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Has the incidence of brain cancer risen in Australia since the introduction of mobile phones 29 years ago?

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ABSTRACT

Background: Mobile phone use in Australia has increased rapidly since its introduction in 1987 with whole population usage being 94% by 2014. We explored the popularly hypothesised association between brain cancer incidence and mobile phone use.

Study methods: Using national cancer registration data, we examined age and gender specific incidence rates of 19,858 male and 14,222 females diagnosed with brain cancer in Australia between 1982 and 2012, and mobile phone usage data from 1987 to 2012. We modelled expected age specific rates (20–39, 40–59, 60–69, 70–84 years), based on published reports of relative risks (RR) of 1.5 in ever-users of mobile phones, and RR of 2.5 in a proportion of ‘heavy users’ (19% of all users), assuming a 10-year lag period between use and incidence.

Summary answers: Age adjusted brain cancer incidence rates (20–84 years, per 100,000) have risen slightly in males ($p < 0.05$) but were stable over 30 years in females ($p > 0.05$) and are higher in males 8.7 (CI = 8.1–9.3) than in females, 5.8 (CI = 5.3–6.3). Assuming a causal RR of 1.5 and 10-year lag period, the expected incidence rate in males in 2012 would be 11.7 (11–12.4) and in females 7.7 (CI = 7.2–8.3), both $p < 0.01$; 1434 cases observed in 2012, vs. 1867 expected. Significant increases in brain cancer incidence were observed (in keeping with modelled rates) only in those aged ≥ 70 years (both sexes), but the increase in incidence in this age group began from 1982, before the introduction of mobile phones. Modelled expected incidence rates were higher in all age groups in comparison to what was observed. Assuming a causal RR of 2.5 among ‘heavy users’ gave 2038 expected cases in all age groups.

Limitations: This is an ecological trends analysis, with no data on individual mobile phone use and outcome.

What this study adds: The observed stability of brain cancer incidence in Australia between 1982 and 2012 in all age groups except in those over 70 years compared to increasing modelled expected estimates, suggests that the observed increases in brain cancer incidence in the older age group are unlikely to be related to mobile phone use. Rather, we hypothesize that the observed increases in brain cancer incidence in Australia are related to the advent of improved diagnostic procedures when computed tomography and related imaging technologies were introduced in the early 1980s.

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1. Introduction

The first call made on a mobile phone in Australia occurred on February 23, 1987. In the 29 years since, usage has grown rapidly, with over 90% of all Australians using the devices today. In 2011 the International Agency for Research on Cancer Working Group

classified radiofrequency (RF) electromagnetic waves as ‘possibly carcinogenic to humans’. Radiofrequency waves are emitted by electronic devices including radar, TV, radio, WiFi, Bluetooth, microwave and cordless devices and mobile phones. IARC issued a classification score of 2B for radio frequency electromagnetic radiation, which is defined as “A positive association has been observed between exposure to the agent and cancer for which a causal interpretation is considered by the Working Group to be credible, but chance, bias or confounding could not be ruled out with reasonable confidence”. The Working Group identified several methodological

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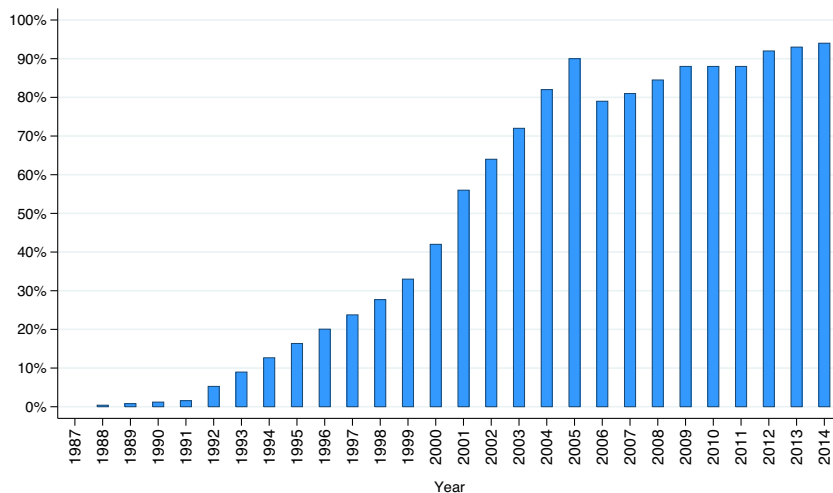


Fig. 1. Percentage of Australians with mobile phone accounts.

issues regarding measurement of RF from mobile phones and noted the inconsistency and poor replicability of most laboratory studies [1].

