Published in final edited form as:

Am J Health Behav. 2014 March ; 38(2): 161–169. doi:10.5993/AJHB.38.2.1.

Shelter Proximity and Affect among Homeless Smokers Making a Quit Attempt

Lorraine R. Reitzel, PhD [Associate Professor],

Department of Educational Psychology, College of Education, University of Houston, Houston, TX

Darla E. Kendzor, PhD [Assistant Professor],

Division of Health Promotion and Behavioral Sciences, University of Texas School of Public Health and The University of Texas Southwestern Harold C. Simmons Comprehensive Cancer, Dallas, TX

Nga Nguyen, MS [Senior Statistical Analyst],

Department of Biostatistics, The University of Texas MD Anderson Cancer Center, Houston, TX

Seann D. Regan, MA [GIS Analyst],

Department of Health Disparities Research, The University of Texas MD Anderson Cancer Center, Houston, TX

Kolawole S. Okuyemi, MD, MPH [Professor and Director],

Program in Health Disparities Research, University of Minnesota Medical School, Minneapolis, MN

Yessenia Castro, PhD [Assistant Professor],

School of Social Work, University of Texas at Austin, Austin, TX

David W. Wetter, PhD [Professor and Chair], and

Department of Health Disparities Research, The University of Texas MD Anderson Cancer Center, Houston, TX

Michael S. Businelle, PhD [Assistant Professor]

Division of Health Promotion and Behavioral Sciences, University of Texas School of Public Health and The University of Texas Southwestern Harold C. Simmons Comprehensive Cancer, Dallas, TX

Abstract

Objectives—To explore the associations between shelter proximity and real-time affect during a specific smoking quit attempt among 22 homeless adults.

Methods—Affect was measured via 485 smartphone-based Ecological Momentary Assessments randomly administered during the weeks immediately before and after the quit day, and proximity to the shelter was measured via GPS. Adjusted linear mixed model regressions examined associations between shelter proximity and affect.

Correspondence Dr Reitzel; reitzel_at_UH@comcast.net.

This work was completed while Lorraine R. Reitzel was an Assistant Professor in the Department of Health Disparities Research at The University of Texas MD Anderson Cancer Center, Houston, TX.

Michael S. Businelle is the senior author of this work.

Human Subjects Statement

The Institutional Review Boards at The University of Texas Health Science Center at Houston and The University of Texas MD Anderson Cancer Center approved this study. Written informed consent for all study procedures was obtained before data collection.

Conflict of Interest Statement

Authors have no competing interests pertaining to this research.

Results—Closer proximity to the shelter was associated with greater negative affect only during the post-quit attempt week ($p = .008$). All participants relapsed to smoking by one week post-quit attempt.

Conclusions—Among homeless smokers trying to quit, the shelter may be associated with unexpected negative affect/stress. Potential intervention applications are suggested.

Keywords

homeless; smokers; affect; geospatial

Between 2 and 3.5 million adults in the United States experience homelessness on an annual basis.¹ Smoking prevalence among the homeless is high, with some estimates suggesting that as many as 4 out of every 5 homeless adults are current smokers.^{2–8} In fact, any history of homelessness independently doubles the odds of being a current smoker after accounting for sociodemographic and behavioral health confounders.⁹ Moreover, some research suggests that homeless smokers may smoke more cigarettes per day than the general population of smokers,^{10,11} and that the experience of homelessness itself might be the catalyst for increasing cigarette consumption.¹² Consequently, smoking-related deaths are disproportionately high among the homeless.⁸ Therefore, smoking among the homeless represents a significant public health issue.

Estimates suggest that approximately one third of homeless smokers are interested in quitting smoking^{6,10} and would like professional help to assist with cessation.¹⁰ A national study indicated that the currently homeless do not differ from the formerly homeless or the never homeless with regard to past-year desire to quit smoking.⁹ Unfortunately, lifetime quit rates among the homeless are low³ – significantly lower than quit rates among smokers who have never experienced homelessness.⁹ Not unexpectedly, homeless smokers encounter numerous barriers that interfere with the ability to quit smoking and remain abstinent, including the acceptability of smoking among peers, the pervasiveness of smoking around homeless shelters,^{12–14} high rates of co-morbid substance use and mental illness,^{14–16} unpredictable daily routines,¹² and limited access to cessation services.¹² Although a few studies have focused on how to address smoking among the homeless more effectively,^{6,12,17–23} abstinence rates in effectiveness/efficacy studies generally have been low (eg, 13%–17.4% at 8 weeks post-quit,²⁰ 15.5% at 12 weeks post-quit,¹⁹ 5.6%–9.3% at 26 weeks post-quit²¹). Consequently, little is known about how best to intervene with homeless smokers to facilitate cessation, and more research is needed in this area.

