

**RESEARCH**

## **Validating Adolescent Socioeconomic Status: Comparing School Free or Reduced Price Lunch with Community Measures**

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### **ABSTRACT**

The use of free or reduced price lunch (FRL), as a measure of socioeconomic status (SES), has received mixed reviews in the literature. This study expands on the limited research on the validity of FRL as a measure of SES by examining the relationship between FRL and a series of community-based SES measures to determine whether FRL is an adequate proxy for adolescent SES. Data are from a nationally representative sample of 154 public high schools in 2010 from Bridging the Gap with corresponding school level data from the National Center for Education Statistics' (NCES) Common Core of Data (CCD) to obtain a measure of percent of students receiving FRL and using ArcGIS 9 software with the ACS 05-09, matched at the census block group level to construct measures of community SES. School zone level SES measures obtained include: median household income, percent of families in poverty, percent of families with children younger than 18 years in poverty, and the percent of all households in poverty. Data collected through community observations were used to construct a physical disorder scale. Percent FRL was strongly and significantly associated with the percent of families in poverty ( $r=0.67$ ), percent of families with children younger than 18 years ( $r=0.67$ ), percent of households in poverty ( $r=0.66$ ), median household income ( $r=-0.60$ ), and physical disorder ( $r=0.56$ ) in the expected directions. Additionally, all community based measures of socioeconomic status were highly correlated with each other. The validity and limitations of FRL as a proxy for adolescent SES are discussed.

**KEYWORDS:** health, child health, health policy, community health, school health

### **INTRODUCTION**

Research has demonstrated that socioeconomic status (SES) is an important determinant of many youth behaviors and related health outcomes (Goodman, Slap, and Huang 2003), but measuring SES for youth remains challenging. Despite decades of research, the way to measure socioeconomic status among youth remains contested. In addition to traditionally used

individual level measures of parental income and mother's education (Entwisle and Astone 1994; Hauser 1994) and family based measures of household composition, family income, educational attainment, and education status (Hernandez 1997), researchers today have more access to measures of socioeconomic context

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including measures of the school and neighborhood environment. Mounting research evidence indicates that the socioeconomic characteristics of neighborhoods can influence health, over and above individual level SES (Robert 1999; Yen and Syme 1999; Pickett and Pearl 2001; Sampson, Morenoff, and Gannon-Rowley 2002) and these effects may be especially strong for youth during the transition to adulthood (Nicholson and Browning 2012). Still other educational and health research, without access to geocoded data and neighborhood context, use the school level measure of free or reduced price lunch (FRL) as a measure of SES (Nierman and Veak 1997; Kurki, Boyle, and Aladjem 2005). A very limited body of research has examined the validity of FRL as a measure of youth SES (Ensminger et al. 2000), although the measure is frequently used in education and health research (Harwell and LeBeau 2010). Of all the measures of SES, FRL has received the least attention and remains highly criticized.

The increased use of FRL as a proxy for SES for adolescents, schools, and school districts, and the use of FRL as a school-based health intervention mechanism, emphasizes the need for the validation of this measure compared to other measures of community SES. FRL remains highly criticized in part, because one of the criteria to receive FRL is based on the U.S. poverty index, a measure that is often argued by researchers as being outdated (Kurki et al. 2005; Harwell and LeBeau 2010). Increasing evidence of the importance of neighborhood effects combined with the mixed results of associations with FRL and proximal health outcomes, suggests the need to examine the validity of FRL as a measure of SES, specifically compared to other community based measures. Our study is the first we know of to examine the associations of FRL with other community based measures of SES. Our study will build on previous research validating FRL with individual level measures of SES from adolescents and parent reports (Ensminger et al. 2000), by examining the associations of FRL with community based SES measures. This will advance the field by testing the criticism that FRL does not adequately capture current SES, by incorporating measures

of neighborhood context.

