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Crowdsourcing data collection of the retail tobacco environment: case study comparing data from crowdsourced workers to trained data collectors

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ABSTRACT

Objective To assess whether crowdsourcing is a viable option for conducting surveillance of point of sale (POS) tobacco marketing practices.

Methods We posted jobs to an online crowdsourcing platform to audit 194 Florida licensed tobacco retailers over a 3-week period. During the same period, trained data collectors conducted audits at the same retail locations. Data were collected on cigarette advertising, cigarette promotions and product availability (electronic cigarettes, snus and dissolvables). We compared data collected by crowdsourced workers and trained staff and computed frequencies, percent agreement and inter-rater reliability. Photographs of e-cigarettes and exterior cigarette advertisements submitted by crowdsourced workers were used to validate responses.

Results Inter-rater reliability between crowdsourced and trained data collectors was moderate to high for coding exterior cigarette advertisements, product availability and some tobacco promotions, but poor to fair when coding presence of sales and interior cigarette advertisements. Photos submitted by crowdsourced workers confirmed e-cigarette availability that was missed by trained data collectors in three stores.

Conclusions Crowdsourcing may be a promising form of data collection for some POS tobacco measures. Future studies should examine the cost-effectiveness of crowdsourcing compared with traditional trained data collectors and assess which POS measures are most amenable to crowdsourcing.

gather information, (2) distribute large-scale tasks that are easier for humans to process (eg, analysing photos) or (3) solicit ideas or solutions to existing problems as a challenge that can also be vetted by peers.⁷ Crowdsourcing has been applied to a wide range of health topics,^{8–12} including collecting local-level data.¹³ Leveraging online networks to identify individuals who can conduct tobacco retail audits in their neighbourhood could potentially provide more rapid data at a lower cost.

To date, no study has crowdsourced POS tobacco retail audits. A recent study found that crowdsourced workers had high agreement with trained data collectors when coding text data,¹⁴ but these results may not generalise to retail audits. The purpose of this study was to examine the feasibility of crowdsourcing tobacco retail data and to compare the quality of data collected by crowdsourced and trained data collectors. Results will inform whether crowdsourcing is a viable option for POS surveillance.

METHODS

RTI conducts an annual audit of licensed tobacco retailers for the Bureau of Tobacco Free Florida.¹⁵ Annually, RTI trains data collectors, ensures high inter-rater reliability and validity, and deploys data collectors to collect data from a random sample of licensed tobacco retailers throughout Florida. During the 2012 audit, we implemented a pilot study at a subset of stores to assess how well untrained crowdsourced workers could collect POS data.

Using Gigwalk, a crowdsourcing mobile application, we posted 194 jobs over a 3-week period (31 August 2012 to 19 September 2012) to the same stores that trained data collectors were visiting. Crowdsourced workers received the same code-book instructions as trained data collectors, but no additional training. After workers uploaded survey answers and photos via the Gigwalk app, we reviewed data, requested clarification on incomplete answers and provided payment (\$7) for completed work.

Measures

For this initial pilot study, we gave crowdsourced workers only a subset of measures from the full audit form used by trained data collectors. We selected measures that were most commonly collected in previous tobacco retail audits.¹⁵ We posted two 'gigs':

INTRODUCTION

The retail environment is the primary advertising channel for the tobacco industry accounting for over 80% of its annual \$8.3 billion advertising expenditure.¹ Exposure to point of sale (POS) tobacco marketing influences youth smoking initiation² and impulse cigarette purchases among adults,³ which undermines quit attempts and increases relapse among recent quitters. Ongoing surveillance of retail tobacco marketing is needed to inform research and regulatory practices.^{4 5} However, traditional retail audits that employ trained field workers are costly and require substantial lead time for planning and implementation. With over 300 000 tobacco retailers across the USA,⁶ a more sustainable surveillance method is needed.

Crowdsourcing may be a promising approach for conducting tobacco retail audits. Crowdsourcing is an 'online, distributed problem solving and production model' that leverages online networks to (1)



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“Cigarette Audit” (N=99 stores)

Workers recorded whether the store sold Marlboro Red cigarettes and, if so, whether any of the following promotions were available: sale offer, multipack discount, mail-in rebate, coupon, or free pack with purchase. Promotions were coded based on advertisements and displays and not purchase of tobacco products. Workers noted whether cigarette advertisement(s) were present on store exterior and if so, took a photograph. No other photographs were taken.

“Smokeless Audit” (N=95 stores)

Workers recorded whether the store sold snus, dissolvable tobacco, e-cigarettes, and flavored e-cigarettes and whether e-cigarette advertisement(s) were posted inside the store. If e-cigarettes were available, workers took a photograph. No other photographs were taken.

