What Commute Patterns Can Tell Us About the Supply of Allied Health Workers and Registered Nurses

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KEY FINDINGS

Information on the available supply of workers in a local job market is important when determining whether there are qualified workers to fill health care jobs in demand. The American Community Survey (ACS), a publicly available annual survey of over 3.5 million households conducted by the U.S. Census Bureau, has been a regular source of information for mapping the geographic distribution of a wide range of occupations, describing the time, duration and distance of workers' commutes, and identifying common forms of transportation for commuting. In this study, we explore what the ACS can tell us about commuting patterns among selected allied health occupations and registered nurses (RNs) as well as how these patterns may inform discussions of health workforce supply.

We analyzed 13 occupations, which included 11 allied health occupations and 2 categories of RNs, those with less than a bachelor's degree and those with a bachelor's degree in nursing or higher. We restricted our analysis to individuals 18 years of age and above, currently employed in the United States. We excluded individuals who reported working from home. Our weighted sample represented 9,318,682 individuals. Our key findings are:

- Most individuals commuted to a different geographic area from their home.
- The average one-way commute time for these occupations ranged from 24.5 to 31.2 minutes compared to the nationwide average for all workers' commute time of 27.0 minutes, and most of these commuters drove alone.
- Blacks, Asians/Pacific Islanders, and other non-White races experienced 1 to 2 minutes longer commute on average compared to Whites. On the other hand, Hispanics had about a 45-second shorter commute compared to non-Hispanics.
- Public transportation was most commonly used in the Northeast Census region where public transportation is widely available, and it was associated with more minutes spent commuting compared to other forms of transportation.
- One additional minute spent commuting by workers was associated with a 0.13% average increase in individual wages. Wage gains associated with spending more time commuting tended to diminish for the longest commutes in four occupations:

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KEY FINDINGS *continued*

clinical lab technicians/technologists, home health aides, nursing/psychiatric aides, and dental hygienists.

- Compared to driving alone, carpooling, commuting by public transportation, and relying on other transportation lowered wages by 9.8%, 21.4%, and 31.8%, respectively.

Our study found that commute patterns among allied health care workers and RNs generally followed national patterns across all occupations including average commute time and common modes of transportation. ACS is a valuable resource that provides detailed commuting information for a wide swath of health care workers although there are limitations and results should be interpreted with some caution. Despite these limitations, a key takeaway from this study is that when estimating supply of health care workers, researchers and workforce planners need to measure local supply based not only on where people report working but also where they live.

What Commute Patterns Can Tell Us About the Supply of Allied Health Workers and Registered Nurses

INTRODUCTION

Information on the available supply of workers in a local job market helps health workforce planners determine whether there are qualified workers to fill health care jobs in demand. Reports on supply often rely on data that identify residence but not work location. Even when both work location and residence data are available, supply estimates are usually based on where someone works, which may not be a good representation of the available local labor supply. Health care, a service industry, ideally should be located where patients have the most demand for services. This study explores commuting patterns among selected health care occupations, including where people live versus work, and how these patterns may inform discussions of health workforce supply.

The American Community Survey (ACS), the data source for this study, has been used regularly for mapping the geographic distribution of a wide range of occupations, not limited to health care, describing the length and distance of workers' commutes, and identifying common forms of transportation for commuting. Studies that analyzed a five-year (2013-2017) pooled sample of the ACS data found the average one-way travel time to work was 26.4 minutes for all workers age 16 years and older, a slight increase from a decade earlier when commute times hovered around 25.5 minutes on average.[1,2] Longer work commute times have been associated with living in large metropolitan areas or small metropolitan areas within close proximity to a larger one, while those living in small metropolitan areas not close to a large metropolitan area experienced shorter commute times.[3] Since 2000, approximately 75% of workers consistently commuted via automobile and reported that they drove alone.[4] Carpooling was the next most frequent form of commuting (9.4%) and was most frequently reported by individuals age 16 to 24 years (12.3%), Hispanics (14.7%), and Asians (12.9%) according to analyses of the 2013 ACS.[4]

A vast literature exists on why people choose to work and live where they do, and their choices in transportation to commute between the two. The reasons for longer commute times are complex and dynamic, including urban traffic congestion, families' desires to live in better and/or more affordable neighborhoods further away from work, individual workers' desires to travel farther to find better jobs with higher pay and flexible hours, and employers moving to locations with lower business costs (e.g., less expensive leases, lower local taxes, lower wages).[5] A number of recent reports describing "mega commuters" or "extreme commuters" whose commutes cover great distances and consume many hours have included stories about health care workers who sought to balance well-paid opportunities and affordable housing.[6-9] Increasing commute time is a societal concern as it may lead to a loss in productivity and quality of life as well as represent a mismatch in labor supply compared to job availability.

Studies of commuting patterns among the health workforce are sparse. One study using multiple years of the National Sample Survey of Registered Nurses (NSSRN) found that the percentage of RNs that worked and lived in the same rural area types has been dropping over time, from 69% in 1980 to 36% in 2004 among isolated small rural areas and from 83% in 1980 to 59% among small rural areas in 2004.[10] Another study using more recent NSSRN data found that rural RNs who commuted to urban areas or to a different type of rural area (e.g., isolated rural to small rural) were more likely to be younger, work in hospitals, hold staff nursing/nurse clinician/consulting positions, have changed employers in the prior year, and have higher salaries.[11] These studies suggest that even though RNs may live in rural areas where jobs may be available and patient demand may exist, like many other Americans they seek opportunities elsewhere for better quality jobs or more preferential work arrangements.

Knowing the commuting patterns of the broader health workforce has value to workforce planners who want to understand the local supply of workers, measure productivity as well as the gain or loss in earnings due to increased commuting, and identify opportunities for additional fringe benefits such as transportation subsidies. To fill this gap in knowledge, this study used the 2017 ACS to explore residence-to-work commuting patterns and factors associated with commuting among selected health care occupations that require a bachelor's degree or less. We focused on these jobs because, while in high demand, these workers may face limited housing and transportation options. We identified which workers in these occupations commute most frequently and the length of time spent commuting; the most common forms of transportation; individual, work and community characteristics associated with commuting patterns; geographic variation; and whether wages are associated with longer commute times. We discuss how these patterns may influence the interpretation of reports on health workforce supply and steps needed to improve our understanding.

DATA AND METHODS

We used data from the 2017 ACS, an annual survey of 3.5 million households collected by the U.S. Census Bureau and extracted through the Integrated Public Use Microdata Series (IPUMS).[12] ACS provides detailed demographic, socioeconomic, and work characteristics (e.g., occupation, industry, wages, and hours worked). We selected health care occupations that require a bachelor's degree or less for entry, often considered allied health occupations: dental hygienists, dental assistants, therapists, licensed practical/vocational nurses (LPNs/LVNs), emergency medical technicians (EMTs)/paramedics, clinical lab technicians/technologists, other technicians/technologists, medical assistants (MAs), nursing/psychiatric aides, home health aides, and personal care aides. Given the small sample sizes, we combined several related occupations into a broad category we call "therapists": radiation therapists, recreational therapists, respiratory therapists, exercise physiologists, and speech language pathologists. In the Census, a single occupation code is used for "nursing, psychiatric, and home health aide." We attempted to isolate the occupation "home health aide" by separating out individuals who were classified under the Census industry code for "home health services." For the remaining individuals, we classified them as "nursing and psychiatric aides" regardless of industry, although home health aides working outside of the home health services industry may still be in this grouping. We also included registered nurses (RNs), which we categorized as: 1) those with less than a bachelor's degree in any field, and 2) those with a bachelor's degree in nursing (i.e., BSN). In total, we analyzed 13 categories of occupations (hereafter referred to simply as occupations). We further restricted our analysis to individuals 18 years old and over, currently employed in the U.S., and reporting that they commute for work (i.e., they do not work at home). Our weighted sample represented 9,318,682 individuals.

