

# Disparities in mental health outcomes among lung cancer survivors associated with ruralness of residence

Michael A. Andrykowski<sup>1\*</sup>, Rachel F. Steffens<sup>1</sup>, Heather M. Bush<sup>2</sup> and Thomas C. Tucker<sup>3</sup>

<sup>1</sup>Department of Behavioral Science, University of Kentucky College of Medicine, Lexington, KY, USA

<sup>2</sup>Department of Biostatistics, University of Kentucky College of Public Health, Lexington, KY, USA

<sup>3</sup>Department of Epidemiology, University of Kentucky College of Public Health, Lexington, KY, USA

\*Correspondence to:

Department of Behavioral Science, University of Kentucky College of Medicine, Lexington, KY 40536-0086, USA. E-mail: mandry@uky.edu

## Abstract

**Objective:** *Healthy People 2020* identifies elimination of health disparities as a key aim. Rural residence is associated with disparities in cancer screening, physical morbidity, and survival. The present study aimed to identify potential disparities in mental health (MH) outcomes (e.g., anxiety and depression symptoms, distress) in lung cancer (LC) survivors associated with ruralness of residence.

**Methods:** Lung cancer survivors (LC group;  $n = 193$ ; mean age = 63.1 years; mean time since diagnosis = 15.6 months) were recruited from the population-based SEER Kentucky Cancer Registry. LC survivors completed a telephone interview and questionnaire assessing MH outcomes. U.S. Department of Agriculture Rural–Urban Continuum Codes were used to identify Rural ( $n = 117$ ) and Urban ( $n = 76$ ) LC survivors. A healthy comparison (HC) group was recruited ( $n = 152$ ) and completed a questionnaire assessing MH outcomes.

**Results:** Across six MH indices, Rural LC survivors reported poorer MH relative to Urban LC survivors with a mean effect size (ES) of 0.43 SD in unadjusted analyses and 0.29 SD in analyses adjusted for education and physical comorbidity. Comparison of the LC and HC groups revealed significant Ruralness  $\times$  Group interactions for five of six MH indices. The Rural LC group reported poorer MH than the Rural HC group with a mean ES of 0.51 SD. The MH of Urban LC and HC groups did not differ (mean ES = 0.00 SD).

**Conclusions:** Rural residence is a risk factor for poorer MH outcomes for LC survivors. The MH of Rural LC survivors may be more negatively impacted by cancer diagnosis and treatment than the MH of Urban LC survivors.

Copyright © 2013 John Wiley & Sons, Ltd.

Received: 23 April 2013

Revised: 20 September 2013

Accepted: 4 October 2013

## Introduction

*Healthy People 2020* [1] proposes elimination of disparities in disease-related physical and mental health outcomes as a key aim of the nation's health agenda. While racial/ethnic disparities have been the focus of most cancer-related disparities research, health disparities can be associated with other population characteristics including gender, sexual orientation, age, or ruralness of residence. Rural residence has been associated with risk for colorectal, cervical, and breast cancers [2,3], and poorer survival following cancer diagnosis [4–6].

While cancer incidence and survival are important foci of disparities research, other endpoints merit attention. It is well established that cancer diagnosis and treatment are associated with stressors that can exert a profound impact upon the mental health (MH) of cancer survivors. Rural cancer survivors in particular may be at greater risk for poor MH outcomes such as anxiety and depression. Rural areas are characterized by low population density and geographic isolation. Consequently, access to health care, particularly MH services, can be limited in rural areas [7–9]. Rural survivors may avoid MH services

because of negative attitudes or stigma associated with MH services [10,11]. Internet access and use is lower in rural areas [12], limiting access to health information and support resources. Rural areas are also characterized by lower educational attainment and income [13], which can limit access to resources that could foster better MH. Rural survivors may also experience greater cancer-related fears [14] and greater stress associated with maintaining family and role responsibilities [15]. Finally, cancer survivors in rural areas may be less likely to have access to a supportive network of cancer survivors. In sum, characteristics associated with rural residence may interact with the experience of cancer diagnosis, treatment, and recovery to increase the stresses associated with the cancer experience all the while offering fewer formal and informal resources that might enhance survivors' ability to cope effectively with this stress [16]. Consequently, rural survivors may be at greater risk for poorer MH outcomes.

Scant research has examined disparities in MH outcomes among cancer survivors associated with rural residence. Most studies have reported no relationship between ruralness of residence and MH outcomes [17–22]. However, each of these studies suffers critical limitations including small

sample size (i.e., <60 cancer survivors) [17,21], examination of a limited set of MH indices [17–20,22], inclusion of only female survivors [18,19,21,22], and the lack of any objective, reproducible criterion for defining ruralness of residence [19,20].

Several recent studies support the hypothesis that rural survivors are at risk for poorer MH outcomes. Non-urban breast cancer survivors reported poorer emotional well-being and greater breast cancer-related concerns than urban survivors, with both urban and non-urban survivors reporting poorer emotional well-being than healthy controls [23]. Rural survivors of breast, colorectal, and hematologic cancers reported *poorer* status than nonrural survivors on a variety of MH indices [24]. Finally, rural survivors of a mixture of cancer diagnoses were more likely to report mild/moderate/serious distress than urban survivors [25]. In both of these latter two studies [24,25], ruralness of residence was categorized based on county of residence using 2003 USDA Rural–Urban Continuum codes [26].

