COVID-19 in North Carolina

Reported COVID-19 Cases in North Carolina: Trends in Age, Time, and Place

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Introduction

North Carolina is now in Phase 3 of the state's multi-phased approach to lifting COVID-19-related restrictions. In Phase 3, more businesses have reopened (with capacity limitations), but large gatherings are still restricted, and people who are at high risk of severe illness from COVID-19 are still encouraged to stay home. Face coverings are still required in public spaces where social distancing is not possible; frequent handwashing and social distancing practices continue to be encouraged for all. While some restrictions remain, many people are more likely to be traveling and interacting with others as compared to earlier in the pandemic. Moreover, K-12 schools, colleges, and universities are in various stages of reopening across the state.

This brief joins several prior briefs in examining COVID-19 trends in North Carolina. Here, we incorporate updated state-supplied data to explore the incidence of COVID-19 cases (i.e., positive coronavirus test results that are then reported to the state) across North Carolina since the beginning of the pandemic.

This brief's analysis includes:

- Case trends by age and region
- Case trends by age and urban-rural classification
- Case trends by proximity to universities with large undergraduate enrollments

Data and Methods

Our main data source for this analysis is NC COVID, an instance of the NC Electronic Disease Surveillance System, supplied by the NC Department of Health and Human Services. NC COVID data were obtained via a data use agreement with UNC Chapel Hill's Cecil G. Sheps Center for Health Services Research (Sheps). The project is a collaboration between researchers at Sheps and the Duke-Margolis Center for Health Policy.*

These data undercount people with COVID-19 in North Carolina, as they include only lab-confirmed cases reported to the State (cases that are never diagnosed or confirmed aren't included). The summarized, anonymized data used in this analysis do not include identifiable information about specific individuals diagnosed with COVID-19, but the dataset does contain information about age and location of reported COVID-19 cases.

In this and a prior brief, our regional analyses are based on the Public Health Regional Surveillance Team (PHRST) region definitions supplied by the State. County-level rurality classifications are based on the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties. County-level population figures used to calculate per-capita case rates are from the U.S. Census Bureau.

Exhibit 1 Public Health Regional Surveillance Team (PHRST) Regions

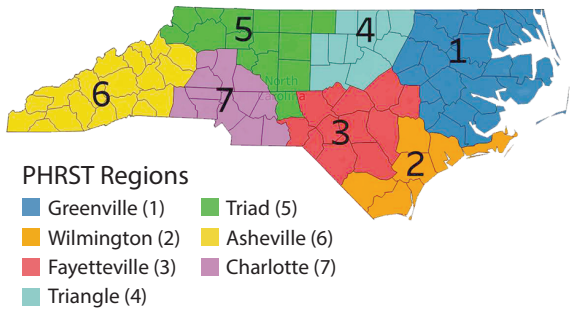
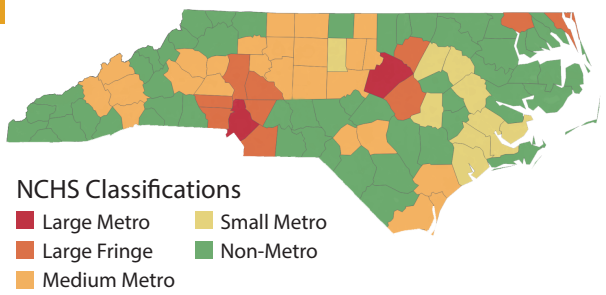


Exhibit 2 National Center for Health Statistics (NCHS) Classifications



For analyses of trends associated with reopening of colleges and universities (and, in some cases, transition to remote-only learning), we examine reported COVID-19 cases using the distance between the reported ZIP code of the individual who tested positive for COVID-19 and the nearest university with an undergraduate enrollment of at least 10,000 students.

We hypothesized that 18-22 year olds nearest to a large university would be most likely to be affected by campus outbreaks. There are limits in assessing this: for example, there are likely many 18-22 year olds living near universities who are not enrolled in those universities. Also, some enrolled students may reside farther from campus. Finally, some enrolled students are outside the 18-22 year old age group.

*The findings and conclusions in this brief are those of the authors and do not necessarily represent the views of the North Carolina Department of Health and Human Services, Division of Public Health, or the authors' institutions.