## BACKGROUND

### Individual Measures of Adolescent SES

A review of the literature indicates that a variety of individual level variables have served as a measure of youth SES, both independently and in combination to form a scale, however there is virtually no standardization. The most frequently used measure is mother's education (Ensminger and Fothergill 2003), likely because it is not refused as frequently in surveys as income questions (Duncan and Magnuson 2003). Other commonly used single measures include parental income (Worly and Story 1967), parental occupation (Miner 1968), and student mobility (Herr and Tobias 1970). Family poverty and affluence are sometimes used but researchers somewhat agree that the measures are too volatile for use (Duncan and Magnuson 2003). Longstanding research has revealed high correlations among measures of parental education, income, and occupation leading many researchers to argue that the variables could not be used in combination in models. However, more recent research argues that income and education are not interchangeable and, although the measures are highly correlated, these correlations are generally not strong enough to justify using one as a proxy for the other (Braveman et al. 2005).

The argument for the use of multiple individual level measures or scaled measures (Hollingshead 1975) has been long argued by other researchers. Entwisle and Astone (1994) argued for the use of income, mothers' education, and household and family structure. Ensminger et al. (2000) argued for the use of mothers' education in combination with adolescents' self-reported items as a way to overcome the limited information that adolescents usually report. Hauser (1994) suggested focusing on the major adult earner in the household and to ascertain their education, labor force status, and occupational position. Hernandez (1997) discussed the use of census based measures of household composition, family

income, educational attainment, race and ethnicity, and employment, but few research databases allow for such geocoded matches today. Very little research has examined the Hollingshead Four-Factor Index of Social Status with other measures of SES or with health or behavioral outcomes, although the scale was designed for use in adolescents (Ensminger and Fothergill 2003) and it has been argued that SES is too multifaceted to be captured by a single index like this one (Duncan and Magnuson 2003). Studies suggest that although the best measure of SES for a given study depends on the research question of that study, including multiple measures of SES may be best for capturing all dimensions of adolescent SES (Entwisle and Astone 1994). Therefore, there is some consensus that multiple components should be measured and used separately in the models (Krieger, Williams, and Moss 1997; Duncan and Magnuson 2003).

### **Neighborhood Context as a Measure of SES**

Advances in statistical methodology, specifically multilevel modeling, has allowed for the incorporation of neighborhood effects into many fields of research. Youth neighborhood socioeconomic context has been shown to correlate with proximal health outcomes, such as physical activity settings as well as adolescent health outcomes including obesity (Gordon-Larsen et al. 2006) and the effects may be particularly critical to youth during the transition to adulthood (Nicholson and Browning 2012). Most importantly, studies find that neighborhood conditions, particularly SES, are accounted for, in part, by family SES, yet also have somewhat small (5-10% of variance) but independent effects on youth outcomes (Leventhal and Brooks-Gunn 2003). It is likely that neighborhood SES effects, especially those involving youth, operate through mechanisms such as families, peers, and schools (Elliott et al. 1996; Klevanov, Brooks-Gunn, Chase-Lansdale, and Gordon 1997; Sampson 1997). It is very important for neighborhood SES studies to point to specific underlying mechanisms at work in order for necessary policy recommendations to be made (Leventhal and Brooks-Gunn 2003). These underlying

mechanisms require a great amount of research since they likely vary by both the outcome of interest and the age of the target population, with variations across children, adolescents, and young adults (Leventhal and Brooks-Gunn 2003).

Measuring neighborhood SES, often referred to as neighborhood disadvantage or advantage has no consistent measurement in the field, although the measure is usually scaled, as opposed to including a series of measures. Neighborhood context literature is currently dominated by poverty and demographic characteristics drawn from census data, which may or may not actually reflect the true characteristics of neighborhoods (Raudenbush 2003). One somewhat frequently used measure of adolescent neighborhood disadvantage is measured using a summed standardized scale from previous research (see Haynie et al. 2006; Nicholson and Browning 2012). The scale comprises four items ( $\alpha=0.93$ ) at the census tract level: the proportion receiving public assistance, the proportion of female-headed families with children younger than 18 years of age and no husband present, the proportion of people living below the poverty level, and the total unemployment rate. However, it is important to note that although commonly used neighborhood context scales have been tested and show strong indications of validity in measurement, social context literature is decades behind the psychometric literature validating individual-level measures of SES that have excellent statistical properties (Raudenbush 2003).