While results were consistent with the hypothesis that rural residence is associated with poorer MH outcomes among cancer survivors, reports of poorer MH status may not be unique to rural cancer survivors. Rather, they may simply reflect a general tendency for rural residents to report poorer MH status. Studies of rural–nonrural differences in MH in the general population have yielded inconsistent results, leading to the conclusion that rural and nonrural residents do not differ in MH status [27,28]. However, inclusion of a non-cancer control group would be critically important to any test of the hypothesis that rural residence is associated with disparities in MH outcomes in cancer survivors.

The present study aims to identify disparities in cancer survivors' MH outcomes associated with rural residence. It extends earlier work in two ways. First and foremost, it includes a non-cancer comparison group to enable determination of whether observed differences in MH outcomes associated with ruralness of residence are unique to cancer survivors or simply reflect differences evident in the general population. Second, it focuses on survivors of non-small cell lung cancer (NSCLC), an understudied survivor subpopulation at particular risk for poor MH outcomes [29]. We hypothesize that rural residence will be associated with poorer MH outcomes among cancer survivors but not among non-cancer, comparison respondents.

## Methods

### Procedure

#### Eligibility criteria

Eligibility criteria for the lung cancer (LC) survivor group included the following: (i) >18 years; (ii) 10–15 months post-diagnosis of NSCLC; (iii) no other history of cancer diagnosis other than basal cell skin carcinoma; and (iv) able

to read and understand English. Survivors 10–15 months post-diagnosis were targeted for enrollment, as most LC survivors will have completed treatment by that time and be transitioning into the survivorship phase of the cancer trajectory, a stressful and challenging period [30]. Eligibility criteria for the healthy control (HC) group included the following: (i) >18 years; (ii) no history of cancer diagnosis other than basal cell skin carcinoma; and (iii) matched with a member of the LC group with regard to age ( $\pm 5$  years), sex, and county of residence.

#### Study recruitment

All procedures were approved by the University of Kentucky Institutional Review Board. NSCLC survivors were recruited from the population-based SEER Kentucky Cancer Registry (KCR). Participants were identified from KCR records using stratified sampling to ensure approximately equal numbers of male and female and rural and urban participants. KCR mailed a letter to the physicians of record to inform them that their patient was eligible for study. If the physician did not object to their patient's participation, KCR mailed an invitation letter to a survivor, including a return postcard to inform KCR of their participation interest. For survivors not returning this postcard, up to 10 telephone calls were made to the survivor's home to assess participation interest. KCR sent study staff contact information for survivors expressing interest in participation. Survivors were mailed an invitation letter, two copies of a consent form, and a stamped, pre-addressed return envelope. On return of a signed consent, a survivor was scheduled for a telephone interview and mailed a questionnaire packet with a stamped, pre-addressed return envelope. Study measures were divided between the interview and questionnaire, with both requiring 20–30 min to complete. Participants in the LC group were paid \$35 for completion of the interview and questionnaire.

As in prior research [31–33], participants in the HC group were recruited using a commercially available database (Marketing Systems Group, Inc., Washington, PA) that includes listed telephone households in the USA. Potential participants in the HC group were mailed a letter describing the study. Interested participants returned via stamped, pre-addressed envelope an information sheet indicating whether they had ever been diagnosed with cancer. If so, type of cancer was indicated. Eligible participants were mailed a study questionnaire, two copies of the consent form, and a pre-addressed stamped return envelope. Participants in the HC group were paid \$20 for completion of the questionnaire packet.

#### Determination of 'ruralness' of residence

Ruralness of residence was categorized based on county of residence using 2003 United States Department of Agriculture Rural–Urban Continuum (RUC) Codes [26]. RUC codes distinguish metropolitan counties (RUC codes

1–3) by the population size of their metropolitan area and nonmetropolitan counties (RUC codes 4–9) by population size and proximity to a metropolitan area. Consistent with prior research [25], participants residing in metropolitan counties (RUC codes of 1–3) comprised the ‘Urban’ group and respondents residing in nonmetropolitan counties (RUC codes 4–9) comprised the ‘Rural’ group.

## Study measures

### Demographic and clinical information

Birth date, race/ethnicity, education, health insurance status (yes vs. no), and partner status were obtained via self-report. Sex, diagnosis date, age and staging at diagnosis, RUC code, cytotoxic treatment, and smoking history (yes vs. never) was obtained from KCR records.

## Study measures

### Medical Outcomes Study 36-Item Short-Form Health Survey [34]

The Medical Outcomes Study (MOS) is a 36-item measure of health-related quality of life. Eight subscale scores are calculated including the 5-item Mental Health subscale (MOS-Mental Health), which was used in the present study. Higher scores indicate *better* status.

### Hospital Anxiety and Depression Scale [35]

The Hospital Anxiety and Depression Scale (HADS) is a 14-item measure of anxiety and depression symptom severity. Anxiety and Depression subscale scores are calculated along with a HADS-Total score. Higher scores suggest greater symptoms. HADS-Total scores  $\geq 15$  suggest clinically significant distress [36]. Coefficient alpha in the entire study sample was .87 and .85 for the Anxiety and Depression subscales, respectively.

### Distress Thermometer [37]

The Distress Thermometer (DT) is a single-item rating of recent distress on a scale from 0 (no distress) to 10 (extreme distress). DT ratings  $\geq 4$  suggest moderate to severe distress.

### Perceived Stress Scale [38]

The Perceived Stress Scale (PSS) is a 10-item measure of the extent to which life situations during the past month are perceived as stressful. A total score (PSS-Total) is calculated with higher scores representing greater stress. Coefficient alpha was .92.

