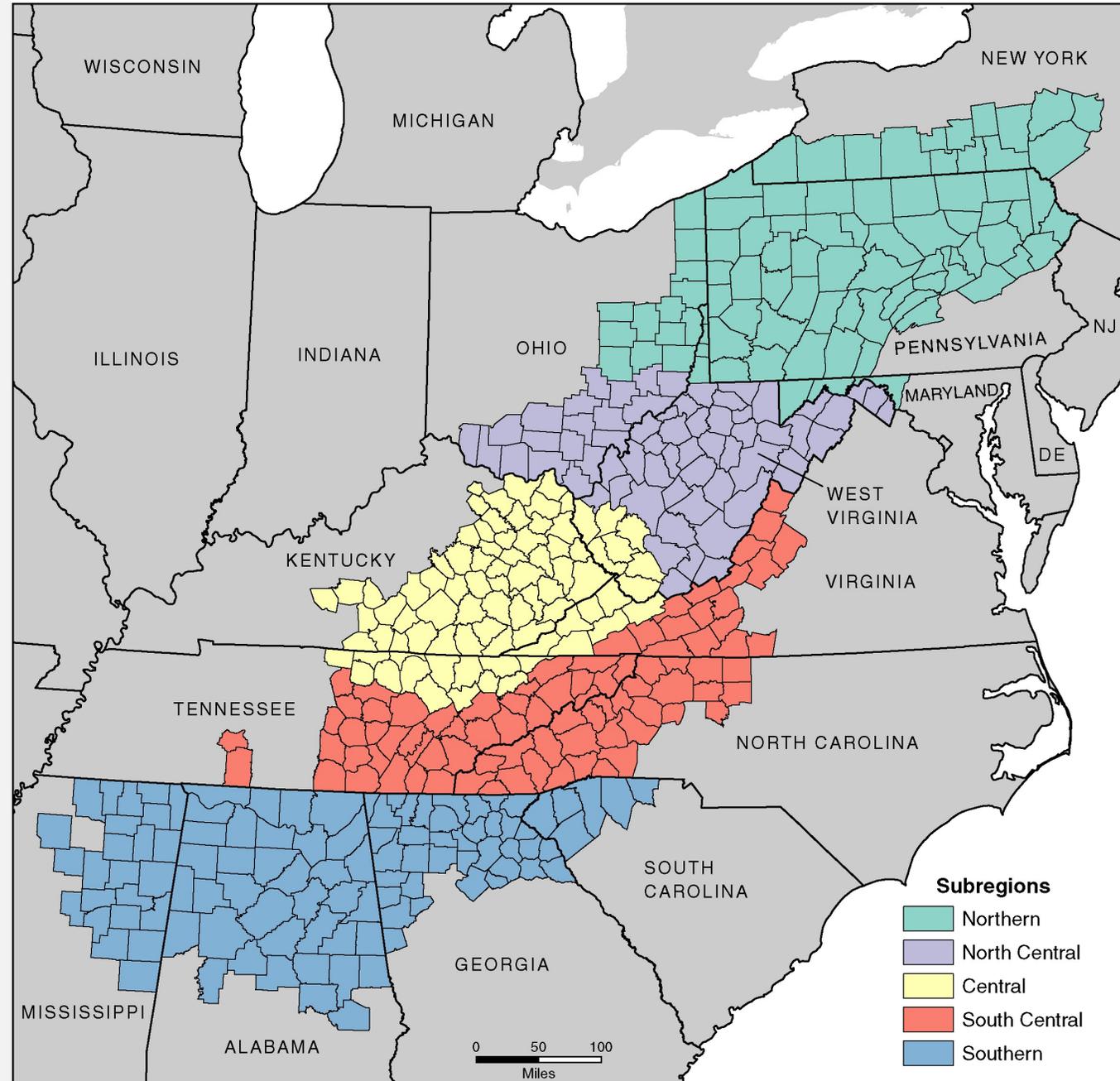


**APPALACHIAN HEALTH DISPARITIES:
UNDERSTANDING STATE VARIATIONS IN HEALTH
OUTCOMES WITHIN APPALACHIA**

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BACKGROUND

- Appalachia, or the Appalachian Mountain Range, is a region of the United States in the eastern portion of the country. 42% of the region is rural and includes 420 counties in 13 states. It extends more than 1,000 miles and is home to more than 25 million people.
- While health disparities in rural America are well documented, only recently have studies sought to examine differences between Appalachian and non-Appalachian regions.
- These studies have only compared counties within one single state and fail to examine differences between Appalachian counties in different states.