### **School FRL as a Measure of SES**

In the United States, students who meet federal United States Department of Agriculture (USDA) guidelines are eligible for free or reduced price lunch (<http://www.fns.usda.gov/cnd/application/FamilyFriendly/english.pdf>). The most commonly cited eligibility guideline is that students from families with incomes at or below 130% of the poverty level are eligible for free lunch and those between 130% and 185% are eligible for a reduced-price lunch. However, all children in households receiving benefits from the

Supplemental Nutrition Assistance Program (SNAP), the Food Distribution Program on Indian Reservations, or, in some states Temporary Assistance for Needy Families (TANF), can get free meals regardless of income. Additionally, any foster, homeless, runaway, or migrant child can get free meals regardless of household income. Children in households receiving assistance from the Women Infants and Children Program (WIC) may also be automatically eligible for free lunches. The assumption in research is that students eligible for free or reduced price lunch have lower SES than those from non-eligible households, but the guidelines may allow for instances where misclassifications can occur.

Although FRL is widely used in education and health research as a measure of SES, it has received continued criticism (Entwisle and Astone 1994; Hauser 1994; Kurkie, Boyle, and Aladjem 2005) and results of the association of FRL with proximal health outcomes, such as the school food environment, have found mixed results. A recent study by Taber and colleagues (2013) finds that in states that exceeded USDA school meal standards, the difference in obesity prevalence between students who obtained free or reduced price lunches and those who did not was significantly lower than in states that did not exceed USDA standards. Other studies have found negative or null findings when examining the association between FRL and the school food environment (Briefel et al. 2009; Finkelstein, Hill, and Whitaker 2008). Mixed associations with FRL with health outcomes and proximal outcomes have led some to conclude that the FRL is based on the outdated poverty index (Hauser) and does not adequately capture all economic elements that are relevant today, such as the effects of concentrated neighborhood poverty (Kurki et al. 2005) or students access to economic resources (Harwell and LeBeau 2010). In sum, there is very little consensus in the field as to the usefulness of FRL as a current measure of youth SES.

