Socioeconomic Status in Pediatric Health Research: A Scoping Review

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Objective To conduct a scoping review of the literature to describe current conceptualization and measurement of socioeconomic status in pediatric health research.

Study design Four databases were used to identify relevant studies, followed by selection and data extraction. Inclusion criteria for studies were the following: enrolled subjects <18 years old, included a health-related outcome, published from 1999 to 2018, and explicitly measured socioeconomic status (SES).

Results Our literature search identified 1768 publications and 1627 unique records. After screening for duplication and relevance, 228 studies satisfied the inclusion criteria, with 75% (n = 170) published since 2009. There were 52 unique singular measures and an additional 20 composite measures. Income-related measures were used in 65% of studies (n = 147) and measures of education in 42% (n = 95). The majority of studies using census-derived variables or insurance status were conducted within the previous 10 years.

Conclusions Pediatric studies use a variety of SES measures, which limits comparisons between studies. Few studies provide an evidenced-based rationale that connects the SES indicator to the health outcome, but the majority of studies do find a significant impact of SES on outcomes. SES should be comprehensively studied so that meaningful measures can be used to identify specific SES mechanisms that impact child health. *(J Pediatr 2019;213:163-70)*.

Socioeconomic status (SES), consistently associated with child health outcomes, encompasses a broad array of factors and has been described as "one's access to collectively desired resources,"[1] a "dimension of stratification which translates the objective distribution of societal resources into meaningful perceptions of relative desirability,"[2] and "all the human qualities that contribute to a certain level of income, education, and occupational status."[3] However, there is little consensus on how SES should be defined, measured, and used in research and practice.[4-7] The practice of controlling for SES is widely debated, because SES-related factors likely mediate its association with health outcomes.[1,5,8]

There is a well-established gradient effect between child health outcomes and SES; as SES improves, health status incrementally improves.[9-14] The SES-health gradient, however, has demonstrated steeper linear trends for some pediatric health outcomes, such as asthma severity and learning disability incidence[14] and curvilinear trends for infant mortality.[9] This gradient variation suggests multiple mechanisms through which SES impacts health outcomes. Low SES is correlated with low birth weight, inadequate nutrition, physical abuse, and fewer opportunities for quality education.[15-20] Given this correlation, it is imperative that SES be measured robustly, SES mechanisms affecting child health outcomes be identified, and interventions and/or policies targeting modifiable SES mechanisms be designed.

Here, we report a scoping review to gain a better understanding of current practices of SES measurement in pediatric research, which may shape our consideration of child health issues and the conclusions we draw about health outcomes. We focus exclusively on healthcare studies conducted in the US, a developed country with relatively high rates of poverty and healthcare spending, but without universal healthcare or a government-designed SES index. An improved conceptualization of what SES measures (and what it does not) may lead to more reliable ways of identifying SES differences in child health outcomes, as well as associated, modifiable SES-related factors.

Methods

Scoping reviews use literature searches that address broad research questions, map the existing literature, identify gaps, operationalize definitions of important concepts, and summarize key findings.[21] This scoping review follows the methodological framework developed by Arksey and O'Malley, with recommendations put forth by Levac, Colquhoun, and O'Brien.[22,23] Relevant literature is included regardless of study design or quality of the evidence.[22] Using the structure recommended for scoping reviews—population, concept, and

SES	Socioeconomic status

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context[24]—we address the following research question: How is SES (concept) measured and used when children (population) are studied in US-based pediatric healthcare research (context)? Pediatric healthcare research refers to studies pertaining to healthcare services and/or health outcomes for individuals <18 years old. Pediatric research could be conducted in a clinical setting or in a child's home or school, so long as it investigates a health-related variable.

Search Strategy

A search of the following databases was performed: PubMed, CINAHL, EMBASE, and the Cochrane Library from 1999 to 2018. A biomedical librarian was consulted in the initial stages of designing the search strategy, which included the following MeSH terms tailored to PubMed: "pediatric hospital," "hospitalized children," "health care disparity," "socioeconomic factor," "socioeconomic status," and "social class." Terms were combined in various searches using Boolean operators (AND and OR); the search was then adapted for the other 3 databases. The 20-year span was chosen so that SES was conceptualized contemporarily, taking into consideration current occupational categories, educational opportunities, assistance programs, and healthcare access options. Inclusion criteria were as follows: available in free, full-text version, in English, peer reviewed, US based, and enrolled participants <18 years old. No limitations were placed on study design. Reviews were excluded to avoid double reports about studies.