HEALTH IN APPALACHIA

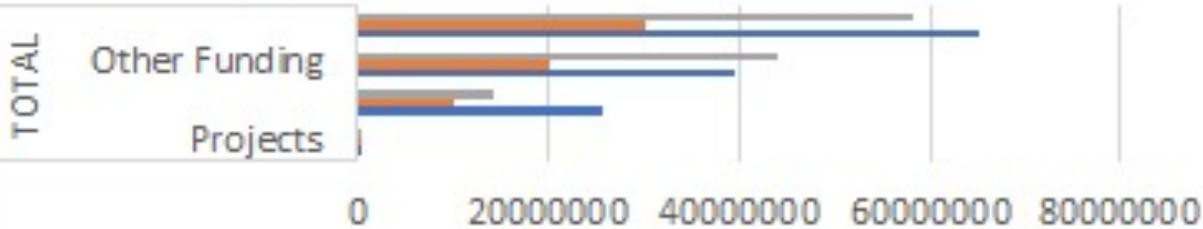
- Appalachia has the highest cancer mortality rate in the United States (Langerich et al, 2005).
- Mortality in Appalachia from cardiovascular diseases, lung cancer, chronic lower respiratory diseases or chronic obstructive pulmonary disease, diabetes, nephritis or kidney diseases, suicide, unintentional injuries, and drug overdose are all above the national average. This contributes to lower life expectancy in the region, compared to the rest of the country. (Singh et al, 2017).
- Appalachian women have higher rates of perinatal complications and low utilization of prenatal care (Bailey & Cole, 2009; Jesse et al, 2009).
- Within states, Appalachian counties have a lower quality of health than non-Appalachian counties (Hogg-Graham et al, 2020).
- **These data provide foundation for this study; health disparities exist in Appalachia that are different from the general association between poverty and health.**

CULTURE AND SIGNIFICANCE

- Although Appalachia is not a demographically homogeneous region, there are factors that define what is “typical” or “modal” Appalachian culture. This includes independence and distrust of outsiders and outside organizations (Gaventa, 1980; Geisler, 1983).
- The history of exploitation, largely by absentee mill and coal mine owners, informs this perspective (Geisler, 1983; Hennen, 1998).
- Appalachian children have an apathetic view on political leaders, while children in other regions tend to feel positive attachments to leaders and figureheads. This research found that while party affiliation or successful policies gain trust of a community in most parts of the country, this is not true in Appalachia (Jaros et al. 1968).
- There is also a greater emphasis on collectivism and community than observed in other regions (Wagner, 2005; Weller, 1965). **Broadly, this makes it a person oriented, rather than task oriented, culture.**

STATE VARIATION

Funding by State



	TOTAL			
	Projects	ARC Funding	Other Funding	Total Funding
■ West Virginia	30	14,178,179	43,998,758	58176937
■ Tennessee	44	10,087,761	19,967,753	30055514
■ Kentucky	33	25,761,259	39,449,855	65211114

■ West Virginia ■ Tennessee ■ Kentucky

- Approaches to public health varied between states, with Tennessee having the most robust set of services. Public health initiatives in Tennessee and West Virginia were generally holistic in their design, while those in Kentucky were specific to one condition.
- West Virginia and Kentucky had public health websites that were difficult to navigate, and it was not clear how to be a part of health programs. In contrast, Tennessee's services were much easier to find and how to utilize them was clearly expressed.
- Federal funding between the states varied as well, with Tennessee receiving the least and Kentucky the most.