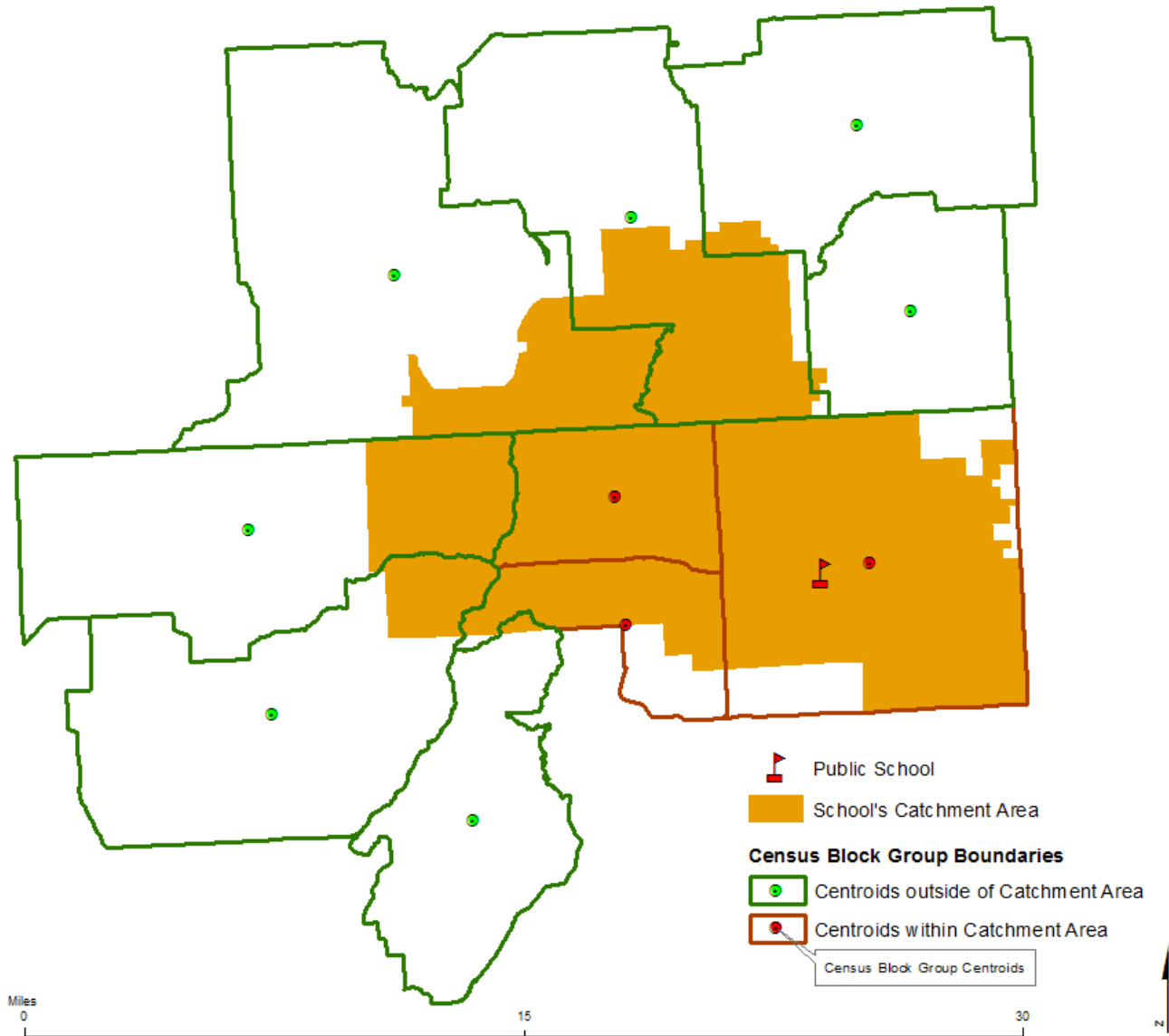
A very limited body of research has examined the validity of FRL as a measure of youth SES (Ensminger et al. 2000), and our study is the first

we know of to examine the associations of FRL with other community based measures of SES. One study has established that adolescent self-reported measures of SES were linked to mother's report of income and that the SES measures related in the expected direction to adolescent self-reported health outcomes, with higher SES adolescents more likely to report better physical and emotional health (Ensminger et al. 2000). Our study will build on previous research validating FRL with individual level measures of SES from adolescent and parent reports, by examining the associations of FRL with community based SES measures. This will advance the field by testing the criticism that FRL does not adequately capture current SES, by incorporating measures of neighborhood context.

## METHODS

This study combined cross-sectional data collected in spring 2010 from a nationally representative sample of 154 public high schools participating in the Monitoring the Future (MTF) survey (see Johnston et al. 2011 for more information) with corresponding school level data from the National Center for Education Statistics' (NCES) Common Core of Data (CCD) and community SES measures from the American Community Survey (ACS) 2005-2009 and on-the-ground observational data collection. Only the traditional public schools involved in Year 2 of MTF participation were included in this study (N=154 schools). Community level environmental measures for the MTF school enrollment zones, the area from which schools draw their student population (area, in square miles: median size=39.8, range=0.26-1517), were developed through the Community Obesity Measures Project (BTG-COMP), an ongoing, large-scale effort conducted by the Bridging the Gap Research team. BTG-COMP identifies local policy and environmental factors that are likely to be important determinants of healthy eating, physical activity, and obesity among children and adolescents. This study was approved by the Institutional Review Board at the University of Illinois Chicago.

