

Re-analysis of risk for glioma in relation to mobile telephone use: comparison with the results of the Interphone international case-control study

From LENNART HARDELL,^{1*} MICHAEL CARLBERG¹ and KJELL HANSSON MILD²

¹Department of Oncology, University Hospital, Örebro and ²Department of Radiation Sciences, Umeå University, Umeå, Sweden

*Corresponding author. Department of Oncology, University Hospital, SE-701 82 Örebro, Sweden.

E-mail: lennart.hardell@orebroll.se

The long-awaited Interphone study on use of mobile phones and the risk of brain tumour was recently published.¹ It was coordinated by International Agency for Research on Cancer (IARC) and included 16 research centres from 13 countries. Results for cases aged 30–59 years of age diagnosed during study periods of 2–4 years between 2000 and 2004 were presented.

Our research group has published results for brain tumour risk and long term use of mobile phones. In contrast to Interphone, we also included use of cordless phones. Radiofrequency emissions from a cordless phone are in the same magnitude as from a digital mobile phone, as discussed in our publications and recently shown also by Redmayne *et al.*² Moreover, cordless phones are used for longer calls. Including such use in the 'unexposed' group as in the Interphone study would bias the odds ratio (OR) towards unity. We have previously compared study methods and results in our investigations with those in the Interphone group.³

Due to the lack of information and any discussion of the Interphone findings in relation to our results, it is pertinent to use the same criteria as in Interphone for our case-control studies on glioma.⁴ Our inclusion period was 1997–2003 and we give results for all glioma for the same age group, 30–59 years as in Interphone (Table 1), and glioma located in the temporal lobe (Table 2). Overall results are also presented for our studies as well as inclusion of the youngest subjects 20–29 years and in one analysis including use of cordless phones among the unexposed. We have also re-analysed our material with the same cumulative exposure time as in the Interphone study, i.e. >1640 h, whereas we before had >2000 h as highest exposure.

In Appendix 2, in the Interphone paper, analysis was restricted to users with lowest category of use as reference in each category. There might be a 'healthy mobile phone user' effect among the controls that participated,¹ similar to a 'healthy worker effect' in occupational studies. Thus, the analysis in Appendix 2 would be justified to correct for the lower prevalence of mobile phone use among controls that refused to participate than among included controls in Interphone.¹

As can be seen in Table 1, our results in the same age group as in Interphone, 30–59 years, are similar as in Appendix 2 for latency ≥ 10 years and

cumulative use ≥ 1640 h. Unfortunately, Interphone did not give results for laterality analysis in Appendix 2.

Interestingly, our results for cumulative use in the age group 30–59 years are similar to Interphone results. Furthermore, in both studies highest ORs were found for ipsilateral use.

We found higher risks if the age group 20–29 years was included. This is in agreement with our previous publication showing highest risk for persons that started use of mobile or cordless phone before the age of 20 years.⁵ Thus, excluding that age group from the final Interphone seems to have biased the risk towards unity. We examined the results if we considered use of cordless phone as involving no exposure to microwaves, which yielded lower ORs indicating that excluding such use, as in Interphone, would also bias the risk towards unity.

Table 2 gives the results for glioma in the temporal lobe. Similarly, as for overall findings, risk estimates were lower in our studies when we restricted the age group to 30–59 years and considered use of cordless phone as no exposure. No results were given in Appendix 2 in the Interphone publication for glioma in the temporal lobe.

The participation rate in the Interphone study was only 64% for glioma cases and 53% for controls, i.e. much lower than in the studies from the Hardell group, 90% of cases with malignant brain tumour and 89% of the controls.⁴ Furthermore, we used a self-administered questionnaire that was supplemented over the phone. This was done without knowing whether it was a case or a control.

Low-participation rate may create selection bias, and not blinding as to case or control status may give observational bias, especially in a study with such vague definition of cut-off for exposure as Interphone. Especially worrying as to observational bias are bed-side interviews of such a mentally ill patient group with brain tumour. Patients may even have been newly operated before the interview. In fact, patients scored significantly lower than controls in the recall of words (aphasia), and in writing and drawing due to paralysis in the Danish part of Interphone.⁶

It is unclear why younger cases were excluded from the final Interphone report, especially since our results indicate highest risk in the youngest age group.⁵ Thus, Denmark and Sweden included the age group 20–29 years, Norway 19–29 years and UK

Table 1 OR and 95% confidence interval (CI) for all glioma in Interphone compared with the Hardell group

Study group, age	Hardell group, 20-80 (all)	Hardell group, 20-59	Hardell group, 30-59	Hardell group, 30-59, cordless among unexposed	Interphone, 30-59	Interphone, 30-59, according to published Appendix 2
Latency \geq 10 years	(88/99) 2.26 1.60-3.19	(57/74) 2.15 1.41-3.29	(56/74) 1.96 1.27-3.01	(56/74) 1.79 1.19-2.70	(252/232) 0.98 0.76-1.26	(190/150) 2.18 1.43-3.31
Latency \geq 10 years, ipsilateral	(57/45) 2.84 1.82-4.44	(36/30) 2.70 1.54-4.73	(35/30) 2.48 1.40-4.38	(35/30) 2.29 1.33-3.97	(108/82) 1.21 0.82-1.80	NR
Latency \geq 10 years, contralateral	(29/29) 2.18 1.24-3.85	(20/24) 2.04 1.04-4.00	(20/24) 1.96 0.995-3.87	(20/24) 1.71 0.89-3.28	(49/56) 0.70 0.42-1.15	NR
Cumulative use \geq 1640 h	(42/43) 2.31 1.44-3.70	(32/37) 2.23 1.30-3.82	(29/37) 1.89 1.08-3.30	(29/37) 1.75 1.02-3.00	(210/154) 1.40 1.03-1.89	(160/113) 1.82 1.15-2.89
Cumulative use \geq 1640 h, ipsilateral	(29/21) 2.94 1.60-5.41	(22/18) 2.71 1.36-5.42	(20/18) 2.32 1.14-4.73	(20/18) 2.18 1.09-4.35	(100/62) 1.96 1.22-3.16	NR
Cumulative use \geq 1640 h, contralateral	(12/12) 2.10 0.90-4.90	(9/11) 1.99 0.77-5.16	(8/11) 1.73 0.65-4.63	(8/11) 1.48 0.57-3.87	(39/31) 1.25 0.64-2.42	NR