Additionally, Gigwalk provided metadata on date/time that gigs were claimed and completed; worker ID; and GIS longitude/latitude coordinates when data were uploaded. Workers could submit comments/questions, which we addressed throughout data collection.

Analysis

Data were exported from Gigwalk and linked with the trained collectors' data at the store level. Using Stata 12.0, we computed percent agreement and Cohen's κ statistics.¹⁶ We interpreted κ values as follows: <0 *poor*, 0–0.20 *slight*, 0.21–0.40 *fair*, 0.41–0.60 *moderate*, 0.61–0.80 *substantial* and 0.81–1 *almost perfect agreement*.¹⁷ The proportions of positive and negative agreements are also reported as κ statistics do not take into account prevalence of the attribute and bias.¹⁸ Photos were downloaded and reviewed by a coauthor (AJL) and a research assistant to validate that e-cigarettes and exterior advertisements were present. Any questions were resolved by the primary author (AEK).

RESULTS

Of the 194 jobs posted online, 78.3% were initiated and 72.2% (n=140) were completed. Of the 140 stores completed by crowdsourced workers, 31 were not completed by the trained data collectors. The total sample for comparison was 109 stores, 55 for the cigarette audit and 54 for the smokeless audit. Twenty-five crowdsourced workers completed an average of three audits (range 1–25 stores). The median time to complete the audit was 18.1 h within posting the job online.

Table 1 summarises agreement between crowdsourced and trained data collectors. There was substantial agreement on exterior cigarette advertisements (85.5%, $\kappa=0.71$, $p<0.01$) but only fair agreement on interior e-cigarette advertising (88.9% agreement, $\kappa=0.21$, $p=0.037$).

Crowdsourced and trained data collectors had overall high agreement on coding mail-in rebate (100%), free pack(s) with purchase (98.2%) and coupons (96.4%). However, κ was either zero or could not be computed because of either perfect agreement (ie, no variability) or low prevalence rate (ie, small cell sizes). There was moderate agreement for multipack discounts (87% agreement, $\kappa=0.46$, $p=0.000$) and poor agreement for sales offers (65.2% agreement, $\kappa=-0.06$, $p=0.837$).

When coding product availability, there was moderate agreement for snus (85.2% agreement, $\kappa=0.57$, $p<0.01$) and e-cigarettes (79.6% agreement, $\kappa=0.57$, $p<0.01$), but only fair agreement for flavoured e-cigarettes (73.2% agreement, $\kappa=0.35$, $p<0.01$). There was high agreement for dissolvables (92.6%), but κ was zero due to low prevalence rates.

Photos were examined to validate exterior advertisements and e-cigarette availability. Crowdsourced workers noted that 28 stores displayed exterior advertisements, whereas trained data collectors noted 30 stores. We reviewed the photos submitted by crowdsourced workers and confirmed that of the 28 stores, 27 had exterior advertisements, while one was mis-coded. We also examined the photos of other stores that crowdsourced workers classified as *not* having exterior advertisements and found that two stores did in fact have exterior advertisements. If these two stores had been coded correctly, the agreement between crowdsourced workers and trained surveyors would be higher. Crowdsourced workers noted that 23 stores sold e-cigarettes and photos were confirmed for 21 stores but 2 stores could not be verified because of low-quality photos. Trained surveyors noted e-cigarette availability in only 18 stores.

DISCUSSION

For most measures, we found high agreement between crowdsourced and trained data collectors. Agreement was lower for sales offers and interior advertisements, which can be challenging to code without the extensive training that field data collectors received. Due to limited resources, we did not have a gold standard for all measures. In this study, photos of e-cigarettes and exterior advertisements served to validate the presence but not the absence of products and advertising. We found that crowdsourced workers were more accurate than trained data collectors in coding e-cigarette availability. However, this may be due to some crowdsourced workers interacting with clerks (suggested in some photos where clerk was holding an e-cigarette) versus trained data collectors who collected data inconspicuously.

This study had several limitations. First, store environments could have changed between the time that crowdsourced and trained data collectors visited the same stores, which may explain some disagreements. Second, we could not directly compare the cost between the two approaches because the contractor that managed the data collection did not specify how much of the \$60 cost per store audit was for the trained data collector's wage versus overhead costs. Third, we were unable to examine whether factors like photo submission, GPS tracking, survey mode (phone app vs pen and paper) or procedure in store (collecting data inconspicuously vs interacting with clerks) may have influenced differences in the quality of data collected by crowdsourced versus trained workers. Fourth, we were unable to validate responses for all measures due to cost constraints. This is a general challenge for the field given that validity assessments were only reported in 6% of tobacco retail audit studies.⁴ Our results suggest that photos may be useful for assessing validity.