The commuting variables explored in this analysis included arrival time at work, self-reported one-way commute time from home to work in minutes, whether an individual lived and worked in different Public Use Microdata Areas (PUMAs), and the primary mode of transportation relied on for home-to-work commute, as follows:

- **Arrival time:** Based on distribution of arrival times to work, we created two categories: standard hours of arrival (6:00 am to 10:59 am) versus non-standard hours (anytime outside the standard range), that is, outside rush hours.
- **Commuting from home to a different geographic area for work:** The geographic unit available in ACS is a PUMA, a Census geographic unit including at least 100,000 people. PUMAs cover the entirety of the U.S. and its territories.[13] They are derived from Census tracts and counties, geographically contiguous, and wholly contained within a state or equivalent geographic entity.
- **Primary mode of transportation:** We categorized transportation modes into four categories: drive alone, carpool, public transportation (i.e., bus/trolley bus, streetcar/trolley car, subway/elevated, railroad, ferryboat, taxicab), and other forms of transportation (i.e., motorcycle, bicycle, walking, other method).
- **Commute time:** This is the one-way commute time in minutes from home to work.

In our analysis, we included the sociodemographic characteristics of age, sex, race, ethnicity, marital status, presence of children in the household, homeownership status, other household income, metro versus non-metro designation for residence, and Census region. We also controlled for work-related characteristics including individual annual wages, full-time status (defined as weekly work hours of 32 or more), weekly work hours, and county-level economic factors such as the unemployment rate within the individuals' county of residence. We obtained county-level economic factors from the U.S. Department of Agriculture Economic Research Service, which we merged with the ACS dataset based on PUMAs.[14]

We conducted descriptive univariate and bivariate analyses of our commuting variables to see how patterns compared across our 13 occupations. We conducted three regressions. The first used ordinary least squares regression models to identify which factors (mode of transportation, standard arrival time to work, living and working in different geographic areas, sociodemographics, work characteristics, and county-level unemployment rate) were associated with a longer commute time. Second was a logistic regression to identify the factors that predicted whether individuals lived and worked in different PUMAs. Third was an ordinary least squares regression to examine the association between individual wages (logged) and commute time, controlling for the same factors in the first regression model.

RESULTS

SOCIODEMOGRAPHIC AND WORK CHARACTERISTICS

Given that many individual sociodemographic or work characteristics may be associated with commute patterns, we begin by summarizing these characteristics for each occupation in our sample (**Table 1**). All occupations had more women (74.0% or more) than men except EMTs/paramedics, where women represented only 33.7% of the occupation. The average age ranged from 35.9 years old among EMTs/paramedics and other technicians/technologists to 44.6 years old among RNs (less than bachelor's). Those in occupations requiring less education tended to be more racially and ethnically diverse. More individuals working in occupations requiring more education were married than those in occupations requiring less education. Percentages of persons with children did not vary greatly across occupations.

The average number of hours worked ranged from 32.0 hours for dental hygienists to 45.3 hours for EMTs/paramedics. (**Table 2**). Most individuals in each occupation worked full-time, with the lowest percentages working full time found among dental hygienists (61.5%), personal care aides (61.5%), and home health aides (61.7%). Average individual wages varied greatly across occupations although in general occupations with a higher educational requirement had higher wages. Average individual wages for personal care aides and home health aides were under $20,000 per year, and contributed, on average, about a third of total household income. Wages of higher-earning occupations such as RNs and therapists contributed close to half of household income.

Table 1: Sociodemographic Characteristics of Allied Health Workers and Registered Nurses, 2017

		N (Weighted)	Female (%)	Average Age (Yrs)	Hispanic	Race				Marital Status			Any Child in Household
Minimum Education Level	Occupation Category					White	Black	Asian/ Pacific Islander	Other	Married	Single	Divorced/ Separated/ Widowed	
High School Degree or Below	Personal Care Aides	1,248,462	83.9%	43.3	20.3%	56.4%	24.5%	9.1%	10.0%	37.5%	37.1%	25.5%	45.6%
	Home Health Aides	471,492	92.5%	44.2	20.2%	42.8%	40.6%	4.5%	12.2%	37.9%	34.0%	28.1%	54.1%
	Nursing/Psychiatric Aides	1,493,521	85.9%	38.8	15.2%	52.7%	33.3%	5.4%	8.5%	37.6%	43.2%	19.2%	48.5%
Post-Secondary Non-Degree Award	Licensed Practical/ Vocational Nurses	844,804	87.4%	42.6	11.8%	63.2%	26.6%	4.8%	5.5%	46.0%	30.0%	24.1%	50.9%
	Medical Assistants	514,353	90.8%	36.7	28.8%	68.0%	14.2%	5.1%	12.7%	44.0%	38.8%	17.3%	52.3%
	EMTs/ Paramedics[1]	207,880	33.7%	35.9	12.7%	82.7%	7.7%	2.7%	6.9%	47.0%	40.5%	12.5%	40.4%
	Dental Assistants	289,373	92.7%	37.0	26.5%	75.3%	7.1%	6.3%	11.3%	49.8%	36.0%	14.2%	47.8%
Associate Degree	Dental Hygienists	190,190	95.0%	42.9	8.8%	88.4%	3.7%	4.4%	3.4%	67.1%	17.9%	15.1%	53.3%
	Clinical Laboratory Technicians/Technologists	320,313	74.0%	42.2	13.1%	67.6%	14.9%	12.0%	5.5%	50.6%	32.0%	17.4%	40.9%
	Other Technicians/ Technologists	655,909	77.4%	36.2	14.0%	71.0%	14.0%	7.1%	7.9%	41.4%	44.6%	14.0%	41.1%
	Therapists[2]	292,837	80.3%	42.4	9.2%	82.8%	8.1%	4.8%	4.3%	66.0%	20.4%	13.6%	51.8%
	Registered Nurses (Less than Bachelor's)	1,549,173	88.3%	44.6	7.5%	78.1%	11.7%	6.2%	4.1%	59.6%	19.8%	20.6%	50.6%
Bachelor's Degree	Registered Nurses[3] (Bachelor's degree)	1,240,375	90.2%	41.8	7.2%	73.7%	9.0%	13.3%	3.9%	63.5%	22.7%	13.7%	51.1%

Data source: Ruggles S, Flood S, Goeken R, Grover J, Meyer, E, Pacas J, Sobek M. IPUMS USA: Version 8.0 [dataset]. Minneapolis, MN: IPUMS, 2018. https://doi.org/10.18128/D010.V8.0
1) EMTs = Emergency Medical Technicians.
2) Therapists include Radiation, Recreational, Respiratory, Exercise Physiologists, and Speech-language Pathologists.
3) RNs with a Bachelor's degree not in the field of nursing and RNs with above a Bachelor's degree in any field are excluded.

