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Measuring socioeconomic adversity in early life

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Abstract

Aim: Early life adversity in leads to enduring effects on physical and mental health, school performance, and other outcomes. We sought to identify potentially modifiable factors leading to socioeconomic adversity in early life.

Methods: We enrolled 1,503 pregnant women aged 16–40 years, without pregnancy complications or pre-existing conditions from Shelby County, Tennessee. Social, familial, and economic variables were analyzed using principal components (PCs) analyses to generate the Socioeconomic Adversity Index (SAI). This was replicated using the National Survey of Children's Health (NSCH). Health and social outcomes were compared across the quintile groups defined by SAI values at the county, state, and national levels.

Results: Significant differences occurred across the SAI Quintile-1 to Quintile-5 groups in marital status, household structure, annual income, education, and health insurance. Significantly worse health and social outcomes occurred in the lower vs. higher SAI quintiles, including maternal depression, parental incarceration, child's birthweight, and potential for child abuse. Maternal age and race also differed significantly across the SAI quintiles.

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Conclusion: Modifiable factors contributing to socioeconomic adversity in early life included marital status, household structure, annual income, education, and health insurance. Those exposed to greater socioeconomic adversity as defined by SAI values had significantly worse maternal and child outcomes.

Table of Contents Summary

Key factors determining socioeconomic adversity in early life were combined into a novel composite index, validated with publicly available data and associated with maternal/child outcomes.

The health of Americans has deteriorated, with widening disparities between rich and poor. Decades of social sciences research has demonstrated strong associations between poverty and increased risks for developing chronic non-communicable diseases and psychopathology(1, 2). Poverty is a major determinant of health and well-being, typically affecting those most vulnerable(2). Despite programs to alleviate poverty, the proportions of women and children living in poverty (groups that these policies were first meant to protect(3, 4)) increased from 15% to 35% between 1968 and 2012(1, 5). Statistical measures for defining poverty, from the Official Poverty Measure (OPM) devised by Mollie Orshansky in the Social Security Administration (poverty threshold = $3 \times$ food budget)(3, 4) to the Supplemental Poverty Measure (SPM) created by the National Academy of Sciences(6) have been hotly debated.

Instead of focusing on poverty, we call for considering socioeconomic adversity more broadly, as that resulting from social, familial, *and* economic factors. Children below 5 years age are vulnerable to the lifelong effects of early adversity and least able to fend for themselves(7). Indeed, socioeconomic adversity contributes to under-5 mortality(8) and leads to intergenerational transfers of inequality(9, 10). We used the CANDLE study (Conditions Affecting Neurocognitive Development and Learning in Early childhood) to identify factors associated with socioeconomic adversity in pregnant mothers and their children. We combined these into a composite numerical index, replicated using the National Survey of Children's Health (NSCH). This is a novel approach to identify high-risk populations (according to modifiable social, familial, economic factors) who may benefit from coordinated/holistic interventions to achieve sustained reductions in early life adversity.

Methods

The CANDLE Cohort

The CANDLE study enrolled 1,503 healthy 16–40 year-old women in their second trimester of pregnancy in Shelby County, Tennessee from December 2009 to July 2011 and continues to follow their children (Figure 1, Table S1). Women were recruited from hospital obstetric clinics and community sources (mailings, flyers at obstetric practices, friend referrals, television ads), to reflect the demographic characteristics of Shelby County. Exclusion criteria included existing chronic diseases (hypertension, diabetes, sickle cell disease), known pregnancy complications (e.g., placenta previa, oligohydramnios), women not planning to deliver at a participating hospital, and primary language other than English.

Institutional Review Boards at University of Tennessee Health Sciences Center (UTHSC) and participating hospitals approved this study. Participants or their legally authorized representatives gave informed consent prior to enrollment and received financial incentives during the study. Table 1 compares the CANDLE data (Shelby County) with the NSCH data for Tennessee (TN) and the United States (US).