There has been interest in understanding more about where homeless persons spend time²⁴ and travel²⁵ inasmuch as this information can help to inform policy and interventions to address the myriad of health outcomes experienced by this group. However, to our knowledge, no previous studies have assessed homeless smokers' daily travel to improve understanding of how it might be associated with experiences during a specific quit attempt. The smoker's proximity to the shelter during the course of the quit attempt might be of particular interest, as the shelter represents a particularly significant place for homeless smokers. For example, the transitional shelter is not only "home," but also the place where smoking cessation treatment services are commonly provided. Yet, the shelter also might represent the place where the risk of smoking relapse is highest given the prevalence of smoking on shelter grounds,¹⁴ the high availability of cigarettes from peers, and potential for increased social pressure to smoke in that setting.²⁶ Anecdotal evidence suggests that smokers often congregate outside of the shelter to smoke. Laboratory-based research suggests that places previously associated with smoking behaviors may evoke stronger withdrawal symptoms among smokers attempting to quit,^{27,28} which might include a greater array of affective symptoms. Consequently, smokers' proximity to a shelter during a quit

attempt might be associated with a myriad of (potentially mixed) emotions, including negative affect, which is a robust predictor of smoking relapse.^{29,30} Understanding more about associations between homeless smokers' daily travel relative to the shelter and their emotions may help to inform interventions to address smoking among this vulnerable and underserved population.

Because affect is a state-dependent variable, known to fluctuate in-the-moment in response to environmental, social, and physiological events, it is difficult to capture accurately using questionnaire-based measures assessed at a later time point because of retrospective recall errors. Ecological Momentary Assessment (EMA) is an innovative method developed for real-time data collection that entails repeatedly administering assessments throughout the day at random or scheduled times, typically via a smartphone or other handheld device.³¹ EMA allows comparatively more ecologically valid data collection for time-varying constructs such as smokers' affect during a quit attempt,³¹ and has improved the field's understanding of smokers' cognitions, emotions, and behaviors at the time of their occurrence in the natural environment.³² Although EMA has been applied to understand the role of affect better in the context of a smoking cessation quit attempt among diverse populations of smokers, it has not been used previously with homeless smokers, who are likely to face unique daily challenges that distinguish them from other groups of smokers attempting to quit.

The purpose of this study was to explore how proximity to the shelter was associated with real-time affect as measured by EMA in the weeks immediately before and after an aided quit attempt among homeless smokers who resided there and received cessation intervention on-site, while controlling for demographics, objective indicators of socioeconomic status (eg, income, education), tobacco dependence, and daily smoking status. Although smoking was not allowed inside this shelter, it was permitted outside the building on the shelter campus without restriction.

METHODS

Study Setting and Recruitment

Data were collected as part of a parent study focused on identifying the barriers to smoking cessation and the predictors of smoking relapse among homeless smokers. Targeted smokers were residents of a homeless transitional shelter in downtown Dallas, TX. Participants were recruited through an established smoking cessation program at the shelter, prior to receiving any intervention. Specifically, study staff (the senior author) briefly presented an overview of the study at the beginning of each smoking cessation clinic group session. Following the cessation session, those who were interested in learning more about the study were asked to go upstairs (to the data collection room) where the study staff could provide further details about the study. Afterwards, interested individuals provided informed consent and were screened for study inclusion criteria. Participants were required to be 18 years of age, English-speaking, literate at 7th grade level (score of 45 on the Rapid Estimate of Adult Literacy in Medicine), willing to quit smoking a week following their initial visit, have an expired carbon monoxide level of 8 ppm (suggestive of current smoking), self-report current smoking of 5 cigarettes per day, and willing to attend the 6 required in-person study visits.

A total of 57 smokers were enrolled in the parent study between January and October of 2012; however, the analyzable sample was limited to 22 participants due to missing geo-location and covariate data. All participants received usual care for smoking cessation treatment as part of the parent study, which consisted of weekly group cessation counseling sessions lasting approximately 40 minutes each that were consistent with national

guidelines.³³ The cessation counseling sessions were led by a therapist, and provided at the shelter. In addition, participants also could obtain pharmacological interventions for smoking cessation if prescribed by the on-site physician. Cessation counseling sessions coincided with weekly study visits from one week pre-quit (eg, one week before the assigned quit day) through 4 weeks post-quit (eg, 4 weeks following the assigned quit day).

Data Collection Procedures

Participants completed survey assessments for the parent project immediately following the one week pre-quit counseling session, and immediately before the quit day, one week post-quit, and 4 weeks post-quit counseling sessions. Survey questionnaires were completed using a computer-administered, self-report format whereby participants heard questions on headphones generated by a computerized program and entered their responses directly on a laptop or tablet computer. Participants were compensated for the time and effort involved in survey data collection with \$20–\$30 Wal-Mart gift cards at each survey assessment visit. In addition, participants provided self-report information about their smoking status at each of the post-quit visits, as well as carbon monoxide readings to verify self-reported abstinence status.