Table 2: Work Characteristics of Allied Health Workers and Registered Nurses, 2017

Minimum Education Level	Occupation Category	N (Weighted)	Average Weekly Hours Worked	Full-time	Average Annual Individual Wages ($)	Average Total Annual House-hold Income ($)	Wages, as a % of House-hold Income
High School Degree or Below	Personal Care Aides	1,248,462	34.2	61.5%	18,779	65,379	28.7%
	Home Health Aides	471,492	34.3	61.7%	19,898	60,226	33.0%
	Nursing/Psychiatric Aides	1,493,521	36.7	78.5%	26,010	73,422	35.4%
Post-Secondary Non-Degree Award	Licensed Practical/Vocational Nurses	844,804	38.1	83.3%	38,106	86,729	43.9%
	Medical Assistants	514,353	38.4	86.5%	30,307	85,159	35.6%
	EMTs/Paramedics[1]	207,880	45.3	85.7%	44,110	103,892	42.5%
	Dental Assistants	289,373	35.6	79.0%	31,580	94,497	33.4%
Associate Degree	Dental Hygienists	190,190	32.0	61.5%	50,428	132,081	38.2%
	Clinical Laboratory Technicians/ Technologists	320,313	38.8	87.7%	47,066	104,583	45.0%
	Other Technicians/Technologists	655,909	36.6	80.2%	31,531	92,040	34.3%
	Therapists[2]	292,837	37.7	84.6%	58,559	132,160	44.3%
	Registered Nurses (Less than Bachelor's)	1,549,173	37.7	84.4%	57,498	117,478	48.9%
Bachelor's Degree	Registered Nurses (Bachelor's)[3]	1,240,375	37.5	84.5%	65,922	134,578	49.0%

Data source: Ruggles S, Flood S, Goeken R, Grover J, Meyer, E, Pacas J, Sobek M. IPUMS USA: Version 8.0 [dataset]. Minneapolis, MN: IPUMS, 2018. https://doi.org/10.18128/D010.V8.0
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2) Therapists include Radiation, Recreational, Respiratory, Exercise Physiologists, and Speech-language Pathologists.
3) RNs with a Bachelor's degree not in the field of nursing and RNs with above a Bachelor's degree in any field are excluded.

RESIDENTIAL AND COMMUTE-RELATED CHARACTERISTICS

The distributions of the occupations included in this study across the four Census regions were generally similar, with only a few exceptions (**Table 3**). The highest proportions of individuals working in almost all occupations resided in the West. The South had the lowest concentration of home health aides (8.5%), but the highest proportion of personal care aides (34.0%). As expected, most of our sample lived in a metro area. The average county level unemployment rate was highest in the communities in which personal care aides and home health aides lived. Homeownership was higher among dental hygienists, therapists, and both types of RNs: close to 80% of workers in these occupations reported owning a home. On the other hand, fewer than half of personal care aides, home health aides and nursing/psychiatric aides owned a home.

The average one-way commute time ranged from 24.5 to 31.2 minutes for these occupations, compared to the national average across all occupations of 27.0 minutes. Workers in the "other technicians/technologists" category reported the shortest commute and home health aides reported the longest. Most individuals commuted to a different PUMA for work and most arrived during standard work hours. About 80% or more in occupations such as MAs, dental assistants, dental hygienists, and therapists arrived at work during standard work hours. Higher proportions in occupations such as nursing/psychiatric aides, EMTs, clinical laboratory technicians/technologists, and RNs (bachelor's) indicated arriving at work outside of regular hours, given that these occupations more often perform health services needed around the clock and seven days a week.

Table 3: Residential and Commute-Related Characteristics of Allied Health Workers and Registered Nurses, 2017

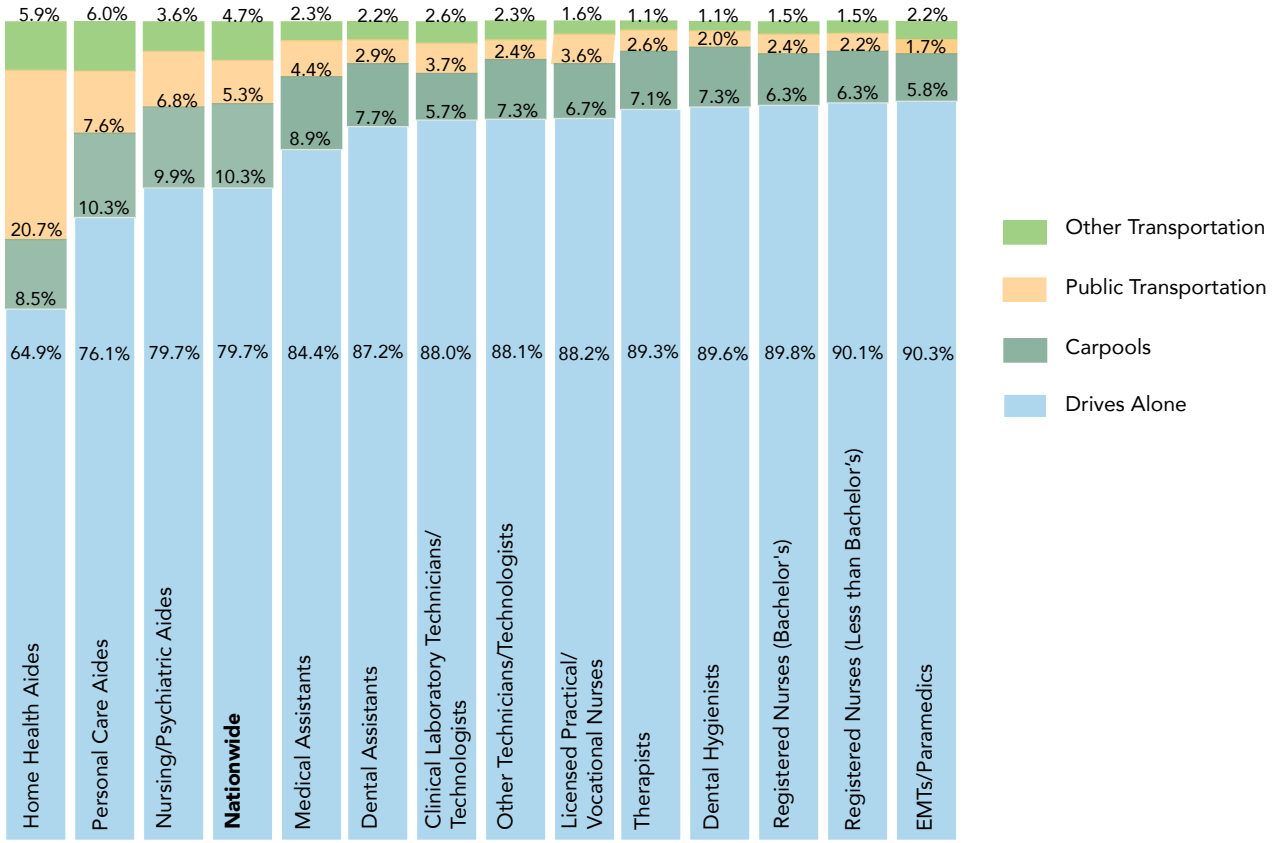
Minimum Education Level	Occupation Category	N (Weighted)	Census Region				Metro Residence	Average Unemployment Rate 2017--County Level of Home Location	Homeownership	One-way Commute Time (Minutes)	Home & Work: Different PUMA	Standard Arrival Time to Work (6:00am to 10:59am)
			Northeast	Midwest	West	South						
High School Degree or Below	Personal Care Aides	1,248,462	20.7%	19.8%	25.5%	34.0%	89.9%	5.6	48.4%	25.6	82.7%	67.6%
	Home Health Aides	471,492	42.8%	18.6%	30.1%	8.5%	90.3%	5.6	38.4%	31.2	86.2%	78.2%
	Nursing/Psychiatric Aides	1,493,521	24.4%	24.7%	33.9%	17.0%	88.2%	5.4	48.5%	25.7	80.5%	57.9%
Post-Secondary Non-Degree Award	Licensed Practical/ Vocational Nurses	844,804	22.2%	21.1%	38.4%	18.2%	86.8%	5.4	60.3%	26.3	80.6%	66.8%
	Medical Assistants	514,353	18.4%	19.0%	34.9%	27.6%	94.2%	5.4	57.4%	27.3	88.1%	88.8%
	EMTs/Paramedics[1]	207,880	24.3%	18.0%	33.8%	23.9%	86.7%	5.5	67.7%	30.0	80.8%	67.2%
	Dental Assistants	289,373	16.3%	17.7%	34.7%	31.4%	92.8%	5.3	62.0%	25.5	87.1%	90.6%
Associate Degree	Dental Hygienists	190,190	20.6%	23.2%	34.0%	22.2%	90.8%	5.2	79.3%	25.2	85.1%	92.8%
	Clinical Laboratory Technicians/Technologists	320,313	20.5%	23.1%	35.2%	21.2%	91.0%	5.1	67.4%	27.9	85.2%	64.7%
	Other Technicians/ Technologists	655,909	15.6%	22.6%	37.6%	24.2%	91.4%	5.3	62.5%	24.5	82.9%	75.1%
	Therapists[2]	292,837	21.2%	22.0%	35.1%	21.7%	93.0%	5.2	79.0%	27.5	86.7%	79.2%
	Registered Nurses (Less than Bachelor's)	1,549,173	19.5%	23.5%	37.8%	19.3%	89.0%	5.2	76.5%	27.5	82.4%	71.2%
Bachelor's Degree	Registered Nurses (Bachelor's)[3]	1,240,375	20.0%	24.1%	33.6%	22.3%	93.1%	5.1	76.7%	27.7	87.2%	68.0%