Results

Reported COVID-19 case trends by age and region

Exhibit 3 presents "heat maps" depicting per capita reported COVID-19 cases statewide and by PHRST region. This allows us to examine changes in the concentration of reported COVID-19 cases within and between regions by age and time. The "darker" colors are those age bands and regions with higher per-capita case counts than those displaying "lighter" colors (see legend for interpretation).

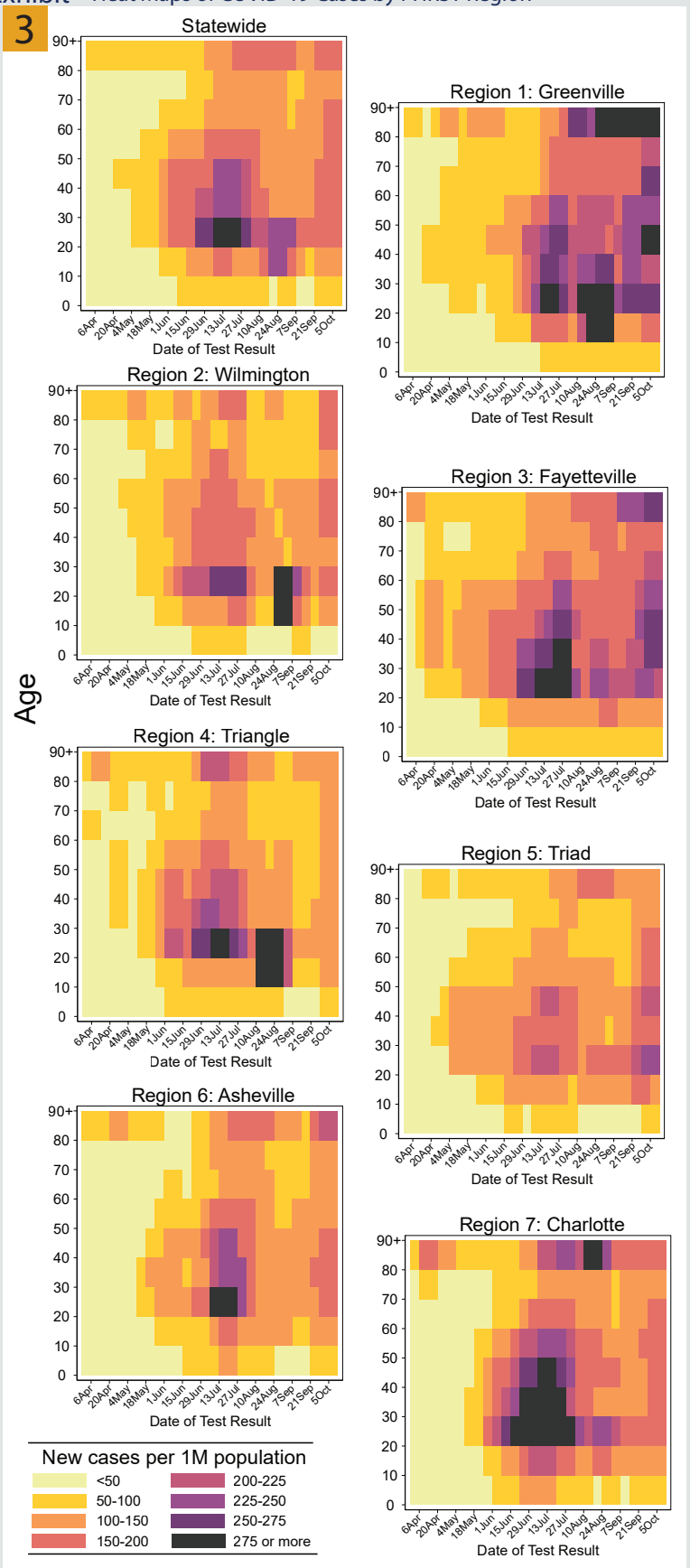
Across these heat maps, two age groups stand out as fairly consistently having the highest per-capita rates by age: young adults (ages 20-30 years old) and the oldest North Carolinians (age 80+). The trend among the oldest North Carolinians is driven more by the relatively smaller population size in this age group than by particularly large case counts. This is consistent with patterns in other states, such as Michigan.