This view was strengthened by several independent national environmental health agencies. For example, a 2012 UK report of the Independent Advisory group on non-ionising radiation [2] and a 2015 review by the European Union's Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) [3] both found no evidence of health effects of mobile phones to humans at current EMF dosage levels. In addition, a number of groups in several countries have documented a stable or declining incidence of brain cancers [4–8]. In the USA [8] and the Nordic countries [7] several risk and latency scenarios about mobile phone use and brain cancers were investigated with the findings being consistent with a null effect or longer latency periods. However, Morgan et al. [9] recently argued that risks of mobile phone use are higher than previously thought, with relative risks in relation to a 'decade long mobile phone use' said to be between 1.8 and 7.8 (Ref. [9], Table 1). By contrast cohort studies in Denmark and the UK published after the IARC report [10,11] found a null effect.

Given these uncertainties, and continuing prominent media coverage of predictions of an eventual increasing incidence of mobile phone caused brain cancers, we investigated the association between mobile use coverage and brain cancer incidence in Australia using an ecological study design.

2. Methods

We obtained data on the percentage of all Australians with mobile phone accounts¹ from the Australian Mobile Telephone Association (AMTA) and the Australian Communications and Media Authority (ACMA) annual reports (see Fig. 1). Data on account holders for 1987–1990 and 1992–1997 were missing and were estimated by linear interpolation. Data by age and gender were unavailable.

These data refer to “accounts”, not individuals. In 2014 there were 31.01 mobile phone million accounts in a population of some 23.86 million [12]. In 2009 (latest available data) nearly one in three children aged 5–14 and 76% of 12–14 years old had their own mobile phone [13]. The exact number of individuals using mobile

phones in Australia is unknown but estimated to be approximately 90% of all people.

Reporting of incident invasive cancer is mandatory in all Australian states and territories, which send data to the Australian Institute of Health and Welfare (AIHW) for national reporting. We used AIHW national tabulated incidence data from 1982 to 2012 (the latest data available) for brain cancer [14] (80% of which are gliomas) to calculate (3-year smoothed) age-adjusted incidence rates (per 100,000) overall and for four age groups (20–39, 40–59, 60–69, 70–84 years). Data become unreliable after 84 years because they are combined into one category of 85 years and over.

To illustrate the purported effect of mobile phones on brain cancer incidence, we assumed a 10-year lag period between exposure to mobile phones, and estimated expected rates per age group over 20 years (R_E) assuming prevalence/use to be spread evenly across all age groups (due to lack of age specific usage data) (P_{mob}), by multiplying the pre-mobile phone baseline rate in 1982–1987 ($R_{1982-1987}$) by a (conservative) relative risk (RR_{mob}) of 1.5, the RR found for 'ever-users' of mobile phones, estimated by Hardell et al. [15], used by Little et al. [8] using the formula for each age group: $R_E = (R_{1982-1987} \times P_{mob} \times RR_{mob}) + (R_{1982-1987} \times (1 - P_{mob}))$, and then obtaining the all-age rate by summation of the age specific groups. Using a recent paper [9] we also modelled brain cancer incidence using a RR of 2.5, among heavy users (>896 h cumulative use), and assumed that 19% of the Australian population falls in this top category, based on data from the INTERPHONE study [16], an international pooled analysis of studies on the association between mobile phone use and brain cancer (which defines heavy users slightly differently, as being those with >735 h cumulative use). Confidence intervals and statistical significance of observed and expected incidence rates were calculated using formulas in Jensen et al. [17].

3. Results

Fig. 1 shows mobile phone use in Australia from 1987 to 2014 increasing from 0% in 1987 to 94% in 2014.

A total of 19,858 males and 14,222 females aged 20–84 were diagnosed with brain cancer between 1982 and 2012. Brain cancer ranks as the 12th most common cancer in Australia, representing 1.4% of all newly diagnosed cancers [14].

Fig. 2 and Supplementary Tables S1 and S2 show the (3-year smoothed) observed and modelled expected rates per 100,000 population for brain cancer incidence for this period.

¹ Mobile phone plans are only available in Australia for people aged 18 or older, but many children have them supplied by parents.

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