Data source: Ruggles S, Flood S, Goeken R, Grover J, Meyer, E, Pacas J, Sobek M. IPUMS USA: Version 8.0 [dataset]. Minneapolis, MN: IPUMS, 2018. https://doi.org/10.18128/D010.V8.0
1) EMTs = Emergency Medical Technicians.
2) Therapists include Radiation, Recreational, Respiratory, Exercise Physiologists, and Speech-language Pathologists.
3) RNs with a Bachelor's degree not in the field of nursing and RNs with above a Bachelor's degree in any field are excluded.

MODES OF TRANSPORTATION AND ASSOCIATED COMMUTE TIME

Most healthcare workers in our sample drove alone, ranging from 64.9% of home health aides to 90.3% of EMTs/paramedics (**Figure 1**). The national average for driving alone for the same time period was 79.7%. Examining public transportation, most notable was that 20.7% of home health aides took public transportation, almost three times the proportion of personal care aides at 7.6%. Use of public transportation as the primary mode of transportation by home health aides, personal care aides, and nursing/psychiatric aides well exceeded the national average of 5.3%. As well it varied considerably across Census regions, which largely reflects differences in transportation infrastructure across the country. Individuals living in the Northeast region used public transportation much more than other regions, a trend which held across health care occupations (data not shown).

Figure 1: Percent Using Mode of Transportation as Primary Source for Commuting by Allied Health Workers and Registered Nurses, 2017



Note: EMTs = Emergency Medical Technicians.
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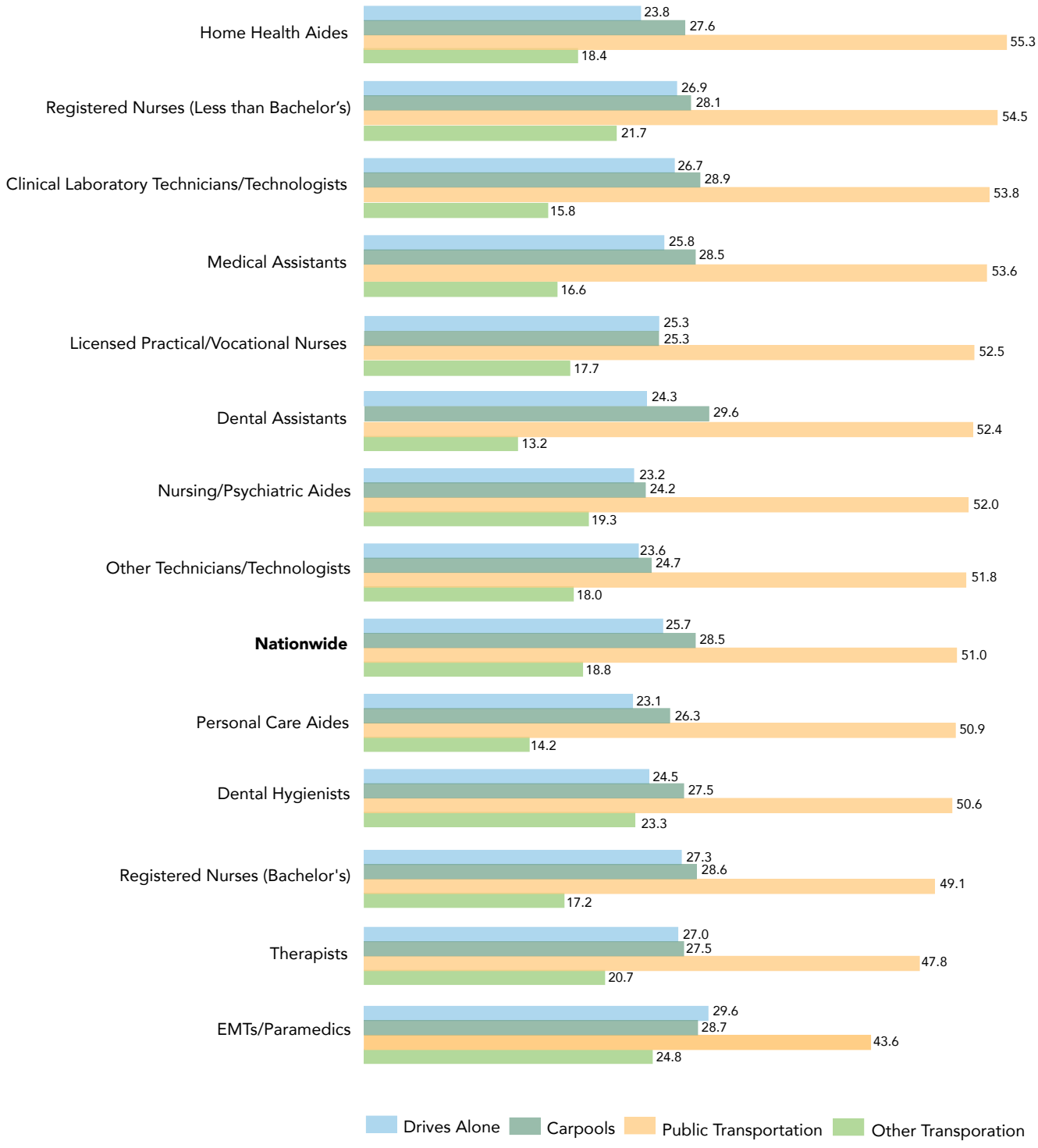
Within each mode of transportation, commute times did not vary greatly across the occupations studied. Those using public transportation exhibited the greatest variation (**Figure 2**). The average commute time for those who drove alone ranged from 23.1 minutes to 29.6 minutes, and carpooling added a few minutes to the average drive time. Those who used public transportation spent the most amount of time commuting, ranging from an average of 43.6 minutes for EMTs/paramedics to 55.3 minutes for home health aides.