### Physical comorbidity

Respondents were provided a list of nine medical conditions (hypertension, stroke, heart attack, emphysema, asthma, lower back pain, ulcer, diabetes, and arthritis) and asked, ‘have you ever been told by a doctor or other health

professional that you had\_\_\_\_\_.’ As in prior research, the number of ‘yes’ responses was summed to yield an index of lifetime physical comorbidity (range 0–9) [39,40].

## Data analysis

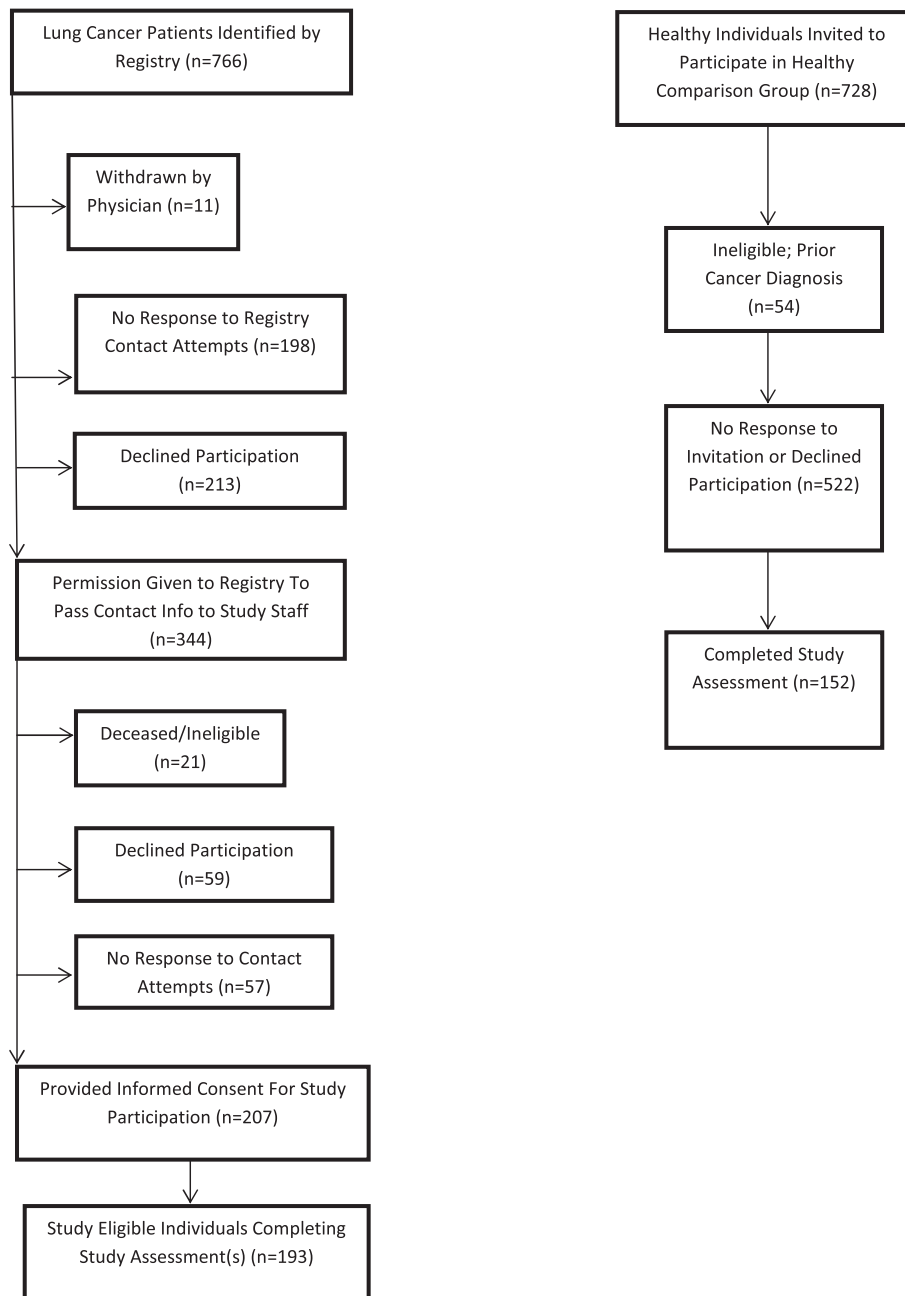
Statistical analyses were performed using the Statistical Package for the Social Sciences, Release 18.0 (SPSS Inc., Chicago, IL, USA). The criterion for statistical significance was  $p \leq .05$ .

Rural and Urban LC survivor groups were compared on demographic (age, education, sex, race/ethnicity, partner status, and health insurance status) and clinical (time since diagnosis, stage at diagnosis, treatment, physical comorbidity, and smoking history) variables. Variables for which significant differences existed were later used as covariates in adjusted analyses. The Rural and Urban LC groups were compared on six MH outcome indices (*DT rating*, *MOS-Mental Health*, *HADS-Depression*, *HADS-Anxiety*, *HADS-Total*, and *PSS-Total*) using independent samples *t*-test in unadjusted analyses and one-way ANCOVA in adjusted analyses. Effect size (ES) was calculated as the difference between group means divided by the standard deviation (SD) in the entire sample. Chi-square analysis compared the proportion of Rural and Urban LC survivors meeting criteria for clinically important distress (HADS) or moderate or severe distress (DT). Finally, the LC and HC groups were compared on demographic variables (age, education, sex, race/ethnicity, partner status, and health insurance status) and physical comorbidity. Variables with significant differences were used as covariates in Group (LC vs. HC)  $\times$  Ruralness (Rural vs. Urban) ANCOVA analyses using the same six MH outcome indices.

