Who are Rural Students? How Definitions of Rurality Affect Research on College Completion

Research in Higher Education
https://doi.org/10.1007/s11162-019-09556-w

SHORT PAPER

Who are Rural Students? How Definitions of Rurality Affect Research on College Completion

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Received: 22 May 2018

Abstract
Given a revived national discourse about rural populations, more educational research on rural students is necessary, including ways that rural students transition to college and the success (or lack thereof) that they experience once there. However, the National Center for Education Statistics (NCES) has changed the definition of rurality used in each iterative dataset over the last few decades, casting doubt on the consistency of what is meant by the term rural. The purpose of this study is to: (a) communicate to the educational research audience various ways of defining rural students, and specifically how NCES has changed their definition of rurality over their last three major data collections; (b) demonstrate how conclusions about rural students' and their college degree completion may differ based on these alternate NCES definitions; and (c) discuss how this specific example using NCES data relates to the wider landscape of research on rural students. Results show that conclusions about college degree completion change depending on the definition of rurality used for analysis. Therefore, the education research community should consider the options for defining rural students, report transparently about the choices made, consider the sensitivity of results to the definition of rurality, and ultimately build a more robust body of literature concerning rural students' college success. Gaining definitional clarity will be beneficial, particularly for those who wish to translate their research into practical action for the benefit of rural students.

Keywords Rural students · Postsecondary education · Quantitative analysis · Secondary data analysis · Degree completion

Introduction

The 60 million Americans who live in rural areas constitute about 20% of the population (US Census Bureau 2010). Similarly, among high school students, a little over 18% are from rural areas (Koricich et al. 2018). Despite the prevalence of rural students, their college trajectories and outcomes have historically been understudied. However, discourse surrounding the 2016

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presidential election brought connections between rurality and educational attainment (as well as income, employment, health, and politics) to the forefront (e.g., Monkovic 2016; Brown and Fischer 2017; Pappano 2017). Past research has shown that rural youth attend postsecondary institutions less often than their non-rural counterparts (e.g., Byun et al. 2012; Koricich 2014; Turley 2009). Moreover, rural students have decreased odds of attending highly selective institutions or institutions that offer graduate degrees, and they have benefited less from a higher socioeconomic status in their college-going than their non-rural peers (Koricich et al. 2018). Given that much existing research uses outdated data and many relevant college-going questions remain unaddressed, a resurgence of educational research on rural students is needed. Questions of college access, college experiences, and degree completion for rural students need attention, particularly with the renewed public interest in rural students' educational outcomes.

As postsecondary researchers address these issues, the National Center for Education Statistics (NCES) provides an obvious and vital source of data, specifically their series of data collections examining high school students' transitions to college, which follow students longitudinally measuring outcomes like degree completion. These nationally generalizable datasets contain information about students' geographic origins and therefore are suitable for researching rural students' college access and success. However, changes to NCES' definitions of rurality across each iterative data collection mean different types of students have been categorized as rural across different cohorts.

As the body of research on rural students grows, it will become increasingly important for the educational research community to understand how changing definitions of rurality impact results, conclusions, and recommendations regarding rural students. As rural and urban settings change over time, updating the definition of rurality is natural and necessary to ensure that educational research targets the intended student populations. However, without understanding the details of how variation in the definition of rurality impacts research on rural students' access and success, researchers can potentially draw incorrect conclusions. Moreover, the use of varying definitions, while desirable in many ways, can cause misleading comparisons across studies or across datasets over time if not used with caution and transparency, even when those data are all from the same governmental agency.

This study aims not to argue for a singular definition of rurality, but to provide insight into how variation in the definition of rurality impacts conclusions drawn from college student research, using NCES data as the specific example. This will be beneficial for informing researchers and for translating research appropriately into practical action for the benefit of rural students. Therefore, this study's purposes are to: (a) communicate to educational researchers various ways of defining rural students, and specifically how NCES has changed their definition of rurality over their last three major data collections; (b) demonstrate how conclusions about rural students' and their college degree completion may differ based on these alternate NCES definitions; and (c) discuss how this specific example using NCES data relates to research on rural students more broadly. Based on our examination of this issue, we make recommendations about how to consider options for defining rural students, report transparently about choices made, and test the sensitivity of those choices with alternate definitions, with the aim of building a more robust body of literature concerning rural students' college access and success.