Figure 2: Average Commute Time (in Minutes) by Means of Transportation and Occupation by Allied Health Workers and Registered Nurses, 2017



Note: EMTs = Emergency Medical Technicians.
Therapists include Radiation, Recreational, Respiratory, Exercise Physiologists, and Speech-language Pathologists.
RNs with a Bachelor's degree not in the field of nursing and RNs with above a Bachelor's degree in any field are excluded.
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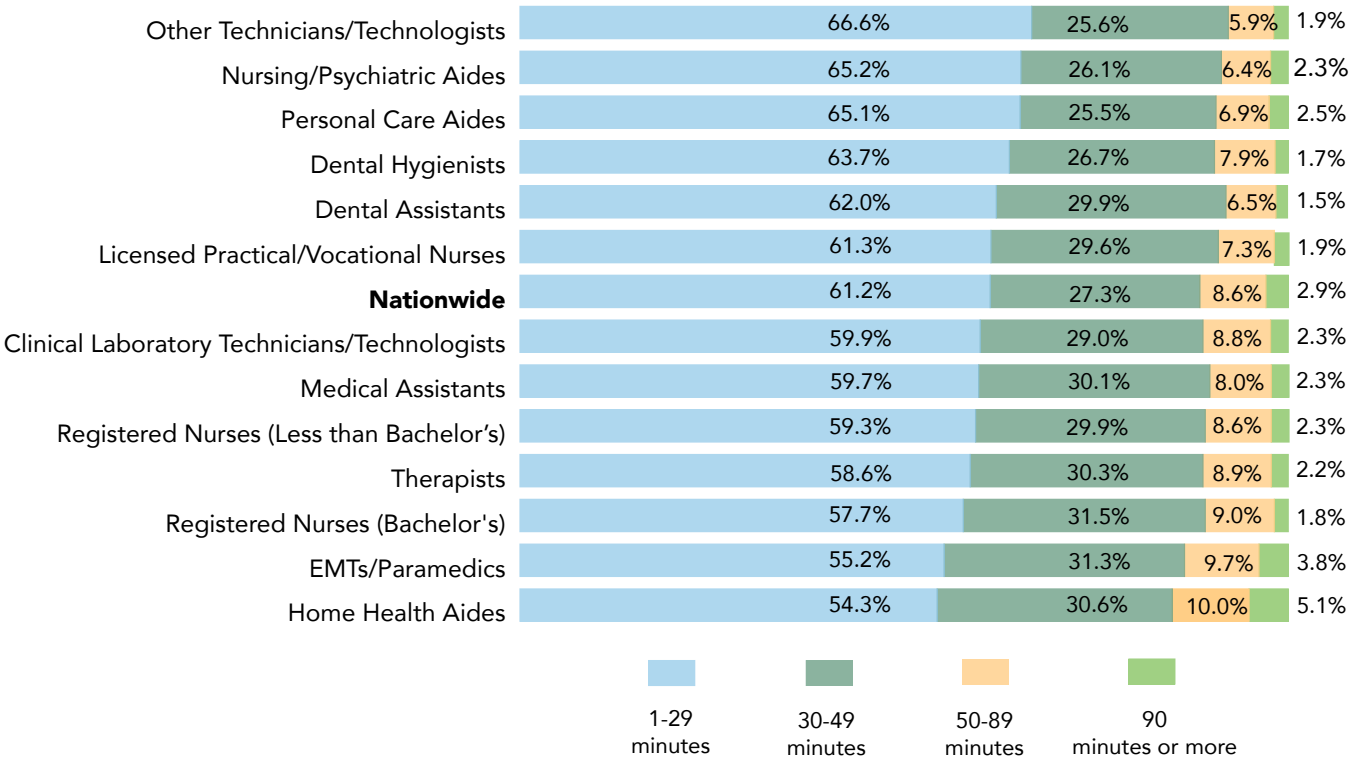
Figure 3: Commute Time Intervals by Allied Health Workers and Registered Nurses, 2017



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RNs with a Bachelor's degree not in the field of nursing and RNs with above a Bachelor's degree in any field are excluded.
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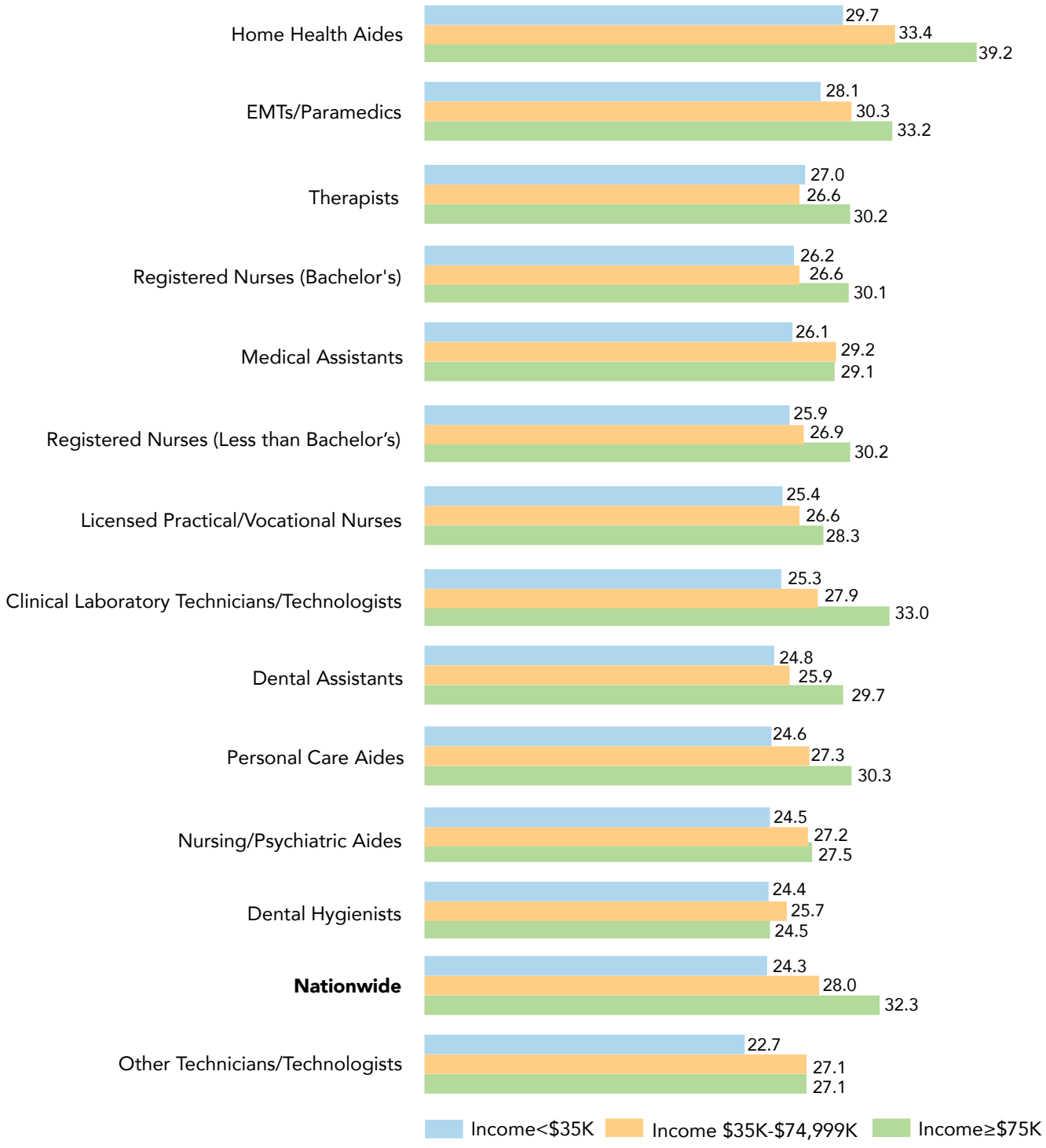
In **Figure 3**, we categorized individuals based on time spent commuting. Although most individuals reported a commute time of less than 30 minutes, it varied by occupation, ranging from just over 50% for home health aides and EMTs/paramedics up to 66.6% for other technicians/technologists. Using the Census definition of extreme commuters (those who travel more than 90 minutes one way),[15] home health aides had the highest percentage of extreme commuters at 5.1%, followed by EMTs/paramedics at 3.8%.