## Results

The Kentucky Cancer Registry identified 766 potential participants. No attempt was made to contact 11 because of lack of physician consent. Of the remaining 755 survivors, 411 did not provide permission to pass contact information to study staff (198 did not respond to repeated contact attempts by KCR and 213 indicated no interest in participation) (Figure 1.)

Of 344 survivors who gave permission to pass contact information to study staff, 21 died before consent was obtained or were ineligible because of poor health or diagnosis of a second cancer, 59 later declined participation, and 57 never responded to subsequent repeat contact attempts. The remaining 207 survivors provided consent. Of these, 194 provided data ( $n = 189$ , interview + questionnaire;  $n = 3$ , questionnaire;  $n = 2$ , interview). This represents a response rate of 26.4% (194/734) based on individuals for whom KCR initiated recruitment efforts ( $n = 755$ ) adjusted for individuals later found to be deceased or ineligible ( $n = 21$ ).



**Figure 1.** Flow chart of participant recruitment

The final LC group consisted of 193 respondents (one respondent was diagnosed with a second cancer prior to participation and was excluded). These 193 participants were compared with 411 individuals identified as study eligible but for whom permission to pass contact information to study staff was not obtained. These groups did not differ on age at diagnosis or ruralness of residence. However, nonparticipants were more likely to be male and have metastatic disease at diagnosis (both  $ps < .05$ ).

Lung cancer group participants were a mean of 63.1 years of age (SD=7.8 years; range 38–77 years)

and 15.6 months post-diagnosis (SD=2.3 months; range 11–22 months), with a mean of 11.8 years of education (SD=3.1 years; range 2–20). The majority were married or partnered ( $n=110$ ; 57%) and white, non-Hispanic ( $n=178$ ; 92%). Stage at diagnosis was localized ( $n=72$ ; 37%), regional ( $n=78$ ; 41%), metastatic ( $n=41$ ; 21%), or unknown ( $n=2$ ; 1%). The LC group consisted of 76 Urban and 117 Rural survivors. Urban and Rural LC survivors did not differ on sex, race/ethnicity, partner status, cytotoxic treatment, stage at diagnosis, age, time since diagnosis, health insurance status, or smoking history

(Table 1). Rural LC survivors, however, were significantly less educated ( $p < .01$ ) and reported more physical comorbidities ( $p < .05$ ) than Urban survivors.

Invitation letters were sent to 728 potential HC group participants. Fifty four reported a prior cancer diagnosis and were ineligible. Matches were obtained for 152 participants in the LC group, representing a 23% response rate from eligible individuals (152/674). These 152 respondents constituted the HC group (Figure 1). The HC and LC groups did not differ on sex, age, or race/ethnicity. However, the HC group was more educated (13.8 years vs. 11.8 years;  $p < .001$ ), more likely to be married/partnered (80% vs. 58%;  $p < .001$ ), and reported fewer physical comorbidities (2.2 vs. 3.2;  $p < .001$ ).

### Differences in mental health outcomes between rural and urban lung cancer survivors

#### Unadjusted analyses

Significant differences were found between the Rural and Urban groups for all six MH outcome indices (Table 2). In all instances, Rural LC survivors reported poorer MH status than Urban LC survivors. ES ranged from 0.30 SD (DT rating) to 0.54 SD (MOS-Mental Health) with a mean ES of 0.43 SD.

The proportion of LC survivors reporting clinically important distress (HADS-Total  $\geq 15$ ) or moderate or severe

distress (DT rating  $\geq 4$ ) was highest among Rural survivors. Specifically, 43% of Rural survivors reported clinically important distress on the HADS compared with 24% of Urban survivors ( $X^2 = 8.44$ ,  $p < .01$ ). Similarly, 60% of Rural survivors met criteria for moderate or severe distress on the DT compared with 43% of Urban survivors ( $X^2 = 4.82$ ;  $p < .05$ ).

#### Adjusted analyses

Adjusted for education and number of physical comorbidities, significant differences between the Rural and Urban LC survivor groups continued to be evident for three of the six MH outcome indices (MOS-Mental Health, HADS-Depression, and HADS-Total; all  $ps < .05$ ) (Table 2). For each of these three MH outcomes, Rural LC survivors reported poorer MH status than Urban LC survivors. ESs for these three MH outcomes ranged from 0.34 SD (MOS-Mental Health) to 0.40 SD (HADS-Depression). Across all six MH outcomes, the mean ES was 0.29 SD with the covariate-adjusted means indicating Rural survivors reporting poorer status than LC survivors on all six MH indices.

### Differences in mental health outcomes between rural and urban groups: lung cancer survivors versus healthy comparison respondents

To determine whether MH outcome differences between Rural and Urban respondents differed between the LC and HC groups, Group (LC vs. HC)  $\times$  Ruralness (Rural vs. Urban) ANCOVAs were performed. Covariates included education, partner status (partnered vs. unpartnered), and number of physical comorbidities. Dependent variables included the six MH outcome indices used in the previous analyses. A significant Group  $\times$  Ruralness interaction effect was evident for five of the six MH outcomes (MOS-Mental Health, HADS-Anxiety, HADS-Depression, HADS-Total, and PSS-Total) (Table 3). The interaction effect for the remaining MH outcome, DT rating, narrowly missed meeting the .05 criterion for statistical significance ( $p = .059$ ). Inspection of the covariate-adjusted means revealed that the differences between the LC and HC groups were most evident among Rural respondents. Across all six MH outcome indices, the mean difference between the LC and HC groups for Rural respondents was 0.51 SD with the LC survivors reporting poorer MH status than the HC comparison group for all six MH outcomes. In contrast, the mean difference between the LC and HC groups for Urban respondents was 0.00 SD. Figure 2 illustrates this pattern of results for two representative MH indices (MOS-Mental Health and HADS-Total).