EMA data were collected on a LG Optimus Android smartphone (model LG-P509) from one week pre-quit through one week post-quit. At the one week pre-quit visit, participants were individually trained by research staff (~5–10 minutes) to use the touch screen smartphone and practiced completing mock EMA assessments. Participants also were given written instructions to take with them. They were asked to keep the phone turned on, to carry it with them at all times, and to charge the phone each night. The EMA protocol included 4 random assessments and one diary assessment each day. The random assessments were pushed to participants at random times during the day, and personalized based on previously provided information about their typical waking hours. Because of the time of day that participants first received the smartphones in the study protocol, there were technically 6 pre-quit days and 7 post-quit days during which the participants were pushed random assessments. Random assessments were signaled with 30 seconds of auditory and visual cues, which would be repeated up to 3 times before the assessment was counted as missed. Random assessments could be delayed up to 3 times for 5 minutes each if the participant was unable to answer immediately. The daily diary was pushed each morning 30 minutes after each participant's self-reported waking time, with all items on this assessment referring to the previous day. Compliance with these 5 daily EMAs was incentivized with up to \$80 in gift cards based on the proportion of assessments completed. In addition, participants were each allotted up to 400 minutes of cell phone time and 400 text messages to use while they had the smartphone.

The smartphone was programmed to collect latitude-longitude data via an internal Global Positioning System (GPS) chip at the time the random assessment was prompted (ie, the “beep” to alert the participant) until the participant began to answer EMA items. GPS data collection was integrated into the EMA programming, and could not be altered (turned on or off) by the participants themselves. The acquisition of this geo-location data at each EMA was dependent upon whether the geo-location capture period was sufficient to acquire positional information via satellites. The integrated GPS chip used in this study (Qualcomm chipset with GPS model # MAM7227) was capable of assisted-GPS to improve signal accuracy in areas without direct line of sight to the sky via the integration of GPS fixes, cell phone triangulation, and orbital data to map satellite locations. Nevertheless, terrestrial interference and other geo-location errors (eg, inability to get a fix within certain buildings) may have contributed to missing geo-location data for some assessments, as may have the EMA programming rule to acquire positional information only until the participant began answering the EMA items.

The EMA and geo-location data were stored on a secure digital card within the smartphone and downloaded at the one week post-quit visit. The current study analyzed questionnaire, EMA, and smoking status data collected from one week pre-quit through one week post-quit, the timeframe during which the EMA and GPS data were collected.

Variables of Interest

Sociodemographics—Sociodemographics collected one week pre-quit included age, sex, race, income, and educational level. These variables were included as covariates in analyses. In addition, the self-reported number of months of lifetime homelessness was collected to describe the sample.

Tobacco dependence—Tobacco dependence was assessed one week pre-quit using the Heaviness of Smoking Index (HSI), which was calculated from the number of cigarettes smoked per day and the time to the first cigarette of the day.^{34,35} Scores on the HSI could range from 0 to 6. The HSI is a widely-used indicator of tobacco dependence that is strongly associated with quitting,^{34,35} and was included as a covariate in analyses. In addition, the number of years participants smoked and the number of previous quit attempts were collected to describe the sample.

Real-time affect—Participants were asked to indicate their level of agreement with the following 10 affect statements at each random assessment: (1) I feel irritable, (2) I feel happy, (3) I feel frustrated/angry, (4) I feel sad, (5) I feel worried, (6) I feel miserable, (7) I feel restless, (8) I feel stressed, (9) I feel hostile, and (10) I feel calm. These items reflect the circumplex model of affect.³⁶ For each affect statement, participants were directed to “Mark the response that most applies to you RIGHT NOW,” with the following response options: (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree. Each item was analyzed separately; however, items 1, 3, 4, 5, and 6 also were added together and divided by 5 to create an overall “negative affect” variable, as consistent with prior EMA studies.³⁷

Proximity to the shelter—The proximity of each participant to the shelter at the time of each completed EMA was calculated based on collected geo-location data using the Spider Diagram Tools Arc-Script for ArcGIS version 10 (ESRI, Redlands, CA) and the Python programming language version 2.7. ArcGIS is a platform for geographic/spatial data processing, management, and analysis. Python is an open source object-oriented programming language. Proximity was measured using Euclidean distance (“as the crow flies”), with higher values indicative of greater distance (in miles) from the shelter.

Daily smoking status—Post-quit daily smoking status was included as a covariate in the post-quit analyses. Post-quit daily smoking status was based on participants’ response to a daily diary EMA item reading: “How many cigarettes did you smoke yesterday?” Participants self-reporting any cigarettes smoked were classified as “smoking” for the previous day, whereas those self-reporting no cigarettes smoked were classified as “abstinent.” Because there was no daily diary assessment reflecting smoking status on the final day of EMA data collection, post-quit week one smoking status was used in place of the daily diary item for that day.

Post-quit week one smoking status—Biochemically verified smoking status was assessed at the week one post-quit visit. Abstinence from smoking was defined as a self-report of no cigarettes smoked over the previous 7 days (not even a puff) and an expired carbon monoxide level of <8 parts per million.