WAGES AND COMMUTING

Generally, longer commutes among the health care occupations studied were associated with higher average wages, a trend that is consistent nationally across all occupations (**Figure 4**). Dental hygienists were an exception: those in the middle earnings interval ($35,000 to $74,999) had a slightly longer commute than those in the highest earnings interval ($75,000 or more). For most occupations, there was only a small difference in commute time between the lowest and middle earnings intervals.

Figure 4: Average One Way Commute Time (in Minutes) by Individual Wage Earnings Intervals of Allied Health Workers and Registered Nurses, 2017



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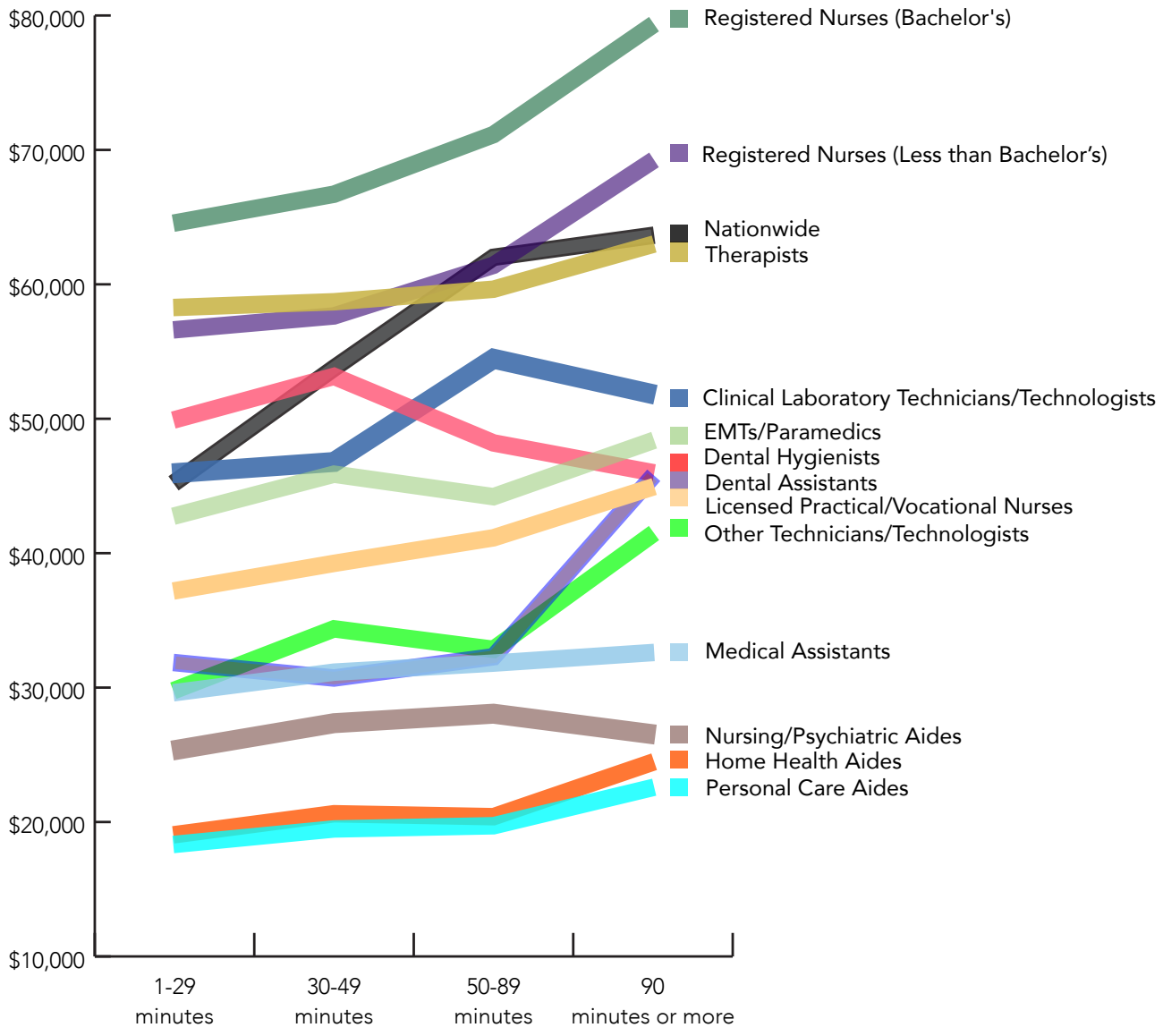
RNs with a Bachelor's degree not in the field of nursing and RNs with above a Bachelor's degree in any field are excluded.
Data source: Ruggles S, Flood S, Goeken R, Grover J, Meyer, E, Pacas J, Sobek M. IPUMS USA: Version 8.0 [dataset]. Minneapolis, MN: IPUMS, 2018. https://doi.org/10.18128/D010.V8.0

The wage gain with additional time spent commuting was not necessarily linear for all health care occupations studied (**Figure 5**), although an analysis of all occupations nationally showed a distinct positive and linear association between the two variables. Dental assistants and other technicians/technologists had the largest gains in earnings for extreme commuters compared to those whose daily one-way commute was less than 30 minutes. Clinical laboratory technicians/technologists, nursing/psychiatric aides, and dental hygienists saw diminishing returns for longer commute times.

Figure 5: Average Individual Wage Earnings by Commute Time Intervals of Allied Health Workers and Registered Nurses, 2017



Note: EMTs = Emergency Medical Technicians.
Therapists include Radiation, Recreational, Respiratory, Exercise Physiologists, and Speech-language Pathologists.
RNs with a Bachelor's degree not in the field of nursing and RNs with above a Bachelor's degree in any field are excluded.
Data source: Ruggles S, Flood S, Goeken R, Grover J, Meyer, E, Pacas J, Sobek M. IPUMS USA: Version 8.0 [dataset]. Minneapolis, MN: IPUMS, 2018. https://doi.org/10.18128/D010.V8.0

REGRESSION ANALYSES

Pooling all health care occupations in this study, we conducted three sets of multivariate regressions that examined (i) predictors of commute time, (ii) whether an individual lived and worked in different geographic regions as defined by PUMAs, and (iii) the linear relationship between wages and commute time.