Defining Rurality

We are not the first researchers to examine varied definitions used for rurality and to consider how inconsistent definitions may impact research conclusions and policy implications. Isserman (2005) clearly articulates the importance: "When we get rural wrong, we reach incorrect research conclusions and fail to reach the people, places, and businesses our governmental programs are meant to serve" (p. 466). The definitional possibilities range widely, from legitimate efforts to define rurality based on the number of cows or deer per capita, or based on land use (Ratcliffe et al. 2016; Jones et al. 2017), to more sophisticated and nuanced aggregated definitions (Isserman 2005). The predominant definitions of rurality are constructed by the Census Bureau and the Office of Management and Budget (OMB), both of which define rurality by what it is not. The Census Bureau precisely defines what is considered urban, based on factors such as population and density, considering rural to be everything else. OMB (2000) instead defines metropolitan statistical areas (MSA) by attempting to tie core metropolitan areas to surrounding communities that are connected to that core. Rural is often used synonymously with non-metropolitan in this case. Even with these predominant federal definitions, and partially due to advances in technology like satellite imagery and computer-based mapping, more nuanced classifications of urban areas continue to be created (Ratcliffe et al. 2016), resulting in continually different conceptualizations of rurality, from which multiple operational definitions for variables in quantitative studies have been generated (e.g., Isserman 2005; Johnson 2012; Ratcliffe et al. 2016).

While researchers need to understand this broad landscape of rural definitions, the scope of this research brief focuses narrowly on one source of particularly salient data for education researchers. NCES provides some of the best data for obtaining nationally generalizable results related to postsecondary trajectories and outcomes. However, as NCES has changed the definition of rurality within their datasets with each iterative data collection, different types of students have been categorized as rural across different cohorts.[1] The changing definition of rurality can lead researchers, and readers for that matter, to draw potentially incorrect conclusions, make inappropriate comparisons, or suggest inappropriate recommendations.

We demonstrate the issues by examining the definition of rurality in three NCES datasets, structured not only to exist as standalone data sources, but also to function effectively as repeated cross-sectional data such that comparisons and trends can be examined over time.[2] These datasets, gathered approximately a decade apart, have been constructed to study a cohort of high school students and follow them longitudinally for several years. We highlight how rurality has been defined in these datasets: (a) the National Educational Longitudinal Study of 1988–2000 (NELS), (b) the Education Longitudinal Study of 2002–2012 (ELS), and (c) the High School Longitudinal Study (HSLS) which began in 2009 and most recently collected their second follow up in 2016. The importance of understanding what is meant by the term rural in these datasets is evident from literature

[1] We note that an additional issue for researchers to consider is the recategorization of geographical areas based on population changes over time, but addressing this issue is beyond the scope of this brief.

[2] This is not strictly true for the most recent HSLS dataset, as NCES gathered data from 9th graders rather than 10th graders and followed a different data collection strategy than previous collections, making comparisons over time less appropriate.

researchers have already produced using them to study rural students (e.g., Byun et al. 2012; Koricich 2014; Byun et al. 2015; Koricich et al. 2018; Wells et al. 2019).

While these studies consistently identified rural students as experiencing lower rates of postsecondary success than their peers, a more nuanced understanding of similarities and differences in their findings is more challenging. For example, whether such gaps are increasing or decreasing as trends over time may not be possible to identify. Assuming researchers in each case used the NCES-derived variables for 'rural' provided with each dataset, then they began from different fundamental definitions of rurality, making comparisons difficult.

While any individual study may be affected by a changing definition, a lack of construct consistency across the body of literature produced is an even larger concern. Even though there are legitimate reasons for using different definitions of rurality from one dataset to the next, if studies use different definitions in a manner that is not transparent (or perhaps without even being aware of it) there is likely to be confusion in the literature at best, and incorrect conclusions or recommendations made for rural students at worst.

NCES Definitions

Until 2006 (in both NELS and ELS), NCES used locale codes for high schools based on both proximity to metropolitan areas and on population size and density (combinations of the Census and OMB approaches described above), and included categories of urban, suburban, and rural (Curtin et al. 2002). Metropolitan areas included counties containing an urban core of 50,000 or more people as well as counties that were highly integrated with such a county as measured by commuting patterns (Johnson 2012). Using these measures in NELS, rural status was defined based on location outside of a defined metropolitan area. ELS used a description of rurality that was, like NELS, based on location outside of a defined metropolitan area. However, a finer grained set of categories was used in ELS to define rural schools (Ingels et al. 2004). This resulted in some of the locations outside of MSAs that were considered rural in NELS to be considered non-rural in ELS. Specifically, areas defined as "towns," both large and small (but over 2500 residents) were included in the *suburban* category in ELS, but would have been placed in the *rural* category in the NELS dataset.

