Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case–control study

The INTERPHONE Study Group*

*List of members of this study group is available in the Appendix.

Accepted 8 March 2010

Background The rapid increase in mobile telephone use has generated concern about possible health risks related to radiofrequency electromagnetic fields from this technology.

Methods An interview-based case-control study with 2708 glioma and 2409 meningioma cases and matched controls was conducted in 13 countries using a common protocol.
Conclusions Overall, no increase in risk of glioma or meningioma was observed with use of mobile phones.

From the authors’ published conclusions.

In the 2010 Interphone Study combined analysis of data for all levels of exposure found that “regular cell phone users” were less likely to have brain tumors than non-users.

This is what was reported in the media about this study.

A reduced odds ratio (OR) related to ever having been a regular mobile phone user was seen for glioma [OR 0.81; 95% confidence interval (CI) 0.70–0.94] and meningioma (OR 0.79; 95% CI 0.68–0.91)

However, “regular use” was defined as a minimum of one call for week for at least 6 months. In other words, anyone who had made at least 26 cell phone calls in their lifetime was categorized as a “regular user” and placed in the risk group.

Cumulative call time without hands-free devices, divided into deciles.
Blue line is Odds Ratio of 1.0 (equal to control group).

Half of the subjects in the study had less than 115 hours of lifetime exposure.

Note that a significantly higher risk for glioma was seen with more than 1640 hours of exposure.

OR for glioma = 1.40 [95% CI = (1.03–1.89)]

Odds Ratio for Meningioma with Cell Phone Use

<table>
<thead>
<tr>
<th>Phone Use</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 4 yr</td>
<td>&lt; 5 hr</td>
<td></td>
</tr>
<tr>
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<td>5 – 114.9</td>
<td></td>
</tr>
<tr>
<td>1 - 4 yr</td>
<td>115 – 359.9</td>
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</tr>
<tr>
<td>1 - 4 yr</td>
<td>360 – 1639.9</td>
<td></td>
</tr>
<tr>
<td>1 - 4 yr</td>
<td>≥ 1640 hrs</td>
<td></td>
</tr>
</tbody>
</table>

Charted data from the Interphone study for risk of meningioma.

With ≥1640 hrs exposure in 1 – 4 years, OR = 4.80 [95% CI = (1.49–15.4)]

1640 hours in 4 years = 7.9 hrs/wk
(range in cohort was 8 – 30 hrs/wk, which the authors discounted as “implausible values of use” in their summary of results)


Odds Ratio for Glioma with Cell Phone Use

<table>
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<td></td>
</tr>
</tbody>
</table>

Charted data from INTERPHONE study group, glioma risk.
Stratified by cumulative call time (without hands/free devices).
Also stratified by years of use.

With ≥1640 hrs exposure in 1 – 4 years, OR for Glioma = 3.77 [95% CI = (1.25–11.4)]
1640 hours in 4 years = 7.9 hrs/wk (range in cohort was 8 – 30 hrs/wk)

The authors rejected their own findings on glioma, stating that this level of reported cell phone use was “implausible”.

Glioma risk by location in the brain.
Also stratified by cumulative call time.

Temporal lobe (With ≥1640 hrs exposure, OR = 1.87 [95% CI = (1.09–3.22)]


Interestingly, the study did report its statistics stratified by total time of reported use, and the top decile (greater than 1640 hours use over a ten year interval, averaging out as greater than 3 hours a week) had an increased risk of certain tumors. Individuals who accrued that greater than 1650 hours of use over a 1 to 4 year interval (ranging from 8 to over 30 hours a week) had a markedly higher odds ratio of meningioma (OR 4.80) or glioma (OR 3.27).

Glioma risk by side of head they habitually held the phone.
Also stratified by cumulative call time.

(With ≥1640 hrs exposure, Ipsilateral OR = 1.96 [95% CI = (1.22–3.22)]

Stratified by years of exposure.