Predictors of commute time. Ordinary least squares regression analysis identified individual, work, and transportation-related characteristics that had statistically significant associations with commute time for the health care occupations studied (**Table 4**). Blacks, Asians/Pacific Islanders, and other non-White races had 1 to 2 minutes longer commutes on average compared to Whites. Hispanics had about a 45-second shorter commute compared to non-Hispanics. Owning a home lengthened the commute time by about 2 minutes, on average. Commuting by public transportation also lengthened commute time by 26 minutes, on average, compared to driving alone. Although higher wages predicted longer commutes, the effect was negligible such that a 10% increase in wage resulted in only 0.04 minutes (or 2.4 seconds) increase. Other factors significantly associated with longer commute time were commuting outside of one's residence PUMA and being divorced/separated/widowed (vs. married). Living in a metro area shortened commute time by more than 3 minutes compared to those not living in metro areas. Other significant factors associated with shorter commutes were being a female, living in the Midwest (vs. Northeast), being single (vs. married), commuting during non-rush hours (11:00 am to 5:59 am), and relying on other forms of transportation such as motorcycle, bicycle, or walking. Factors that were not significant predictors at $p<0.05$ were living in the South or West Census regions, age, county unemployment rate, having any children in the household, or having other household income.

Predictors of commuting outside one's geographic area. The odds of commuting outside one's residential geographic areas (as defined by PUMAs) for work significantly increased for those who were older, single, Hispanic (vs. Non-Hispanic), Black or Asian/Pacific Islander (vs. White), lived in a metro area, had higher individual wages and higher household incomes, lived in the West (vs. Northeast), and traveled by public transportation (**Table 4**). Of particular note, the odds of Blacks and Asian/Pacific Islanders traveling outside their residential geographic area were 2.7 to 4.2 times higher, respectively, compared to Whites, and Hispanics had 2.7 times higher odds compared to non-Hispanics. Given the density of metropolitan areas, where PUMAs cover smaller geographic areas, individuals had much higher odds of leaving their residential areas than those in nonmetropolitan areas. Those using public transportation were four times more likely to work in a different geographic area from their residence than those driving alone. Living in a community with a higher unemployment rate, living in Midwest or South (vs. Northeast), and traveling during non-rush hours (11:00 am to 5:59 am) lowered the odds of commuting outside of one's residential geographic area. Factors not associated with commuting outside of the residential area at $p<0.05$ were gender, having children in the household, being divorced/separated/widowed, being an "other"/mixed race individual, owning a home, carpooling, or taking another form of transportation.

The relationship between wages and commuting. We found a statistically significant positive association between wage and commute time such that a one-minute increase in commute time led to 0.13% improvement in individual wages for the health care occupations studied (**Table 4**). Other variables that had statistically significant positive relationship with the individual wages were being a homeowner, living and working in different geographic areas, and working full-time. In particular, living and working in different geographic areas was associated with a 15.1% increase in individual wages. Age had a non-linear relationship with earnings, with individuals' rate of earning increasing as age increased, but the rate declined as individuals got older, which is consistent with the broader labor economic literature. Factors that had a negative effect on wages were living in the Midwest, South, or West (vs. Northeast), living in a county with higher unemployment rates, being divorced/separated/widowed or single (vs. married), being Black or other races (vs. White), being Hispanic (vs. Non-Hispanic), having more other household income, and traveling by public or other forms of transportation (vs. driving alone). In particular, compared to driving alone, other modes of commuting including carpooling, public, and other forms of transportation lowered wages by 9.8%, 21.4%, and 31.8%, respectively. Factors not significantly associated with wages at $p<0.05$ were gender, having children in the household, being Asian/Pacific

Table 4: Regression Results Predicting Commute Time, Commuting to a Different Geographic Area for Work from Home, and Individual Wages for Allied Health Workers and Registered Nurses, 2017

	Regression# 1: Commute Time		Regression# 2: Commute to Different Geographic Area		Regression# 3: Wages (Logged)	
	Coef.	Std. Err.	Odds Ratio	Std. Err.	Coef.†	Std. Err.
Age	-0.01	0.01	1.01***	0.00	0.05***	0.01
Age-squared					0.00***	0.00
Female (vs. Male)	-1.40***	0.31	0.96	0.05	-0.05	0.02
Any Child in Household	0.38	0.22	1.00	0.04	0.02	0.02
Marital Status (vs. Married)						
Divorced/Separated/Widowed	0.60*	0.29	1.00	0.06	-0.26***	0.03
Single	-0.56*	0.28	1.18**	0.06	-0.25***	0.03
Race (vs. White)						
Black	1.06**	0.33	2.67***	0.17	-0.21***	0.03
Asian/Pacific Islander	1.66***	0.43	4.21***	0.47	-0.04	0.03
Other/Mixed Races	1.60**	0.49	1.13	0.10	-0.11***	0.03
Hispanic	-0.74*	0.34	2.73***	0.19	-0.24***	0.03
Homeownership	2.00***	0.23	0.97	0.05	0.32***	0.02
Metro Area	-3.35***	0.83	21.38***	3.22	0.20	0.11
Regions (vs. Northeast)						
Midwest	-2.01***	0.30	0.47***	0.03	-0.14***	0.03
South	0.09	0.32	0.55***	0.03	-0.20***	0.02
West	-0.08	0.31	2.10***	0.15	-0.08***	0.02
County Unemployment Rate	0.22	0.12	0.84***	0.01	-0.02***	0.01
Work/Home in Different PUMAs	8.69***	0.31			0.16***	0.03
Non-Rush Hours Commute	-1.19***	0.24	0.89**	0.04	0.00	0.01
Log(Wages)	0.38***	0.08	1.07***	0.01	-0.04	
Log(Other HH Income)	0.00	0.03	1.01*	0.01	2.38***	0.00
Fulltime Employment					0.00***	0.03
Commute Time (outcome measure)					0.00**	0.00
Modes of Transportation (vs. Drive Alone)						
Carpools	1.49***	0.41	1.02	0.08	-0.09**	0.03
Public Transportation	25.99***	0.71	4.13***	0.83	-0.19***	0.04
Other Transportation	-6.87***	0.55	0.98	0.12	-0.27***	0.06
Constant	17.14***	1.48	0.33***	0.08	5,420.73***	0.15

* p<=0.05, ** p<=0.01, *** p<=0.001. Balanced repeated replication standard errors
† Coefficients converted using the formula Exp(B(hat)-1).

Islander, living in a metro area, and commuting during standard times. The lack of significance for these factors may be subject to small sample size, particularly for health care workers who are male or Asian/Pacific Islander.

Most trends held within individual health care occupations studied (data available upon request). For example, living in different geographic areas from work and carpooling or relying on public transportation had a statistically significant positive association with commute time for all occupations, while using other forms of transportation had a statistically significant negative relationship with commute time for most occupations, except for RNs (less than bachelor's), therapists, dental hygienists, and EMTs/Paramedics, which was inconclusive due to lack of statistical significance. Also, similar to the pooled analysis, age had a non-linear relationship with wages, and living in the South almost always had a negative association with wages in analyses of individual occupations. In addition, being Hispanic (vs. Non-Hispanic), or Black or Asian/Pacific Islander (vs. White), and relying on public transportation almost always significantly increased the likelihood of commuting to a different geographic area for work, while living in the Midwest or South (vs. Northeast), and traveling during non-rush hours (11:00 am to 5:59 am) lowered the likelihood.