Data Collection

Enrollment occurred at research clinics in the 2nd trimester (M1), or in the 3rd trimester (M2) at delivery hospitals (M3); with home visits at 4 weeks (HV1) and 2 years (HV2), and annual clinic visits centered around 1–4 years of age (CV1, CV2, CV3, CV4). Data collection included demographic, environmental, social, health, nutritional, cognitive, socioemotional, behavioral, and other measures(11). We selected 55 variables empirically related to socioeconomic adversity and measured at multiple points in time to develop a composite Socioeconomic Adversity Index (SAI).

Developing the Socioeconomic Adversity Index

To reflect dynamic changes in adversity, we divided all 55 variables into the perinatal (12 variables from M1, HV1), infant/toddler (23 variables from CV1, CV2, HV2), and preschool periods (20 variables from CV3, CV4) (Table S2). Some variables were recoded because of their graded socioeconomic impact resulting from legal regulations, social welfare programs, or other existing conditions in the US. For example, federal and state income taxes, insurance eligibility, court-ordered child support or alimony, and spousal death benefits are determined by marital status and number of dependents in the household(12). All recoded variables are listed online (Table S3).

After recoding, principal components analyses (PCA) included 7 variables in the perinatal period, 13 in the infancy/toddler period, and 10 in the preschool period using the ‘svdImpute’ algorithm for missing data implemented in the R package ‘pcaMethods’(13) (Table S4). Variables and individuals with more than 40% missing data were excluded from analysis (Table S1). We chose the minimum number of PCs that explained 90% of data variability(14) and examined correlations of the input variables with each PC (Figure 2).

We weighted the scores for each PC by the percent variation explained by that PC and summed these scores to compute individual SAI values*. Based on SAI values, participants were split into quintile (Q) groups experiencing high (Q-1) to low (Q-5) degrees of socioeconomic adversity. The distribution of component variables across the SAI quintiles determined the face validity of SAI (Tables S5, S6, S7). To examine reproducibility, we conducted the same analyses in NSCH data. NSCH included cross-sectional data from 50,212 households randomly surveyed in 2015/16 (Tables S8, S9).

One-way ANOVA or Fisher’s exact tests were used to examine associations between the SAI quintiles and maternal/child outcomes matched in CANDLE and NSCH. For example, CANDLE measured child abuse using the Child Abuse Potential Inventory (CAPI)(15),

*For example, if 3 PCs explained 90% of the variation such that PC1 explained 75%, PC2 10% and PC3 5%, and if Subject_001 scored 1 for each PC, then this individual’s weighted sum would be $1*(0.75) + 1*(0.15) + 1*(0.05) = 0.95$.

whereas NSCH asked participants if their child was exposed to child abuse or not. If CAPI Abuse Scale scores were >263 in any assessment performed at 1, 2, or 3 years in CANDLE (characteristic of adults with confirmed child abuse(16, 17), we assumed that child abuse was highly likely. Other maternal/child outcomes had comparable definitions in CANDLE and NSCH. Receiver Operating Characteristic (ROC) curves were plotted to compare the SAI vs. SES measures for maternal/child outcomes in the NSCH-US data (Figure 5).

Results

Sample characteristics

CANDLE enrolled 1503 pregnant mothers, with some attrition occurring in the infant/toddler ($n=1241$, 82.6%) and preschool ($n=1208$, 80.4%) groups because of missed clinic visits (Figure 1). The proportion of Non-Hispanic Blacks (NHB) ranged 61%–68% across all visits in CANDLE, contrasting with smaller NHB populations in Tennessee (8.6%) and the US (6.1%). Other demographic features from CANDLE and the NSCH data for Tennessee and USA are presented in Table 1.