### Discussion

Results support the hypothesis that ruralness of residence is associated with differences in MH outcomes among LC survivors. In general, LC survivors residing in rural counties reported poorer MH compared with LC survivors

**Table 1.** Demographic and clinical characteristics for Rural and Urban lung cancer survivors

	Rural (n = 117)	Urban (n = 76)	p-value <sup>a</sup>
Male	49%	45%	.588
White, non-Hispanic	93%	91%	.583
Married/partnered	56%	61%	.515
Treatment			
None	3%	4%	.110
Surgery	48%	37%	
Chemotherapy (CT)	4%	12%	
Radiotherapy (RT)	5%	1%	
CT + RT	13%	21%	
Surgery + CT	13%	10%	
Surgery + RT	1%	4%	
Surgery + RT + CT	13%	11%	
Stage at diagnosis			
Localized	34%	42%	.306
Regional	44%	34%	
Metastatic	20%	24%	
Unknown	2%	0%	
Smoking history			
Never	5%	7%	.695
Yes	90%	85%	
Unknown/not recorded	5%	8%	
Health insurance			
Yes	90%	95%	.272
No	10%	5%	
# physical comorbidities	3.4 (SD = 1.9)	2.9 (SD = 1.6)	.042
Education—years	11.0 (SD = 3.0)	12.9 (SD = 2.8)	<.001
Age at diagnosis—years	61.6 (SD = 7.6)	62.2 (SD = 8.2)	.626
Time since diagnosis—months	15.5 (SD = 2.4)	15.6 (SD = 2.1)	.977

<sup>a</sup>For t-test or  $X^2$ .

**Table 2.** Comparison of Rural and Urban lung cancer survivors on mental health outcome indices

	Rural	Urban	p-value <sup>a</sup>	Pooled SD <sup>b</sup>	ES <sup>c</sup>
	Mean (SD)	Mean (SD)			
DT rating					
Unadjusted	4.4 (3.0)	3.5 (2.9)	.050	3.0	0.30
Adjusted <sup>d</sup>	4.2	3.7	.242		0.17
MOS-Mental Health					
Unadjusted	61.8 (24.2)	74.3 (19.4)	<.001	23.2	0.54
Adjusted	63.8	71.7	.021		0.34
HADS-Depression					
Unadjusted	6.5 (4.1)	4.4 (3.5)	<.001	4.0	0.53
Adjusted	6.3	4.7	.009		0.40
HADS-Anxiety					
Unadjusted	7.5 (4.8)	5.8 (3.3)	.008	4.3	0.40
Adjusted	7.3	6.1	.073		0.28
HADS-Total					
Unadjusted	13.9 (8.1)	10.1 (6.3)	.001	7.7	0.49
Adjusted	13.6	10.8	.016		0.36
PSS-Total					
Unadjusted	15.5 (8.4)	12.6 (7.8)	.015	8.3	0.35
Adjusted	15.0	13.3	.178		0.20

DT, Distress Thermometer; MOS, Medical Outcomes Study; HADS, Hospital Anxiety and Depression Scale; PSS, Perceived Stress Scale.

<sup>a</sup>For t-test for unadjusted analyses; ANCOVA for adjusted analyses.

<sup>b</sup>For entire sample (n = 193).

<sup>c</sup>Effect size (ES), SD units.

<sup>d</sup>Adjusted for education, # physical comorbidities.

**Table 3.** Covariate-adjusted means for mental health outcome indices for Rural and Urban respondents from lung cancer (LC) and healthy comparison (HC) groups