DISCUSSION

We found that commute patterns among the 11 allied health occupations and 2 categories of RNs that we studied generally followed national patterns for all occupations, including average commute time and common modes of transportation.[4] Individuals working as personal care aides, home health aides, or nursing/psychiatric aides (often low-paid jobs) were more likely to use public transportation, particularly in the Northeast, where public transportation infrastructure is most robust. After controlling for several factors, those who used public transportation, carpooled, or relied on "other means of transportation" had significantly lower earnings compared to those who drove alone. Public transportation and carpooling were both associated with a longer commute time in the regression analysis.

Longer commutes were associated with higher individual wages overall. For dental assistants and other technicians/technologists, extreme commuting had considerable wage benefits, but for most other occupations there was either a very small gain or even loss in wages. In the regression analysis, we found a small, positive association between commute time and earnings. Our results also showed that among the working occupations we studied, living in a community with higher unemployment is associated with less time commuting and low earnings. While long commutes are not inherently desirable, their association with higher wages deserves more investigation. Structural barriers may be limiting some workers from commuting further to seek higher wage jobs. It is also possible that higher paying jobs provide workers more resources that allow them to live farther from their place of work.

Most workers examined for this study commuted outside the areas in which they lived. We were not able to identify the relationship between employment opportunities, longer commutes, and traveling outside the geographic area (defined as PUMAs) where they reside. For example, those who had longer commutes were more likely to own a home, which could suggest that the worker may have located farther away from work in order to own a more affordable home. Smaller and denser PUMAs within metropolitan areas make the meaning of movements across geographic areas difficult to interpret.

CHALLENGES ASSESSING COMMUTE PATTERNS

ACS is a valuable research resource that provides detailed commuting information for a wide swath of health care (and other) workers. While surveys such as the American Time Use Survey collected by the U.S. Department of Labor Bureau of Labor Statistics or the National Household Travel Survey collected by the U.S. Department of Transportation Federal Highway Administration could provide additional information about commute patterns, these surveys lack detailed information about occupations and wages, which ACS provides.[16] ACS, however, has some significant limitations and should be used with some caution.

Commuting questions in the ACS allow individuals to report only one mode of transportation that was "used for most of the distance."[17] We know, however, that people may not consistently use the same mode of transportation every day, and may bike on a sunny day and bus on rainy days. People also may combine transportation modes such as walking and bus, bus and train, or car and train. An increasing number of people are using ride-hailing apps such as Uber and Lyft, but this is not currently captured in ACS.[18,19] Understanding who uses multiple modes of transportation is important to gain a full picture of all modes of transportation that contribute to a commute.

ACS provides information about the time of day people begin their commute and the length of their initial one-way daily commute captured in minutes. This information provides only a partial picture of a person's commute pattern. First, we do not know how to associate the time spent commuting with the mode of transportation when only one mode of transportation is reported; just because one travels the farthest with one form of transportation does not mean that is the most time-intensive part of a commute (e.g., traveling a short distance within a congested city). We do not know how many hours in a day a person typically works, only the number of weekly hours.[20] We also do not know what days of the week a person works. While we found that many health care workers start work within typical work hours, we know that others, especially RNs (bachelor's), home health aides, personal care aides, and EMTs/paramedics work nights and weekends, sometimes on longer shifts for fewer than five days a week. Without this information, we are not able to factor into our analyses how work schedules may influence commute choices or options.

Another data challenge is how ACS measures work location: ACS asks about the commute to the work location where the person "worked the most last week." This question poses a challenge for health care occupations that may work in multiple locations (e.g., EMTs/paramedics, personal care aides, or home health aides). Further investigation is needed to understand how workers employed in multiple locations would answer questions on commute time and means of transportations. Yet another challenge is that we are unable to capture an individual's commuting direction. For example, if individuals are commuting more from smaller rural to larger rural areas, then policies that yield more competitive jobs and salaries in rural areas could provide incentives to rural healthcare workers to work in the communities they reside. In our analysis, we rely on PUMAs, which have only two designated statuses, metro and non-metro. We find that over 85% of our sample live in metro areas. A more detailed categorization of rural and urban status, such as the ones provided by Rural-Urban Commuting Area codes,[21] may help us understand more about commuting flows and local labor market scenarios.

Lastly, we do not have precise information about the distance to work. ACS restricts geographic detail of home and work to the level of a PUMA. As a result, we can only calculate straight-line distances between the centroids of the home and work PUMAs. Since PUMA sizes reflect population density, metro areas have geographically smaller PUMAs, and it is more likely that a metro resident would travel for work to a different PUMA within a short distance. In rural parts of the country where a single PUMA can cover a large geographic area, PUMAs may be many miles apart. Yet it is possible that a rural person may not travel as far as the centroids of PUMAs would suggest; a person could live close to the boundary of one PUMA and work on the other side of the boundary in another. Accurate distance measurement is critical for a better understanding of geospatial patterns related to commuting.

CONCLUSIONS

The ACS provides a starting point to understanding health care workers' commute patterns, helping policymakers identify opportunities for transportation subsidies, transportation infrastructure that improves access to jobs for individuals and communities, and affordable housing. This area of inquiry exists within a much larger literature explaining the complex dynamics of the socioeconomic factors associated with the decision to work (e.g., employment patterns of women, household composition), decisions about the locations of health care systems and the resulting impacts on the availability of jobs, and the challenges associated with the lack of available affordable housing.

Findings of our study demonstrate reason for particular concern for home health aides, personal care aides, and nursing/psychiatric aides, which our prior studies have identified as primarily people of color whose jobs leave them in precarious socioeconomic conditions (e.g., limited health insurance benefits, high levels of poverty, low pay) compared to other health care jobs.[22,23] Home health aides, personal care aides, and nursing/psychiatric aides were among the highest users of public transportation, associated with significantly longer commute times but not necessarily higher wages. Given their low pay, these workers may rely on public transportation for its affordability rather than its convenience. These workers are also more likely to live where housing is affordable but unemployment is high, leaving them with few local job opportunities. Understanding commuting patterns in different occupations can begin to unveil socioeconomic barriers that lead to the socially determined segregation between some categories of health care workers and the patients they serve.

While the reasons for working, living, and commuting between different locations cannot be answered with ACS data, it is clear that many people require a significant commute to reach their work location, and differences between occupations follow systematic patterns. When estimating supply of health care workers, researchers and workforce planners need to measure local supply based not only on where people report working but also based on where they live. Demand for some types of health care workers is likely to be higher in areas with larger elderly populations and wealthier populations, but these are not necessarily where health care workers, especially those who are younger (e.g., EMTs/paramedics) or less wealthy (e.g., home health aides, personal care aides, and nursing/psychiatric aides) want or can afford to live. While we were able to examine home ownership in this study, we do not know whether individual workers would prefer to live closer to where they work but do not because of housing affordability concerns or preferences for neighborhood quality (e.g., access to better quality schools). The work conducted in this study results in additional questions needing investigation such as the extent to which health care markets are drawing upon their local labor supply or whether they may be drawing supply from areas that could otherwise use health care workers. Our findings suggest that when assessing health workforce supply, consideration of both where workers work and live is important because we cannot presume that workers are available close to where health care Is delivered. For example, specific information about commuting patterns of the health workforce can be highly useful for planning for disasters, natural or otherwise, that cause disruption to the transportation infrastructure. For a workforce to be effective, workers must be located or able to be deployed where population need is greatest.

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