1640 hours in 10+ years ~ > 3 hrs/wk
1640 hours in 4 years = 7.9 hrs/wk (range in cohort was 8 - 30 hrs/wk)


Odds Ratio for Glioma (by Years of Use)

Glioma risk by side of head they habitually held the phone.
Also stratified by cumulative call time.

1640 hours in 10+ years ~ > 3 hrs/wk

Acoustic neuroma risk in relation to mobile telephone use: Results of the INTERPHONE international case–control study

The INTERPHONE Study Group

ABSTRACT
Background: The rapid increase in mobile telephone use has generated concern about possible health risks of radiofrequency electromagnetic fields from these devices. Methods: A case–control study of 1,095 patients with newly diagnosed acoustic neuroma (vestibular schwannoma) and 2,145 controls was conducted in 15 countries using a common protocol. Past mobile telephone use was assessed by personal interview, in the primary analysis, exposure time was censored at one year before the reference date (date of diagnosis for cases and date of diagnosis of the matched case for controls), analyses concurring exposure at four years before the reference date were also done to allow for a possible longer latency period. Results: The odds ratio (OR) of acoustic neuroma with ever having been a regular mobile phone user was 0.95 (95% confidence interval 0.89–1.04). The OR for ≥10 years after first regular mobile phone use was 0.38 (0.22–0.65). There was no trend of increasing OR with increasing cumulative call time or cumulative number of calls, with the lowest OR (0.88 (0.81–0.94)) observed in the 9th decile of cumulative call time. In the 10th decile (≥1,450 h) of cumulative call time, the OR was 1.32 (0.88–1.97); there were, however, implausible values of reported use in those with ≥1,640 h of accumulated mobile phone use. With censoring at 5 years before the reference date the OR for ≥10 years after first regular mobile phone use was 0.31 (0.20–0.48) and for ≥1,440 h of cumulative call time it was 2.57 (1.51–4.46). But again with no trend in the lower nine deciles and with the lowest OR in the 9th decile. In general, ORs were not greater in subjects who reported usual phone use on the same side of the head as their increase than in those who reported it on the opposite side, but it was greater in those in the 10th decile of cumulative usage time of use. Conclusions. There was no increase in risk of acoustic neuroma with ever regular use of a mobile phone or for users who began regular use 10 years or more before the reference date. Elevated odds ratios observed at the highest level of cumulative call time could be due to chance, reporting bias or a causal effect. An acoustic neuroma is usually a slowly growing tumour; the interval between introduction of mobile phones and occurrence of the tumour might have been too short to observe an effect, if there is one.

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From 2011 INTERPHONE study of acoustic neuroma, Table 2.

This study was also funded in major part by the telecommunications industry.

In their conclusion, the authors stated that this data showed "no trend of increasing risk with increasing cumulative call time"

They discounted their findings for the highest decile of exposure.

But with ≥1,640 h exposure in 1 – 5 years of exposure, OR = 2.79 [95% CI = (1.51–5.16)]


Odds Ratio for Acoustic Neuroma with Cell Phone Use

Regular Use < 1 Year

Regular Use < 5 Years

Never

5-12.9

31-60.9

115-199.9

360-734.9

≥ 1640 hrs

*

From 2011 INTERPHONE study of acoustic neuroma, Table 2.

This study was also funded in major part by the telecommunications industry.

In their conclusion, the authors stated that this data showed "no trend of increasing risk with increasing cumulative call time"

They discounted their findings for the highest decile of exposure.

But with ≥1,640 h exposure in 1 – 5 years of exposure, OR = 2.79 [95% CI = (1.51–5.16)].
In the high use group, risk of acoustic neuroma was significantly higher on the side of the head where the subject habitually held the cell phone.

**1640 hours in 1 year = 4.5 hours a day = 31.5 hours/week**

With ≥1640 hrs exposure, ipsilateral tumor Odds Ratio = 2.33 [95% CI = (1.23–4.40)]


Risk increased with increased years of exposure.