APPROACHES TO HEALTH DISPARITIES IN APPALACHIA

- **Community Health Workers → culturally competent intermediaries**
 - Pilot study in Mingo County, West Virginia found that CHWs were effective in diabetes care
 - Emergency department visits decreased from year 1 to year 2 by 55 (22%), and hospitalizations by 62 (30%). Another measure of success in diabetes care is a reduction in hemoglobin (HbA1c). The pilot saw a mean reduction from a baseline of 10.2% to 8.5% after 12 months (Crespo et al., 2020).
 - Although it targets diabetes specifically, benefits were observed for those suffering from heart disease and chronic obstructive pulmonary disease as well. Has now expanded to cover 18 counties in parts of Ohio, West Virginia, and Kentucky
- **Group Care**
 - Centering Pregnancy is group care for pregnant individuals where they learn in groups and those further along in their pregnancy help teach and mentor others.
 - The program has been clinically effective in reducing rates of preterm birth (Ickovics et al., 2007), but participating by Appalachian women is low.
 - Participation increases when covered by Medicaid (Phillippi, 2011).

THEORY

- The most expensive infrastructure projects are not always the most effective. Projects that provide tangible access to healthcare or clinical services contribute most to patient's health improvements (ARC, 2010).
- Community Health Workers, educational outreach, and group treatment can improve health in multiple categories, including cancer care. These services aim to empower communities to have agency over their own healthcare and focus on the “cultural competency” of providers. This creates an intermediary between patient and healthcare provider, typically another community member who has gone through a similar medical experience.
- Community support and trust is instrumental in success, impact, and sustainability of health projects, regardless of intended outcome or focus of the initiative (ARC, 2012).
- **Based on the influence of social and political factors, I hypothesize that there will be measurable differences in health between Appalachian counties across state lines, even when controlled for other economic factors.**

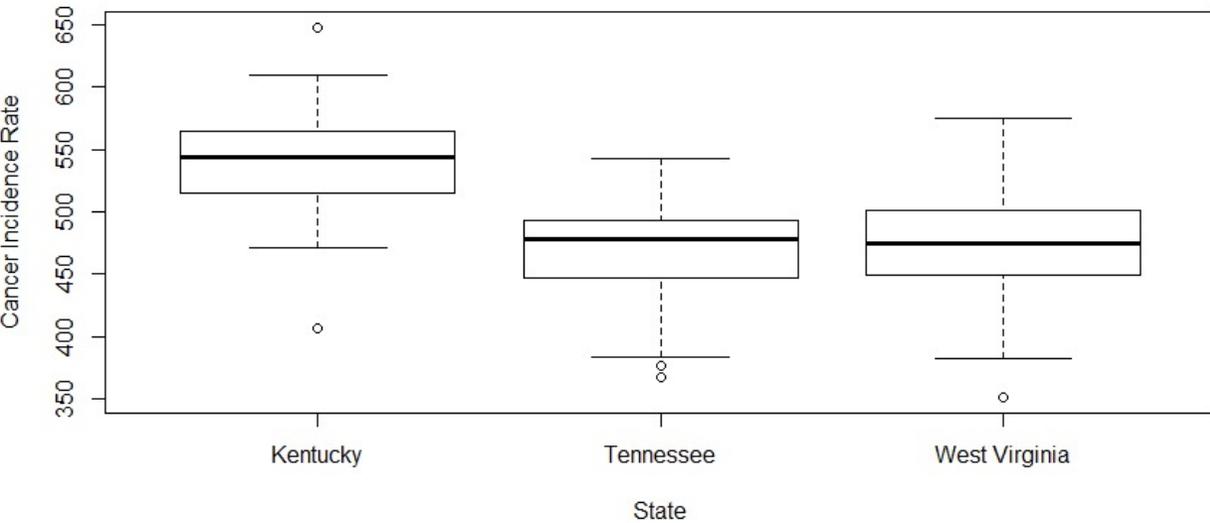
DATA

- Three states were examined: Kentucky, Tennessee, and West Virginia
 - Analysis was done on the county level with all 161 Appalachian counties in these states.
- Economic Classification → 5 levels (distressed, at-risk, transitional, competitive, and attainment) factor determined by the Appalachian Regional Commission based on three-year average unemployment rates, per capita market income, and poverty rates. These data only contained distressed, at-risk, and transitional counties.
- Cancer Incidence Rates and Cancer Mortality Rates → 2019 data from the CDC
- Prenatal Care → 2018-2020 rates of types of prenatal care and infant mortality
- Funding data (state and federal) and public health practices of all three states informed the development of theory and hypotheses.