Research typically includes SES as a demographic variable, often displayed in a "Table 1" and/or as a predictor variable in statistical analyses. We included research that acknowledges that SES could affect some aspect of health in children and subsequently included it in data analysis, because these studies presumably give more consideration to the use and measurement of SES than studies that exclusively use it as a demographic characteristic.

Screening and Selection

Titles and abstracts of retrieved articles were screened for eligibility and full texts were read if relevance could not be assessed from the initial screening. Reference lists of included papers were consulted if references cited within the papers seemed to fit the inclusion criteria. The abstracts of these citations were reviewed using the same inclusion criteria, with examination of the full texts if necessary. Studies were excluded if they did not explicitly refer to SES and attempt to measure it; for example, a study that looked at the effect of educational level but not SES was excluded.

Data Extraction

Study characteristics were extracted and tabulated. Extracted data included title, publication year, sample size, study setting, study design, and SES measure. In addition, relevant information regarding why a particular SES measure was used, data source, and conclusions about the effect of SES on an outcome were collected. Adhering to traditional standards of conducting scoping reviews, no assessment of study quality was performed.[22] SES measures were analyzed and coded based on discriminating features such as self-reported income (=selfincome) vs census block-derived median income (=census1). Measures were then categorized by overall type, for example, education, and subsequent frequency counts were calculated for each measure and category.

Results

The database searches initially produced 1606 articles, with additional records (n = 162) identified from reference lists. After duplicates articles were removed, 1627 unique articles remained. Records were excluded for to the following reasons: not US based, children not enrolled as subjects, could not access, and SES was not explicitly referenced. After screening the abstracts of the remaining records, 782 articles were read in full to assess for inclusion. This resulted in a total of 228 publications included in the scoping review (**Appendix**; available at www.jpeds.com). **Figure 1** provides details on the search and selection process.

Study Characteristics

The characteristics of included studies can be found in **Table I**. From the total number of studies meeting selection criteria (n = 228), 74.6% (n = 170) took place in the last 10 years (2009-2018). The most frequently used study design was a cross-sectional observational study (n = 67) followed by secondary data analysis of existing datasets (n = 40). Only 4.8% of studies (n = 11) used a randomized clinical trial design. The majority of studies (76.3%) took place in a healthcare setting, which included hospitals, specialty clinics, community health centers, or primary care offices. Several studies (n = 12) included multiple settings, such as data from the hospital and home, and 21.8% of studies took place in a school setting (n = 50). Sample sizes ranged from 30 subjects to 4.2 million subjects, with larger sample sizes occurring in more recent studies (**Figure 2**). Secondary analyses were typically conducted with healthcare setting-derived datasets, including those from health departments, federally funded representative studies like the National Survey of Children's Health, chart reviews, and disease-specific registries (eg, cancer or cystic fibrosis). Research focused on a variety of illness types (eg, autism and diabetes), body systems (eg, cardiovascular and respiratory), and health-related topics (eg, sleep and vaccination). Nearly 20% of the included studies (n = 45) focused on diet, nutrition, obesity, or weight.

SES Measures

A total of 460 SES measures were used in the included studies (n = 228), and of those, 52 were unique singular SES measures and an additional 20 were unique composite or index measures. The majority of studies (n = 167) used either an index or multiple measures to represent SES, as opposed to a singular measure (n = 61). The majority of studies (n = 165) did not include a rationale for the measure that represented SES, and 28 studies provided an evidence-based

