

Abstract

Introduction: As the use of cell phones have increased immensely in the last two decades, so has public concern regarding cell phone and its relationship to cancer. Cell phones emit radio frequency waves, a type of electromagnetic energy. Theoretically, these radiofrequency waves are considered as a form of non-ionizing radiation, and do not contain enough energy to damage DNA. However, human and animal studies on cell phone use and cancer risk have shown mixed results. The Danish cohort study, one of the largest long-term studies to date, compared everyone in Denmark with cell phone subscriptions between 1982 and 1995, and found no evidence of increased risk in brain or other nervous system tumors in cell phone users. After we analyzed the Danish cohort study, we found several limitations that brought the conclusion of this study into question. We hypothesized that cell phones may still be associated with increased cancer risks.

Materials and Methods: We reanalyzed data from the Danish cohort study. Data as reported from the Danish cohort were used. The overall significant level was 0.025 (1-sided). The simulation method by R was applied to estimate statistical power from the Danish data. The sample sizes for the future studies were also evaluated using the simulation method based on appropriate study power.

CELL PHONE USAGE AND THE RISK OF CANCER

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Purpose and Hypothesis

- Purpose: To evaluate the possible association between cell phone use and cancer risk
- Hypothesis: Cell phone use is not related to any increase in overall cancer risk and in brain tumors.

Data Analysis

- Under the assumption of the baseline incidence for brain tumors as reported (16.80/105 personal year), sample sizes were calculated using 1-side statistical level 0.025 with 80% power as follows.

Increase in Cancer Risk (%)	Personal Years (10 ⁵)
5	200
10	50

Conclusion

- Overall, there is no evidence to rule out cell phone's carcinogenic effect for brain tumors currently.
- The possible increase in risk for brain tumors could be lower.

Future Considerations

- Studies with larger population and/or longer follow-up data.

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Results: Data from the Danish cohort study included 420,095 cell phone users in Denmark with an average of an 8.5-year follow-up. The observed overall cancer and brain tumor incidences were 420.10 and 16.24 per 100,000 personal years respectively. Comparing expected cancer incidences (overall-399.04 and brain tumor-16.80 per 100,000 personal years), there were no statistically significant changes. We further estimated the statistical power to detect an increase in cancer risk from the Danish data. The Danish data had more than 95% and 99% power to detect 3% and 5% increase in overall cancer risk. But it had very low power to detect an increase in brain tumor risk; it had only 11% and 23% power to detect a 3% and 5% increase in brain tumor risk respectively. The statistical power in Danish data would increase more than 80% and 90% if the brain tumor risk increased 12% and 15% respectively. Furthermore, we explored the appropriate power for future studies. Our results indicated a cohort study with 80% power needs at least 20,000,000 and 5,000,000 personal years for follow-up to detect 5% and 10% increase in brain tumor risk respectively.

Literature Review

- Current study results for the cell phone use and cancer risk were were inconsistent due to limited data.
- Cell phone's radio frequencies (RF) exposure has been suspected as a possible carcinogen.
- To control known and unknown influences and biases, results from the cohort data were one of ways to identify the possible moderate or small increase in cancer risk related to cell phone use.

Methods

- Data from a recently reported cohort study with null results (Schuz et al, 2006) were reanalyzed.
- To estimate the statistical power at 1-sided alpha 0.025 level for the results from the study, a simulation method was applied using R.
- Appropriate sample sizes for further analysis at 1-sided alpha 0.025 level with 80% power were explored.

What I learned

- How to use statistics to analyze and organize data
- How to use R

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Conclusion: Our simulation results found that there was enough power to detect more than 3% increase in overall cancer risk and confirmed that there was no association between overall cancer risk and cell phone use. But the Danish data had little power to detect any less than 5% increase in brain tumor risk associated with cell phone use. Therefore, there was insufficient evidence to suggest that there was no increased risk in brain tumor associated with cell phone use. Future studies with either a larger population or longer follow-up times should be conducted to elucidate the relationship between cell phone and brain tumor risk.

Data Analysis

- In Schuz's study, data were reported from 420,095 cell phone users in Denmark with average 8.5 year follow-up.

Statistical Power Estimates				
Cancer Type	Cases Observed	Observed Cancer Incidence (10 ⁵ Personal Years)	Cases Expected	Expected Cancer Incidence (10 ⁵ Personal Years)
Overall	14249	399.04	15001	420.10
Brain Tumors	580	16.24	600	16.80

In Schuz's study, data observed from 3,570,808 (=420,095X8.5) personal year.

Data Analysis

- Statistical powers to detect cancer risk increase in overall and brain tumors were estimated for Schuz's study.

Statistical Power Estimates (%)		
Increase in Cancer Risk (%)	Overall Cancers	Brain Tumors
20	99	99
15	99	94
10	99	66
5	99	23
3	95	11

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