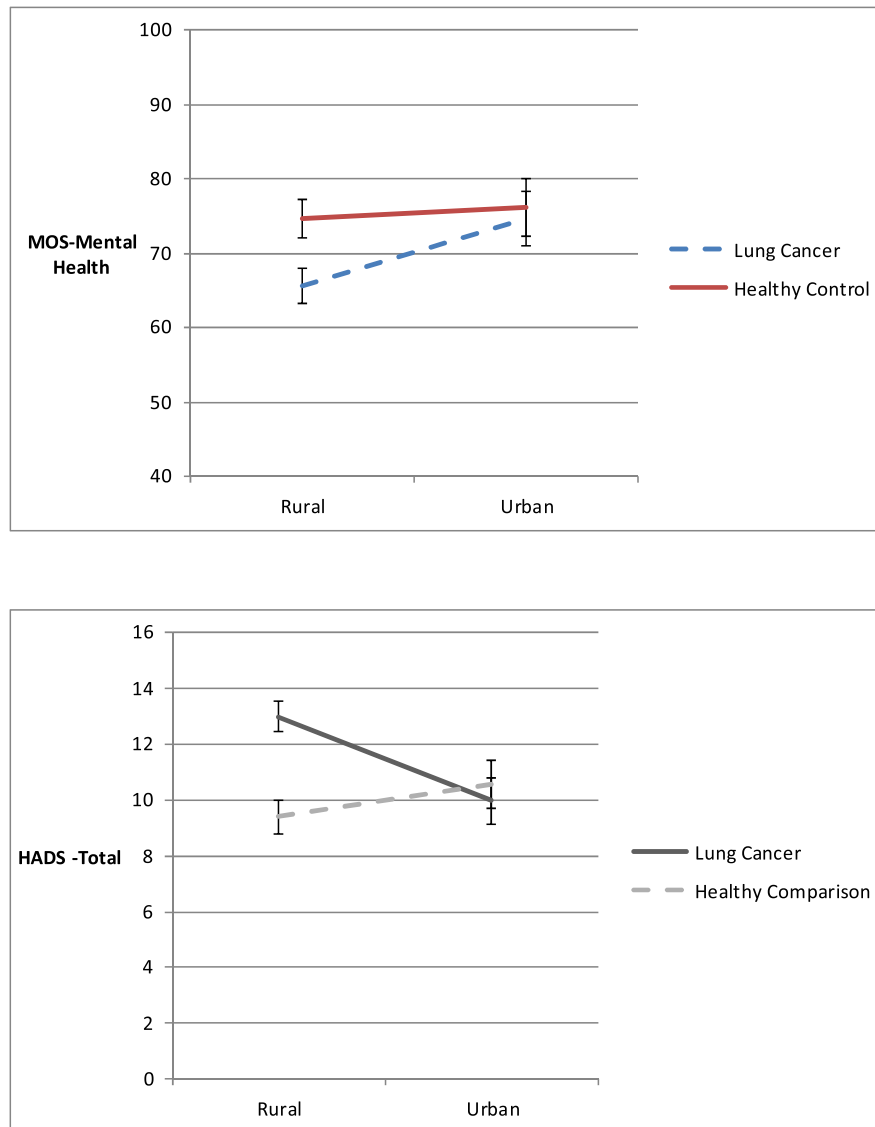
	Rural	Urban	Pooled SD <sup>a</sup>	Interaction p-value <sup>b</sup>
DT rating				
LC group	3.98	3.43	3.03	.059
HC group	2.12	2.75		
ES <sup>c</sup>	0.61	0.22		
MOS-Mental Health				
LC	65.57	74.69	22.22	.011
HC	78.51	76.19		
ES	0.60	0.07		
HADS-Depression				
LC	5.97	4.27	3.84	.023
HC	4.19	4.30		
ES	0.46	(-) 0.01		
HADS-Anxiety				
LC	7.07	5.70	4.10	.006
HC	5.22	6.26		
ES	0.45	(-) 0.14		
HADS-Total				
LC	13.04	9.97	7.27	.005
HC	9.41	10.56		
ES	0.50	(-) 0.08		
PSS-Total				
LC	14.39	12.40	8.43	.024
HC	10.82	12.90		
ES	0.42	(-) 0.06		
Mean ES	0.51	0.00		

DT, Distress Thermometer; MOS, Medical Outcomes Study; HADS, Hospital Anxiety and Depression Scale; PSS, Perceived Stress Scale.

<sup>a</sup>For entire sample (n = 345).

<sup>b</sup>p-value for Group x Rural-Urban interaction, controlling for education, partner status, and # of physical comorbidities.

<sup>c</sup>Effect size (ES), SD units.



**Figure 2.** Comparison of Rural and Urban respondents from the lung cancer and healthy comparison groups for two mental health outcome indices. MOS, Medical Outcomes Study; HADS, Hospital Anxiety and Depression Scale

residing in urban counties. In unadjusted analyses, mean ES comparing the Rural and Urban LC groups across six MH indices was 0.43 SD. Similar to previous research [24,25], adjustment for education and number of physical comorbidities preserved the pattern of poorer MH status among rural survivors but with a somewhat reduced ES. In adjusted analyses, mean ES comparing Rural and Urban survivors across all six MH indices was 0.29 SD. As ESs in the one-third to one-half SD range can be considered clinically important [41], observed differences between the Rural and Urban LC survivors groups are generally in the meaningful range, even when adjusted for covariates education and physical comorbidity.

Very importantly, this study extends previous research [23–25] by being the first to demonstrate that the differences in MH status in LC survivors associated with ruralness of

residence do not simply reflect similar differences in the general population. Inclusion of the HC group allowed testing of whether the relationship between ruralness of residence and MH status differed in the LC and HC groups. A significant Group  $\times$  Ruralness interaction was obtained for five of six MH outcome indices with the *p*-value for the remaining MH outcome narrowly missing the .05 criterion for significance. Importantly, *these are adjusted analyses*, controlling for differences in education, partner status, and physical comorbidity. Across all six MH outcome indices, differences between the LC and HC groups were quite pronounced (and in the clinically important range) for Rural respondents (mean ES = 0.51 SD), while essentially no differences existed between the LC and HC groups among Urban respondents (mean ES = .00 SD). While the cross-sectional design prevents causal attributions, our results are consistent with the

notion that the MH status of LC survivors from rural areas was more negatively impacted by the cancer experience compared with LC survivors from urban areas.

Why should this be? It has been suggested that MH outcomes in cancer survivors are determined by the stressfulness of a survivor's cancer experience and the resources available to cope with that stress [16]. Rural areas are characterized by poorer health care access, particularly MH care access [7–9]. Furthermore, rural survivors report less favorable attitudes and social norms regarding MH resource use [10,11]. Rural areas are characterized by less Internet access [12] and lower income and education [13], all resources that could foster better MH outcomes. Whether the cancer experience is inherently more stressful for rural survivors is more difficult to demonstrate. However, consistent with this notion, rural LC survivors in our study reported more perceived stress relative to urban survivors.

