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Paediatric emergency department-based carbon monoxide detector intervention: a randomised trial

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Abstract

Background—Although non-fire-related carbon monoxide (CO) poisoning is almost entirely preventable, over 400 people die and 20 000 people are injured each year in the USA from unintentional CO poisoning. Thus, there is a critical need for evidence-based interventions for preventing CO poisoning and increasing the proper use and installation of CO detectors.

Methods—A randomised, controlled trial (Project CODE, a Carbon Monoxide Detector Education intervention) with 2-week and 6-month follow-up home observations was conducted in 299 parents of children aged 18 years recruited in the emergency department of a level 1 paediatric trauma centre. The intervention group received an educational tool, a spiral-bound,

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laminated booklet that resembled a CO detector containing theory-based safety messages based on the precaution adoption process model, a plug-in CO detector and 9 V battery. The control group received a one page flyer on CO poisoning prevention.

Results—Although the difference was not statistically significant, mean CO knowledge score increased at a greater rate for the intervention group than the control group. Intervention group parents were more likely to exhibit ‘safe’ CO detector use than control group parents at the 2-week follow-up (RR: 2.75; 95% CI 2.06 to 3.69) and 6-month follow-up (RR: 2.78; 95% CI 2.06 to 3.76), after adjusting for self-reported CO detector use behaviour at enrolment and annual per capita income.

Conclusions—An emergency department-delivered intervention containing a theory-based educational tool paired with a CO detector can be an effective method for increasing knowledge about CO poisoning, for prevention and for appropriate use of a CO detector.

Trial registration number—NCT00959478.

INTRODUCTION

Non-fire-related carbon monoxide (CO) poisoning, the leading cause of poison-related death in the USA, results in over 400 deaths¹² and 20 000 non-fatal injuries annually.³ Many symptoms of CO poisoning, including headache, dizziness, nausea/vomiting and loss of consciousness, are easily mistaken for other conditions including viral illness.³ In addition to the acute morbidity and mortality, approximately 10%–40% of CO poisoning survivors have persistent neurological injury.⁴

Poisoning occurs when CO, an odourless, colourless and tasteless gas, escapes from fuel-burning appliances and becomes trapped in enclosed spaces. Installing residential CO detectors is the most effective step for protecting household occupants. Although detectors are effective in alerting occupants to the presence of CO, nationally less than one-third own a CO detector and most are unsure where to place CO detectors or how many should be installed.³ Common misuses include incorrect placement and failure to replace batteries every 6 months which can lead to false alerts, decrease in the device’s effectiveness or the device becoming inoperable. Thus, there is a critical need for evidence-based interventions aimed at increasing the proper installation and use of CO detectors to prevent CO poisoning.

Our objective was to test the effectiveness of Project CODE, a Carbon Monoxide Detector Education intervention, designed to promote correct and consistent CO detector use and increase CO safety knowledge. The a priori hypothesis was that participants receiving the intervention, a theory-based educational tool paired with a safety device, would exhibit higher rates of correct CO detector use and have more CO safety knowledge.

METHODS

A randomised controlled trial was undertaken in a level 1 paediatric trauma centre’s emergency department (ED). From June 2009 to May 2010, a study recruiter screened electronic medical charts identifying children aged 18 years being treated for an injury or minor medical complaint (ie, triage levels 3–5) and approached parents in the examination

rooms to determine their interest and eligibility. Recruitment occurred during preselected times representing the busiest shifts (10:00–22:00) and days of the week (Sunday–Thursday). Eligibility requirements specified that participants should be English-speaking, parents/guardians of a child 18 being treated for an injury or minor medical complaint, living in Franklin County, Ohio, USA, residing with the child ‘at least some of the time’ and self-identified as someone ‘responsible for the child’s safety’. The study recruiter met with eligible parents to explain the study’s purpose and obtain written informed consent.

Consented participants completed a 15 min enrolment survey on a tablet computer. In this survey, participants reported their age, sex, race/ethnicity, education, employment, annual income, number of children living in the home, number of individuals supported on annual income, marital status, time in current residence, home ownership status, number of smokers in the home, medical insurance and age and relationship of the child being treated in the ED. Annual per capita income was calculated by dividing the midpoint of the reported income by the number of individuals supported by that income. Poverty status was determined by comparing per capita income to poverty guidelines⁵ for the year in which the data were collected.