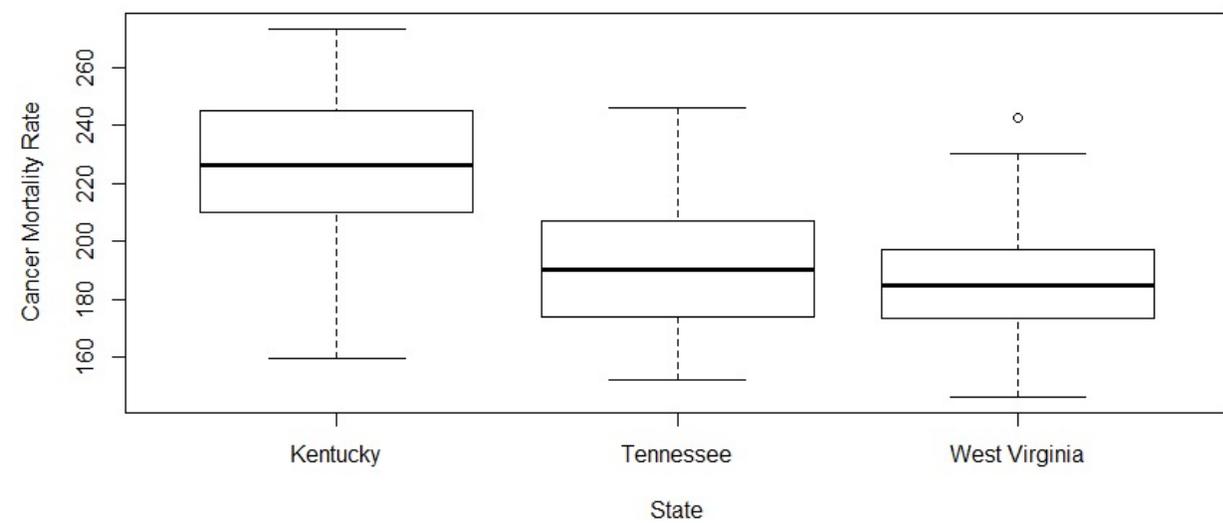
METHODOLOGY

- An analysis of variance (ANOVA) was performed to see if cancer incidence and mortality rates of a county varied based on economic factors
- An analysis of variance (ANOVA) was performed to see if cancer incidence and mortality rates of a county varied based on the state a county was in (state effect)
 - Evaluated which variances were largest (Tukey HSD)
- I evaluated whether the state effect could be explained by economic differences between states, or if it existed regardless of economic classification. (GLM)
- Brief analysis of prenatal health, comparing state rates to each other and national averages
 - Confidentiality protocol prohibit county level analysis for many of these variables