Data Analyses

All analyses were performed using Statistical Analysis Software version 9.3 (SAS Institute, Cary, NC). Preliminary analyses first explored differences between included (N = 22) and excluded (N = 35) participants with regard to sociodemographics, tobacco dependence, and participant-level mean affect endorsements using chi-square tests and t-tests. Next, differences in participant-level mean affect endorsements during the pre- versus post-quit week were explored among the 22 included participants using repeated measure ANOVAs.

Main analyses examined the associations between proximity to the shelter and real-time affect during the pre- and post-quit weeks, respectively, using linear mixed model regressions. Pre-quit analyses were adjusted for age, sex, race, income, educational level, and tobacco dependence. Post-quit analyses additionally controlled for daily post-quit smoking status. The linear mixed model regressions (PROC MIXED)³⁸ accounted for the structure of the data, whereby assessments were nested within days nested within participants.³⁹

RESULTS

EMA Compliance and Geo-Location Availability

The 22 participants included in this study generated 443 random assessments during the pre-quit week and 515 random assessments during the post-quit week. This represented a pre-quit EMA compliance rate of 83.9% (22×4 daily random assessments $\times$ 6 days of collection = 528, $443/528 = 83.9\%$) and a post-quit EMA compliance rate of 83.6% (22×4 daily random assessments $\times$ 7 days of collection = 616, $515/616 = 83.6\%$). Of these random assessments, 42% (N = 222) in the pre-quit week and 44% (N = 271) in the post-quit week had valid geo-location data. The within-participant number of assessments with geo-location data ranged from 1 to 21 (mean = 10.1 ± 5.6) in the pre-quit week and from 1 to 26 (mean = 12.3 ± 7.6) in the post-quit week. This was equivalent to a within-participant proportion of 6.7% to 100% of completed pre-quit assessments with geo-location data (mean = 50.1 ± 27.6), and 4% to 92.9% of completed post-quit assessments with geo-location data (mean = 52.2 ± 29.8). Please note that 6 pre-quit assessments and 2 post-quit assessments with valid geo-location data were missing EMA variables of interest in this study, resulting in a total of 216 pre-quit and 269 post-quit assessments remaining for analyses.

Participant Characteristics

Participants (N = 22; 50% African American) were 51.1 (± 7.6) years of age on average. Participants endorsed smoking for an average of 30.0 (± 13.1) years, and reported that they usually smoked 20.8 (± 11.1) cigarettes on a typical day. About 27% of participants (N = 6) smoked their first cigarette within the first 5 minutes of waking. Participants reported an average of 3.1 (± 2.7) previous quit attempts (with abstinence lasting at least 24 hours). Participants reported an average of 29.2 (± 31.3) months of homelessness in their lifetimes, with a range of 4–132. Participant characteristics are in Table 1. On average, participants were within .93 ($\pm .3$) miles of the shelter when completing pre-quit random assessments and within .95 ($\pm .3$) miles of the shelter when completing post-quit random assessments. None of the 22 participants included in these analyses were biochemically-verified abstinent at the one week post-quit visit.

Preliminary Analyses

Results indicated no significant differences between included participants (ie, those with geo-location data, N = 22) and excluded participants (ie, those with no geo-location data, N = 35) on sociodemographics, tobacco dependence, or participant-level averages of real-time affect.

There was, however, a single significant difference amongst the included participants ($N = 22$) with regard to participant-level mean affect endorsements between the pre-quit compared to the post-quit week. Specifically, participants endorsed significantly less happiness during the post-quit week than they did during the pre-quit week. The results of the participant-level mean affect comparisons during the pre- and post-quit weeks are in Table 2.

Main Analyses

In the pre-quit week, there were no significant associations between proximity to the shelter and happiness, frustration/anger, sadness, worry, misery, restlessness, stress, hostility, calmness, or overall negative affect. However, proximity to the shelter was significantly associated with irritability, such that the closer the participant was to the shelter the less irritability they reported [$\beta = .05$ (.02), $p = .050$; N (hereafter, number of observations) = 216] in covariate-adjusted analyses.

In the post-quit week, there were no significant associations between proximity to the shelter and happiness, sadness, misery, or hostility. However, proximity to the shelter was significantly associated with irritability [$\beta = -.06$ (.02), $p = .003$], frustration/anger [$\beta = -.04$ (.02), $p = .031$], restlessness [$\beta = -.06$ (.02), $p = .006$], stress [$\beta = -.06$ (.02), $p = .004$], and overall negative affect [$\beta = -.04$ (.01), $p = .008$; all N s = 269]. Specifically, results indicated that the closer the participant was to the shelter, the greater their reported irritability, frustration/anger, restlessness, stress, and negative affect. In addition, associations between proximity to the shelter and worry and calmness were marginally significant [p values = .073 – .074], such that closer proximity to the shelter was marginally associated with greater self-reported worry and less calmness. Table 3 displays all results in detail.

DISCUSSION

The current study was the first, to our knowledge, to assess relationships between shelter proximity and real-time affect before and after a specific aided quit attempt among homeless smokers. Results suggest that participants experienced less irritability when closer to the shelter, but otherwise general emotional equivalence regardless of shelter proximity, during the week before the quit attempt. However, during the post-quit week, closer proximity to the shelter was associated with more irritability, frustration/anger, restlessness, stress, and overall negative affect even accounting for the influence of sociodemographics, tobacco dependence, and daily smoking status.