NCES revised its definitions of school locale types again in 2006, creating a new locale classification system for the HSLS dataset. While both the NELS and ELS datasets used the metro-centric locale codes described above (Curtin et al. 2002; Ingels et al. 2004), the HSLS dataset used a new system for determining locale codes. The revised categorization was based on improved geocoding technology that relied less on population size and county boundaries and more on the proximity of an address to an urbanized area. Referred to as an "urban-centric" classification, there were four major locale categories generated—city, suburban, town, and rural—each of which could be subdivided into three subcategories depending on the size (large, midsize or small) for cities and suburbs, and distance to urbanized area (fringe, distant or remote) for towns and rural areas (National Center for Education Statistics, n.d.).

An Example Analysis Utilizing Varying NCES Rural Definitions

We focused on the definitions of rurality in the three widely used U.S. longitudinal, nationally representative datasets from NCES discussed above: NELS, ELS, and HSLS. These definitions were applied to the ELS data, which are the most recent that would allow us to explore degree completion. ELS defined high schools as rural in 2002 and 2004, and followed students longitudinally through 2012, which is when we examine college degree completion. (For more information about ELS, see Ingels et al. 2004.) The sample was restricted to students who enrolled in postsecondary education, resulting in an analytic sample of 9360 students. Missing data were handled with multiple imputation (100 imputations; van Buuren 2012), and analyses were conducted accounting for the complex survey design used in the ELS data collection (Heeringa et al. 2010).

We defined rurality of a student's high school location in the three ways described above, so that we could compare different operationalizations of rurality using the same data (ELS). (To be clear, we did not use NELS or HSLS data in these analyses, only their definitions of rurality.) Using the source data in ELS, we created rural, urban, and suburban variables based on the NELS and HSLS operational definitions (as well as a 'town' variable for HSLS). This resulted in three unique operational definitions of rurality: the predefined definition for rurality in ELS as well as our two recreated definitions of rurality, consistent with NELS and HSLS. These variables facilitated investigation of how conclusions might be drawn differently from the same students based only this definitional difference in rurality.

Once these three sets of variables were created, we used them in otherwise identical analyses. We first described the proportion of students in the sample that would be considered rural under each definition, and how the other demographic and academic experience variables may have changed depending on the definition used. Using t-tests, we also compared means for the HSLS definition of rural, suburban, and urban to the corresponding definitions from NELS and ELS. We then examined the association between high school rurality and completion of a college degree using a multinomial logistic regression model comparing the outcomes of bachelor's degree completion (or higher), associate's degree completion, and no degree completion (reference group; Long 1997). We used identical regression models, changing only the way rurality was defined across the analyses. With these methods, we isolated how conclusions and recommendations would change based solely on a change in operational definition.

Results: Differential Outcomes Based on Alternate Definitions

Descriptive results in Table 1 show that mean values, which correspond to the percentage of students considered rural under the three definitions, varied from 32% with a NELS definition, to 20% with ELS, and to 23% with HSLS. The difference between NELS and HSLS definitions was statistically significant. This is the simplest and perhaps clearest demonstration that the rural student sub-populations under these varied definitions are quite different from one another. (Full descriptive results for all variables, across all three definitions, may be found in "Appendix 1.")

Conclusions about college degree completion across rural, suburban, and urban students (as well as town students when using an HSLS definition), as shown in Table 2,

Table 1 Estimated (weighted) means and standard errors of the estimates for all college enrollees, including whether the NELS or ELS rurality definitions significantly differ from the corresponding HSLS rurality definition

Variables	NELS rurality definition		ELS rurality definition		HSLS rurality definition	
	Mean	(SE)	Mean	(SE)	Mean	(SE)
Rural HS area	0.32**	(0.01)	0.20	(0.01)	0.23	(0.01)
Town HS area	–	–	–	–	0.14	(0.01)
Suburban HS area	0.40**	(0.01)	0.51**	(0.01)	0.36	(0.02)
Urban HS area	0.28	(0.01)	0.29	(0.01)	0.27	(0.01)
Observations	9630		9630		9630	

Source: Education Longitudinal Study (ELS 2002/2012)

Other analysis variables omitted for conciseness are shown in "Appendix 1." All reported sample sizes rounded to the nearest 10 in accordance with NCES restricted data license