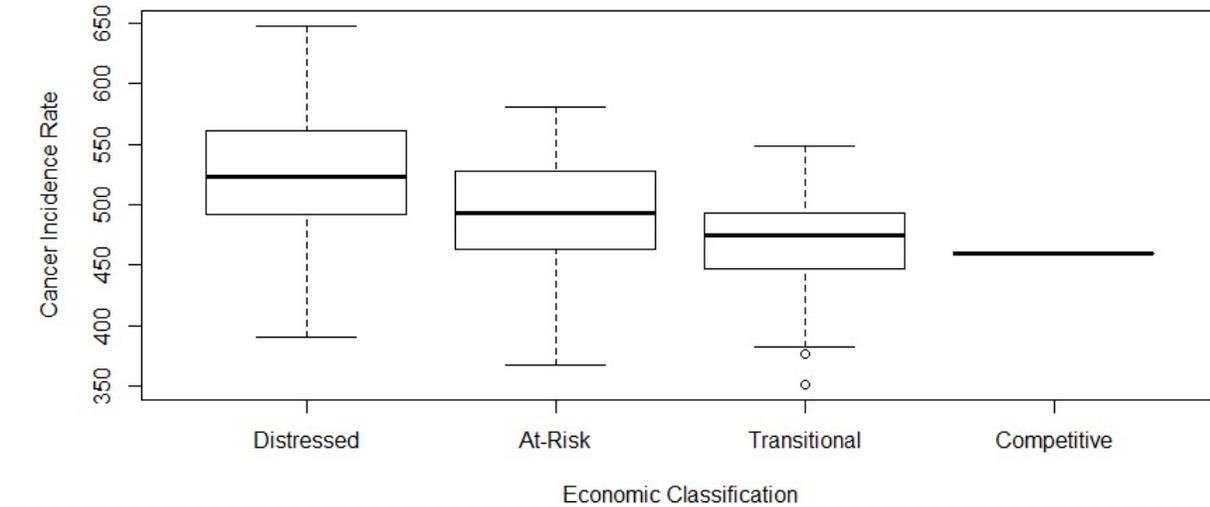
Cancer Incidence Rate by State



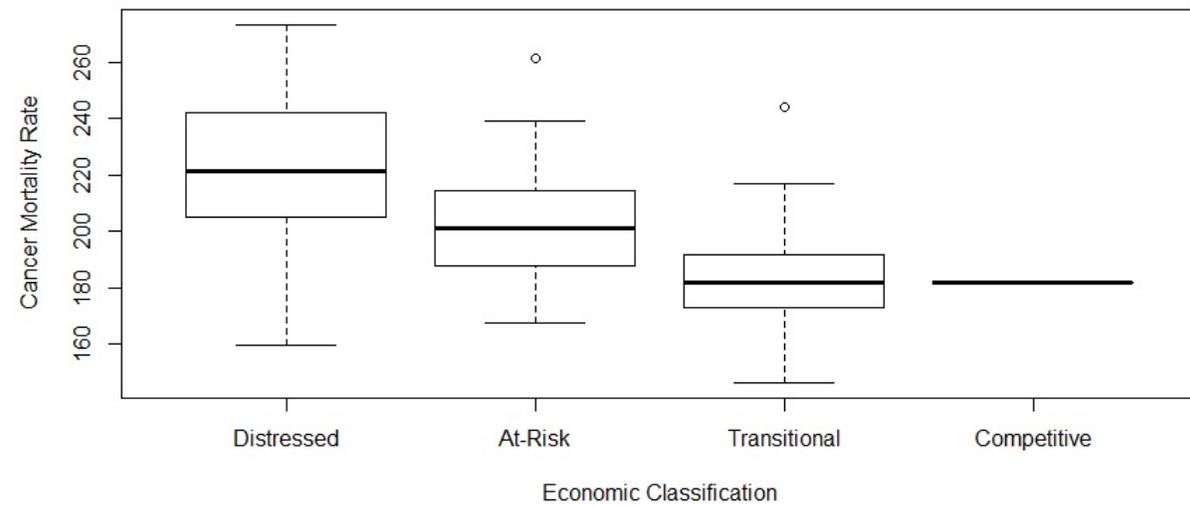
Cancer Mortality Rate by State