Although fewer than half of participants in this study self-reported days without smoking cigarettes during the first 6 days post-quit, all had relapsed by one week post-quit. It is possible that proximity to the shelter cued negative affect and stress (ie, withdrawal symptoms) among these struggling would-be quitters in the post-quit week due to the increased exposure to cigarettes and other smoking cues nearby (eg, prevalence of smoking on the shelter campus, high availability of cigarettes), or because of previously established associations between the shelter and smoking behavior.^{27,28} Alternatively, the observed association between shelter proximity and negative affect and stress in the post-quit week may have been related to disappointment and reduced self-efficacy (due to post-quit smoking lapses/relapse), embarrassment (associated with facing treatment personnel and possibly staff and peers who supported the quit attempt), and/or a lack of perceived control over quitting. These variables were not directly assessed in this study, but are worthy of future study as potential mechanisms that may underlie the relationship between shelter proximity and negative affect during a specific quit attempt. Each of these potential mechanisms might be addressed in cessation interventions. For example, smokers might be informed that shelter-related smoking cues may seem especially prominent after the quit

day,⁴⁰ and may engender spikes in affective withdrawal symptoms. Smokers should be prepared to anticipate and cope with these reactions, as well as with potential experiences of disappointment, embarrassment, and loss of control. In addition, it might be helpful for shelters to provide smokers with additional activities (eg, specialized programming availability focused on art, journaling, Bible studies, or other stress relieving activities) during the initial weeks following the quit attempt given prior research suggesting that quitting smoking may free up a considerable amount of time and also potentially lead to a decrease in social interaction.¹² Creating specific positive activities at the shelter might also help to dissociate feelings of negative affect with the shelter environment during this period.

Abstinence rates in the current sample (0 of 22 abstinent at one week post-quit) were low compared to previous research among homeless adults (eg, 13%–17.4% at 8 weeks post-quit,²⁰ 15.5% at 12 weeks post-quit,¹⁹ 5.6%–9.3% at 26 weeks post-quit²¹), even though study participants had access to both cessation counseling and pharmacotherapy at the shelter. Available data indicate that low rates of counseling attendance (eg, 5 of 22 participants attended counseling on the quit day and 2 of 22 attended counseling on the one week post-quit visit) and pharmacotherapy use and compliance might have undermined cessation for this group. Although not directly assessed in this study, it is possible that the negative affect associated with the shelter might have interfered with participants' willingness to (return to the shelter and) comply with recommended treatment. Because the availability of cessation services comes at an expense (ie, clinician availability to hold cessation groups or prescribe/dispense medications), results suggest the importance of normalizing lapses (ie, emphasizing the high likelihood of lapses) and preparing participants to expect and cope with the negative affect they might experience when exposed to the shelter environment during this critical time. Any efforts made in this regard may contribute to the likelihood of the smokers' willingness to participate in post-quit cessation services at the shelter. Shelter clinicians and administrators are encouraged to think creatively about how to help smokers attempting to quit cope better with this negative affect, which might include policy changes that disallow smoking around the perimeter of the shelter.⁴¹ Research suggests that homeless smokers may be exposed to 10 times as many smokers on a daily basis compared with other economically disadvantaged but domiciled smokers, and many of these exposures likely occur in close proximity to the shelter grounds.¹⁴ In addition, it is also possible that the standard of care for smoking cessation may not be effective for homeless smokers. New approaches that integrate peer support into cessation intervention sessions/groups might be beneficial, given previous research indicating that knowing 5 quitters was associated with greater odds of achieving smoking abstinence among homeless smokers.²⁴ Previous research suggests that former homeless smokers might be particularly willing to assist in this regard.²² Offering more frequent cessation counseling/support groups also might be considered.

The current study was innovative in its methods, which paired EMA to assess real-time affect among homeless smokers with associated geo-location coordinates. Limitations of the approach include the high prevalence of missing geo-location data, which contributed to the exclusion of 35 potential participants and the unequal contribution of assessments with geo-location data among the included participants. Technical difficulties with the program designed to capture and record geo-location data in this study contributed to missingness, as the program searched for geo-location data for only a limited timeframe between the cueing of the assessment and the first EMA response. Therefore, missing geo-location data may not be missing at random, and collected geo-location data may not be representative of participants' daily travels to and from the shelter. Consequently, results of this study are preliminary in nature and require replication. In addition, the extent to which any null results were attributable to missing geo-location data is unknown. Future studies should include the collection of more continuous geo-location data to facilitate imputation of any missing

positional data. Other limitations include potential geo-location error (positional inaccuracy). Sources of geo-location error from consumer grade devices such as the cellular phone GPS chipsets used in this study typically include satellite signal loss, atmospheric conditions, and interference from terrestrial objects (multipath error⁴²). However, geo-location data were estimated at 90% accurate to within 20 meters based on testing on similar hardware using a known geodetic point.