**$p < 0.001$; *$p < 0.01$; $^{+}p < 0.05$

also changed depending on the definition of rurality used for analysis. In Table 2, we present average marginal effects (AME) of urban, suburban, and town locations (with rural as the reference group, to facilitate comparison of this category to all others) on degree completion. (Full analysis results including controls may be found in "Appendix 2," presented as odds ratios.) In Table 2, the AMEs indicate the average change in probability of completion, as calculated from the results of the multinomial logistic regression analyses, in which several outcome categories are each compared to a base category (in this case, the outcome of no degree). We report AMEs in order to represent our results as changes in probabilities, a more intuitive metric than either regression coefficients or odds ratios. Unlike with these two other possible ways of presenting results, AMEs allow results for all outcomes, including no degree, certificate/AS, and BA/higher degree. Given that we compare town, suburban, and urban each to rural, presenting our results as AMEs simplifies interpretation by focusing on this rurality comparison of interest. As seen in Table 2, conclusions about bachelor's degree completion for rural versus urban students were similar across the rurality definitions. In all cases, on average, urban students had higher probabilities of attaining a bachelor's degree, ranging from a five to a seven percentage point advantage.

However, other conclusions drawn would vary depending upon the definition of rurality used. For example, urban students compared to rural students under a NELS definition of rurality would have a probability four percentage points lower on average of obtaining a certificate or associate's degree, whereas they would not under an HSLS rurality definition. (The conclusion drawn under the ELS rurality definition would depend upon whether $p < 0.05$ was considered significant, which we do not given the large sample size.) Also, when comparing rural students to suburban students, different conclusions would be drawn based on the definition used. Under NELS and HSLS definitions of rurality, on average, suburban students had a probability of bachelor's degree attainment that was four to five percentage points higher than rural students. However, under the definition of rurality used in the ELS dataset, researchers would conclude that there was no difference in bachelor's degree attainment between rural and suburban students.

Table 2 Average marginal effects of predictors of college degree completion for college attendees across three different definitions of rurality using the same student data—town, suburban, and urban high school areas compared to rural high school areas

Variables	NELS rurality definition			ELS rurality definition			HSLS rurality definition		
	No degree	Certificate/AS	BA/higher	No degree	Certificate/AS	BA/higher	No degree	Certificate/AS	BA/higher
Town HS area	–	–	–	–	–	–	0.014	−0.014	−0.001
	–	–	–	–	–	–	(0.020)	(0.017)	(0.017)
Suburban HS area	−0.039*	−0.005	0.044*	−0.003	−0.002	0.005	−0.038^{+}	−0.013	0.051**
	(0.015)	(0.014)	(0.014)	(0.017)	(0.015)	(0.015)	(0.017)	(0.015)	(0.014)
Urban HS area	−0.036^{+}	−0.037*	0.073**	−0.015	−0.037^{+}	0.051**	−0.026	−0.028	0.054**
	(0.016)	(0.014)	(0.013)	(0.019)	(0.015)	(0.015)	(0.019)	(0.016)	(0.015)
Observations	9630			9630			9630		

Source: Education Longitudinal Study (ELS 2002/2012)

Standard errors in parentheses. Control variables omitted for conciseness are shown in "Appendix 2". All reported sample sizes rounded to the nearest 10 in accordance with NCES restricted data license

**$p < 0.001$; *$p < 0.01$; $^{+}p < 0.05$

Discussion and Implications

The information in this brief is most immediately significant for educational researchers interested in studying rural students. To get meaningful results, scholars must start from a clear definition of rurality and understand the nuances of what is meant by 'rural' in any given dataset. Moreover, when interpreting and comparing results to other research, the different definitions across studies should be considered fully. For trends over time or comparisons across datasets, scholars may need to create their own variables to match operational definitions. Even then, re-classification of metropolitan areas over time due to demographic shifts can still lead to complicated comparisons (Johnson 2012). We do not suggest that this complication can or should be avoided, but rather that the messiness of appropriately changing conceptualizations of rurality make clarity and explicit communication about rural definitions essential.

While we compared results using different definitions with ELS data, it may be instructive to re-analyze with NELS data, using the ELS and HSLS definitions of rurality to verify whether similar changes in results may be found. For example, our findings suggest that Byun et al.'s (2012) results around rural students' college enrollment using NELS data may not be directly comparable to enrollment findings of Koricich et al. (2018), which used ELS data. Similarly looking forward to the research that is needed in the near future with HSLS, results will not be directly comparable to either prior study unless purposeful and careful operational definitions are used. In short, research using different NCES datasets should be executed and compared with caution.