Crowdsourcing retail audits may have several benefits. First, data collection can be deployed quickly with minimal lead time providing rapid data to policymakers. Second, locals' familiarity with their neighbourhood could facilitate data collection. However, this could also be a potential hindrance if assessing retailers' compliance with regulations. Finally, because crowdsourced platforms like Gigwalk have an app that can be downloaded on mobile devices, researchers can easily collect photographs and geolocation data without having to build these capabilities. Photographs can serve as validity assessments or as data sources for coding.

In conclusion, crowdsourcing may be a viable option for collecting data on the tobacco retail environment. Future studies should systematically test other POS measures, crowdsourcing

Brief report

Table 1 Inter-rater reliability of POS measures collected by crowdsourced versus trained data collectors

Measure	Crowdsourced data collectors % (n)	Trained data collectors % (n)	%Agreement for present, absent % (n)	% Agreement overall, κ statistic, p value
Tobacco advertising				
Exterior cigarette advertising (N=55 stores)				
Present	50.9%, n=28	54.6%, n=30	86.2%, n=25	85.5%, $\kappa=0.71$, p=0.000
Absent	49.1%, n=27	45.4%, n=25	84.6%, n=22	
Interior e-cigarette advertising (N=54 stores)				
Present	3.7%, n=2	11.1%, n=6	25.0%, n=1	88.9%, $\kappa=0.21$, p=0.037
Absent	96.3%, n=52	88.9%, n=48	94.0%, n=47	
Tobacco promotions (N=55 stores)*				
Sale offer				
Present	29.1%, n=16	3.6%, n=2	0.0%, n=0	67.3%, $\kappa=-0.07$, p=0.822
Absent	70.9%, n=39	96.4%, n=53	80.4%, n=37	
Multipack discount				
Present	16.4%, n=9	10.9%, n=6	53.3%, n=4	87.3%, $\kappa=0.46$, p=0.000
Absent	83.6%, n=46	89.1%, n=49	92.6%, n=44	
Mail-in rebate				
Present	0.0%, n=0	0.0%, n=0	N/A	100.0%, $\kappa=N/A$, p=N/A
Absent	100.0%, n=55	100.0%, n=55	100.0%, n=55	
Coupon attached to pack				
Present	3.6%, n=2	0.0%, n=0	0.0%, n=0	96.4%, $\kappa=0.00$, p=N/A
Absent	96.4%, n=53	100.0%, n=55	98.2%, n=53	
Free pack(s) with purchase				
Present	1.8%, n=1	0.0%, n=0	0.0%, n=0	98.2%, $\kappa=0.00$, p=N/A
Absent	98.2%, n=54	100.0%, n=55	99.1%, n=54	
Product availability (N=54 stores)				
Store sells snus				
Present	22.2%, n=12	22.2%, n=12	66.7%, n=8	85.2%, $\kappa=0.57$, p=0.000
Absent	77.8%, n=42	77.8%, n=42	90.5%, n=38	
Store sells any brand of dissolvable (eg, Camel Orbs, Camel Sticks, Ariva)				
Present	7.4%, n=4	0.0%, n=0	0.0%, n=0	92.6%, $\kappa=0.00$, p=N/A
Absent	92.6%, n=50	100.0%, n=54	96.2%, n=50	
Store sells e-cigarettes				
Present	42.5%, n=23	33.3%, n=18	73.2%, n=15	79.6%, $\kappa=0.57$, p=0.000
Absent	57.5%, n=31	66.7%, n=36	83.6%, n=28	
Store sells flavoured e-cigarettes				
Present	37.0%, n=20	20.4%, n=11	51.6%, n=8	72.2%, $\kappa=0.34$, p=0.003
Absent	63.0%, n=34	79.6%, n=43	80.5%, n=31	

*Promotions were assessed for Marlboro cigarettes based on posted advertisements and display and not actual purchase. POS, point of sale.

platforms and quantify potential cost benefits so that we understand how crowdsourcing can be best leveraged for tobacco retail audits.

What this paper adds

- ▶ Ongoing surveillance of retail tobacco marketing is needed to inform research and regulatory practices. However, the traditional method of using trained field workers to conduct retail audits can be costly and requires substantial lead time for planning and implementation.
- ▶ The results of this study suggest that crowdsourcing may be a promising method for conducting tobacco retail audits. We found high agreement between untrained crowdsourced workers and trained data collectors for most point-of-sale measures.

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Contributors AEK conceptualised the study, oversaw study implementation and analysis, and drafted and revised the manuscript. AJL implemented the study and contributed to writing and revising the manuscript. DD conducted the analysis and contributed to writing and revising the manuscript.

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