As has been reported elsewhere, incidence of diagnosed coronavirus infections shifted to younger populations in the April/May time period, with the statewide rate among 20-30 year olds exceeding 250 new daily cases per million population in mid-June. This is visible in the statewide heat map. The "dark orange" (100-150 per million population) case rates were first seen among individuals between 30-50 years old, and the dark purple (250-275 per million population) and black (275+ per million population) case rates were first seen among 20-30 year-olds.

The case rate increases seen in July were largest among younger adults; those rates subsided in late July and then were seen again among young adults in early August.

Notably, for most time periods, people in the 60-80 year age group generally had the lowest per-capita reported incidence rate of any age group other than young children. It is unclear why this is the case. Among other possibilities, it may reflect active risk-avoidance behavior by individuals in this age group and/or lower testing frequency.

Exhibit 3 Heat Maps of COVID-19 Cases by PHRST Region



We identify several differences in reported case rates across geographic regions. The regions around Greenville, Wilmington, and the Triangle had marked spikes among those of college age in mid-August. Likewise, the highest per-capita reported COVID-19 rates statewide and across all regions were typically among young adults. The Fayetteville and Greenville regions, however, had similar case rates across a broader age range, from 20 to 50 years old, so transmission dynamics appear to differ in these areas as compared to the rest of the state.

Reported COVID-19 case trends by age and urban-rural classification

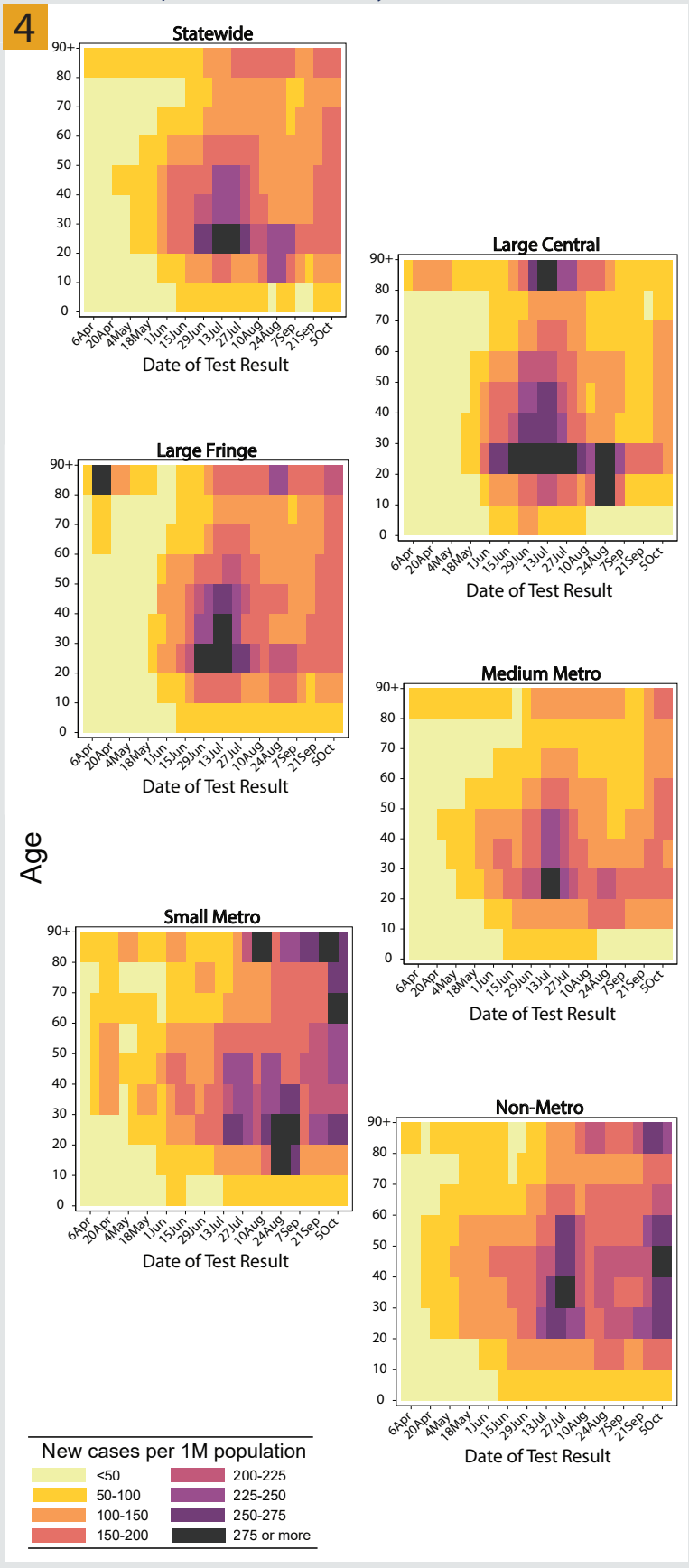
Looking first at the most urban classification, Large Central, which applies to Mecklenburg and Wake counties: the highest (per-capita) reported COVID-19 case rates in these counties occured during the summer and were primarily among young adults, as well as the oldest residents of those counties.