Further options for defining rurality should also be explored with additional research. Studies using NCES datasets rely on a rural/suburban/urban(/town) categorization of the high school a student attended, rather than a definition of where the student actually lived. It would be interesting to see how the difference in educational outcomes between rural and non-rural students would differ if their home locations were used instead of school locations. With opportunities to use geocoded home address data, more sophisticated spatial concepts and techniques can be used to consider the boundaries between rural and urban, and how conclusions about education may change based on such boundaries (Burdick-Will and Logan 2017). Such techniques and perspectives can allow researchers to be more flexible in defining rurality based on the precise location of the students. This flexibility can be viewed as a double-edged sword: researchers could get more nuanced and specific in their methods in a given study, and yet this would introduce even greater variation into the body of literature regarding how rurality is defined. If research methods and approaches were to expand in this way, providing clarity around the term rural would become even more necessary.

One way of providing scholars with more stability and clarity would be to establish several commonly-used definitions of rurality with clear information on how these definitions differ, and consequently, what specific group of students each definition targets. Perhaps conceptual (if not actual variable-based) crosswalks could be developed. These could allow researchers to purposefully choose a definition that fits their research aim, as well as providing the opportunity for comparing studies across datasets and over time. Additionally, researchers could further explore how robust findings are based on sensitivity analyses using varying definitions, which is a recommended practice in all educational research.

The significance of this conversation extends to practitioners and policymakers who aim to provide support to rural students. For example, federal programs such as the Small, Rural School Achievement Program (U.S. Department of Education 2017) use definitions

that are different than those used in any of the datasets described in this study, limiting the utility research findings from studies based on these data may have for such programs and policies. Therefore, it is also essential for practitioners and policymakers to be clear and transparent about their definitions, and to consider carefully how to translate research findings for policy and educational practice. Along these lines, researchers may want to purposefully align with rurality definitions used in earlier work to enable clarity for practitioners and policy makers.

Ultimately, lessons learned from these considerations will be most significant for rural students themselves. If scholars and practitioners can meaningfully understand not only the conclusions of a single study, but also how that study appropriately relates to the larger body of literature containing varying definitions, efforts will be better coordinated and able to serve students more effectively. As society has begun asking more questions about the educational attainment of rural students and how this relates to issues such as employment, mobility, and voting behavior (e.g. Monkovic 2016; Brown and Fischer 2017; Pappano 2017), the educational research community will have little that is coherent to add to the conversation without first understanding what is meant when referring to rural students.

Appendix 1

See Table 3.

Table 3 Estimated (weighted) means and standard errors of estimates for college enrollees, and by subpopulations defined by the NELS, ELS, and HSLS rurality definitions

Variables	Overall	NELS rurality definition	ELS rurality definition	HSLS rurality definition
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)
Degree completion				
No college degree	0.36	0.37	0.36	0.36
	(0.01)	(0.01)	(0.02)	(0.01)
Certificate/AS	0.22	0.24	0.24	0.24
	(0.01)	(0.01)	(0.01)	(0.01)
BA/higher	0.43	0.40	0.41	0.40
	(0.01)	(0.01)	(0.02)	(0.01)
NELS rurality coding				
Rural	0.32	–	–	–
	(0.01)	–	–	–
Suburban	0.40	–	–	–
	(0.01)	–	–	–
Urban	0.28	–	–	–
	(0.01)	–	–	–
ELS rurality coding				
Rural	0.20	–	–	–
	(0.01)	–	–	–

Table 3 (continued)