Study limitations are acknowledged. The sample was largely white, non-Hispanic, and recruited from a single state. The response rate was less than 50%. Thus, usual concerns regarding sample representativeness exist. In particular, scores on the HADS and MOS-Mental Health outcomes in our sample appear to be a bit worse than similar outcomes reported in previous research (e.g., [42–44]). However, straightforward comparison of the present study to earlier studies is difficult because of differences in the timing of assessment post-diagnosis and stage of disease. Consequently, whether the present study was biased toward inclusion of survivors with poorer MH outcomes is difficult to gauge. An additional limitation is the cross-sectional design. MH status was assessed at a single time point—on average, 15 months post-diagnosis. Whether differences in MH outcomes associated with ruralness of residence dissipate over time is unknown. The trajectory

of disparities in MH outcomes associated with ruralness of residence is an important research question and would require a longitudinal design to address.

In conclusion, evidence is accumulating, suggesting that rural residence may place cancer survivors at risk for poorer MH outcomes [23–25]. While differences between rural and urban survivors in education and physical comorbidity contributed to this disparity, they did not completely account for it. No differences existed between the Rural and Urban groups with regard to smoking history and possession of health insurance, two factors that might be expected to affect MH outcomes. Research is needed to identify mechanisms by which spatial, social, economic, and cultural characteristics associated with ruralness of residence interact with cancer diagnosis, treatment, and recovery to foster different MH outcomes in survivors. Research is also needed to identify the parameters of this phenomenon. Are rural–urban disparities more evident among subgroups of survivors defined by clinical characteristics such as cancer type or prognosis? Do these disparities diminish, stabilize, or increase over time? Answers to these questions are critically important to the development, testing, and dissemination of strategies for minimizing disparities in MH outcomes associated with ruralness of residence.

### Acknowledgement

This research was supported by a grant from the Commonwealth of Kentucky Lung Cancer Research Program (#200806130835).

### Conflict of interest

The authors have declared that there is no conflict of interest.

### References

1. U.S. Department of Health and Human Services. Healthy People 2020. Office of Disease Prevention and Health Promotion: Washington, DC, 2010 Available at <http://www.healthypeople.gov/2020>. Accessed August, 21, 2012.
2. Coughlin SS, Richards TB, Thompson Miller BA, VanEenwyk J, Goodman MT, Sherman RL. Rural/nonrural differences in colorectal cancer incidence in the United States. *Cancer* 2006;**107**:1181–1188.
3. Schootman M, Fuortes LJ. Breast and cervical carcinoma: the correlation of activity limitations and rurality with screening, disease incidence, and mortality. *Cancer* 1999;**86**:1087–1094.
4. Loberiza FR, Jr, Cannon AJ, Weisenburger DD et al. Survival disparities in patients with lymphoma according to place of residence and treatment provider: a population-based study. *J Clin Oncol* 2009;**27**:5376–5382.
5. Crowell RE, Goetz T, Wiggins C, Magana E. Regional disparities in treatment and survival of early stage non-small cell lung cancer. *Ethn Dis* 2007;**17**:358–364.
6. Jemal A, Ward E, Wu X, Martin HJ, McLaughlin CC, Thun MJ. Geographic patterns of prostate cancer mortality and variations in access to medical care in the United States. *Cancer Epidemiol Biomarkers Prev* 2005;**14**:590–595.
7. Bull CN, Krout JA, Rathbone-McCuan E, Shreffler MJ. Access and issues of equity in remote/rural areas. *J Rural Health* 2001;**17**:356–359.
8. Hauenstein EJ, Petterson S, Rovnyak V, Merwin E, Heise B, Wagner D. Rurality and mental health treatment. *Admin Policy Mental Health* 2007;**34**:255–267.
9. Merwin E, Snyder A, Katz E. Differential access to quality healthcare: professional and policy challenges. *Fam Community Health* 2006;**29**:186–194.
10. Andrykowski MA, Burris JL. Use of formal and informal mental health resources by cancer survivors. Differences between rural and nonrural survivors and a preliminary test of the theory of planned behavior. *Psycho-Oncology* 2010;**19**:1448–1455.
11. Bettencourt BA, Schlegel RJ, Talley AE, Molix LA. The breast cancer experience of rural women: a literature review. *Psycho-Oncology* 2007;**16**:875–887.
12. Wang JY, Bennett K, Probst J. Subdividing the digital divide: differences in internet access and use among rural residents with medical limitations. *J Med Internet Res* 2011;**13**:e25.
13. Miller MK, Farmer FL, Clarke LL. Rural populations and their health. In *Rural Health Services: A Management Perspective*, Beaulieu JE, Berry DE (eds). AUPHA Press: Ann Arbor, MI, 1994;3–26.
14. Girgis A, Boyes A, Sanson-Fisher RW, Burrows S. Perceived needs of women diagnosed with breast cancer: rural versus urban location. *Aust N Z J Public Health* 2000;**24**:166–173.
15. McGrath P, Patterson C, Yates P, Treloar S, Oldenburg B, Loos C. A study of postdiagnosis



