



Using air-quality feedback to encourage disadvantaged parents to create a smoke-free home: Results from a randomised controlled trial

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ABSTRACT

Objective: To determine if low-cost air-quality monitors providing personalised feedback of household second-hand smoke (SHS) concentrations plus standard health service advice on SHS were more effective than standard advice in helping parents protect their child from SHS.

Design: A randomised controlled trial of a personalised intervention delivered to disadvantaged mothers who were exposed to SHS at home. Changes in household concentrations of fine Particulate Matter (PM_{2.5}) were the primary outcome.

Methods: Air-quality monitors measured household PM_{2.5} concentrations over approximately 6 days at baseline and at one-month and six-months post-intervention. Data on smoking and smoking-rules were gathered. Participants were randomised to either Group A (standard health service advice on SHS) or Group B (standard advice plus personalised air-quality feedback). Group B participants received personalised air-quality feedback after the baseline measurement and at 1-month. Both groups received air-quality feedback at 6-months.

Results: 120 mothers were recruited of whom 117 were randomised. Follow up was completed after 1-month in 102 and at 6-months in 78 participants. There was no statistically significant reduction in PM_{2.5} concentrations by either intervention type at 1-month or 6-months, nor significant differences between the two groups at 1-month ($p = 0.76$) and 6-month follow-up ($p = 0.16$).

Conclusions: Neither standard advice nor standard advice plus personalised air-quality feedback were effective in reducing PM_{2.5} concentrations in deprived households where smoking occurred. Finding ways of identifying homes where air-quality feedback can be a useful tool to change household smoking behaviour is important to ensure resources are targeted successfully.

1. Introduction

Second-hand tobacco smoke (SHS) is a common indoor air pollutant linked to a wide range of respiratory (Snodgrass et al., 2016; Merianos et al., 2017), cardiovascular (Dunbar et al., 2013) and early life ill-health effects (Dai et al., 2017), with exposure more common in disadvantaged households (Hajizadeh & Nandi, 2016). Non-smokers who live with smokers can have high SHS exposures, particularly young children who spend much of their day at home with a smoker (Mills et al., 2012; Semple et al., 2015a). Globally it is estimated that 40% of children experience regular exposure to SHS with much of this exposure occurring in their own home (Mbulo et al., 2016). The global burden of

this exposure is estimated to be over 600,000 deaths and almost 11 million disability-adjusted life-years per year. Children are particularly vulnerable to the effects of SHS exposure and suffer 28% of these deaths and 61% of this morbidity (Oberg et al., 2011).

Enabling parents to create a smoke-free home is challenging but it is one of the key ways that children's exposure to SHS can be reduced globally. Scotland is at the forefront of protecting children from exposure to SHS with the Scottish Government's 'Take it Right Outside' campaign including a world first: a governmental target to reduce the proportion of children exposed to SHS at home by 50% (from 12% to 6%) by 2020 (Scottish Government, 2014). Increased adoption of smoke-free homes in low income populations has also been shown to