Variables	Overall	NELS rurality definition	ELS rurality definition	HSLS rurality definition
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)
Suburban	0.51	–	–	–
	(0.01)	–	–	–
Urban	0.29	–	–	–
	(0.01)	–	–	–
HSLS rurality coding				
Rural	0.23	–	–	–
	(0.01)	–	–	–
Town	0.14	–	–	–
	(0.01)	–	–	–
Suburban	0.36	–	–	–
	(0.02)	–	–	–
Urban	0.27	–	–	–
	(0.01)	–	–	–
Female	0.53	0.54	0.55	0.54
	(0.01)	(0.01)	(0.01)	(0.01)
White	0.66	0.83	0.84	0.84
	(0.01)	(0.01)	(0.02)	(0.02)
Asian	0.05	0.02	0.02	0.01
	(0.00)	(0.00)	(0.01)	(0.00)
Hispanic	0.14	0.09	0.07	0.09
	(0.01)	(0.01)	(0.01)	(0.01)
Black	0.15	0.07	0.08	0.05
	(0.01)	(0.01)	(0.01)	(0.01)
Northwest	0.20	0.14	0.16	0.14
	(0.01)	(0.02)	(0.02)	(0.02)
Midwest	0.25	0.27	0.28	0.28
	(0.01)	(0.02)	(0.02)	(0.03)
South	0.34	0.42	0.42	0.47
	(0.01)	(0.02)	(0.02)	(0.03)
West	0.22	0.17	0.14	0.11
	(0.01)	(0.02)	(0.02)	(0.02)
Parents attained ≤ HS education	0.23	0.26	0.27	0.27
	(0.01)	(0.01)	(0.02)	(0.01)
≥ 1 parent attended college, no BA	0.22	0.25	0.24	0.23
	(0.01)	(0.01)	(0.01)	(0.01)
≥ 1 parent earned BA or higher	0.55	0.49	0.49	0.50
	(0.01)	(0.01)	(0.02)	(0.02)
Parents income ≤ $25,000	0.17	0.16	0.16	0.17
	(0.01)	(0.01)	(0.01)	(0.01)
Parents income $25,001–$50,000	0.30	0.34	0.35	0.34
	(0.01)	(0.01)	(0.01)	(0.01)
Parents income > $50,001	0.53	0.50	0.50	0.49

Table 3 (continued)

Variables	Overall	NELS rurality definition	ELS rurality definition	HSLS rurality definition
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)
	(0.01)	(0.01)	(0.02)	(0.02)
Two parent family	0.78	0.81	0.81	0.81
	(0.01)	(0.01)	(0.01)	(0.01)
Number siblings	1.43	1.37	1.36	1.36
	(0.02)	(0.03)	(0.03)	(0.03)
Parents expect child to earn ≤ HS	0.04	0.04	0.04	0.04
	(0.00)	(0.00)	(0.01)	(0.01)
Parents expect attend college, no BA	0.15	0.19	0.20	0.19
	(0.01)	(0.01)	(0.01)	(0.01)
Parents expect child to earn ≥ BA	0.82	0.77	0.76	0.77
	(0.01)	(0.01)	(0.01)	(0.01)
HS GPA	2.90	3.01	2.97	2.99
	(0.01)	(0.02)	(0.02)	(0.02)
Math/reading standardized test score	52.49	53.04	53.22	53.38
	(0.18)	(0.27)	(0.36)	(0.29)
HS academic concentrator	0.32	0.30	0.29	0.30
	(0.01)	(0.01)	(0.02)	(0.02)
Highest HS math course	5.77	5.66	5.64	5.69
	(0.03)	(0.04)	(0.06)	(0.05)
Observations	9630	2820	1680	2330

Source: Education Longitudinal Study (ELS 2002/2012)

Standard errors in parentheses. All reported sample sizes rounded to nearest 10 in accordance with NCES restricted data license

Appendix 2

See Table 4.

Table 4 Predictors of college degree completion for college attendees across three different definitions of rurality using the same student data—multinomial logistic regression models, odds ratios reported, compared to no degree completion

Variables	NELS rurality definition		ELS rurality definition		HSLS rurality definition	
	Cert./AS	BA/Higher	Cert./AS	BA/Higher	Cert./AS	BA/Higher
Rurality (rural reference)						
Town HS area	–	–	–	–	0.904	0.958
	–	–	–	–	(0.108)	(0.117)
Suburban HS area	1.097	1.371**	0.999	1.035	1.053	1.407**
	(0.102)	(0.125)	(0.100)	(0.109)	(0.109)	(0.140)
Urban HS area	0.927	1.537**	0.873	1.312^{+}	0.946	1.377*
	(0.093)	(0.145)	(0.100)	(0.147)	(0.111)	(0.149)
Female	1.338**	1.061	1.340**	1.064	1.335**	1.055
	(0.096)	(0.081)	(0.095)	(0.081)	(0.095)	(0.081)
Race/ethnicity (White reference)						
Asian	1.009	1.332^{+}	1.023	1.383^{+}	0.989	1.333^{+}
	(0.130)	(0.168)	(0.132)	(0.177)	(0.129)	(0.170)
Black	0.987	1.025	0.997	1.057	0.970	1.036
	(0.102)	(0.133)	(0.104)	(0.137)	(0.103)	(0.134)
Hispanic	0.897	0.811	0.912	0.849	0.884	0.819
	(0.094)	(0.093)	(0.095)	(0.098)	(0.095)	(0.097)
Region (south reference)						
Northwest	1.113	1.656**	1.129	1.762**	1.113	1.599**
	(0.100)	(0.176)	(0.102)	(0.183)	(0.102)	(0.171)
Midwest	1.111	1.114	1.124	1.157	1.116	1.120
	(0.097)	(0.103)	(0.099)	(0.107)	(0.098)	(0.102)
West	0.902	0.716*	0.914	0.744*	0.913	0.709*
	(0.097)	(0.080)	(0.099)	(0.083)	(0.101)	(0.078)

