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Validation of objective records and misreporting of personal radio use in a cohort of British Police forces (the Airwave Health Monitoring Study)

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ABSTRACT

Background: Terrestrial Trunked Radio (TETRA) is a digital communication system progressively adopted by Police Forces in Great Britain since 2001. In 2000, the UK Independent Expert Group on Mobile Phones suggested that exposure to TETRA-like signal modulation might have adverse effects on health. The Airwave Health Monitoring Study was established to investigate possible long-term effects of TETRA use on health. This requires estimation of TETRA use among Police Force employees participating in the study.

Methods: We investigated TETRA usage among 42,112 Police officers and staff. An algorithm was created to link each personal radio user to his/her objective radio usage records for the 26,035 participants with available data. We linked 16,577 personal radio users to their objective radio usage records and compared self-reported usage with data from the TETRA operator for those individuals.

Results: For weekly usage, the correlation between self-reported and operator-derived personal radio usage was r=0.69 for number and r=0.59 for the duration of calls. Compared with objective data, participants under-reported the number of calls and over-reported the duration of calls by a factor of around 4 and 1.6 respectively. Correlations were lower and bias higher when looking at daily usage.

Conclusion: Where both objective and self-reported information were available, our study showed substantial misreporting in self-reported TETRA usage. Successful linkage of large numbers of TETRA users to objective data on their personal radios will allow objective assessment of TETRA radio usage for these participants and development of algorithms to correct bias in self-reported data for the remainder.

1. Introduction

The possibility of adverse health effects associated with exposure to radiofrequency (RF) electromagnetic fields (EMF) from mobile telephones or other wireless devices is an issue of public concern and scientific debate with the widespread dissemination of these technologies since the 1990s. Terrestrial Trunked Radio (TETRA) is a digital communication system progressively adopted by Police Forces and other emergency services in Great Britain since 2001. It uses a TETRA-based national network provided by Airwave Solutions Limited. Several radio types are used: personal radio (the majority of usage, usually mounted on the shoulder of users), car mounted radio, motorcycle mounted radio, desk mounted radio and covert radio. TETRA differs from GSM (Global System for Mobile Communication) mobile phone technology in two important respects (AGNIR, 2001). First, the average output power of TETRA portable radios can, in some circumstances, exceed those from GSM900 and GSM1800 mobile phones. Second, TETRA transmission is pulsed at 17.6 Hz (1/56.7 ms) whereas mobile phones transmission is pulsed at 217 Hz (1/4.6 ms).

In 2000, the UK Independent Expert Group on Mobile Phones (Stewart Report) suggested that exposure to signal modulation at or around 16 Hz might have adverse effects on health (IEGMP, 2000) based on experimental findings of increased calcium efflux from brain tissue (Bawin et al., 1975). However, brief exposure to TETRA signals did not affect cognitive function, subjective symptoms or indices of well-being in several double-blind randomised trials (Nieto-Hernandez et al., 2011; Riddervold et al., 2010; Wallace et al., 2010, 2012). To address the concerns raised by the Stewart Report, in 2004 the UK Home Office commissioned the

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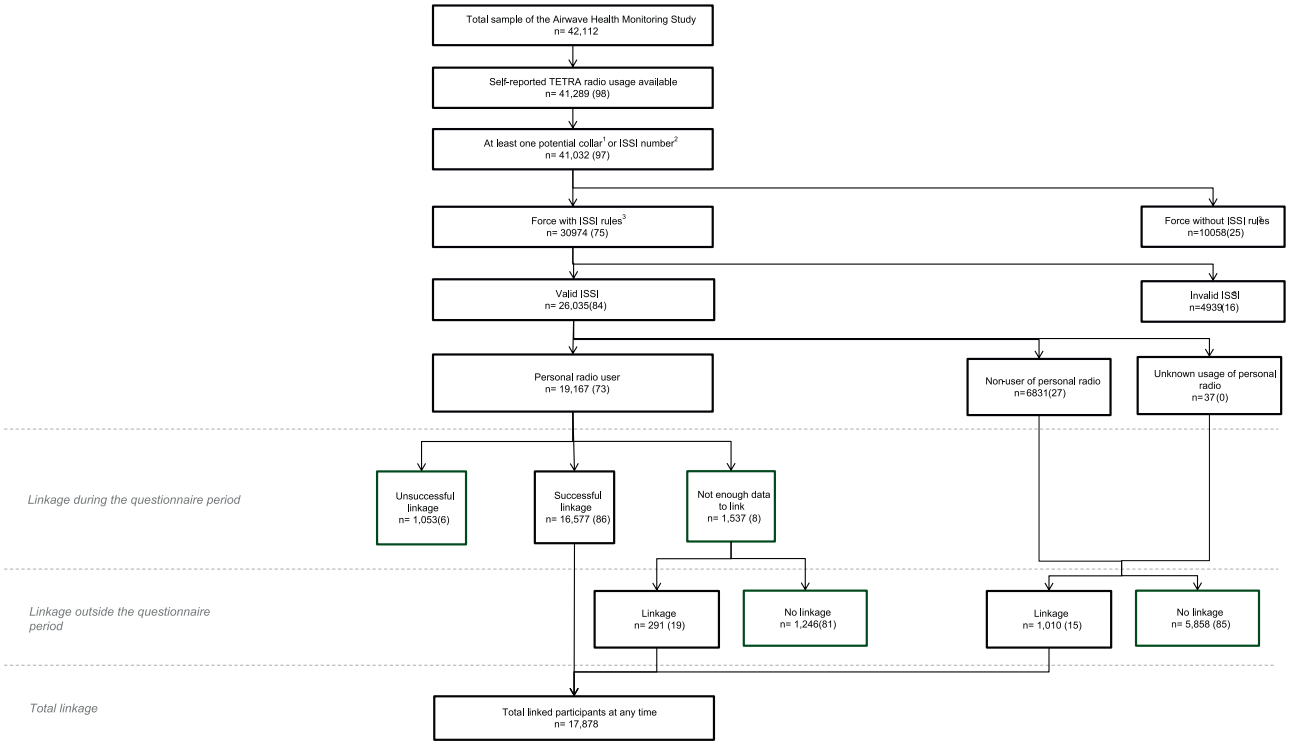