This study benefitted from a focus on an understudied and underserved population at exceedingly high risk of smoking-related health disparities, the ability to control for numerous covariates, and the biochemical verification of smoking abstinence. These strengths are balanced by additional limitations, which include the small sample size, the inclusion of only sheltered homeless, and lack of variability among participants in their ability to achieve abstinence at one week post-quit. Consequently, results may not generalize to homeless adults who are not in transitional shelters or to smokers who are able to achieve post-quit abstinence. Future studies in this area should include a larger sample to achieve greater diversity in cessation outcomes. In addition, the recruitment of smokers from multiple homeless shelters would be helpful to increase the generalizability of results. Also, it is unknown whether associations between proximity to the shelter and negative affect might persist beyond one week post-quit, which might be addressed in future studies with a longer duration of post-quit EMA.

In summary, cigarette smoking is a major public health problem among the homeless and little is known about how to intervene effectively to facilitate cessation among this population. The current study was the first to combine EMA and geo-location to understand how shelter proximity was associated with affect during the weeks immediately before and after a smoking quit attempt. Results indicated that, among homeless smokers unsuccessfully trying to quit, closer proximity to the shelter was associated with greater negative affect and stress during the first week of a quit attempt. Results of this exploratory study are in need of replication, but findings inspire intriguing ideas for modifying current practices. For example, shelter clinicians and administrators might consider how they could attenuate the link between shelter proximity and negative affect/stress during the early phase of a quit attempt, which might include specifically preparing smokers to handle potentially unexpected negative affect/stress associated with the shelter in the post-quit period, normalizing smoking lapses, encouraging repeated quit attempts, integrating former homeless smokers into cessation programming, temporarily increasing other shelter activity programming, and disallowing smoking within and around the perimeter of the shelter.

Acknowledgments

Funding for this research was provided by the University of Texas Health Science Center, School of Public Health in the form of a PILOT grant (to M.S. Businelle) and start-up funds (to M.S. Businelle and D.E. Kendzor). Data analysis and manuscript preparation were additionally supported through grant MRSMT-10-104-01-CPPHS (to D.E. Kendzor) and MRSMT-12-114-01-CPPB (to M.S. Businelle) awarded by the American Cancer Society, the National Institutes of Health through MD Anderson's Cancer Center Support Grant (CA016672), as well as by faculty incentive funds (to L.R. Reitzel) as provided by The University of Texas MD Anderson Cancer Center. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the sponsoring organizations.

REFERENCES

1. Burt, MR.; Aron, LY.; Lee, E.; Valente, J. Helping America's Homeless: Emergency Shelter or Affordable Housing?. Washington, DC: Urban Institute; 2001. p. 23-54.
2. Baggett TP, Anderson R, Freyder PJ, et al. Addressing tobacco use in homeless populations: a survey of health care professionals. *J Health Care Poor Underserved*. 2012; 23(4):1650–1659. [PubMed: 23698679]

