



Recall of mobile phone usage and laterality in young people: The multinational Mobi-Expo study

Geertje Goedhart^{a,1}, Luuk van Wel^{a,*,1}, Chelsea E. Langer^{b,c,d}, Patricia de Llobet Viladoms^{b,c,d}, Joe Wiart^e, Martine Hours^f, Hans Kromhout^a, Geza Benke^g, Evdoxia Bouka^h, Revital Bruchimⁱ, Kyung-Hwa Choi^j, Amanda Eng^k, Mina Ha^j, Anke Huss^a, Kosuke Kiyohara^l, Noriko Kojimahara^l, Daniel Krewski^m, Brigitte Lacourⁿ, Andrea 't Mannetje^k, Milena Maule^o, Enrica Migliore^o, Charmaine Mohippⁿ, Franco Momoli^{m,p,q}, Eleni Th. Petridou^h, Katja Radon^r, Thomas Remen^s, Siegal Sadetzki^{i,t}, Malcolm Sim^g, Tobias Weinmann^r, Elisabeth Cardis^{b,c,d}, Martine Vrijheid^{b,c,d}, Roel Vermeulen^a

^a Institute for Risk Assessment Sciences (IRAS), Utrecht University, PO Box 80178, 3508 TD Utrecht, the Netherlands

^b ISGlobal, Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Spain

^c Biomedical Research Centre Network for Epidemiology and Public Health (CIBERESP), Barcelona, Spain

^d Universitat Pompeu Fabra (UPF), Barcelona, Spain

^e Chaire C2M, LTCL, Telecom ParisTech, Université Paris-Saclay, France

^f Epidemiological Research and Surveillance Unit in Transport, Occupation and Environment (UMRESTTE), Université de Lyon/The French Institute of science and technology for transport, development and networks (IFSTTAR), Lyon, France

^g Department of Epidemiology & Preventive Medicine, School of Public Health & Preventive Medicine, Monash University, Melbourne, Australia

^h Department of Hygiene, Epidemiology and Medical Statistics, Medical School, National and Kapodistrian University of Athens, Athens, Greece

ⁱ Cancer and Radiation Epidemiology Unit, Gertner Institute for Epidemiology and Health Policy Research, Chaim Sheba Medical Center, Tel Hashomer, Israel

^j Department of Preventive Medicine, Dankook University College of Medicine, Cheonan, Republic of Korea

^k Centre for Public Health Research, Massey University, Wellington, New Zealand

^l Department of Public Health, Tokyo Women's Medical University, Tokyo, Japan

^m School of Epidemiology and Public Health, University of Ottawa, Canada

ⁿ French National Registry of Childhood Solid Tumours, CHU, Nancy, Inserm UMRS-1153, CRESS-EPICEA, University of Paris-Sorbonne, Paris, France

^o Cancer Epidemiology Unit, Department of Medical Sciences, University of Turin and AOU Città della Salute e della Scienza di Torino, Italy

^p Children's Hospital of Eastern Ontario Research Institute, University of Ottawa, Canada

^q Ottawa Hospital Research Institute, Canada

^r Occupational and Environmental Epidemiology & NetTeaching Unit, Institute and Outpatient Clinic for Occupational, Social and Environmental Medicine, University Hospital of Munich (LMU), Munich, Germany

^s French National Registry of Childhood Solid Tumours, CHU, Nancy, France

^t Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

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ABSTRACT

Objective: To study recall of mobile phone usage, including laterality and hands-free use, in young people.

Methods: Actual mobile phone use was recorded among volunteers aged between 10 and 24 years from 12 countries by the software application XMobiSense and was compared with self-reported mobile phone use at 6 and 18 months after using the application. The application recorded number and duration of voice calls, number of text messages, amount of data transfer, laterality (% of call time the phone was near the right or left side of the head, or neither), and hands-free usage. After data cleaning, 466 participants were available for the main analyses (recorded vs. self-reported phone use after 6 months).

Results: Participants were on average 18.6 years old (IQR 15.2–21.8 years). The Spearman correlation coefficients between recorded and self-reported (after 6 months) number and duration of voice calls were 0.68 and 0.65, respectively. Number of calls was on average underestimated by the participants (adjusted geometric mean ratio (GMR) self-report/recorded = 0.52, 95% CI = 0.47–0.58), while duration of calls was overestimated (GMR = 1.32, 95% CI = 1.15–1.52). The ratios significantly differed by country, age, maternal educational level, and level of reported phone use, but not by time of the interview (6 vs. 18 months). Individuals who

* Corresponding author.

E-mail address: l.vanwel@uu.nl (L. van Wel).

¹ These authors contributed equally.

reported low mobile phone use underestimated their use, while individuals who reported the highest level of phone use were more likely to overestimate their use. Individuals who reported using the phone mainly on the right side of the head used it more on the right (71.1%) than the left (28.9%) side. Self-reported left side users, however, used the phone only slightly more on the left (53.3%) than the right (46.7%) side. Recorded percentage hands-free use (headset, speaker mode, Bluetooth) increased with increasing self-reported frequency of hands-free device usage. Frequent ($\geq 50\%$ of call time) reported headset or speaker mode use corresponded with 17.1% and 17.2% of total call time, respectively, that was recorded as hands-free use.