Table 4 (continued)

Variables	NELS rurality definition		ELS rurality definition		HSLS rurality definition	
	Cert./AS	BA/Higher	Cert./AS	BA/Higher	Cert./AS	BA/Higher
Parent attended college, no BA (HS reference)	0.910	1.037	0.913	1.046	0.912	1.029
	(0.080)	(0.106)	(0.080)	(0.107)	(0.080)	(0.104)
Parent earned a BA or higher (HS reference)	0.740**	1.475**	0.746**	1.505**	0.738**	1.470**
	(0.067)	(0.140)	(0.066)	(0.143)	(0.066)	(0.138)
Parents income (≤$25 K reference)						
$25,001–$50,000 (≤$25 K	1.195	1.027	1.194	1.025	1.194	1.026
	(0.118)	(0.116)	(0.118)	(0.116)	(0.118)	(0.116)
>$50,001	1.271^{+}	1.519**	1.278^{+}	1.542**	1.272^{+}	1.509**
	(0.135)	(0.185)	(0.136)	(0.188)	(0.136)	(0.184)
Two parent family	0.924	0.898	0.923	0.889	0.926	0.894
	(0.077)	(0.087)	(0.077)	(0.086)	(0.077)	(0.087)
Number of siblings	0.966	0.918^{+}	0.966	0.918^{+}	0.965	0.917^{+}
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
Parents expect child to… (HS reference)						
Attend college, no BA	0.973	1.182	0.968	1.151	0.967	1.165
	(0.183)	(0.355)	(0.182)	(0.346)	(0.181)	(0.347)
Earn BA/higher	0.934	2.478*	0.934	2.458*	0.926	2.460*
	(0.170)	(0.695)	(0.170)	(0.693)	(0.168)	(0.686)
HS GPA	1.581**	4.740**	1.568**	4.605**	1.590**	4.702**
	(0.111)	(0.383)	(0.110)	(0.372)	(0.112)	(0.379)
Math/reading standardized test score	0.974**	1.012^{+}	0.974**	1.012^{+}	0.974**	1.013^{+}
	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)
HS academic concentrator	0.894	1.161	0.895	1.161	0.890	1.157
	(0.097)	(0.103)	(0.097)	(0.103)	(0.097)	(0.102)

Table 4 (continued)

Variables	NELS rurality definition		ELS rurality definition		HSLS rurality definition	
	Cert./AS	BA/Higher	Cert./AS	BA/Higher	Cert./AS	BA/Higher
Highest HS math course	0.975	1.266**	0.978	1.277**	0.973	1.267**
	(0.036)	(0.046)	(0.036)	(0.046)	(0.036)	(0.046)
Constant	0.783	0.000**	0.815	0.000**	0.800	0.000**
	(0.233)	(0.000)	(0.245)	(0.000)	(0.239)	(0.000)
Observations	9630		9630		9630	
Log-likelihood	− 2,047,682		− 2,050,021		− 2,049,021	
McFadden's adjusted R^2	0.1964		0.1955		0.1959	
F-adj. mean residual [*p* value]	32.972 [0.007]		39.088 [0.001]		38.739 [0.001]	

Source: Education Longitudinal Study (ELS 2002/2012)

Standard errors in parentheses. No math/non-academic and low/middle academic math categories compared to advanced academic math preparation. All reported sample sizes rounded to the nearest 10 in accordance with NCES restricted data license. Fit statistics from stacked data

$^{**}p < 0.001$; $^{*}p < 0.01$; $^{+}p < 0.05$

References

Brown, S., & Fischer, K. (2017, December 29). A dying town. *The Chronicle of Higher Education*. Retrieved from https://www.chronicle.com/interactives/public-health.

Burdick-Will, J., & Logan, J. R. (2017). Schools at the rural–urban boundary: Blurring the divide? *The ANNALS of the American Academy of Political and Social Science, 672*(1), 185–201.