**1640 hours in 5 years = 0.9 hours a day = 6.3 hours/week**

With ≥1640 hrs exposure, ipsilateral tumor Odds Ratio = 3.53 [95% CI = (1.59–7.82)]

Higher risk with ten or more years of exposure.

1640 hours in 10 years = less than half an hour a day. = 3.2 hours/week = 0.45 hours a day

With ≥1640 hrs exposure, ipsilateral tumor Odds Ratio = 3.74 [95% CI = (1.58–8.83)]


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**Acoustic Neuroma Risk with 1 to 4 Years of Cell Phone Use**

2011 INTERPHONE study of acoustic neuroma

From Table 4: Short, medium, long-term accumulation of >1640 hours.

2011 INTERPHONE study of acoustic neuroma

From Table 4: Short, medium, long-term accumulation of >1640 hours.


Acoustic Neuroma Risk with 10 + Years of Cell Phone Use

2011 INTERPHONE study of acoustic neuroma

From Table 4: Short, medium, long-term accumulation of ≥1640 hours.

Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries

E Cardis,1 B K Armstrong,2 J D Bowman,3 G G Giles,4,5 M Hours,6 D Krewski,7 M McBride,8 M E Parent,9 S Sadetzk,1,11 A Woodward,12 J Brown,2 A Chetrit,10 J Figuerola,1 C Hoffmann,1,13 A Jarus-Hakak,10 L Montestruq,8 L Nadon,3 L Richardson,1,14 R Villegas,1 M Vrijheid1

ABSTRACT

Objectives The objective of this study was to examine the associations of brain tumours with radio frequency (RF) fields from mobile phones.

Methods Patients with brain tumour from the Australian, Canadian, French, Israeli and New Zealand components of the Interphone Study, whose tumours were localised by neuroradiologists, were analysed. Controls were matched on age, sex and region and allocated the ‘tumour location’ of their matched case. Analyses included 953 glioma and 678 meningioma cases and 1762 and 1911 controls, respectively. RF dose was estimated as total cumulative specific energy (TCSE; J/kg) absorbed at the tumour’s estimated centre taking into account multiple RF exposure determinants.

Results ORs with ever having been a regular mobile phone user were 0.93 (95% CI 0.73 to 1.18) for glioma and 0.80 (95% CI 0.66 to 0.96) for meningioma. ORs for glioma were below 1 in the first four quintiles of TCSE but above 1 in the highest quintile, 1.35 (95% CI 0.96 to 1.89). The OR increased with increasing TCSE 7+ years of mobile phone use (p-trend 0.01; OR 1.91, 95% CI 1.05 to 3.47 in the highest quintile). A complementary analysis in the four lower quintiles. When risk was examined as a function of dose received in different time windows before diagnosis, an increasing trend was observed with increasing radio frequency dose, though reduced risks were seen in the four lower quintiles. When risk was stratified by Total Cumulative Energy Exposure (joules/kilogram)

Interphone latest study 2011


Odds Ratio for Brain Tumor (7+ years of cell phone use)

From Table 3: Cardis E, Armstrong BK, Bowman JD et al. Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries. Occup Environ Med (2011); 68(9):631-640.
Our results suggest that there may be an increase in risk of glioma in the most exposed area of the brain among long-term and heavy users of mobile phones. These results are uncertain (in light of the uncertainties associated with tumour centre localisation, radio frequency dose estimation and sample size) and require replication before they can be taken to indicate a cause and effect relationship.

From the conclusions of the 2001 INTERPHONE study (industry-financed). Study authors finally admitted that their data showed increased risk of glioma, but said that this finding required replication before being taken as a cause and effect relationship. This despite the fact that this finding was already a replication of their previously published data, and had also been confirmed several times in the published data of the Hardell group in Sweden.
Further research has been published suggesting there is no link between mobile phones and brain cancer.