Across all rurality classifications, lower reported case rates among the 60-80 year old age group were observed compared to other adult age groups, but that pattern is less pronounced among the most rural designations. This may suggest that the 60-80 year old age group finds it more difficult to avoid risky behavior in less urbanized settings.

Importantly, recent reported case rates are quite a bit higher in Non-Metro and Small Metro counties than the Large Central and Medium Metro counties. For both Non-Metro counties and Small Metro counties, the current case rate across 20-60 year olds is at least 200 new daily cases per million, while for most ages in the Large Central and Medium Metro counties, the rate is currently below 150 cases per million. This reflects the national trend of initial outbreaks being concentrated among more urbanized areas, but rural areas experiencing faster case rate increases once the pandemic eventually reaches them.

Here, again, we see that increases in reported case rates in less-urbanized areas appear broadly across age groups, while in more urban counties, younger adults seem to have higher case rates distinctly earlier than older adults. Of course, like all other results described here, this may also reflect different testing rates, not just different infection rates.

Exhibit 4 Heat Maps of COVID-19 Cases by NCHS Urban-Rural Classification



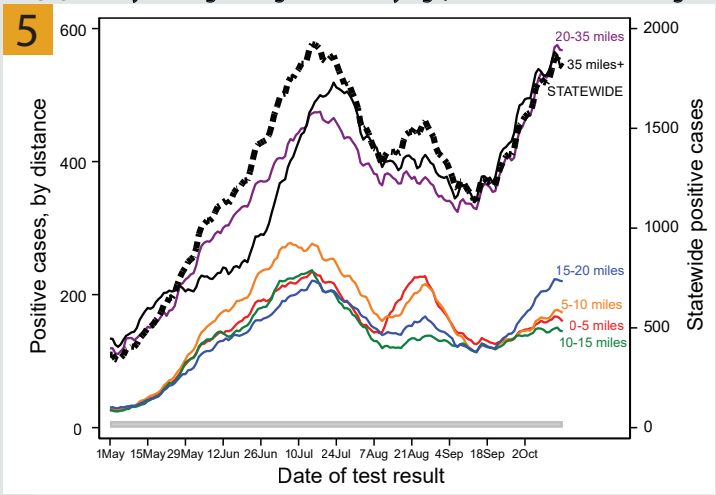
Reported COVID-19 case trends by proximity to universities with large undergraduate enrollments

Finally, we turn to an examination of the number of reported cases by age group, time, and proximity to a large university. For Exhibits 5, 6, and 7, the "temperature" of the line's color denotes the distance to the nearest large university, with "hotter" colors (like red and orange) denoting closer geographic proximity to a university with at least 10,000 undergraduate students enrolled. These lines are plotted using the scale on the vertical axis to the left.

The thicker black dashed lines in Exhibits 5 and 6 denote the total number of reported COVID-19 cases statewide and are plotted on a separate scale on the vertical axis to the right in those exhibits. Unlike the analyses by region and rurality, these results are not shown on a per-capita basis because it is more difficult to obtain reliable age-specific population sizes (denominators) at the ZIP level.

We expected to see the fastest increases in reported COVID-19 cases to be among 18-22 year olds who live nearest a large university, reflecting spread among students congregating and interacting with one another. We further expected to observe later increases among older age groups near those universities, reflecting spread among staff, faculty, and community members beyond the campus.