Discussion: These results indicate that young people can recall phone use moderately well, with recall depending on the amount of phone use and participants' characteristics. The obtained information can be used to calibrate self-reported mobile use to improve estimation of radiofrequency exposure from mobile phones.

1. Introduction

The rapid worldwide increase in mobile phone use has led to increased concern about potential health effects due to exposure to radiofrequency (RF) fields. Additionally, mobile phone use has changed dramatically in recent years with both the introduction of third and fourth generation cellular networks as well as continuously evolving smartphone hardware and software. Potential health effects (if they exist) related to RF fields originating from mobile phones would likely be greater among young people for various reasons. The neurological system of children is still developing and may be more sensitive to effects of RF, the distribution of RF absorption across the brain may be different compared to adults, and the specific absorption rate (SAR) in the most exposed part of the brain tend to be higher in children than it is in adults (Wart et al., 2011). Lastly, the lifetime exposure of children to RF from mobile phones will be larger as they start using a mobile phone at a young age compared to current adults. Several national and international bodies have recommended studies of exposure in childhood and adolescence as high priority RF research areas due to this (Kheifets, 2005). As a result, two large multinational case-control studies were set up, the CEFALO study in four (Northern) European countries (Aydin et al., 2011c), and the MOBI-Kids study in 14 countries, both within and outside Europe (Sadetzki et al., 2014). In addition several national studies were set up, including the HERMES study in Switzerland (Schoeni et al., 2015), and the SCAMP cohort study in the United Kingdom (Mireku et al., 2018), looking at cognitive and behavioural outcomes.

Exposure assessment within epidemiological studies on health effects of mobile phone use generally relies on participants' recall of their mobile phone use. Previous validation studies among children and adolescents have found that this recall comes with substantial random and systematic errors (Aydin et al., 2011a; Goedhart et al., 2015b; Inyang et al., 2010, 2009; Kiyohara et al., 2016; Redmayne et al., 2012), which can lead to under- or overestimation of the explored health risks (Aydin et al., 2011b; Vrijheid et al., 2006a, 2006b). As part of MOBI-Kids, a case-control study exploring the potential effects of childhood and adolescent exposure to electromagnetic fields from mobile communications technologies on brain tumour risk (Sadetzki et al., 2014), the Mobi-Expo validation study was performed to study recall of mobile phone use among young people from 12 out of 14 countries. This is the largest multinational validation study to date. A software application (app) was developed by Whist Lab (Paris, France) to be installed on participants' own smartphone or a study phone (Goedhart et al., 2015b). In addition to duration and frequency of calls and text messages, the app also recorded information regarding laterality, hands-free usage, and data transfer. We report here the results of mobile phone usage and use behaviour recall at 6 and 18 months after the use of the app by study individuals. In addition, we explore if the observed differences in recall are related to demographic variables and/or phone usage.

2. Methods

From October 2012 to August 2014, volunteers between 10 and 24

years old were recruited in 12 MOBI-Kids countries: Australia, Canada, France, Germany, Greece, Israel, Italy, Japan, Korea, New Zealand, Spain and the Netherlands. The study was approved by the Institutional Review Boards in each country; all volunteers and/or their legal guardians provided informed consent following the country-specific protocols, including parental consent if indicated. More details about the recruitment procedures in each country are described in the paper by Langer et al. (2017).

2.1. Participants

Two types of participants were enrolled in the study. The first type of participants were those who owned a smartphone using the Android operating system (OS) (60% of total study population). The second type (40%), who did not own a smartphone using the Android OS, received a study phone (either a Samsung Galaxy Mini or a Galaxy S2) for four weeks. These participants were instructed to insert their own SIM card into the study phone and use it just as they would use their own phone. All participants installed the XMobiSense application (app) on the smartphone. After four weeks of data collection, data were either automatically transferred to a server or a data file was created by the participant or study coordinator. Four countries only recruited participants who owned their own smartphone using the Android OS: Greece, Japan, Korea and New Zealand while the other eight countries recruited a mix of the first and second type of participants.

2.2. Recorded mobile phone use (XMobiSense)

Whist Lab (Paris, France) developed a smartphone app called "XMobiSense", which can be installed on any smartphone using the Android OS. This app records date, time, and duration (in seconds) of voice calls, laterality (right/left side) of use (hands-free while using a device (i.e.: wired headset, speaker mode, Bluetooth headset/car kit), and other hands-free without using a device (e.g., answering/ending a call)), number of text messages sent and received, amount of data transfer (in bytes), and the communication system and technology used for voice calls (2G/3G) and data transfer (WiFi, GPRS, EDGE, UMTS, HSDPA, and other). No personal information or call/text content was recorded by the app. After piloting the app and study protocol (Goedhart et al., 2015b), some errors were observed in the recording of laterality and 'other hands-free use' for some devices. As such, only the following phone models were included in the current analyses on laterality and hands-free usage: Samsung Galaxy Ace, S (Plus), S2, S3, S3 (mini), S4, and S4 (mini).

2.3. Self-reported mobile phone use

Before participants started to use the app, a baseline questionnaire (Q1, 0 months) was completed (either face to face (64%), by phone (27%), or by (e)mail (9%)). The questionnaires included socio-demographic questions (parental education), and questions regarding current mobile phone use (frequency and duration of calls and number of text messages, laterality, hands-free use, proportion of use in urban/

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