- breast cancer concerns for women living in rural and remote Queensland. Part II: support issues. *Aust J Rural Health* 1999;**7**:43–52.
16. Andrykowski MA, Lykins E, Floyd A. Psychological health in cancer survivors. *Sem Oncol Nurs* 2008;**24**:193–201.
  17. Beck SL, Towsley GL, Caserta MS, Lindau K, Dudley WN. Symptom experiences and quality of life of rural and urban older adult cancer survivors. *Cancer Nurs* 2009;**32**:359–369.
  18. Bettencourt BA, Talley AE, Molix L, Schlegel R, Westgate SJ. Rural and urban breast cancer patients: health locus of control and psychological adjustment. *Psycho-Oncology* 2008;**17**:932–939.
  19. Kurtz ME, Wyatt G, Kurtz JC. Psychological and sexual well-being, philosophical/spiritual views, and health habits of long-term cancer survivors. *Health Care Women Int* 1995;**16**:253–262.
  20. Lancee WJ, Vachon MLS, Ghadirian P, Adair W, Conway B, Dryer D. The impact of pain and impaired role performance on distress in persons with cancer. *Can J Psychiatry* 1994;**39**:617–622.
  21. Reid-Arndt SA, Cox CR. Does rurality affect quality of life following treatment for breast cancer? *J Rural Health* 2010;**26**:402–405.
  22. Schlegel RJ, Talley AE, Molix LA, Bettencourt BA. Rural breast cancer patients, coping, and depressive symptoms: a prospective comparison study. *Psychol Health* 2009;**24**:933–948.
  23. DiSipio T, Hayes SC, Newman B, Aitken J, Janda M. Does quality of life among breast cancer survivors one year after diagnosis differ depending on urban and non-urban residence? A comparative study. *Health Qual Life Outcomes* 2010;**8**:3.
  24. Burris JL, Andrykowski MA. Disparities in mental health between rural and nonrural cancer survivors: a preliminary study. *Psycho-Oncology* 2010;**19**:637–645.
  25. Weaver KE, Geiger AM, Lu L, Case LD. Rural–urban disparities in health status among US cancer survivors. *Cancer* 2013;**119**:1050–1057.
  26. U.S. Department of Agriculture. Rural–urban continuum codes. United States Department of Agriculture: Washington, DC, 2004. Available at <http://www.ers.usda.gov/data-products/rural-urban-continuum-codes>. Accessed August 21, 2012.
  27. Dennis LK, Palotta SL. Chronic disease in rural health. In *Handbook of Rural Health*, Loue S, Quill BE (eds). Kluwer: New York, NY, 2001;189–207.
  28. Lorenz FO, Wichrama KAA, Yeh H-C. Rural mental health: comparing differences and modeling change. In *Critical Issues in Rural Health*, Glasgow N, Morton SW, Johnson NE (eds). Blackwell Publishing: Ames, IA, 2004;75–88.
  29. Zabora J, Brintzenhofesoc K, Curbow B, Hooker C, Piantodosi S. The prevalence of psychological distress by cancer site. *Psycho-Oncology* 2001;**10**:19–28.
  30. Stanton AL, Ganz PL, Rowland JH, Meyerowitz BE, Krupnick JL, Sears SR. Promoting adjustment after breast cancer. *Cancer* 2005;**104**(Suppl):2608–2613.
  31. Jim HS, Donovan KA, Small BJ, Andrykowski MA, Munster PN, Jacobsen PB. Cognitive functioning in breast cancer survivors: a controlled comparison. *Cancer* 2009;**115**:1776–1783.
  32. Andrykowski MA, Burris JL, Walsh E, Small BJ, Jacobsen PB. Attitudes towards information about genetic risk for cognitive impairment after cancer chemotherapy: breast cancer survivors versus healthy controls. *J Clin Oncol* 2010;**28**:3442–3447.
  33. Goedendorp MM, Andrykowski MA, Donovan KA et al. Prolonged impact of chemotherapy on fatigue in breast cancer survivors: a longitudinal comparison with radiotherapy treated breast cancer survivors and non-cancer controls. *Cancer* 2012;**118**:3833–3841.
  34. Ware JE, Jr, Kosinski M, Bayliss MS, McHorney CA, Rogers WH, Raczek A. Comparison of methods for the scoring and statistical analysis of SF-36® health profiles and summary measures: summary of results from the Medical Outcomes Study. *Med Care* 1995;**33**(Suppl. 4):AS264–AS279.
  35. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavia* 1983;**67**:361–370.
  36. Ibbotson T, Maguire P, Selby T, Priestman T, Wallace L. Screening for anxiety and depression in cancer patients: the effects of disease and treatment. *Eur J Cancer* 1994;**30A**:37–40.
  37. National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines): distress management, Version 3.2012. 2012; Available at [http://www.nccn.org/professionals/physician\\_gls/pdf/distress.pdf](http://www.nccn.org/professionals/physician_gls/pdf/distress.pdf). Accessed July 20, 2012.
  38. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav* 1983;**24**:385–396.
  39. Andrykowski MA. Physical and mental health status of survivors of multiple cancer diagnoses: findings from the National Health Interview Survey. *Cancer* 2012;**118**:3645–3653.
  40. Phillips-Salimi, CR, Andrykowski, MA. Physical and mental health status of female adolescent/young adult survivors of breast and gynecological cancers: a national, population-based, case–control study. *Support Care Cancer* 2013;**21**:1597–1604.
  41. Hays RD, Wooley JM. The concept of clinically meaningful differences in health-related quality-of-life research: how meaningful is it? *Pharmacoeconomics* 2000;**18**:419–423.
  42. Myrdal G, Valtysdottir S, Lambe M, Stahle E. Quality of life following lung cancer surgery. *Thorax* 2003;**58**:194–197.
  43. Ostroff JS, Krebs P, Coups EJ et al. Health-related quality of life among early-stage, non-small cell, lung cancer survivors. *Lung Cancer* 2011;**71**:103–108.
  44. Welcker K, Marian P, Thetter O, Siebeck M. Cost and quality of life in thoracic surgery—a health economic analysis in a German center. *Thorac Cardiovasc Surg* 2003;**51**:260–266.