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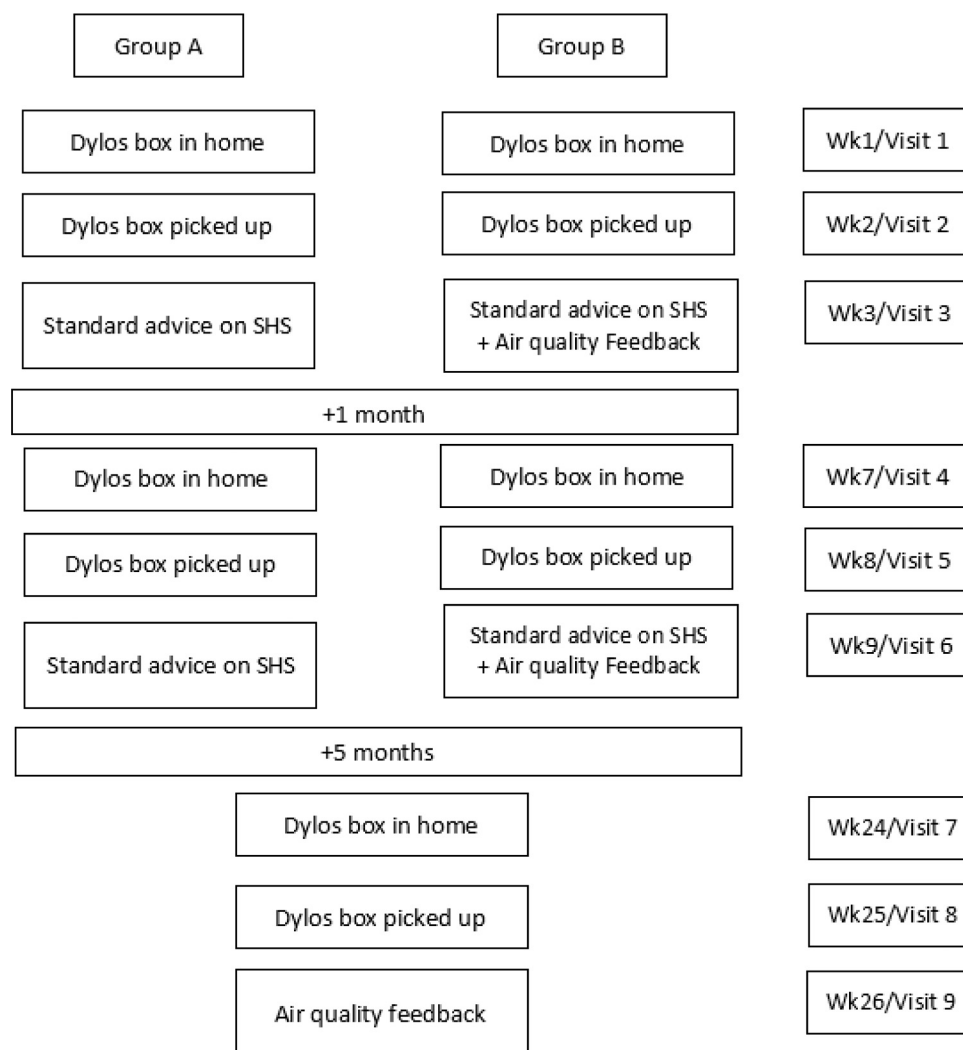


Fig. 1. Overall research design. Each participant received nine visits over a 26-week period. [Group A = standard care; Group B = standard care plus air quality feedback].

increase cessation rates and prevent relapse (Vijayaraghavan et al., 2013). There is a need for good quality evidence on ways to increase the proportion of smoke-free homes in different settings. The most recent Cochrane review (Baxi et al., 2014) of programmes to reduce children's exposure to SHS screened 57 relevant studies but identified that only 6 used objective measures of children's SHS exposure to evaluate intervention effectiveness. None of the included studies used air-quality feedback. A recent systematic review and meta-analysis (Rosen et al., 2015) identified seven interventions designed to encourage smoke-free homes that had used objective measures of household air quality as an outcome measure. The meta-analysis indicated that these approaches generally had an impact on reducing air concentrations of fine particulate matter (PM_{2.5}) or nicotine within the household; though all studies reported evidence of continuing SHS 'contamination' post-intervention.

Methods to measure SHS in indoor settings using airborne PM_{2.5} as a marker of SHS concentrations have been used in tobacco control science over the past decade (Repace et al., 2006; Van Deusen et al., 2009; Sureda et al., 2012). Several studies have explored the concept of air-quality feedback to modify smoking behaviour in the home (Wilson et al., 2013a; Ratschen et al., 2018; Hughes et al., 2018).

There are considerable challenges in rolling out this type air-quality feedback intervention at scale. The REFRESH study identified low recruitment rates (when potential participants were approached via GP

letter); the high cost of available instruments and technical complexity; and the labour costs of delivering, setting up and collecting instruments from participants' homes (Shaw et al., 2013). Recent work has identified low-cost air-quality monitoring devices that have the potential to address the practical problems of noise, cost and complexity of operation identified in previous studies (Semple et al., 2013).

The aim of the study was to determine if delivery of personalised air-quality feedback plus standard advice on the health effects of SHS was more effective than standard advice on its own in encouraging changes to household smoking as measured by objective assessment of PM_{2.5} concentrations one-month later. The study was nested within the First Steps Programme (FSP) in Lanarkshire in Scotland (NHS Health Scotland, 2014), providing an opportunity to overcome many of the barriers identified in the REFRESH study (Wilson et al., 2013b) in terms of recruiting disadvantaged parents, embedding the intervention within an existing service and use of a simpler, low-cost device to deliver air quality feedback.

2. Methods

2.1. Study design

This was a randomised controlled trial which compared standard advice to achieve a smoke-free home against standard advice plus

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