Byun, S., Meece, J. L., & Irvin, M. J. (2012). Rural–nonrural disparities in postsecondary educational attainment revisited. *American Educational Research Journal, 49*(3), 412–437. https://doi.org/10.3102/0002831211416344.

Byun, S. Y., Irvin, M. J., & Meece, J. L. (2015). Rural–nonrural differences in college attendance patterns. *Peabody Journal of Education, 90*(2), 263–279.

Curtin, T. R., Ingels, S. J., Wu, S., Heuer, R., & Owings, J. (2002). *National education longitudinal study of 1988 base-year to fourth follow-up data file user's manual*. Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics. Retrieved from https://nces.ed.gov/pubs2002/2002323.pdf.

Heeringa, S., West, B. T., & Berglund, P. (2010). *Applied survey data analysis*. Boca Raton, FL: Chapman & Hall.

Ingels, S. J., Pratt, D. J., Rogers, J. E., Siegel, P. H., Stutts, E. S., & Owings, J. A. (2004). *Education longitudinal study of 2002: Base year data file user's manual* (NCES No. 2004-405). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. Retrieved from http://eric.ed.gov/?id=ED484410.

Isserman, A. M. (2005). In the national interest: Defining rural and urban correctly in research and public policy. *International Regional Science Review, 28*(4), 465–499.

Johnson, K. M. (2012). Rural demographic change in the new century: Slower growth, increased diversity. *The Carsey School of Public Policy at the Scholars' Repository*. Retrieved from https://scholars.unh.edu/cgi/viewcontent.cgi?referer=https://www.ecosia.org/&httpsredir=1&article=1158&context=carsey.

Jones, M., Ewald, M., & McKown, C. (2017). *Understanding rural–urban divides requires a complex spectrum of definitions*. Retrieved from https://www.wiscontext.org/putting-rural-wisconsin-map.

Koricich, A. (2014). *The effects of rurality on college access and choice*. Paper presented at the American Educational Research Association Annual Conference, Philadelphia, PA. Retrieved from http://www.aera.net/Newsroom/Recent-AERA-Research/-Effects-of-Rurality-on-College-Access-and-Choice.

Koricich, A., Chen, X., & Hughes, R. P. (2018). Understanding the effects of rurality and socioeconomic status on college attendance and institutional choice in the United States. *The Review of Higher Education, 41,* 281–305.

Long, J. S. (1997). *Regression models for categorical and limited dependent variables*. Thousand Oaks, CA: SAGE Publications.

Monkovic, T. (2016, November 1). Why does education translate to less support for Donald Trump? *The New York Times*. Retrieved from https://www.nytimes.com/2016/11/02/upshot/why-does-education-translate-to-less-support-for-donald-trump.html.

National Center for Education Statistics. (n.d.). *School locale definitions*. Washington, DC: US Department of Education, Institute for Education Sciences. Retrieved from https://nces.ed.gov/surveys/ruraled/definitions.asp.

Office of Management and Budget (2000). Standards for defining metropolitan and micropolitan statistical areas; Notice. *Federal Register, 65*(249). Retrieved from https://www.gpo.gov/fdsys/pkg/FR-2000-12-27/pdf/00-32997.pdf.

Pappano, L. (2017, January 31). Voices from rural America on why (or why not) to go to college. *The Chronicle of Higher Education*. Retrieved from https://www.nytimes.com/2017/01/31/education/edlife/voices-from-rural-america-on-why-or-why-not-go-to-college.html.

Ratcliffe, M., Burd, C., Holder, K., & Fields, A. (2016). Defining rural at the U.S. Census Bureau American Community Survey and geography brief. Retrieved from https://www2.census.gov/geo/pdfs/reference/ua/Defining_Rural.pdf.

Turley, R. N. L. (2009). College proximity: Mapping access to opportunity. *Sociology of Education, 82*(2), 126–146.

U.S. Department of Education. (2017, April 19). *Eligibility: Small, rural school achievement program*. Retrieved from https://www2.ed.gov/programs/reapsrsa/eligibility.html.

van Buuren, S. (2012). *Flexible imputation of missing data*. Boca Raton, FL: CRC Press.

Wells, R. S., Manly, C. A., Kommers, S., & Kimball, E. K. (2019). *Narrowed gaps and persistent challenges: Examining rural-nonrural disparities in postsecondary outcomes over time*. Manuscript submitted for publication.