Exhibit 5 **14-Day Moving Average of Cases by Age, Time and Distance: All Ages**



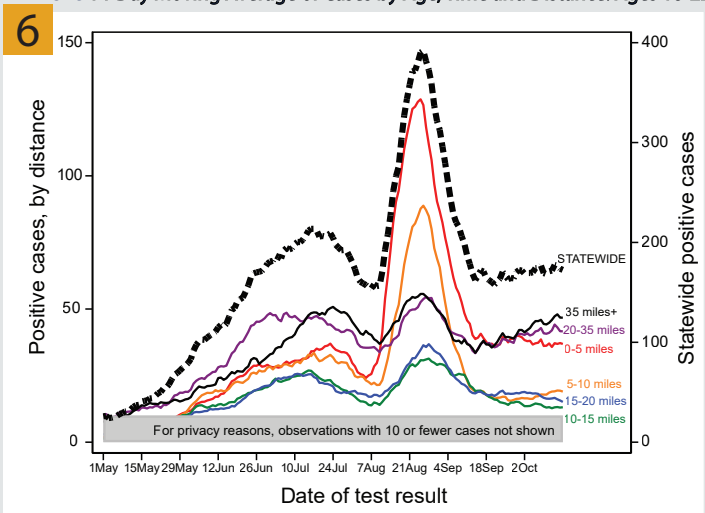
First, looking across all ages, we see that the trend lines in Exhibit 5 generally track together. Trends in the number of reported COVID-19 cases are largely independent of distance to a large university.

The exception, of course, is in August, when reported cases among ZIPs within ten miles of a large university increased, consistent with known COVID-19 case spikes in those areas.

Notably, recent case counts in ZIPs more distant from large universities are increasing faster than in ZIPs closer to large universities, which is consistent with our observation that reported cases of viral spread have increasingly shifted to rural areas of the state.

Turning now to Exhibit 6 and the 18-22 age group: as expected, there were marked increases in reported cases among 18-22 year olds in early to late August, with the increases most pronounced in areas nearest to a large university. Beyond 10 miles from a large campus, the increases in reported cases among 18-22 year olds were much smaller.

Exhibit 6 **14-Day Moving Average of Cases by Age, Time and Distance: Ages 18-22**

