FACTORS ASSOCIATED WITH LUNG CANCER SCREENING IN URBAN VS. RURAL INDIVIDUALS AT RISK FOR LUNG CANCER

Presenter: Anja Zgodic, MS, PhD Candidate in Biostatistics
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• Lung cancer is the leading cause of cancer deaths in the US
• The 5-year survival rate is ~20.5% overall, but 59.0% if found at an early stage
• The mortality rate is higher among rural populations
• Rural populations also have higher rates of smoking and higher overall and late-stage incidence rates
• National Lung Screening Trial (NLST) showed that Low-Dose Computed Tomography (LDCT) detected lung cancer earlier and reduced mortality up to 20% compared to chest x-ray, in high-risk individuals.

Sources: National Cancer Institute; Henley et al. 2017 MMWR; Doogan et al. 2017 Prev Med
BACKGROUND: LDCT LUNG CANCER SCREENING

• US Preventive Services Task Force (USPSTF) began recommending annual LDCT lung cancer screening for high-risk individuals in 2013
  • High-risk individuals:
    • Current smokers and former smokers who quit within 15 years with a 30+ pack-year smoking history
    • Age between 55 and 80 years old

• Private insurance and Medicare began covering screening in 2015 (Medicaid varies by state)

• Population-based estimates of LDCT utilization range:
  • 3.8% in the 2015 National Health Interview Survey (NHIS) to 14.4% in the 2017 Behavioral Risk Factor Surveillance System (BRFSS) survey
  • Rural vs. urban estimates from 2015 NHIS were low in both groups (3.72% and 3.83%, respectively)

Sources: Moyer V et al. USPSTF Ann Intern Med 2014; Center for Medicare and Medicaid Services 2015; Aberle et al. 2015 NEJM
STUDY AIMS

• To determine population-based, rural and urban estimates of utilization of LDCT screening for lung cancer using the 2018 (newest available) BRFSS survey
  • We examine predictors of LDCT screening for lung cancer using a mixed-effects model that incorporates state level clustering

• 2018 BRFSS-population-based phone survey of US residents on health-related risk behaviors, chronic health conditions, and use of preventive services

• Optional module: Lung Cancer Screening Module (LCSM)
  • Smoking History
  • Receipt of LDCT screening for lung cancer
METHODS: DATA SOURCE & STUDY SAMPLE

• Sample: adults 55-80 years with 30+ pack-year smoking history, currently smoking or quit within the past 15 years, per USPSTF
  • Excluded those whose eligibility could not be determined due to incomplete data or who had a previous lung cancer diagnosis
  • Final sample included 2,620 eligible participants

• Outcome variable: receipt of LDCT screening to check for lung cancer

• Factors:
  • Rural-urban status
  • Demographic characteristics (e.g., age, gender, race)
  • Health factors (e.g., respiratory conditions, self-reported health status)
  • Socioeconomic factors (e.g., income, insurance status)
METHODS: STATISTICAL ANALYSIS

• Exploratory analysis with chi-square tests
  • Overall
  • Stratified by rural/urban

• Mixed-effects multivariable logistic regression model (unadjusted/adjusted, survey weights)
  • Study factors as fixed effects
  • State as random effect (random intercept)
  • Random effect allows to capture unobserved variability not accounted for otherwise
  • Recalculated survey weights for use in our multilevel model
RESULTS: EXPLORATORY ANALYSIS

• Exploratory analysis indicated no difference between rural vs. urban LDCT screening uptake
  • All eligible who were screened (19.54%)
  • Rural (N=383, 13.41%) vs. urban (N=2237, 20.15%) (p=0.45)

• Stratified exploratory analysis shows no association between LDCT screening and study factors in rural participants, except for pack-year history (sample size, power considerations)
RESULTS: REGRESSION ANALYSIS

• Unadjusted model shows significant impact of rurality on screening uptake
• Rural BRFSS participants had odds of LDCT lung cancer screening 40% lower than urban BRFSS participants
• Adjusted model: non-significant association

| Demographic Factors | Unadjusted | | | Adjusted | | |
|---------------------|------------|-----------------|------------|-----------------|-----------------|
|                     | Odds Ratio | 95% CI          | P-Value    | Odds Ratio      | 95% CI          | P-Value        |
| Rurality            |            |                 |            |                 |                 |                |
| Rural               | 0.60       | 0.37-0.97       | 0.04       | 0.53            | 0.23-1.21       | 0.13           |
| Urban               | Reference  | Reference       | Reference  | Reference       | Reference       |                |
RESULTS: REGRESSION ANALYSIS

• However, rurality was a significant effect modifier in the relationship between smoking status and LDCT lung cancer screening uptake in an adjusted mixed-effects model.

<table>
<thead>
<tr>
<th>Health Factors</th>
<th>Adjusted</th>
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<th>P-Value</th>
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<tbody>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>95% CI</td>
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<td>Smoking Status by Rurality</td>
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<td>Rural Participants</td>
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<tr>
<td>Former Smoker, ≥30 pack-year history, quit &gt; 1 year ago, but &lt; 15 years ago</td>
<td>2.52</td>
<td>1.06-6.03</td>
<td>0.04</td>
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<tr>
<td>Former Smoker, ≥30 pack-year history, quit within the past year</td>
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<td>0.08-2.00</td>
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<td>Current Smoker, ≥30 pack-year history</td>
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<td>0.03-0.67</td>
<td>0.01</td>
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<td>Urban Participants</td>
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<td>Former Smoker, ≥30 pack-year history, quit &gt; 1 year ago, but &lt; 15 years ago</td>
<td>Reference</td>
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<tr>
<td>Former Smoker, ≥30 pack-year history, quit within the past year</td>
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<td>0.81-2.08</td>
<td>0.28</td>
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<td>Current Smoker, ≥30 pack-year history</td>
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<td>0.48-1.14</td>
<td>0.17</td>
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• Current rural smokers have odds of screening 86% lower than former urban smokers (p=0.01).
LIMITATIONS

• Only a small number of states included this optional module in their survey
• Self-report of screening and smoking status
• Model could not account for evolving pack-year history due to data
• No available data on insurance type or other cancer detection and diagnoses
• Data does not allow to exclude participants with symptoms of lung cancer or other life-constraining illnesses, etc.
• Sample size of rural participants and low power to detect
• The NLST excluded participants who had previous malignancies within the last 5 years, but such exclusions are not part of the USPSTF recommendations
  • This may complicate survey reporting as well as increase measurement error in data collection
DISCUSSION & CONCLUSION

• Estimates of screening utilization are higher than in past years

• There are no rural-urban differences in screening uptake except when clustering by state, but this was attenuated when accounting for other factors
  • Differences by state may be due to important factors such as access to screening and Medicaid coverage and power/sample size issues

• Rural current smokers had lower odds of screening utilization: important area of intervention

• This research focus is important as rural populations have higher tobacco use, lung cancer incidence, late-stage incidence, mortality and comprise a disproportionate percentage of the LDCT-eligible population

Sources: Henley et al. 2017 MMWR; Odahowski et al. 2019 JACR
THANK YOU!

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