**Figure 1.** Overlay of block groups selected from within the school enrollment zone



**Community Measures**

Using ArcGIS 9 software with the ACS 05-09, matched at the census block group level to the school enrolment zone described above we constructed measures of community SES. Figure 1 shows that block groups with centroids within the school enrollment zone were included in the analysis, while other block groups with partial overlap or adjacent borders were excluded. Socioeconomic measures obtained included: median household income, percent of families in

poverty, percent of families with children younger than 18 years in poverty, and percent of all households in poverty. Median household income was calculated for the school enrollment zone as the average median household income across the block groups selected. All other socioeconomic measures were computed by calculating the total number of individuals in each poverty category, divided by the total number of individuals living in all selected block groups, and multiplying by 100. Other techniques using intersecting block groups with the school

enrollment zone boundary were also tested and yielded virtually identical results.

Data collected through community observations via on-the-ground field work were used to construct a physical disorder scale including measures on the presence or absence of: (1) homeless persons loitering on the streets; (2) bars on windows of buildings; (3) unkempt or dilapidated buildings; (4) security barriers around residential and retail property; (5) teens hanging out (showing negative behaviors such as smoking or drinking); and (6) vandalism and/or graffiti (Cronbach's  $\alpha = 0.75$ ). The measure is the proportion of streets in the catchment area with physical disorder present. A more detailed description of the street audit tool is described elsewhere (Slater et al. 2013).

### School Level Measures

School level demographic and socioeconomic data were obtained from the National Center for Education Statistics' Common Core of Data (NCES 2011). Data were obtained from the 2008-09 school year data (2009-10 data were not available at the time of analysis). Data were obtained on the percentage of students eligible for FRL, region, and locale. The percent of FRL is calculated as the number of students receiving FRL divided by the total number of students in a given school, multiplied by 100.

### Data Analysis

All data were analyzed using STATA SE v. 12 and all results indicate the p-value level of significance. No results were considered statistically significant unless  $p < .05$ . Descriptive statistics were calculated for all variables (Table 1).

After removing cases with missing data on the percentage of students eligible for a free or reduced price lunch ( $N=14$ ), 140 public high schools remained for analysis. Pearson regression coefficients were first compared to examine the strength of associations among variables. Next, multivariate ordinary least square regressions were conducted to examine

associations with key variables of region and locale. Regression based power analysis determined that the sample size was large enough to determine statistical significance at 90% power including five control variables in the models. Schools were somewhat evenly distributed across regions (West  $n=26$ , 19%; Midwest  $n=39$ , 28%; South  $n=43$ , 31%; Northeast  $n=32$ , 23%) and locale (urban  $n=28$ , 20%; suburban  $n=49$ , 35%, rural  $n=63$ , 45%). Lastly, principal component analysis (PCA) and Stata's biplot for PCA (Kohler and Luniak 2005) were completed to examine the extent to which common variance was appreciably shared between FRL and the other indicators of SES.

## RESULTS

Table 1 displays descriptive characteristics and Pearson's correlation coefficients for all socioeconomic variables. Percent FRL was strongly and significantly associated with the percent of families in poverty ( $r=0.67$ ), percent of families with children younger than 18 years ( $r=0.67$ ), percent of households in poverty ( $r=0.66$ ), median household income ( $r=-0.60$ ), and physical disorder ( $r=0.56$ ) in the expected directions. Additionally, all community based measures of socioeconomic status were highly correlated with each other.

Results from Table 2 display additional examination of potential differences in associations of locale and region with all socioeconomic variables. As expected from the correlation results described above, percent FRL tracks similarly with percent of families in poverty, percent of families with children younger than 18 years in poverty, and the physical disorder scale, and in the opposite direction as median household income. Results of associations with predictors are more consistent for urban versus suburban, and Midwest or South versus Northeast.