The risk mobiles present has been much debated over the past 20 years as use of the phones has soared.
Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects

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**Abstract.** We studied the association between use of mobile and cordless phones and malignant brain tumours. Pooled analysis was performed of two case-control studies on patients with malignant brain tumours diagnosed during 1997-2003 and matched controls alive at the time of study inclusion and one case-control study on deceased patients and controls diagnosed during the same time period. Cases and controls or relatives to deceased subjects were interviewed using a structured questionnaire. Replies were obtained for 1,251 (85%) cases and 2,438 (84%) controls. The risk increased with latency period and cumulative use in hours for both mobile and cordless phones. Additionally, most populations are exposed to radiofrequency/microwave (RF) radiation from wireless communications (1). The frequency used and output power from these devices are of the same order of magnitude. The digital system (Global System for Mobile Communications) is used. The frequency used and output power from these devices are of the same order of magnitude.

The most reliable research on the tumor risks of cell phones has been performed by the Hardell group in Sweden. This group does not receive funding from the cell phone industry.

This is the only group that has controlled for use of in-home cordless phones as well as cell phones [which makes their data more reliable].

Orient to the bar graph.

Hardell group -- current summary


Tumor Risk by Years of Use – Astrocytoma

Hardell group -- current summary

Hardell group -- current summary


Risk of All Brain Tumors (Usage Below Median)

Risk of All Brain Tumors (Usage Above Median)
Hardell group -- current summary


Comments on Notice of Inquiry, ET Docket No. 13-84
Hardell group -- current summary


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Risk of Astrocytoma (Usage Below Median)

<table>
<thead>
<tr>
<th>Latency</th>
<th>Cordless Phone (≤243 h)</th>
<th>Mobile Phone (≤74 h)</th>
<th>Both (≤195 h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1 – 5 Year Latency</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>&gt;5 – 10 Year Latency</td>
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<td>1</td>
</tr>
<tr>
<td>&gt;10 Year Latency</td>
<td>*</td>
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</tbody>
</table>

Risk of Astrocytoma (Usage Above Median)

<table>
<thead>
<tr>
<th>Latency</th>
<th>Cordless Phone (&gt;243 h)</th>
<th>Mobile Phone (&gt;74 h)</th>
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</tr>
<tr>
<td>&gt;10 Year Latency</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>
Risk of Oligodendroglioma (Usage Below Median)

Hardell group -- current summary


Risk of Oligodendroglioma (Usage Above Median)

Hardell group -- current summary

Hardell group -- current summary


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Hardell group -- current summary

Hardell group -- current summary


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**Risk of Tumor by Location – Low Grade Astrocytoma**

<table>
<thead>
<tr>
<th>Location</th>
<th>Cordless Phone</th>
<th>Digital Cell Phone</th>
<th>Analogue Cell Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Locations Combined</td>
<td>1.2</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Ipsilateral</td>
<td>1.0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Contralateral</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Ambidextrous</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

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**Risk of Tumor by Location – Other Malignant Tumors**

<table>
<thead>
<tr>
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<th>Cordless Phone</th>
<th>Digital Cell Phone</th>
<th>Analogue Cell Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Locations Combined</td>
<td>1.0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Ipsilateral</td>
<td>2.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Contralateral</td>
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</tr>
<tr>
<td>Ambidextrous</td>
<td>1.0</td>
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<td>1.0</td>
</tr>
</tbody>
</table>

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Tumor Risk by Cumulative Hours of Use – Any Brain Cancer

Hardell group -- current summary


Tumor Risk by Cumulative Hours of Use – Glioma

Hardell group -- current summary

Hardell group -- current summary

Tumor Risk by Cumulative Hours of Use – Other/Mixed Glioma

Courdless Phone  Mobile Phone  Both

1 – 1000 Hours  1001 – 2000 Hours  > 2000 Hours

Hardell group -- current summary


Tumor Risk by Cumulative Hours of Use – Other Brain Malignancy

Courdless Phone  Mobile Phone  Both

1 – 1000 Hours  1001 – 2000 Hours  > 2000 Hours

Hardell group -- current summary

Tumor Risk by Age of First Use – Any Brain Cancer

Hardell group -- current summary


Tumor Risk by Age of First Use – Astrocytoma

Hardell group -- current summary