Participants were randomly assigned via a computerised pseudo-random number generator to receive either (1) a 14-page, stage-based CO educational tool and a plug-in CO detector and 9 V battery (intervention group) or (2) a standard, one page black and white educational flyer on CO poisoning prevention (eg, description of CO, symptoms of CO poisoning and detection/prevention information) developed and distributed by the institutions’ poison centre (control group). Follow-up observations were conducted at the participant’s home 2 weeks and 6 months after enrolment between July 2009 and November 2010 and included a survey completed on the tablet computer and a 20 min home observation (in which the alarm presence, location and functionality was noted by the home visitor). Home visitors were blinded to treatment group. All participants received parking vouchers after completion of the enrolment survey and gift cards for each completed home visit (\$25 for 2-week home visit and \$50 for 6-month home visit) for a total possible incentive of \$75. At the conclusion of the study, the control group was given a CO detector and the educational tool. All protocols were reviewed and approved by the institutional review board at the study institution and registered with ClinicalTrials.gov (NCT00959478).

The intervention group received a 14-page educational tool, titled *Fast Facts about Carbon Monoxide*, developed to help people understand the dangers of CO poisoning and the importance of proper CO detector use and maintenance. Each section of the tool was designed to address the needs of people in different precaution adoption process model (PAPM) stages of CO detector use and therefore provide targeted, relevant and highly focused theory-based educational messages. The spiral-bound, laminated booklet resembling a CO detector described common sources of CO and provided illustrations of those appliances. Sections of the booklet included information on what to look for when buying a CO detector, why smoke detectors and CO detectors are needed, where to install a CO detector, how to take care of it, what to do if the detector sounds and emergency phone numbers. It also included a peel-out magnet with a quick reference guide and emergency and

poison control telephone numbers, non-emergency numbers and a place to write down the month and year when CO detector batteries should be replaced.

The primary outcome measures were CO safety knowledge and CO detector use at enrolment, 2-week and 6-month follow-up home visits. To test CO safety knowledge, eight multiple choice and true/false items were developed and administered at enrolment, 2-week and 6-month follow-ups. Correct responses were assigned 1 point, incorrect responses 0 points and points were summed to determine a *total knowledge score* for each participant and the mean *total knowledge score* was calculated for each time point.

The outcome variables for CO detector use were single, ordinal variables incorporating both behavioural profile (ie, self-reported CO detector use at enrolment or observed CO detector use at the 2-week and 6-month follow-up home visits) and PAPM stage (table 1). The PAPM, which depicts behaviour change as a process that evolves through predictable stages,⁶⁷ has been used in prior injury behaviour research and has received increasing support for predicting health-related actions.⁸⁹ Participants were assigned to one behavioural profile and PAPM stage through a series of questions using 'staging algorithms'. The behavioural profiles correspond to the goal behaviour and build on the previous profile. The existence of a CO detector, maintenance of device and ideal placement in the home correspond to behaviour profiles 1, 2 and 3, respectively. Participants were then matched to the PAPM stage (1 through 6) that aligned with the process of adopting that profile's behaviour. For instance, participants were assigned to profile 1 if they did *not* have a working CO detector and then were asked if they knew about and/or if they were planning to adopt the behaviour of getting a working CO detector (response determined the appropriate PAPM stage). Participants in the highest profile (profile 3, stages 1 through 6) were considered to have 'safe' CO detector use (ie, observed having at least one working CO detector and having replaced the batteries in past 6 months, but the detector may or may not be near the sleeping area) compared with 'unsafe' detector use (profiles 1 and 2, stages 1 through 6) (ie, observed not having a working CO detector or observed having at least one working CO detector but have not replaced the batteries in past 6 months). Parents in the highest behavioural profile and stage (profile 3, stage 6) were considered to have 'perfect' CO detector use (ie, observed having at least one working CO detector near the sleeping area and having replaced the battery within 6 months), while everyone else was then considered to have 'less than perfect' CO detector use (profiles 1 and 2, stages 1 through 6 and profile 3, stages 1 through 5).

Two-sample t-tests, χ^2 tests and Fisher's exact tests were used to compare demographic characteristics at enrolment between treatment groups and loss to follow-up for each home visit. All analyses were conducted on an intent-to-treat basis. Repeated measures log-binomial regression using the method of generalised estimating equations was used to estimate and compare adjusted RRs for 'safe' and 'perfect' behaviour between treatment groups, respectively. Variables associated with treatment group, visit, an interaction between group and visit, self-reported behaviour profile at enrolment, mean knowledge score at enrolment and socio-demographic characteristics were used in the multivariate model-building process. RR estimates from the parsimonious final model, adjusted for significant non-collinear covariates and confounders, are presented. Self-reported PAMM behavioural

profile, per capita income and time living at current residence were collected only at the enrolment visit. The impact of the intervention on CO knowledge was assessed using linear mixed-model regression with random intercepts including the following predictors: treatment group, visit and an interaction between group and visit. Data were analysed using SAS (V.9.4; SAS Institute, Cary, North Carolina, USA). Hypothesis testing was conducted with a 5% type 1 error rate.

