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ORIGINAL ARTICLE

# Mobile phone use and health symptoms in children



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## KEYWORDS

cross-sectional study;  
electromagnetic  
fields;  
exposure assessment;  
radiofrequency;  
subjective symptoms

**Background/purpose:** To investigate the mobile phone (MP) use for talking in relation to health symptoms among 2042 children aged 11–15 years in Taiwan.

**Methods:** A nationwide, cross-sectional study, using the computer assisted telephone interview (CATI) technique, was conducted in 2009 to collect information on children's utilization of MPs and the perceived health symptoms reported by their parents.

**Results:** The overall prevalence of MP use in the past month was estimated at 63.2% [95% confidence interval (CI) = 61.1–65.3%]. MP use was associated with a significantly increased adjusted odds ratio (AOR) for headaches and migraine (1.42, 95% CI = 1.12–1.81) and skin itches (1.84, 95% CI = 1.47–2.29). Children who regularly used MPs were also considered to have a health status worse than it was 1 year ago ( $\beta = 0.27$ , 95% CI = 0.17–0.37).

**Conclusion:** Although the cross-sectional design precludes the causal inference for the observed association, our study tended to suggest a need for more cautious use of MPs in children, because children are expected to experience a longer lifetime exposure to radiofrequency electromagnetic fields (RF-EMF) from MPs.

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Conflicts of interest: The authors have no conflicts of interest relevant to this article.

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## Introduction

The main difference between today's children and adults concerning the use of mobile phones (MPs) is the longer lifetime exposure of children when they grow older, i.e., children are starting to use MPs at an early age. Due to competition between network providers, the use of MPs is becoming cheaper and cheaper, leading to an increased use of MPs not only in adults, but also in children and adolescents. In an earlier review,<sup>1</sup> reported percentages of MP use among children aged 15–19 years in developed nations in 2002, indicated that the prevalence of MP users ranged from 42% to 52% in North America to >90% in the UK and Nordic countries. In 2007, a Swedish study disclosed that 79.1% of children aged 7–14 years reported MP access and 26.7% of them talked for  $\geq 2$  minutes/day.<sup>2</sup> Furthermore, the use of the modern means of interpersonal and mass communication has become an essential part of being young. Children are connected to global networks through internet access and MPs.<sup>3,4</sup> Like many nations, since 2007 Taiwan has a MP penetration rate of >100%,<sup>5</sup> i.e., there are more subscribers than inhabitants. However, little is known concerning the current prevalence of MP use in young adolescents in Taiwan.

Most of the existing evidence concerning MP use and adverse health effects comes from retrospective studies and studies of adults.<sup>6,7</sup> Longitudinal studies as well as studies in children and adolescents are scarce.<sup>6</sup> Given the fact that children and adolescents are still in the developmental process, there is concern over the question of whether children are more sensitive to electromagnetic fields (EMF) than adults.<sup>8</sup> This is also one of the reasons why the World Health Organization (WHO) research agenda set in 2006 emphasizes the need for studies on children and their radiofrequency EMF (RF-EMF) exposures.<sup>9</sup> This agenda states that research is needed to document the rapidly changing patterns of wireless communication use because such a large proportion of the young population is exposed.<sup>2,9</sup>

Whether there is a chronic effect from exposure to MP use is still under debate. Preece et al<sup>10</sup> examined the effect of a standard MP exposure at 902 MHz on cognitive function in 18 children aged 10–12 years. Exposures were set at 0 W (baseline), 0.025 W, or 0.25 W from a standard Nokia 3110 MP handset mounted on a plastic headset in normal use position. They found a tendency for reaction time to be shorter during exposure to radiation than in the sham (baseline) condition. However, such findings were not replicated in a later study concluding that a standard 902 MHz global system for mobile communication (GSM) MPs has no significant effect on children's cognitive function as measured by response speed and accuracy in children aged 10–14 years.<sup>11</sup> In a questionnaire survey of 2000 Swedish adolescents aged 15–19 years,<sup>12</sup> a number of health complaints, including tiredness, stress, headache, anxiety, concentration difficulties, and sleep disturbances, were frequently reported in regular MP users, and regular users of wireless phones had health symptoms more often and reported poorer perceived health than less frequent users. A recent German study with a random sample of >3000 children and adolescents investigated the possible

association between RF-EMF and chronic wellbeing in young people using personal dosimetry for 24 hour exposure.<sup>13</sup> The study found that half of the children and nearly every adolescent owned a MP which was used only for short durations per day. In spite of that, no statistically significant association between measured RF-EMF exposure levels and chronic symptoms was observed in this study.

Limited information is available regarding the prevalence of MP use in young Taiwanese people. Additionally, it is still inclusive concerning the potential chronic health symptoms resulting from MP use. We thus conducted this national telephone survey to investigate the use of MPs in Taiwanese children aged 11–15 years (i.e., Grade 5–9) and to explore the cross-sectional relationship between MP use and perceived health symptoms in children.

## Materials and methods

### Selection of study participants

In Taiwan, there are 365 districts in 25 cities/counties and each district has a varying number of households. Based on the Statistical Yearbook of Taiwan,<sup>14</sup> there were a total of 1,501,914 children (boys: 782,666; girls: 719,248) aged 11–15 years (i.e., Grade 5–9) registered at the end of 2009. These children were inhabitants of 1,000,957 households located in 365 districts. The study children were sampled with two stages. To best represent the distribution of households occupied by children aged 11–15 years, at the first stage the probability proportional to size (PPS) technique was used to determine that a total of 40 districts in 25 cities/counties of the nation should be identified.<sup>15</sup> The number of districts required in each city/county ranged from one to five. At the second stage, a simple random sampling (SRS) method was used to select the districts to be approached in each city/county. We limited our target population to children aged 11–15 years, primarily due to a higher likelihood of starting MP use at this age group. Exclusion of older children aged >15 years was due to the fact that some older children might live in dormitories of senior high schools in Taiwan and their MP use patterns might not be known to their guardians. Selection of guardians as the interviewees of this survey was mainly due to the consideration that children may not be fully aware of the legitimacy of the study, which is a central element of ethical concern.

The area codes and the first four digits of telephone numbers are unique for households in each district. Given that one of the primary research objectives in this survey was to estimate the prevalence [and 95% confidence interval (CI)] of MP use in Grade 5–9 children, it was estimated that 2040 children are required to yield an estimated prevalence with an error of 0.1 at a 95% level of confidence and an expected prevalence of 0.5.

We employed the computer assisted telephone interview (CATI) system to perform household selections in each of the 40 selected districts, using a random digit dialing (RDD) technique. According to the size of the child population aged 11–15 years, the predetermined total number of eligible children in each district ranged from 73 to 1170. Based on the

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