3. Baggett TP, Rigotti NA. Cigarette smoking and advice to quit in a national sample of homeless adults. *Am J Prev Med.* 2010; 39(2):164–172. [PubMed: 20621264]
4. Sachs-Ericsson N, Wise E, Debrody CP, Paniucki HB. Health problems and service utilization in the homeless. *J Health Care Poor Underserved.* 1999; 10(4):443–452. [PubMed: 10581887]
5. Lee TC, Hanlon JG, Ben-David J, et al. Risk factors for cardiovascular disease in homeless adults. *Circulation.* 2005; 111(20):2629–2635. [PubMed: 15897342]
6. Connor SE, Cook RL, Herbert MI, et al. Smoking cessation in a homeless population: there is a will, but is there a way? *J Gen Intern Med.* 2002; 17(5):369–372. [PubMed: 12047734]
7. Szerlip MI, Szerlip HM. Identification of cardiovascular risk factors in homeless adults. *Am J Med Sci.* 2002; 324(5):243–246. [PubMed: 12449444]
8. Snyder LD, Eisner MD. Obstructive lung disease among the urban homeless. *Chest.* 2004; 125(5):1719–1725. [PubMed: 15136382]
9. Baggett TP, Lebrun-Harris LA, Rigotti N. Homelessness, cigarette smoking, and desire to quit: results from a U.S. national study. *Addiction.* In press.
10. Arnsten JH, Reid K, Bierer M, Rigotti N. Smoking behavior and interest in quitting among homeless smokers. *Addict Behav.* 2004; 29(6):1155–1161. [PubMed: 15236817]
11. Butler J, Okuyemi KS, Jean S, et al. Smoking characteristics of a homeless population. *Subst Abus.* 2002; 23(4):223–231. [PubMed: 12438835]
12. Okuyemi KS, Caldwell AR, Thomas JL, et al. Homelessness and smoking cessation: insights from focus groups. *Nicotine Tob Res.* 2006; 8(2):287–296. [PubMed: 16766421]
13. Arangua L, McCarthy WJ, Moskowitz R, et al. Are homeless transitional shelters receptive to environmental tobacco control interventions? *Tob Control.* 2007; 16(2):143–144. [PubMed: 17400954]
14. Businelle MS, Cuate E, Kesh A, et al. Comparing homeless smokers to economically disadvantaged domiciled smokers. *Am J Public Health.* In press.
15. North CS, Eyrich-Garg KM, Pollio DE, Thirthalli J. A prospective study of substance use and housing stability in a homeless population. *Soc Psychiatry Psychiatr Epidemiol.* 2010; 45(11):1055–1062. [PubMed: 19816646]
16. Okuyemi KS, Goldade K, Whembolua GL, et al. Smoking characteristics and comorbidities in the power to quit randomized clinical trial for homeless smokers. *Nicotine Tob Res.* 2013; 15(1):22–28. [PubMed: 22589422]
17. Spector A, Alpert H, Karam-Hage M. Smoking cessation delivered by medical students is helpful to homeless population. *Acad Psychiatr.* 2007; 31(5):402–405.
18. Goldade K, Whembolua GL, Thomas J, et al. Designing a smoking cessation intervention for the unique needs of homeless persons: a community-based randomized clinical trial. *Clinical Trials.* 2011; 8(6):744–754. [PubMed: 22167112]
19. Shelley D, Cantrell J, Wong S, Warn D. Smoking cessation among sheltered homeless: a pilot. *Am J Health Behav.* 2010; 34(5):544–552. [PubMed: 20524884]
20. Okuyemi KS, Thomas JL, Hall S, et al. Smoking cessation in homeless populations: a pilot clinical trial. *Nicotine Tob Res.* 2006; 8(5):689–699. [PubMed: 17008196]
21. Okuyemi KS, Goldade K, Whembolua GL, et al. Motivational interviewing to enhance nicotine patch treatment for smoking cessation among homeless smokers: a randomized controlled trial. *Addiction.* 2013; 108(6):1136–1144. [PubMed: 23510102]
22. Goldade K, Guo H, Jarlais DD, et al. Homeless former smokers' interest in helping homeless current smokers quit. *Am J Health Promot.* 2012; 27(2):90–93. [PubMed: 23113778]
23. Goldade K, Des Jarlais D, Everson-Rose SA, et al. Knowing quitters predicts smoking cessation in a homeless population. *Am J Health Behav.* In press.
24. Alexander-Eitzman B, Pollio DE, North CS. The neighborhood context of homelessness. *Am J Public Health.* 2013; 103(4):679–685. [PubMed: 23409889]
25. Parker RD, Dykema S. The reality of homeless mobility and implications for improving care. *J Community Health.* 2013 Mar 15. (Epub ahead of print).

26. Shiffman S, Gwaltney CJ, Balabanis MH, et al. Immediate antecedents of cigarette smoking: an analysis from ecological momentary assessment. *J Abnorm Psychol.* 2002; 111(4):531–545. [PubMed: 12428767]
27. Conklin CA, Robin N, Perkins KA, et al. Proximal versus distal cues to smoke: the effects of environments on smokers' cue-reactivity. *Exp Clin Psychopharmacol.* 2008; 16(3):207–214. [PubMed: 18540780]
28. Conklin CA, Perkins KA, Robin N, et al. Bringing the real world into the laboratory: personal smoking and nonsmoking environments. *Drug Alcohol Depend.* 2010; 111(1–2):58–63. [PubMed: 20510552]
29. Shiffman S. Dynamic influences on smoking relapse process. *J Pers.* 2005; 73(6):1715–1748. [PubMed: 16274451]
30. Shiffman S, Paty JA, Gnys M, et al. First lapses to smoking: within-subjects analysis of real-time reports. *J Consult Clin Psychol.* 1996; 64(2):366–379. [PubMed: 8871421]
31. Shiffman S. Ecological momentary Assessment (EMA) in studies of substance abuse. *Psychol Assess.* 2009; 21(4):486–497. [PubMed: 19947783]
32. Shiffman S, Stone AA, Hufford MR. Ecological momentary assessment. *Annu Rev Clin Psychol.* 2008; 4:1–32. [PubMed: 18509902]
33. Fiore, M.; Jaen, C.; Baker, T., et al. Treating Tobacco Use and Dependence: 2008 Update. Clinical Practice Guidelines. Rockville, MD: US Department of Health and Human Services. Public Health Service; 2008.
34. Borland R, Yong HH, O'Connor RJ, et al. The reliability and predictive validity of the Heaviness of Smoking Index and its two components: findings from the international tobacco control four country study. *Nicotine Tob Res.* 2010; 12(Suppl):S45–S50. [PubMed: 20889480]
35. Heatherton TF, Kozlowski LT, Frecker RC, et al. Measuring the heaviness of smoking: using self-reported time to the first cigarette of the day and number of cigarettes smoked per day. *Br J Addict.* 1989; 84(7):791–799. [PubMed: 2758152]
36. Russell J. A circumplex model of affect. *J Pers Soc Psychol.* 1980; 39(6):1161–1178.
37. Shiffman S, Kirchner TR. Cigarette-by-cigarette satisfaction during ad libitum smoking. *J Abnorm Psychol.* 2009; 118(2):348–359. [PubMed: 19413409]
38. Littell, RC.; Milliken, GA.; Stroup, WW., et al. SAS for Mixed Models. Cary, NC: SAS Institute, Inc; 2006.
39. Raudenbush, SW.; Bryk, AS. Hierarchical Linear Models: Applications and Data Analysis Methods. 2nd ed.. Newbury Park, CA: Sage; 2002.
40. Wertz JM, Sayette MA. Effects of smoking opportunity on attentional bias in smokers. *Psychol Addict Behav.* 2001; 15(3):268–271. [PubMed: 11563808]
41. Porter J, Houston L, Anderson RH, Maryman K. Addressing tobacco use in homeless populations: recommendations of an expert panel. *Health Promot Pract.* 2011; 12 Suppl 2(6):144S–151S. [PubMed: 22068577]
42. Wing MG, Eklund A, Kellogg LD. Consumer-grade global positioning system (GPS) accuracy and reliability. *J Forestry.* 2005; 103(4):169–173.