Sample size estimates were based on previous work showing rates of 'safe' CO detector use as low as 14% in various subgroups.¹⁰ A priori, with an α -level of 0.025 to account for the two time point comparisons, 125 households per group would have provided 80% power to detect a difference in the proportion of CO detector use of 0.18 (an increase from 0.19 to 0.37). The sample size was increased from 125 to 150 per study group to account for dropout and loss to follow-up.

RESULTS

Of the 756 parents approached in the ED, 336 were assessed for eligibility and 310 met the eligibility criteria (figure 1). Of those 310 parents, 11 had children discharged before the enrolment process was completed, resulting in a final sample of 299. A total of 251 parents (83.9%) completed the 2-week follow-up visit and 238 (79.6%) completed the 6-month follow-up visit (131 intervention and 107 control).

The majority of parents enrolled were women (90.3%), had at least some college education (64.2%), had a per capita income of >\$5000 (56.2%) and rented their home (61.5%) (table 2). There was no difference between intervention and control groups for the majority of characteristics measured at enrolment (table 2). Intervention group parents had a greater proportion of at least one smoker in the home (44.9%) compared with controls (32.2%) ($p=0.024$).

CO knowledge

There was no difference in mean CO knowledge scores between intervention (mean: 6.87, 95% CI 6.54 to 7.21) and control (mean: 7.08, 95% CI 6.73 to 7.43) groups at enrolment ($p=0.407$). The intervention group mean knowledge score at 2 weeks (8.28, 95% CI 7.93 to 8.63) was trending towards being greater than the control group mean knowledge score (7.59, 95% CI 7.21 to 7.96) ($p=0.053$). The 6-month follow-up knowledge scores were not significantly different between the intervention (mean: 8.28, 95% CI 7.93 to 8.63) and control (mean 7.96, 95% CI 7.59 to 8.34) groups ($p=0.233$). The group by visit interaction was significant ($p=0.002$). The mean CO knowledge score increased at a greater rate for the intervention group than the control group from enrolment to the first follow-up home visit and then increased minimally from 2-week to 6-month follow-up (figure 2).

CO detector use

Intervention group parents were more likely to exhibit 'safe' behaviour than control group parents at the 2-week (RR: 2.75; 95% CI 2.06 to 3.69) and 6-month follow-up (RR: 2.78; 95% CI 2.06 to 3.76), after adjusting for self-reported CO detector behaviour at enrolment and annual per capita income (table 3). Parents who self-reported 'safe' CO behaviour at

enrolment were more likely to exhibit 'safe' CO detector behaviour (RR: 1.26; 95% CI 1.05 to 1.50) than parents who self-reported 'unsafe' CO detector behaviour at enrolment after adjusting for intervention and annual per capita income. Parents with annual per capita income > \$5000 were more likely to exhibit 'safe' CO detector behaviour (RR: 1.20; 95% CI 1.00 to 1.44) than parents with annual per capita income ≤ \$5000, after adjusting for intervention and self-reported CO behaviour at enrolment.

Intervention group parents were 3.43 times more likely to exhibit 'perfect' CO detector behaviour than control group parents in the final model at the 2-week (RR: 3.43; 95% CI 2.23 to 5.29) and 6-month follow-up (RR: 3.20; 95% CI 2.02 to 5.09) after adjusting for self-reported CO detector behaviour at enrolment and annual per capita income (table 3). Parents who self-reported 'safe' CO detector behaviour at enrolment were more likely to exhibit 'perfect' CO detector behaviour (RR: 1.49; 95% CI 1.08 to 2.03) than parents who self-reported 'unsafe' CO detector behaviour at enrolment after adjusting for visit and annual per capita income. Parents with annual per capita income > \$5000 were more likely to exhibit 'perfect' CO detector behaviour (RR: 1.31; 95% CI 0.95 to 1.82) than parents who earned ≤ \$5000 after adjusting for visit and self-reported CO detector behaviour at enrolment. Although annual per capita income was not statistically significant in the final reduced model which compared 'perfect' with 'less than perfect' behaviour ($p=0.078$), it was retained because it approached significance in the final model and was the measure of socioeconomic status that was most predictive of behaviour in the model comparing 'safe' with 'unsafe' CO detector behaviour.