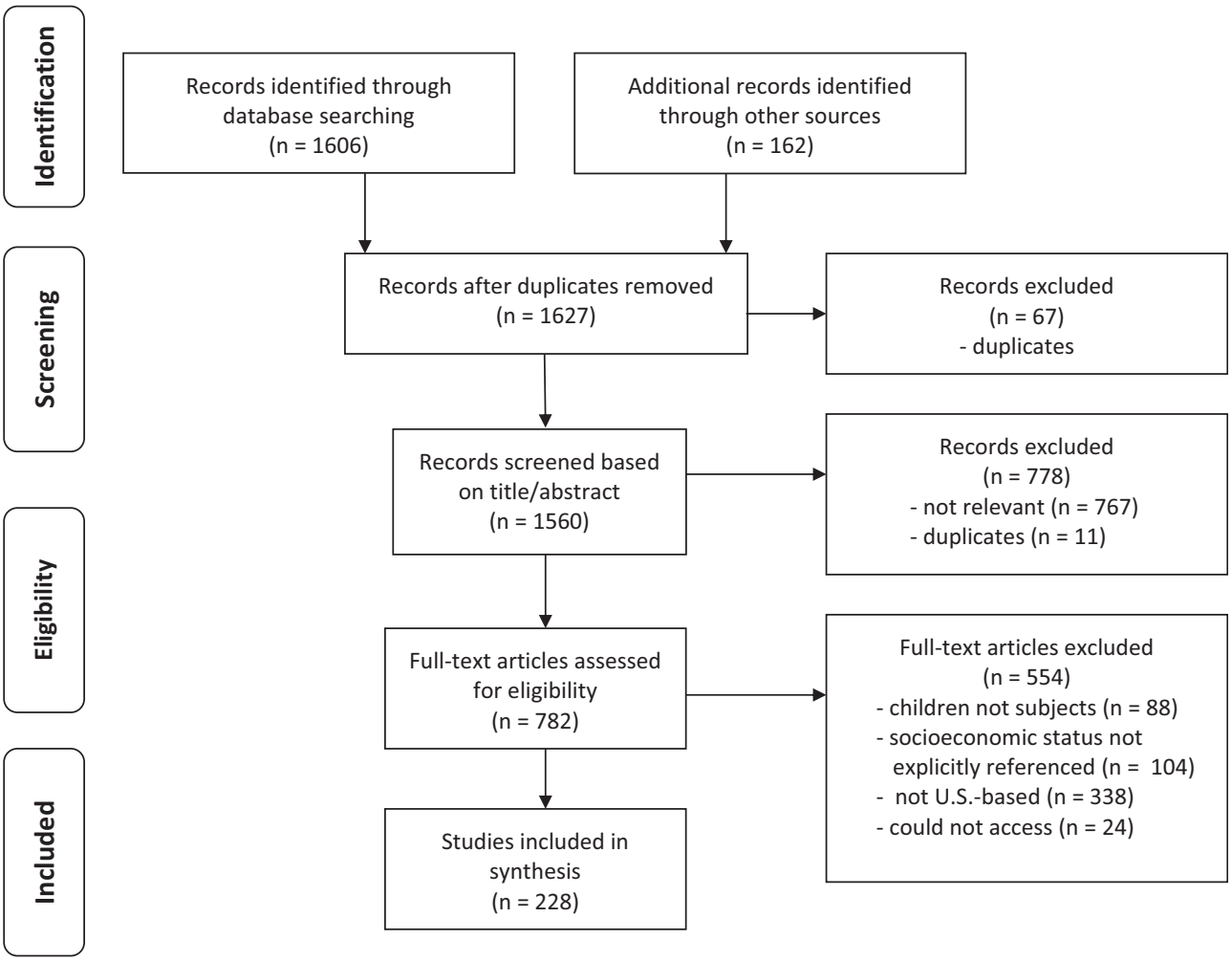

Figure 1. Selection process of articles to include in scoping review of SES in pediatric health research.

explanation for why the SES measure was chosen in relation to the health outcome investigated in the study. The remaining studies either stated a rationale without justifying details or citations (n = 13) or merely cited a prior study that used the SES measure but without a clear connection to the review study's health outcome of interest (n = 22).

Measures were organized into 9 groups by type (**Table II**). Assistance/aid included forms of health-related assistance such as food stamps or health insurance. Demographic measures included common variables like race and age. Education, employment/occupation, and income/poverty consisted of measures related to level of education, employment status or occupation type, and level of income or poverty, respectively. Index/composite variables were constructed from multiple SES measures—such as income, marital status, and education level—but represented by a singular value, often as a result of weighting the importance of variables based on factor analysis. The ownership/possession category represented SES by the ownership of a home, car, or both. School-related measures were derived from the percentage of a student body financially eligible for federally funded programs like free or reduced price lunches and Head Start programs. Uncategorized variables included having a smoker in the household, census-derived variables such as nearest distance to a major road, and self-perceived social status. In addition, 2 studies used a questionnaire to assess SES but did not describe the content or questions. This review included studies that used categorical and continuous approaches to represent a range of SES measurements. All 9 groups included SES as a categorical variable but only 3 groups included continuous measurements (education, income, and index/composite variable).