Table 1

Participant Characteristics (N = 22)

Variable	N(%) / M[SD]
Age	51.1 [7.6]
Sex	
Male	14 (63.6)
Female	8 (36.4)
Race	
African American	11 (50.0)
Not African American	11 (50.0)
Last month's income	
No income	10 (45.5)
\$500	6 (27.3)
>\$500	6 (27.3)
Education	
12 years of education	11 (50.0)
>12 years of education	11 (50.0)
Number of years smoked	30.0 [13.1]
Typical number of cigarettes smoked per day	20.8 [11.1]
Smoked within 5 minutes of waking	6 (27.3)
Number of previous quit attempts	3.1 [2.7]
Tobacco Dependence	3.0 [1.2]
Lifetime months of homelessness	29.3 [31.3]

Note.

Tobacco dependence was measured using the Heaviness of Smoking Index. M[SD] = mean [and standard deviation]

Table 2

Differences in Participant Level Mean Affect Endorsements during the Pre- vs. Post-Quit Week

Outcomes	Pre-Quit Week Estimate (StdErr)	Post-Quit Week Estimate (StdErr)	p value
Irritability	2.26 (0.20)	2.35 (0.20)	.576
Happiness	3.98 (0.14)	3.59 (0.14)	.022
Frustration/anger	2.16 (0.20)	2.33 (0.20)	.207
Sadness	2.05 (0.17)	2.16 (0.17)	.536
Worry	2.37 (0.22)	2.54 (0.22)	.188
Misery	2.16 (0.19)	2.21 (0.19)	.646
Restlessness	2.57 (0.24)	2.67 (0.24)	.592
Stress	2.58 (0.25)	2.74 (0.25)	.446
Hostility	1.93 (0.16)	1.93 (0.16)	.998
Calmness	3.69 (0.14)	3.63 (0.14)	.618
Negative affect	2.20 (0.17)	2.32 (0.17)	.288

Note.

Participant-level mean affect endorsements were calculated by first averaging responses within participants, and then between participants. Differences were assessed using unadjusted repeated measure ANOVAs. Because these analyses were unadjusted, the estimates presented represent the mean values for each affect item at the participant level.

Table 3

Linear Mixed Model Results of Associations Between Proximity to the Shelter and Real-Time Affect during the Pre- and Post-Quit Week

Outcomes	Pre-Quit Week (N = 216)		Post-Quit Week (N = 269)	
	Estimate (StdErr)	p value	Estimate (StdErr)	p value
Irritability	0.05 (0.03)	.050	−0.06 (0.02)	.003
Happiness	−0.02 (0.02)	.483	−0.01 (0.02)	.519
Frustration/anger	0.01 (0.03)	.841	−0.04 (0.02)	.031
Sadness	0.02 (0.02)	.355	−0.02 (0.02)	.211
Worry	0.00 (0.03)	.953	−0.04 (0.02)	.073
Misery	0.03 (0.03)	.382	−0.02 (0.02)	.314
Restlessness	0.00 (0.03)	.890	−0.06 (0.02)	.006
Stress	0.02 (0.03)	.560	−0.06 (0.02)	.004
Hostility	0.03 (0.03)	.265	−0.01 (0.02)	.662
Calmness	0.01 (0.03)	.721	0.03 (0.02)	.074
Negative affect	0.02 (0.02)	.240	−0.04 (0.01)	.008

Note.

Higher values for proximity to the shelter indicate a farther distance from the shelter (in miles) at the time of the assessment. All affect outcomes are coded such that higher values indicate stronger agreement with the associated affect statement. Pre-quit analyses were adjusted for age, sex, race, income, education, and tobacco dependence. Post-quit analyses were adjusted for age, sex, race, income, education, tobacco dependence, and daily smoking status.