DISCUSSION

We believe this is the first study examining the effectiveness of a theory-based educational tool and device intervention for CO poisoning delivered in an ED. CO exposure kills and injures thousands of people annually. Homes with working CO detectors have fewer and less severe episodes of CO exposure; however, it is currently estimated that less than one-third of homes nationally have CO detectors.³ Effective countermeasures to reduce CO poisoning exist, yet are not routinely used. To date, there has been a dearth of interventions designed to increase CO detector use.

Previous studies have examined smoke alarm ownership and functionality in residential settings and have evaluated varying methods for distribution including give-away programmes, installation programmes and other distribution techniques.¹¹¹² We investigated whether a stage-based health communication, paired with distribution of a CO detector and battery, could increase correct CO detector use, thereby reducing the risk of CO poisoning. We found parents who received the educational tool and CO detector were more likely to exhibit 'safe' behaviour than control group parents, both at the 2-week and 6-month follow-ups, after adjusting for self-reported CO detector use at enrolment and annual per capita income. Intervention group parents were also more likely to exhibit 'perfect' CO detector use at the 2-week and 6-month follow-ups, after adjusting for self-reported CO detector use at enrolment and annual per capita income. By combining elements of other successful primary prevention interventions and incorporating a behavioural theory to address

behaviours relevant to stages of adoption, the developed intervention successfully increased CO detector use. Future studies should examine similar interventions for other safety topics.

While the intervention was effective in increasing CO detector use, there were differences in effectiveness based on annual per capita income. Parents with an annual per capita income > \$5000 were more likely to exhibit 'safe' and 'perfect' CO detector behaviour than parents with an annual per capita income of \$5000. Previous studies have found many families, especially those with low income, do not consistently or properly use safety products or practice safety behaviours.⁸¹⁰¹³ Among families reporting income <\$10 000, the number of acute injuries per 100 persons is 33.9, while it is only 27.1 for families reporting income of \$35 000.¹⁴ Poorer children sustain more injuries and are also more likely to die from injury than children of families with more economic resources.¹⁵¹⁶ National household survey data suggest parents' reported safety practices, such as having smoke alarms, also vary by income.¹⁷ Parents of lower socioeconomic status have been found to underestimate their children's injury risk and be less likely to take injury prevention precautions.¹⁸ Previous research has found having less income and living in substandard housing were associated with implementing fewer safety practices.¹⁹ Because of the difficulty of varying or modifying socioeconomic circumstances, efforts to influence the adoption and continued use of safety practices among families of varying socioeconomic levels are key to preventing injuries. Future research is needed to determine how to increase the effectiveness of CO detector and other injury prevention interventions for at-risk populations including low-income families and non-English speaking, immigrant families.

CO knowledge increased among both intervention and control group parents, demonstrating that the ED setting offers an unparalleled opportunity to reach a large and vulnerable population of families. While there was no difference in mean CO knowledge scores between intervention and control group parents at enrolment, 2-week or 6-month follow-ups, the mean knowledge score increased at a greater rate for the intervention parents from enrolment to the first follow-up home visit. Presenting information to parents in a format that is easy to read and reference may result in more immediate changes in knowledge of safety practices, especially when the information is provided in an environment like a busy ED. Additional research is needed to determine the long-term impact of the intervention on CO knowledge, whether the knowledge rate increase is valuable despite the absence of a difference in knowledge scores and, if so, how that value compares with the added costs of booklets versus flyers.

This study had limitations. First, self-report bias may have been present. There were no observed baseline measures of CO detector use at enrolment. Furthermore, the PAPM is a cognitive behavioural model that identifies a person's thoughts, decisions and plans regarding the adoption of a health behaviour; these are important and relevant variables that cannot be observed. Parents may have been more likely to report socially desirable answers and over-report safety practices or they may have believed their CO detector was functional even if it was not. Despite the potential for bias, parents' self-reported behaviours accurately described observed behaviour at the 2-week and 6-month follow-up visits (data not presented). Second, the generalisability of our results were limited as parents were recruited from a single ED. However, as this ED treats extremely high volumes of infant, child and