Cancer Incidence Rate by Economic Classification



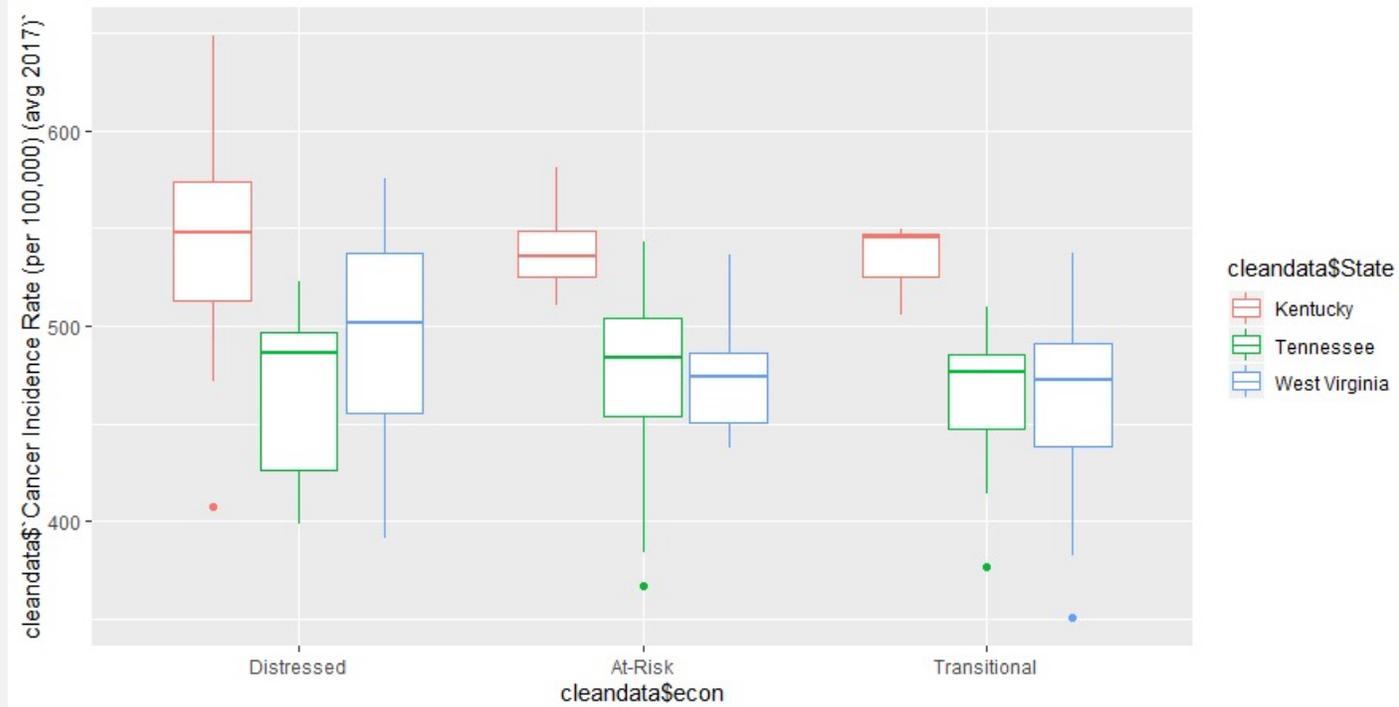
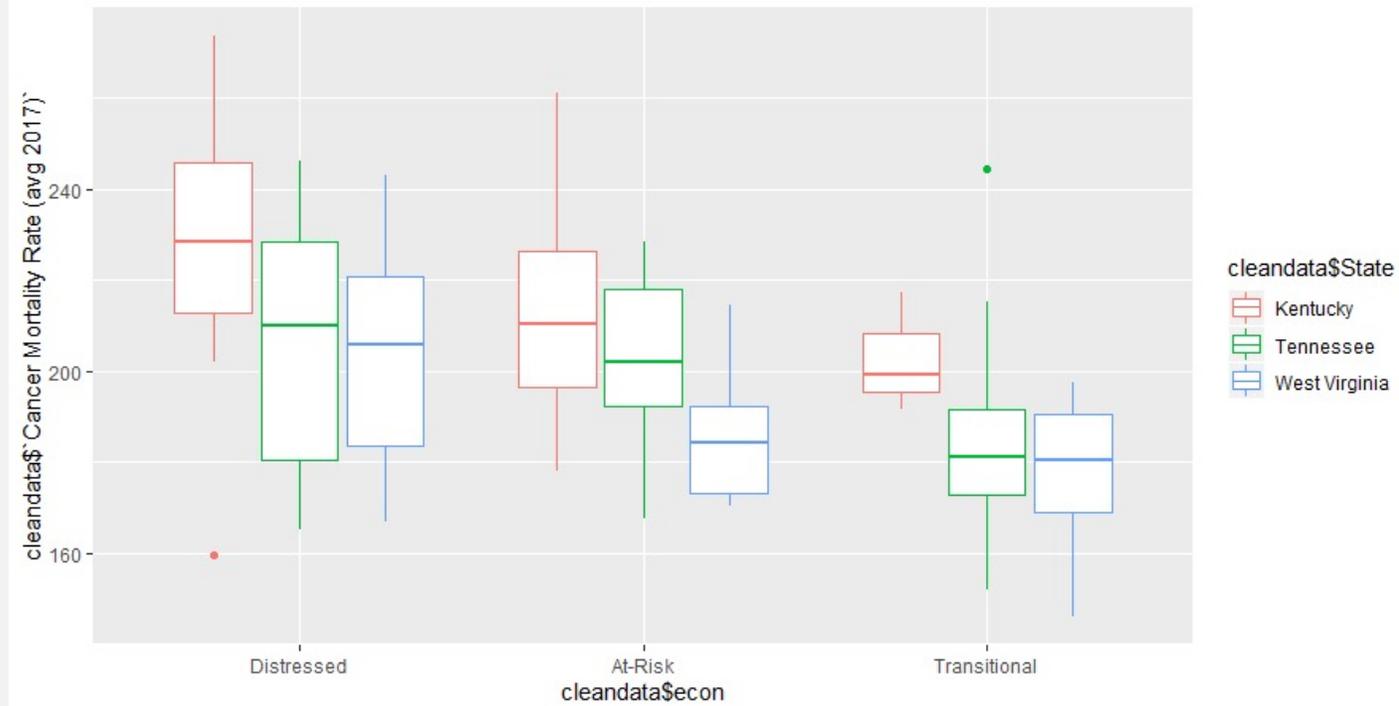
Cancer Mortality Rate by Economic Classification