Figure 2 plots the results of the PCA biplot analysis. In a biplot, the length of the lines approximates the variances of the variables with longer lines indicating higher variance. Based on

**Table 1.** Descriptive statistics and correlations (N= 140 schools for all variables)

Variable	Mean(SD)	Range	1	2	3	4	5	6
1. % Free-reduced lunch	40.9 (24.9)	0.0-99.8	1.00					
2. % families in poverty	10.0 (7.3)	0.6-57.8	0.67	1.00				
3. % families with children <18 in poverty	15.6 (12.8)	0.2-100.0	0.67	0.98	1.00			
4. % of households in poverty	12.4(7.5)	2.1-53.7	0.66	0.95	0.80	1.00		
5. Median household income	54795.6 (21281.7)	13175.7-1845096.6	-0.60	-0.62	-0.57	-0.67	1.00	
6. Prop of streets with physical disorder	0.4 (0.3)	0.0-1.0	0.56	0.53	0.67	0.49	-0.32	1.00

Notes: all correlations are significant at p<.001 (2-tailed)

**Table 2.** Results of linear regression analysis predicting SES variables (N=140)

	% Free-reduced lunch	% families in poverty	% of households in poverty	Median household income	% households in poverty	Physical disorder scale
	b (s.e.)	b (s.e.)	b (s.e.)	b (s.e.)	b (s.e.)	b (s.e.)
<b>Suburban</b>	-0.2 (0.1)**	-4.5 (1.4)**	-7.5 (2.4)**	9760.3 (4016.2)*	-4.8 (1.4)**	-1.1 (0.2)**
<b>Rural</b>	0.1 (0.1)	-1.8 (1.4)	-5.0 (2.4)*	-7457.9 (4104.0)	-0.9 (1.4)	-1.4 (0.1)**
<b>West</b>	0.1 (0.1)*	3.1 (1.6)	6.5 (2.8)*	-3113.9 (4792.9)	2.1 (1.7)	0.4 (0.2)
<b>Midwest</b>	-0.1 (0.1)	-2.5 (1.6)	-4.3 (2.8)	1719.8 (4659.6)	-3.1 (1.6)	-0.3 (0.2)
<b>South</b>	0.1 (0.1)**	2.4 (1.4)	4.0 (2.5)	-7074.4 (4205.3)	-2.2 (1.5)	0.4 (0.2)**

Notes: Urban is the omitted category for locale and northeast is the omitted category for region. \*p<.05 (2-tailed); \*\*p<.01 (2-tailed)

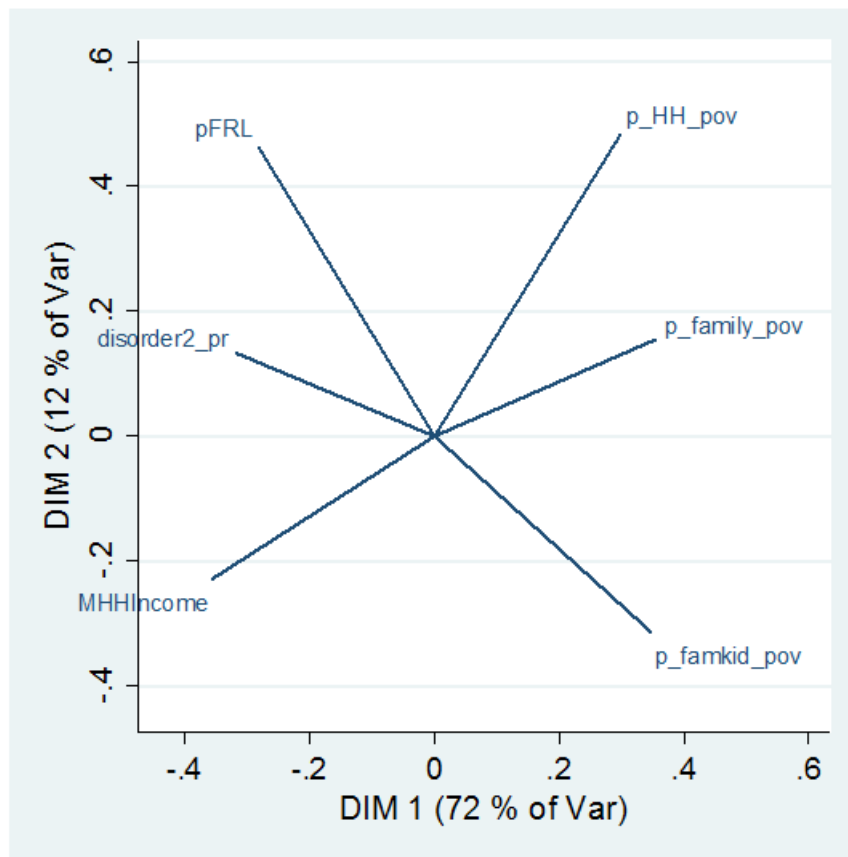
Figure 2, results suggest that all variables are of similar variance with slightly less variance in the percentage of families in poverty and physical disorder. The cosine of the angles between the lines indicates correlation. Angles of 0 or 180 degrees reflect strong correlations of 1 while 90 and 270 degrees suggest smaller correlations. Again, all variables have similar angles of 30 to 45 degrees, suggesting strong and consistent correlation.