adolescent patients, there is good potential for translation to other EDs as well as other settings given the nature and simplicity of delivering the intervention. EDs can provide an appropriate venue for injury prevention interventions because it can allow for access to large populations and provide ‘teachable moment’ opportunities for visitors.^{320–25} An additional limitation for generalisability of our results is that we do not know detailed information from those parents who declined to be assessed for eligibility for this study. Third, parents were considered to have ‘perfect’ CO detector use if they had at least one working CO detector near the home’s sleeping area and had replaced the battery within the past 6 months. Many residents require more than one CO detector for safety and compliance with national guidelines for these devices and battery replacement after the 6-month follow-up was not evaluated. In addition, responding appropriately to the CO detector if it sounds is also a part of the correct behaviour and this information was presented in the educational tool but was not evaluated. Finally, the impact of the components of the intervention cannot be disentangled, that is, the influence of the educational tool and delivery of the CO detector independently on behaviour and knowledge, as these components were delivered together. Despite these limitations, this randomised controlled trial provided valuable information on the effectiveness of an ED-delivered CO poisoning intervention.

By examining the extent to which the intervention increased CO detector use and knowledge, these findings demonstrate how theory-based health communications, including ED-delivered interventions, can reduce the risk of CO poisoning among vulnerable families when paired with appropriate safety equipment distribution. The lessons learnt from this intervention trial have widespread applicability to other EDs or urgent care settings and other injury prevention topics. Future studies are needed to test the effectiveness of this evidence-based intervention when distributed in a community setting.

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What is already known on the subject?

- Carbon monoxide (CO) poisoning is a leading cause of poison-related death in the USA.
- CO poisoning is entirely preventable.

What this study adds?

- This study describes the results of a successful intervention to increase CO detector use.
- Families who received the intervention, which included an educational tool, a CO detector and a 9 V battery, reported safer CO detector use behaviour at 2 weeks and 6 months after delivery of the intervention than families who only received a flyer on CO poisoning prevention.

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Figure 1.
Flow chart showing subject recruitment, project CODE, a carbon monoxide detector education intervention.

Figure 2. Mean carbon monoxide knowledge score at enrolment, 2-week follow-up and 6-month follow-up by treatment group, project CODE, a carbon monoxide detector education intervention.

Table 1

Definitions of precaution adoption process model (PAPM) behavioural profiles for carbon monoxide (CO) detector use, project CODE, a carbon monoxide detector education intervention

CO detector use			
	Behavioural profile 1: Do you have a working CO detector?*	Behavioural profile 2: Do you have a CO detector, with battery changed within the past 6 months?*	Behavioural profile 3: Do you have a CO detector, with battery changed within the past 6 months and the CO detector is near sleeping areas?*
Stage in PAPM			
<i>Stage 1: Unaware</i> (does not know about the need for the behaviour)	Profile 1, stage 1	Profile 2, stage 1	Profile 3, stage 1 [†]
<i>Stage 2: Not engaged</i> (not thinking about adopting the behaviour)	Profile 1, stage 2	Profile 2, stage 2	Profile 3, stage 2 [†]
<i>Stage 3: Undecided</i> (thinking about adopting the behaviour)	Profile 1, stage 3	Profile 2, stage 3	Profile 3, stage 3 [†]
<i>Stage 4: Decided not to act</i> (decided not to adopt the behaviour)	Profile 1, stage 4	Profile 2, stage 4	Profile 3, stage 4 [†]
<i>Stage 5: Decided to act</i> (planning to adopt the behaviour)	Profile 1, stage 5	Profile 2, stage 5	Profile 3, stage 5 [†]
<i>Stage 6: Acting</i> (adopting/maintaining the behaviour)	Profile 1, stage 6	Profile 2, stage 6	Profile 3, stage 6 ^{†‡}

* If participant answered 'no,' then they remained in that behavioural profile and were assigned to a PAPM stage based on their responses to the PAPM model questions. If the participant answered 'yes', then they proceeded to the questions corresponding to the next behavioural profile.

[†] Defined as 'safe' behaviour—*profile 3, stages 1–6* (versus 'unsafe' which incorporates *profile 1, stages 1–6* through *profile 2, stages 1–6*).

[‡] Defined as 'perfect' behaviour—*profile 3, stage 6* (versus 'less than perfect' which incorporates *profiles 1 and 2, stages 1–6* and *profile 3, stages 1–5*).