RESULTS

- Cancer incidence rates and mortality rates increased as the economic classification of a state became worse.
- State effect was significant for cancer incidence rates
 - $F(2, 158)=50.782, p< .001$
 - The largest difference in means was between Tennessee and Kentucky (difference=-74.492, CI:-94.079, -54.904) significant at $p< .001$. The difference in means between West Virginia and Tennessee was not significant (difference=5.813, CI:-13.686, 25.313), with $p=0.76$.
- State effect was significant for cancer mortality rates
 - $F(2, 158)=43.799, p< .001$
 - The largest difference in means was between West Virginia and Kentucky (difference=-38.343, CI:-48.825, -27.861) significant at $p< .001$. The difference in means between West Virginia and Tennessee was not significant (difference=-5.111, CI: -15.694, 5.472) with $p=0.489$.

- Data are shown plotted with economic classification as the explanatory variable, cancer incidence and mortality as the response variable, and state as a grouping variable.
- This was done to see if the state effect observed from ANOVA was the result of economic differences between the states, or if it would persist within economic classifications. **These plots indicated that there were differences between the states that could not be explained by economic factors.**
- The minimal variation between West Virginia and Tennessee can be seen in the plots for both cancer incidence and mortality. Kentucky is higher in cancer incidence rates and mortality rates compared to Tennessee and West Virginia at all economic classifications.



- GLM using economic classification and state as explanatory variables and cancer incidence (top) and cancer mortality (bottom) as response variable

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              Estimate Std. Error t value
(Intercept)  536.28097    6.53891  82.014
cleandata$econ.L -13.14489    6.48003  -2.029
cleandata$econ.Q   0.05028    6.35033   0.008
cleandata$StateTennessee -64.52852    9.63736  -6.696
cleandata$StateWest Virginia -61.02234    8.95442  -6.815
              Pr(>|t|)
(Intercept)  < 2e-16 ***
cleandata$econ.L  0.0442 *
cleandata$econ.Q  0.9937
cleandata$StateTennessee  3.72e-10 ***
cleandata$StateWest Virginia 1.97e-10 ***
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

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- These models confirmed what was observed visually and with ANOVA; economic classification and state were significant variables with respect to cancer incidence and mortality**

