by children, it is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes.

Finally, in reviewing the SAR standard, the FCC has the opportunity to highlight the importance of limiting media use among children. The Academy has found potentially negative effects and no known positive effects of media use by children under the age of two, including television, computers, cell phones, and other handheld wireless devices. In addition, studies consistently show that older children and adolescents utilize media at incredibly high rates, which potentially contributes to obesity and other health and developmental risks. In reviewing the SAR limit, the FCC has the opportunity to improve the health of our nation by highlighting the importance of limiting screen time and media use for children and adolescents.

The AAP supports the proposal for a formal inquiry into radiation standards for cell phones and other wireless products and the Academy encourages the FCC to vote in favor of moving forward with this investigation. If you have questions or concerns, please contact Kristen Mizzi in the AAP's Washington Office at 202/347-8600.

Sincerely,

Robert W. Block, MD FAAP
President

RWB/km