Table 2

Demographic characteristics by treatment group, project CODE, a carbon monoxide (CO) detector education intervention

Characteristics	Total n=299 (%) [*]	Intervention n=156 (%) [*]	Control n=143 (%) [*]	p Value
Age (years), mean (SD)	35.0 (0.6)	34.5 (9.0)	35.6 (10.8)	0.318
Sex				
Male	29 (9.7)	14 (9.0)	15 (10.5)	0.658
Female	270 (90.3)	142 (91.0)	128 (89.5)	
Race/ethnicity				
White, non-Hispanic	145 (48.5)	75 (48.1)	70 (49.0)	0.840
Black, non-Hispanic	128 (42.8)	66 (42.3)	62 (43.4)	
Other [†]	26 (8.7)	15 (9.6)	11 (7.7)	
Education				
High school/GED	107 (35.8)	56 (35.9)	51 (35.7)	0.148
Some college	134 (44.8)	76 (48.7)	58 (40.6)	
Bachelor's degree	58 (19.4)	24 (15.4)	34 (23.8)	
Annual per capita income				
\$5000	131 (43.8)	71 (45.5)	60 (42.0)	0.536
>\$5000	168 (56.2)	85 (54.5)	83 (58.0)	
Insurance				
Medicaid	153 (51.2)	84 (53.9)	69 (48.3)	0.257
No insurance	5 (1.7)	1 (0.6)	4 (2.8)	
Other	141 (47.2)	71 (45.5)	70 (49.0)	
Marital status				
Married/couple	169 (56.5)	84 (53.9)	85 (59.4)	0.615
Single, never married	91 (30.4)	50 (32.1)	41 (28.7)	
Other [‡]	39 (13.0)	22 (14.1)	17 (11.9)	
Employment status				
Full time	122 (40.8)	59 (37.8)	63 (44.1)	0.518
Other [§]	64 (21.4)	34 (21.8)	30 (21.0)	
Not employed	113 (37.8)	63 (40.4)	50 (35.0)	
Time in home				
<1 year	95 (31.8)	51 (32.7)	44 (30.8)	0.916
1—2 years	84 (28.1)	44 (28.2)	40 (28.0)	
>2 years	120 (40.1)	61 (39.1)	59 (41.3)	
Home ownership				
Own	102 (34.1)	46 (29.5)	56 (39.2)	0.172
Rent	184 (61.5)	101 (64.7)	83 (58.0)	
Stay with someone	11 (3.7)	7 (4.5)	4 (2.8)	
Other [¶]	2 (0.7)	2 (1.3)	0 (0.0)	
Smoking status				

Characteristics	Total n=299 (%) [*]	Intervention n=156 (%) [*]	Control n=143 (%) [*]	p Value
1 smoker at home	116 (38.8)	70 (44.9)	46 (32.2)	0.024
No smokers at home	183 (61.2)	86 (55.1)	97 (67.8)	
CO detector use ^{**}				0.272
Safe	65 (21.7)	30 (19.2)	35 (24.5)	
Unsafe	234 (78.3)	126 (80.8)	108 (75.5)	

^{*} Percentages may not sum to 100.0% due to rounding.

[†] Includes Hispanic Latino, Somali, Asian/Pacific Islander, American Indian or Other.

[‡] Includes divorced or widowed.

[§] Includes part-time employees, students and retired participants.

[¶] Includes stays with someone, stays in a shelter, or other.

^{**} Self-reported CO detector behaviour at enrolment.

GED, General Educational Development.

Table 3

Factors associated with observed 'Safe' and 'Perfect' carbon monoxide (CO) detector use, project CODE, a CO detector education intervention

Covariates	RR (95% CI)	
	'Safe' [*] final model	'Perfect' [†] final model
2-week follow-up		
Intervention	2.75 (2.06 to 3.69)	3.43 (2.23 to 5.29)
Control	1 (referent)	1 (referent)
6-month follow-up		
Intervention	2.78 (2.06 to 3.76)	3.20 (2.02 to 5.09)
Control	1 (referent)	1 (referent)
Self-reported CO detector behaviour at enrolment		
'Safe'	1.26 (1.05 to 1.50)	1.49 (1.08 to 2.03)
'Unsafe'	1 (referent)	1 (referent)
Annual per capita income		
>\$5000	1.20 (1.00 to 1.44)	1.31 (0.95 to 1.82) [‡]
\$5000	1 (referent)	1 (referent)

^{*} Defined as 'safe' behaviour—*profile 3, stage 1–6* (versus 'unsafe' which incorporates *profile 1, stages 1–6* through *profile 2, stages 1–6*).

[†] Defined as 'perfect' behaviour—*profile 3, stage 6* (versus 'less than perfect' which incorporates *profiles 1 and 2, stages 1–6* and *profile 3, stages 1–5*).

[‡] p=0.078.