- For economic classification, the linear predictor (.L) was significant in both models while the quadratic predictor (.Q) was not. This suggests that as economic classification increases, cancer incidence/mortality decreases at a steady rate

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              Estimate Std. Error t value
(Intercept)  216.669    3.226  67.166
cleandata$econ.L -19.597    3.197  -6.130
cleandata$econ.Q   1.055    3.133   0.337
cleandata$StateTennessee -18.251    4.754  -3.839
cleandata$StateWest Virginia -27.280    4.418  -6.175
              Pr(>|t|)
(Intercept)  < 2e-16 ***
cleandata$econ.L  6.97e-09 ***
cleandata$econ.Q  0.73680
cleandata$StateTennessee  0.00018 ***
cleandata$StateWest Virginia 5.55e-09 ***
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

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PRENATAL CARE AND INFANT MORTALITY

- Infant mortality in Kentucky was 5 deaths/1,000 live births, total 266 deaths. Tennessee had 7.06 deaths/1,000 live births with 563 total deaths. West Virginia had 6.31 deaths/1,000 live births with 112 total deaths. National average 5.6 deaths/1,000 live births (CDC, 2020).
- Of the live births in 2019, 6.1% were born to a woman receiving late or no prenatal care in both Kentucky and West Virginia compared to 6.8% in Tennessee.
- In 2018, preterm births were slightly above the national average of 10% in all three states at 11.3% in Kentucky, 11.1% in Tennessee, and 11.8% in West Virginia. This is also true of births of low birthweight, with 8.9% in Kentucky, 9.3% in Tennessee, and 9.4% in West Virginia. The national average is 8.3% (CDC, 2018).
- West Virginia extends Medicaid coverage to pregnant women at or below 190% of the federal poverty line (FPL), an increase from 163% in 2019. Kentucky and Tennessee extend care to pregnant women at 200%, on par with the national average (Kaiser Family Foundation, 2021). 51% of births in Kentucky are financed by Medicaid, 50% in Tennessee, and 54% in West Virginia (Kaiser Family Foundation, 2019).

CONCLUSION

- Given the variation in Medicare services offered between these states and the availability of these services, no conclusion can be made demonstrating the exact effectiveness of one strategy over another. **What is clear is that any attempt to address infant care in these states will need to work within the Medicare system** or provide a more attractive alternative as this is the coverage for over half of all births in these states.
- The state effect shown in this paper indicates that quality of health can not be explained just by a person or county's economic position. **Rather, there is some social or political factor that exists even when these economic factors are held constant.** Even within the demographically similar region of Appalachia the state effect was significant, indicating that policies aimed at improving health need to account for this effect.
- **The cultural element of distrust has acted concurrently with variations in state efforts to reduce health disparities to create the variations seen between these three states.**

LOOKING FORWARD: SOLUTIONS

- Policy solutions can best address low rates of screening and participation in preventative measures.
- Tennessee's success with holistic, community-oriented approaches reflect the important of trust and community buy-in with any policy attempt.
- Wider adoption of CHW programs and other community initiatives may not only reduce the widespread health inequality observed but offer a tailored approach at the community level.
 - Programs where cancer survivors or those currently seeking treatment explain the importance of screening can destigmatize the process, increase community engagement and trust, and ensure the services being offered by the state are utilized effectively.
- For these programs to be effective, buy in from communities and Medicare coverage will be instrumental. Medicare coverage will ensure a program is widely accessible in these states. This requires expansion of Medicare services in these states.

DISCUSSION

- **Appalachia is not a homogeneous region, and this paper has established groundwork for further research into state variation. This is important in forming appropriate political and social interventions to address health disparity.**
- Due to COVID-19 restrictions, the data relied upon here is limited to publicly available data sets. First-hand interviews and observations of the health programs and initiatives discussed could give insight into the public perception and receptiveness that this paper is unable to do.
- Future research could replicate the approach used here on the 10 other Appalachian states. Insight could be gained by examining counties/states in the Southern and Northern Appalachian sub-regions.