Common SES Measures

The most common SES measures in this review were related to income (n = 147), education (n = 95), index/composite variables (n = 58), and insurance status (n = 55). Self-reported annual income was the most frequently used income measure in this review (n = 49), followed by census-derived income at the ZIP code level (n = 28). Education was most often measured as a self-reported variable

Table I. Characteristics of included studies

Characteristics	Number (n = 228)	Percentage*
Publication year		
2009-2018	170	74.6
1999-2008	58	25.4
Study setting		
Healthcare	174	76.3
School	50	21.9
Multiple settings	12	5.3
Home	7	3.1
Unknown	3	1.3
Study design		
Randomized clinical trial	11	4.8
Prospective longitudinal	32	14.0
Prospective cohort	16	7.0
Prospective observational	4	1.8
Case-control	13	5.7
Retrospective cohort	11	4.8
Retrospective observational	33	14.5
Cross-sectional	67	29.4
Secondary data analysis	40	17.5
Qualitative	1	<1
SES measure		
Income	147	64.5
Education	95	41.7
Assistance/aid	63	27.6
Indexes/composites	60	26.3
Demographic	32	14.0
Employment/occupation	22	9.6
Uncategorized	16	7.0
School	13	5.7
Ownership/possession	12	5.3
Health focus		
Diet/obesity	45	19.7
Cancer	17	7.5
Asthma	15	6.6
Behavioral	15	6.6
Psychosocial/emotional	15	6.6
Cardiovascular	14	6.1
Cognitive/language	14	6.1
Neurological	11	4.8
Multiple illnesses	10	4.4
Diabetes	9	3.9
Inflammation/infection	8	3.5
Respiratory	8	3.5
Autism	7	3.1
Cystic fibrosis	7	3.1
GI/GU	7	3.1
Sleep	7	3.1
Musculoskeletal	5	2.2
Vaccination	5	2.2
Violence/abuse	4	1.8
Auditory	3	1.3
Dental	3	1.3

GI, gastrointestinal; *GU*, genitourinary.
*Not all category percentages equal 100% owing to rounding as well as overlap when studies used >1 type of SES measure, for example.

using the highest level achieved (eg, less than high school, high school graduate, some college, etc) by 1 or both parents. Index/composite variables combine SES measures, typically using a factor analysis, and included income (n = 18), education (n = 44), employment status (n = 32), and neighborhood characteristics (n = 12). Each index produced a single score that places an individual or family along an SES spectrum. The Hollingshead Four-Factor Index of Socioeconomic Status (n = 24) uses 4 individual-level pieces of data (marital status, retired/employed status, educational attainment, and occupational prestige), and Diez Roux's neighborhood SES index (n = 4) uses neighborhood-level data from the US Census. Insurance status was often classified into 3 categories: private (or commercial), public, and uninsured.

Effects of SES on Outcomes

The majority of studies (n = 182) found that SES had a statistically significant effect on ≥1 health outcome of interest when controlling for other covariates, and 4 studies only detected an effect in the presence of an additional variable (eg, ethnicity). Measures used in the studies that did find an effect are represented by each of the 9 categories (eg, assistance/aid) in Table II. Nineteen studies found no impact of SES on health outcomes; these studies used SES measures represented by every category except ownership/possession (Table II). The remaining studies (n = 23) did not report the presence or absence of an effect. Statistical approaches to testing for and presenting effects of SES on health outcomes varied, but included the reporting of significance with *P* values, raw beta coefficients, and ORs.

Levels of Measurement

The following structural levels of SES measurement were identified: individual, family, neighborhood, and school. At the individual level, SES was collected by self-report and represented by proxies such as child insurance status, maternal education level, home ownership, and marital status. The family level included household income and family structure, taking into consideration multiple or all family members. Neighborhood-level measures encompassed a particular geographical area and were usually derived from census data, based on ZIP code, tract, or block, with ZIP codes covering the largest area and blocks covering the smallest. They included measures of income, poverty, and education. It is possible that the school level could correlate with the neighborhood level, because place of residence can mandate site of school enrollment. Nonetheless, school-level measures directly related to income-based eligibility for federally funded programs.

Discussion

As income inequality increases and gaps in health outcomes widen in the US, the importance of accurately representing SES becomes critical, particularly when SES is shown to influence health outcomes.[25,26] This review reveals variability in the types of SES measures used and their potential to detect an effect of SES on outcomes, with no particular category (eg, education) or subcategory (eg, highest maternal education level) emerging as more or less likely to significantly impact study outcomes. Although the majority of measures are income related, remaining measures such as occupation, home ownership, and education level are arguably associated with income as well. Despite the large number of studies included in this review, few provided a rationale for choosing particular SES measures.