Developing the Socioeconomic Adversity Index in CANDLE

In the perinatal period, three PCs explained 93% variability ($PC1=67\%$, $PC2=18\%$, $PC3=8\%$) and included five variables: marital status, education, household structure, annual income, and health insurance (Figure 2A). During pregnancy, most mothers in Q-1 were from single-parent households, with high-school education or less, and income $<\$25,000$ per year, whereas most mothers in Q-5 were from 2-parent households, with college or higher education, and income $>\$65,000$ per year (Figure 3; Table S5).

In the infant/toddler period, five PCs explained 95% of the variance ($PC1=50\%$, $PC2=16\%$, $PC3=12\%$, $PC4=9\%$, $PC5=6\%$; Figure 2B) and included 11 variables. In addition to variables identified in the perinatal period, parental employment at 2 years of age was correlated with infant/toddler PCs. At HV2, fewer than 50% of mothers and 44% of fathers were employed in Q-1 (most common occupation: service/sales), whereas 75% of mothers and 93% of fathers were employed in Q-5 (most common occupation: management/professional). All factors were differentially distributed between Q-1 and Q-5 groups as noted above (Figure 3; Table S6).

In the preschool period, four PCs explained 91% of the variability ($PC1=60\%$, $PC2=17\%$, $PC3=8\%$, $PC4=6\%$; Figure 2C) and included 10 variables. Similar differences in marital status, household structure, education, income, and health insurance were obtained between Q-1 and Q-5 as noted in the perinatal and infant/toddler periods (Figure 3; Table S7).

Across the perinatal, infant/toddler, and preschool periods, density plots showed bimodal distributions of SAI values in CANDLE (Figure 4), with redistribution of some individuals from the extremes (Q-1, Q-5) to the middle quintiles (Q-2, Q-3, Q-4). Some mothers completed education, entered/ended romantic relationships, found/lost jobs, thereby altering their socioeconomic adversity during the study, but differences between the highest and lowest quintiles remained significant.

Calculating the Socioeconomic Adversity Index in NSCH

We found more NSCH participants in the middle quintiles than at the extremes, peaking at Q-4 for both Tennessee and US populations (Figure 4). NSCH data showed that most individuals were from 2-parent households, had more education, and higher annual incomes than CANDLE participants (Tables S8, S9).

Socioeconomic Adversity and Maternal/Child Outcomes

To show the utility of SAI, we compared maternal/child outcomes across the quintiles at county, state, and national levels. Because data collection methods differed between CANDLE and NSCH, we did not compare the maternal/child outcomes across these two datasets.

Socioeconomic adversity was associated with maternal depression in CANDLE and NSCH ($p<0.015$), maternal anxiety in NSCH ($p=0.01$), parental incarceration in all populations ($p<0.0001$), sexually transmitted diseases in CANDLE ($p<0.0001$), and drug abuse in the CANDLE ($p=0.0005$) and NSCH-US populations ($p<0.0001$). Significant differences occurred across the SAI quintiles in all populations for birthweight ($p=0.002$) and child abuse potential ($p=0.0005$). SAI quintiles also differed according to demographic factors such as maternal age ($p<0.0001$) and race ($p<0.0001$) in the CANDLE and NSCH-US populations (Table 2a and Table 2b).

ROC curves using the SAI values vs. income-based SES showed greater association with maternal/child outcomes in the NSCH-US database for: maternal depression (AUC 0.62 vs. 0.56, $p<0.0001$), maternal anxiety (0.57 vs. 0.52, $p<0.0001$), parental incarceration (0.78 vs. 0.70, $p<0.0001$), maternal drug abuse (0.63 vs. 0.54, $p<0.0001$), and child abuse (0.71 vs. 0.66, $p<0.0001$). Association with low birthweight (dichotomized as ≤ 2500 or >2500 grams) was similar for the SAI vs. SES measures (0.55 vs. 0.55, $p=0.7224$; Figure 5).