Numbers of cases and controls are given within parenthesis. NR = not reported. Note that >10 years latency were used in the Hardell group studies and contralateral was defined as $<50\%$ use of tumour side.

Table 2 OR and 95% CI for glioma temporal lobe in Interphone compared with the Hardell group

Study group, age	Hardell, 20-80 (all)	Hardell, 20-59	Hardell, 30-59	Hardell, 30-59, cordless among unexposed	Interphone, 30-59	Interphone, 30-59, Appendix 2
Latency \geq 10 years	(28/99) 2.26 1.32-3.86	(15/74) 1.74 0.85-3.56	(14/74) 1.48 0.71-3.10	(14/74) 1.40 0.70-2.81	(94/69) 1.36 0.88-2.11	NR
Latency \geq 10 years, ipsilateral	(18/45) 2.49 1.29-4.81	(10/30) 1.94 0.81-4.63	(9/30) 1.73 0.70-4.26	(9/30) 1.69 0.71-4.02	NR	NR
Latency \geq 10 years, contralateral	(9/29) 2.08 0.89-4.87	(4/24) 1.35 0.41-4.49	(4/24) 1.28 0.38-4.28	(4/24) 1.21 0.37-3.90	NR	NR
Cumulative use \geq 1640 h	(14/43) 2.44 1.21-4.95	(9/37) 1.96 0.82-4.66	(7/37) 1.53 0.60-3.94	(7/37) 1.46 0.59-3.63	(78/47) 1.87 1.09-3.22	NR
Cumulative use \geq 1640 h, ipsilateral	(11/21) 3.08 1.32-7.19	(7/18) 2.18 0.77-6.24	(5/18) 1.68 0.52-5.41	(5/18) 1.82 0.59-5.60	NR	NR
Cumulative use \geq 1640 h, contralateral	(2/12) 1.04 0.22-5.00	(1/11) 0.72 0.08-6.11	(1/11) 0.72 0.08-6.12	(1/11) 0.64 0.08-5.33	NR	NR

Numbers of cases and controls are given within parenthesis. NR = not reported. Note that >10 years latency were used in the Hardell group studies and contralateral was defined as $<50\%$ use of tumour side.

18–29 years, and the age groups are unclear for the countries that have not published individual results.⁷

We urge Interphone to fill in the gaps in our Tables 1 and 2, so as to make full comparison with our data possible. Currently, we have presented results on the association of use of wireless phones and malignant brain tumours among deceased cases, that were excluded from our study, using deceased controls. These results confirm our previous findings of an increased risk for malignant brain tumour among mobile phone users.⁸

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A pilot study to explore whether airborne endotoxins play a role in the association between environmental tobacco smoke and non-respiratory, smoking-related diseases

From JILL P PELL,^{1*} GAËL TAVERNIER² and SALLY HAW³

¹University of Glasgow, Glasgow, UK, ²North West Lung Research Centre, Wythenshawe Hospital, Manchester, UK and

³Scottish Collaboration on Public Health Research Policy, Edinburgh, UK

*Corresponding author. Henry Mechan Professor of Public Health, University of Glasgow, Glasgow, G12 8RZ, UK.

E-mail: jill.pell@glasgow.ac.uk

Lipopolysaccharides (endotoxins produced by Gram-negative bacteria) are present on the surface of cigarettes and have been implicated in a number of diseases. Active smoking predisposes to periodontal disease which, in turn, facilitates gastrointestinal absorption of endotoxins. Serum endotoxin concentrations are higher among active smokers and are associated with risk of cardiovascular disease.¹ In addition to being present on the surface of cigarettes, endotoxins are present in both mainstream and sidestream cigarette smoke.² Inhaled airborne endotoxins have been implicated in the pathogenesis of respiratory disease.³ In a guinea pig model, endotoxins have been shown to penetrate the lung barrier and be detectable in the blood.⁴ Similarly, non-smokers with occupational exposure to organic dust containing high levels of endotoxin have been shown to have increased plasma concentrations of lipopolysaccharide.⁵ However, no previous study has examined whether

exposure to environmental tobacco smoke is associated with increased serum endotoxin concentrations.

In a pilot study, we compared serum endotoxin levels in three groups of individuals: 10 self-reported never smokers who lived with non-smoking partner and had a serum cotinine concentration of ≤ 0.1 ng/ml; 10 self-reported never smokers who lived with partners who smoked and had a cotinine concentration of 6–11 ng/ml; and 10 self-reported current smokers (at least 20 cigarettes per day) who lived with non-smoking partners and had a cotinine level of ≥ 600 ng/ml. Cotinine was assayed using gas chromatography with a specific nitrogen phosphorus detector. The lowest level of detection was 0.1 ng/ml. Serum endotoxin was measured using a kinetic turbidometric *Limulus amoebocyte lysate* (LAL) assay, following heat inactivation (1:10 serum, 15 min at 70°C). Diluted serum samples (0.1 ml) were assayed with 0.1 ml of LAL and incubated at 37°C for 75 min. Optical density readings were obtained every 30 s