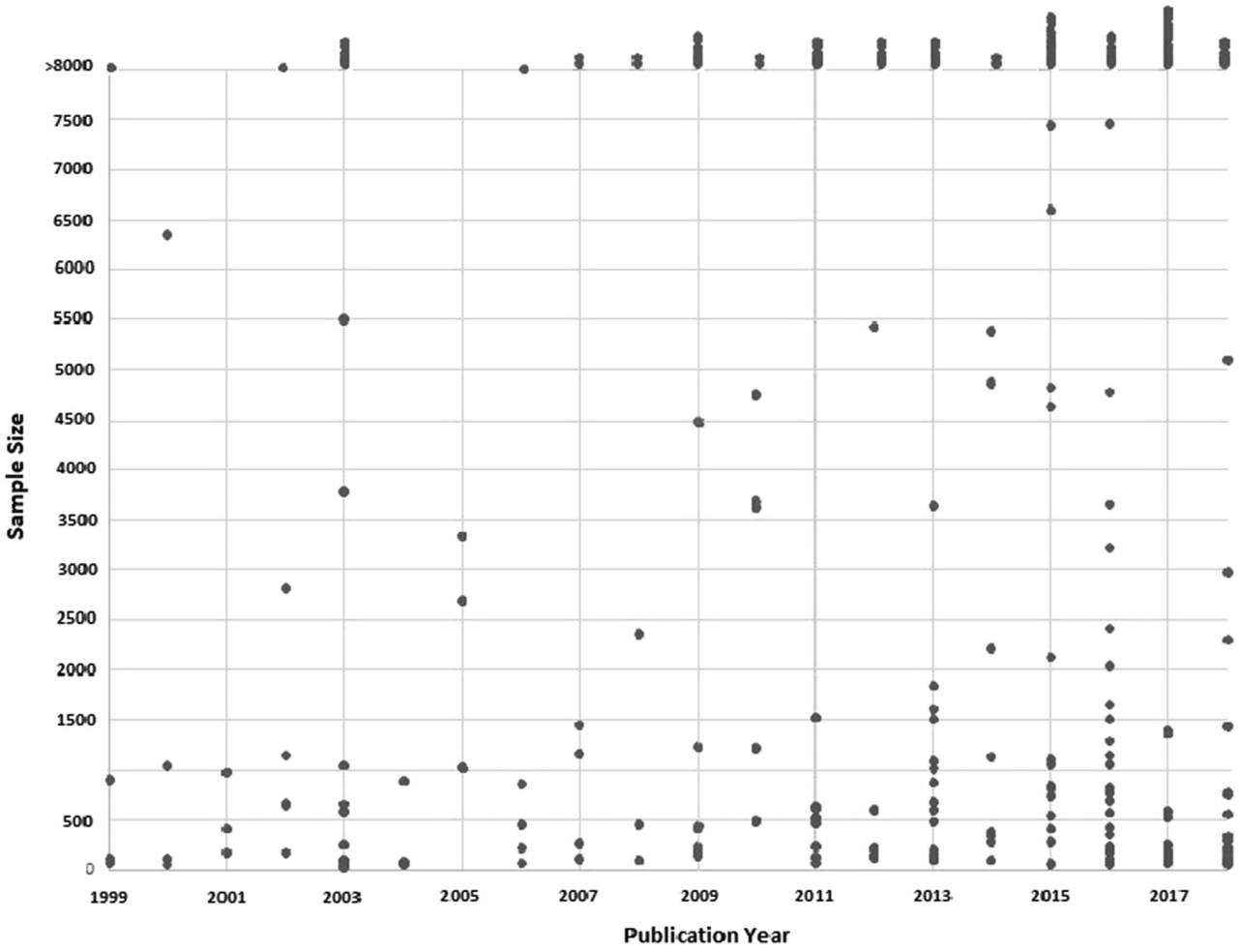

Figure 2. Scatter plot of studies by sample size and publication year.