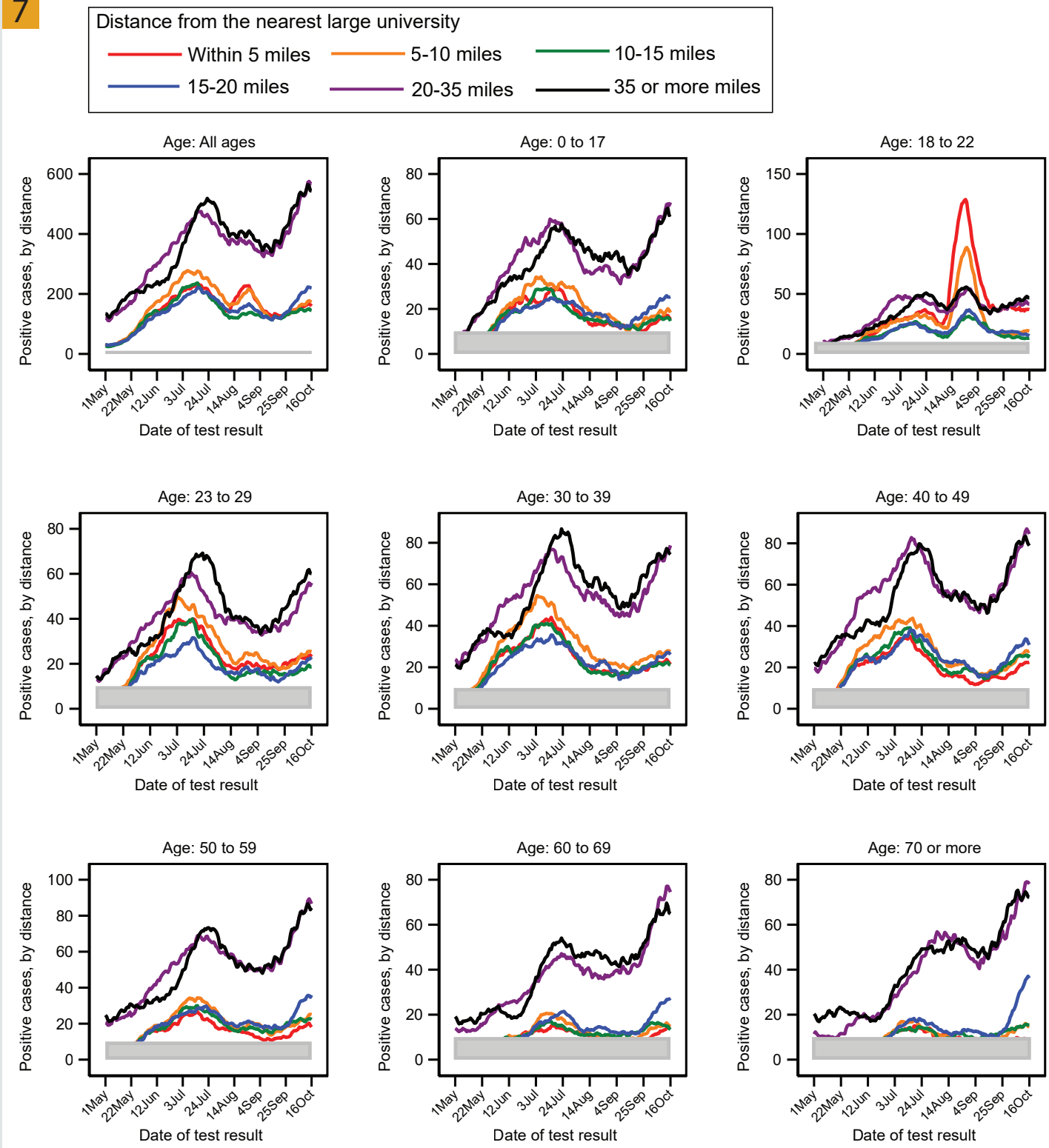


One concern has been whether a large population of college students experiencing outbreaks may "spill over" into people in other age groups in the same local community. Exhibit 7 shows reported cases in other age groups by proximity to large universities. We observe no obvious increase in reported cases associated with proximity to a large university except for the 18-22 year old age group. That is, the red and orange lines do not diverge from the remaining lines in those charts.

If there is spread among faculty and staff who live across more distributed distances from campus, it may be obscured in segmenting by proximity. However, Exhibit 7 does seem to indicate that, at least among those living closest to universities, outbreaks stayed relatively contained in the 18-22 year old age group.

There are limitations to this analysis (see appendix); however, the signal of reported cases among traditionally college-age young adults near university reopenings for the fall was still strong, as expected.

Exhibit 7 14-Day Moving Average of Cases by Age, Time, and Distance from Large Universities



For privacy reasons, observations with 10 or fewer cases are not shown.

Key Takeaways

- Who is currently most affected by COVID-19, and how consistent are the effects across time and regions?
  - We found that the age profiles of reported COVID-19 cases have varied over time and across regions. Recently, the ages of people with reported cases of COVID-19 have skewed older in the Greenville and Fayetteville regions, and in the more rural county classifications (small metropolitan and non-metropolitan). The oldest-age (80+) adults have some of the highest per-capita case rates, especially in the more rural counties.
- What is the urban-rural profile of reported COVID-19 cases per capita?
  - Though there were initially higher case rates in urban areas of the state, the pandemic is now well-established in rural areas, and it is currently more acute in rural regions than in urban ones.
- Have the August spikes in reported COVID-19 cases among college-age adults near large universities led to heightened viral transmission in other populations in those communities?
  - Our preliminary analysis finds little evidence that the student outbreaks have affected the broader university communities. There were large, temporary spikes in reported cases among 18-22 year olds in communities closest to large universities and some smaller increases among 23-29 year olds, but there was little evidence of increases across other age groups in the same communities.

Appendix: Methods

Distances using ZIPs:

We classified ZIP codes by the distance between the geocoded centroid of the ZIP and that of the closest university with an undergraduate enrollment of 10,000 or more students, classifying the aerial distance into categories of: less than 5 miles, 5-10 miles, 10-15 miles, 15-20 miles, 20-35 miles, or 35 or more miles.

Less than one percent of reported cases had no valid ZIP code included; those were excluded from the analysis.

Limitations:

The use of distance by ZIP is crude and non-specific, and it is not clear whether students give the ZIP of their permanent address or of their current address local to the university when being tested.

Furthermore, the reported cases from the NC COVID system using this distance-related method were often lower than the case counts reported by the universities on their own dashboards, which also signals there are limitations on assigning NC COVID cases to "university communities" with the ZIP method used in this preliminary analysis.

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