### DISCUSSION

The purpose of this study was to conduct an exploratory analysis of associations among frequently used measures of adolescent SES. We

were especially interested in the potential correlation between the school based measure of percent of FRL with community based measures including: percent of families in poverty, percent of families with children younger than 18 years in poverty, percent of households in poverty, median household income, and neighborhood physical disorder. We found strong associations among all SES measures. These associations remained consistent for urban and suburban areas as well as for Northeast, Midwest, and Southern regions in our sample. Caution should still be taken when deciding on the most appropriate measure of SES for rural locales and the West region. We also noted that this study only validated the school-based measure of FRL and does not assess the measure of FRL

**Figure 2.** Biplot for principal component analysis



aggregated at the school district level.

The measure of FRL suffers from many of the same limitations as other community based measures. For instance, FRL, much like neighborhood disadvantage, suffers from the possibility of differential selection. In the example of FRL, poorer, less healthy students may select into poorer schools with lower quality meals and a lack of resources, making it difficult to disentangle the true effect of FRL compared to the prior poverty of selection. Also important to note is that youth are nested in many environments simultaneously including peer groups, schools, neighborhoods, families, workplaces, and religious institutions, and these environments may have mediating and/moderating effects with each other in association with any outcome.

Based on the data presented herein, FRL does

appear to be an adequate proxy for adolescent SES in school based studies. This finding came as somewhat of a surprise given the fact that existing school-based studies have not found FRL to be significantly associated with school or student based outcomes (Finkelstein, Hill, and Whitaker 2008; Briefel et al. 2009). One explanation could be that FRL (or SES) is not driving school policies/practices related to school food and/or physical activity environments. Instead, other factors such as state and/or district requirements, geography, and urban/rural distinctions may be more important than measures of SES (Taber, Chriqui, and Chaloupka 2011). Another possibility for the null findings could relate to policy implementation. In one case study, researchers found that low SES school districts that had strong competitive food policies did not have as many barriers to implementation, because fewer students could afford to purchase competitive foods and were already on FRL.



Thus, policy implementation was stronger in low SES (high FRL) districts, possibly offsetting lower levels of implementation/compliance in higher SES districts, leading to null findings (Bassler et al. 2013). Thus, this area of research will continue to require further exploration and should be expanded to examine correlations between district FRL and community SES.

### Competing Interest

Competing Interest: None to declare.

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### Contributorship Statement

All authors fulfill the ICMJE criteria for authorship, and there is no one else who fulfill the criteria who has not been included as an author. LMN has contributed to conception, design, analysis, interpretation of the data, and drafted the manuscript. JFC has contributed to conception and design, interpretation of the data, and revisions of the drafted manuscript. SJS has contributed to conception and design, analysis, interpretation of the data, data acquisition, and revisions of the drafted manuscript. FJC has contributed to conception and design, interpretation of the data, data acquisition, funding, and revisions of the drafted manuscript.

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