Issues with Common SES Measures

Besides income, additional factors with financial implications, such as wealth and debt, are 2 powerful indicators of SES that research has shown more accurately reflect one's financial standing.[27] A recent study found that hospitalization rates were higher in areas with greater income inequality, positing that neighborhood income inequality may decrease social cohesion and result in fewer clinics and resources for low-income individuals.[28] Education level is less prone to error and more stable over time as compared with income and categorized similarly across studies. However, education level fails to consider differences such as public vs private education, or 2-year vs 4-year colleges. Like education level, insurance status types are simple to categorize and can be found in hospital health records, but significant variability exists within a public program like Medicaid, with income eligibility varying by state and age (133%-375% of the federal poverty level) and medically needy children qualifying regardless of income.[29] Furthermore, private insurance options widely differ in terms of costs and coverage.

Index/composite variables offer a more comprehensive measurement of SES, but they also decrease distinctive SES factors to a single number, thus, attenuating the connections made between factors and health outcomes. This review featured 20 different index/composite variables, preventing comparisons of SES level and affected outcomes between studies. The commonly used Hollingshead Four-Factor Index is a psychometrically and conceptually problematic indicator of SES: it has been shown to have low predictive power compared with family income and parental education, was never validated, and was never published.[30,31]

Measurement Challenges

US-based research typically represents SES with a univariate measure, as was the case in most studies identified in this review, but a justification for why is rarely given.[32] Research has shown that a correlation between different SES measures can be low or moderate, suggesting that each measures a distinct characteristic.[27] For instance, insurance status, income, and parental education level as SES proxies may perform differently in a study investigating nonurgent pediatric emergency department use. This lack of interchangeability highlights the importance of carefully choosing and justifying a measure. There is no single solution to the

Table II. Types of SES measures

Socioeconomic measures	Number (n = 228)	Percentage	Categorical variable, range	Categorical variable, mode
Assistance/aid	63	27.6	2-5	2
Insurance status	55	24.1		
Receiving public assistance	7	3.1		
Receiving SNAP benefits	1	<1		
Demographic	32	14.0	2-5	2
Marital status	10	4.4		
Race	9	3.9		
Family structure	7	3.1		
Age	4	1.8		
Language spoken at home	1	<1		
No. of children	1	<1		
Education	95	41.7	2-7	4
Highest education level (either parent, not specified)	37	16.2		
Highest maternal education level	29	12.7		
Area/Census-based	14	6.1		
Highest education level between mother and father	11	4.8		
Highest paternal educational level	4	1.8		
Employment/occupation	22	9.6	2-9	2
Employment status	12	5.3		
Occupation type	7	3.1		
Blue collar workers (%)	2	<1		
Military officer ranking	1	<1		
Income/poverty	147	64.5	2-11	4
Self-reported income	49	21.5		
Census-derived (ZIP code level)	28	12.3		
Persons below poverty level (%)	20	8.8		
Census-derived (tract level)	16	7.0		
Income-to-needs ratio	15	6.6		
Census-derived (block level)	13	5.7		
Unknown	4	1.8		
Census-derived (ZIP code tabulation zone level)	1	<1		
Perceived financial status	1	<1		
Index/composite variable	60	26.3	2-7	2
Other	30	13.2		
Hollingshead	24	10.5		
Diez Roux	4	1.8		
Gini	2	<1		
Ownership/possession	12	5.3	2	2
Home	3	1.3		
Mean home value	4	1.8		
Car	2	<1		
Crowding	1	<1		
Home or car	1	<1		
Moving history	1	<1		
School	13	5.7	2-3	2
Free/reduced price lunch eligible	10	4.4		
Head Start eligible	2	<1		
School area-level income	1	<1		
Uncategorized	16	7.0	2-5	2
Other Census variables*	12	5.3		
Questionnaire	2	<1		
Smoker in household	1	<1		
Subjective social status	1	<1		

These measures are organized into 9 categories according to type. Included studies measured SES categorically and continuously. The range represents the number of groups when the SES type was measured categorically (eg, insurance status as Medicaid vs private vs uninsured = 3 groups). The mode represents the most commonly used number of groups.
*Other census variables include high school graduation rate, percent single female-headed household, distance to nearest major road, and so on.

measurement and methodological issues surrounding SES, but rather than perceiving a measure as right or wrong, it is more useful to consider the advantages and disadvantages to each approach in the context of the specific study.[33,34] Studies should not control for SES, because the complexity and scope of SES as a concept cannot definitively be represented by a proxy measure.[32]