Fig. 1. Sample selection - Sample size (proportion of parent sample). 1–Unique identification number within a force for each police officer; 2–Individual Short Subscriber Identity, ie. identification number unique for each radio; 3–Refer to the force-specific rules allowing to derive an ISSI number from a collar number; 4–ISSI confirmed by at least two independent sources; 5–ISSI or collar number which do not conform to the expected format of an ISSI or collar number.

Airwave Health Monitoring Study, an epidemiological (cohort) study into the possible long-term health effects of TETRA use among the police forces in Great Britain (Elliott et al., 2014).

In 2011, the International Agency for Research on Cancer (IARC) classified RF EMF as a possible carcinogen (Group 2B) with the evidence considered inadequate to draw conclusions for occupational exposures which are likely to be higher than those for the general public. To date, most epidemiological studies investigating the association between EMF exposure and health outcomes relied on self-reported usage, with few exceptions (Auvinen et al., 2002; Aydin et al., 2011b; Dreyer et al., 1999; Frei et al., 2012; Mohler et al., 2012; Schoeni et al., 2015; Schuz et al., 2006). Self-reported usage of mobile phones has been shown to overestimate true usage among low users and underestimate among heavy users (Abeele et al., 2013; Timotijevic et al., 2009; Vrijheid et al., 2006a) In addition, random errors in exposure estimates substantially bias risk estimates (Vrijheid et al., 2006b). Therefore, where possible, studies investigating EMF should use objective rather than self-reported usage data. However, since objective data are not always available, some combination of self-reported and objective data will be required.

One of the main strengths of the Airwave Health Monitoring Study is the availability for the duration of the study of computerised records of TETRA radio traffic from the network operator (Airwave O_2) for a large proportion of the cohort. All TETRA radios are assigned an Individual Short Subscriber Identity (ISSI) number. For some of the forces, the police employee's collar number (unique identification number for each police officer, police community support officer, Special Constable and some police staff within his or her force) is embedded in the ISSI number of their personal radio. This means that ISSI numbers could be derived from collar numbers using force-specific rules.

The aims of the present study are to (i) validate the link between each personal radio user and his or her operator-derived personal radio records, (ii) determine how retrospective and prospective operator-derived records can reliably be used for each personal radio user, (iii) evaluate the extent and potential determinants of misreporting in self-reported personal radio usage, so that a reliable estimate of TETRA use can be derived for each participant in the study. This will enable analyses of possible health effects in relation to TETRA use.

2. Materials and methods

2.1. Study population

The Airwave Health Monitoring Study is an occupational cohort launched in June 2004 enrolling police officers and staff across Great Britain. The study design and rationale have previously been described (Elliott et al., 2014). Briefly, participants from each force who agreed to participate were enrolled either with an enrolment questionnaire or a comprehensive health screening performed locally. At the health screen, the participant also filled out an extensive questionnaire on a touchscreen computer. Both questionnaires include demographic, health and lifestyle questions, and information on TETRA radio usage. The time between the enrolment questionnaire and the health screening was determined by logistic constraints and varied between 6 months and one or more years. As of 31 December 2012, the Airwave Health Monitoring Study had enrolled 42,112 participants. For participating forces, on average, 50% of their employees were recruited once enrolment was complete. Participants signed a consent form permitting use of their data and samples for future research. The study had ethical approval through the National Health Service multi-site research ethics committee (MREC/13/NW/0588). The present study was restricted to participants who we were potentially able to link to their operator-derived personal radio records (N=26,035–62% of the whole cohort as shown in Fig. 1).