# Point process modelling of the relationship between mobile phone use and brain tumours

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The energy absorbed in human tissue from the radio frequency (RF) fields of mobile phones is highly localised with the greatest absorption close to the phone, and therefore it is essential to take the localisation of the brain tumour into account when investigating the association between mobile phone use and brain tumours. The Interphone Study[1], an international case-control study with the main objective of assessing whether use of mobile phones increases the risk of brain tumours, includes data of detailed information on past mobile phone use obtained via interviews, and tumour localisation and best guess of the tumour origin recorded by neuroradiologists on a three-dimensional grid map of the human brain made up of 1 cm cubes. The persons in the study were classified as regular mobile phone users if they had had an average of at least one call per week for a period of 6 months and non-regular users were regarded as unexposed.

To use point process modelling the tumours are regarded as single points, namely the origin points, and to keep the notation simple the mobile phone is a single point which implies that the exposure comes from a point source $x_0$. Assume that the tumour locations from the non-regular phone users are a realisation of a spatial inhomogenouos Poisson process on the region covering the entire brain with intensity $\lambda_0$. Then $\lambda_0$ represents the spatial variation in local intensity under the null hypothesis, that is in absence of an association between tumour locations and exposure to RF fields. Furthermore assume that the tumour locations from the regular phone users are a realisation of an independent inhomogeneouos Poisson process with intensity $\lambda$ given by $\lambda(\mathbf{x}) = \lambda_0(\mathbf{x})f(\mathbf{x}-\mathbf{x}_0;\theta)$ where $f$ describes the change in intensity as a function of the distance between the location $x$ and the point source $x_0$. The function $f$ should be unimodal with maximum greater than 1 at $\mathbf{x}-\mathbf{x}_0 = 0$ since the RF dose is highest in the point from where the signal is emitted. Far from the mobile phone all the RF energy will have been absorbed and $f$ should not contribute to the intensity, therefore $f(\mathbf{x}-\mathbf{x}_0) \to 1$ for $\mathbf{x}-\mathbf{x}_0 \to \infty$. Numerical maximization can be used to test hypotheses about the parameter(s) $\theta$ which has been done by adapting already known approaches[2],[3] to this problem.

*Use of the Interphone data was approved by the Interphone Study Group, see [1] for list of members.*

## References

[1] E. Cardis, L. Richardson, I. Deltour, B. Armstrong, M. Feychting, C. Johansen, M. Kilkenny, P. McKinney, B. Modan, S. Sadetzki, et al., *The interphone study: design, epidemiological methods, and description of the study population*, European Journal of Epidemiology **22** (2007), no. 9, 647–664.

[2] P.J. Diggle, *A point process modelling approach to raised incidence of a rare phenomenon in the vicinity of a prespecified point*, Journal of the Royal Statistical Society. Series A (Statistics in Society) (1990), 349–362.

[3] P.J. Diggle and B.S. Rowlingson, *A conditional approach to point process modelling of elevated risk*, Journal of the Royal Statistical Society. Series A (Statistics in Society) (1994), 433–440.