Regardless of the measure used, measurements are typically extrapolated from 1 time point, despite the fact that SES proxies are subject to change over time. When SES measurements are obtained by self-report, the sensitive nature of financial status-based measures in particular can result in a significant amount of missing data or, just as concerning, misreported data.[35] When income is reported, it can be intentionally misreported owing to its association with the receiving of government aid and resources, taxes, and social status.[8] Individuals at the middle of the income distribution for self-report variables are the most likely to respond, and to respond truthfully, which can then skew the data and the interpretation of the data.[36,37]

Levels and Precision of SES Measurement

SES is measured on different structural levels—individual, family, school, and neighborhood—honing in on distinct social and economic facets of everyday life. Evidence shows that measurements of SES at the neighborhood level can affect the health of individuals, beyond what may be gleaned exclusively from individual-level SES.[27,38-41] In a study comparing neighborhood SES measures and assessing at which geographic-level (eg, ZIP code, tract, or block) inequalities in health could be detected, tract-level SES produced the most consistent results, and measures of economic deprivation (eg, percent of persons below the poverty line) most accurately reflected SES gradients in health outcomes.[42]

Race as a Confounder

Although 9 studies used race as a measure of SES, many more studies included it alongside SES as a demographic characteristic and potential variable in statistical analyses. Research across disciplines has remarked on the challenge of disentangling the effects of race/ethnicity and SES on health outcomes, particularly in a heterogeneous country like the US.[43,44] Numerous pediatric studies have analyzed the relationships between race/ethnicity and morbidity and mortality outcomes, some of which found significant associations.[45-49] However, many studies do not consistently analyze the effects of SES and race/ethnicity together and separately to identify independent associations.

Strengths and Limitations

This review has many strengths, including the consideration of a range of study designs and settings, a comprehensive search of the literature, and a search strategy that involved multiple databases known to have distinctive focuses, including one that searches the nursing literature. As is customary with scoping reviews, we did not rate the level of evidence; therefore, we may have included studies of questionable quality that met the inclusion criteria. Methodological limitations may have narrowed the scope of the review: restricting the search to studies available in English may have resulted in missing key articles, but because our geographical area of interest is the US, this inclusion criterion was deemed appropriate.

Future Directions and Implications

It may be important for more pediatric studies to consider SES factors as potential influencers of outcomes. Some studies may benefit from employing a bio-ecological framework that includes SES factors as mechanisms operating along distinctive pathways that affect health outcomes.[50] Such a framework could account for social determinants of health that closely relate to SES. Recommendations were made for the purpose of screening for poverty-related social determinants of health during the clinical encounter, thus demonstrating that collecting SES and social determinants of health data can be used in real time to connect pediatric patients and their families with the resources and care they need.[51] Screening tool questions—and eventually interventions—may target food insecurity, childcare vouchers, literacy programs, or healthcare access.

It is unlikely that a singular SES measure will be ideal in all scenarios and settings; of importance here is how SES measurements are interpreted and used in relation to child health outcomes. Measuring to what extent specific SES factors contribute to outcomes cannot be accomplished without first having a reliable measurement of SES.[32] Measurement theory, however, has been largely absent from SES measure construction in healthcare research.[4]

The wide variability in SES measurement practices, rationales, and hypothesized associations with health outcomes should caution researchers against comparing findings across studies. As demonstrated from this review, there is significant ambiguity that surrounds the term "socioeconomic status" when it is treated as a manifest variable rather than a latent construct: SES cannot be measured directly, but indicators that contribute to the construct of SES, such as education level and insurance status, can be measured. For this reason, we recommend referring to the indicator itself (eg, low income in lieu of low SES) when describing measurement and effects on health outcomes within and between studies. Furthermore, we recommend assessing as many indicators of SES as is practical to collect, with the caveat that each one should be justified based on evidence in the literature that presents theoretically plausible pathways leadings from SES to health outcomes.

SES measures should be justified with the health outcome in mind and limitations regarding measurement and data collection should be acknowledged. SES should not be controlled for in studies, as it is likely associated with factors that directly impact health outcomes. The majority of SES measures either explicitly or implicitly relate to income. If the feasibility of SES data collection is a concern, area-based income is a relatively reliable and easily obtainable proxy for SES in a variety of US-based studies. To make logical inferences regarding the impact of SES factors on health outcomes, and to compare findings across studies, the indicator used should be referred to instead of SES. SES should continue to be studied comprehensively so that optimal measures can be used for research and screening for SES-related factors that affect health outcomes. ■

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