Discussion

Any single indicator of adversity cannot estimate the cumulative burdens of those facing material, emotional, physical, and social deprivation. Assessments of socioeconomic adversity must include context-specific factors relevant for different phases of the lifespan (e.g., adolescents vs. elders) and geographically defined populations (e.g., Vermont vs. Texas). Using 55 variables from the CANDLE Study, we developed a composite numerical index measuring socioeconomic adversity in the perinatal, infant/toddler, and preschool age groups.

In our analyses, five variables (marital status, household structure, education, income, health insurance) contributed to socioeconomic adversity in all three periods. Marital status played a particularly significant role. Associations among marital status, teen pregnancy, social adversity and subsequent birth outcomes are well-documented(9, 18, 19), but implementing policies or programs to improve pregnancy outcomes(20, 21) were hampered by ideological views that maternal adversities stem from individual choices and not social inequities. Children from single-parent families are five times more likely to be poor (45.8%) than children of married couples (9.2%)(22). In most families, two parents are expected to

provide greater financial, emotional, and other resources than one parent, and both parents play unique roles in raising children. Household structure is another important factor underlying social adversity, as documented previously(23–25) and confirmed by our results. Earning vs. dependent members in a household may account for individual taxation and other social benefits.

Having publicly-funded or no health insurance contributed to socioeconomic adversity in our study. If families are unable to pay medical bills, their ability to pay other bills deteriorates rapidly, necessitating multiple sacrifices to stay solvent(26) and accentuating socioeconomic adversity. Given that healthcare costs are being increasingly billed to consumers, lack of health insurance is likely to have a growing impact on socioeconomic adversity.

Income and education are well-documented determinants of social class(2, 5). CANDLE participants had lower educational attainments and incomes than NSCH participants. These patterns, as illustrated in Figure 4, highlight the social *and* economic differences for Shelby County vs. Tennessee and the USA. Despite these demographic differences, the proposed index *can* be validated using publicly available data to identify specific groups that differ in socioeconomic adversity.

Maternal and child outcomes differed significantly between the SAI quintiles in CANDLE and in NSCH (Table 2). In the lower SAI quintiles, more mothers had a history of depression, as also reported previously(27). Parental incarceration occurred more frequently in the lower SAI quintiles at the county, state, and national levels, reflecting historical trends(28, 29). Greater exposure to sexually transmitted diseases occurred in the lower SAI quintiles from CANDLE, also confirming previous associations(30). Birthweights increased across the SAI quintiles in all populations, likely reflecting differences in prenatal nutrition and prenatal care between these groups(9, 31, 32). Perinatal adversity is not only associated with lower birthweights and higher infant mortality(2, 33), but also with impaired brain growth, poor cognition and mental health(34), poorer child health, academic success, intergenerational inequities(9, 19) and risks of chronic non-communicable diseases(1, 2, 25).

We present a novel approach measuring socioeconomic adversity, to identify high-risk groups for social and health inequities(35). If socioeconomic adversity is a useful construct, it must predict the outcomes known to be associated with lower SES. On comparing the ability of SAI vs. SES to predict maternal and child outcomes in the NSCH database, we found that SAI statistically outperformed SES for every outcome except birthweight, perhaps because birthweight was dichotomized into low and normal birthweight groups. These results and other studies support the utility of this construct(36).

While examining the long-term consequences of early life adversity, it is important to distinguish between socioeconomic adversity and adverse childhood experiences (ACEs). Both may occur in similar populations, and socioeconomic adversity may increase the odds of experiencing ACEs. Slopen et al. found that poor children experienced twice as many ACEs as did children from high-income groups(37). Our data also showed higher child abuse potential in lower vs. higher SAI quintiles. Traditionally, ACEs include 10 indicators

of child abuse or household dysfunction(38), but Merskey et al. expanded the ACEs to include family financial problems, food insecurity, homelessness, parental absence, parent/sibling death, bullying, and violent crime(39). We believe that the construct of socioeconomic adversity must be kept separate from that of ACEs for fear that combining the two constructs may result in labeling impoverished families as abusive and/or dysfunctional. This is particularly important because socioeconomic adversity was associated with maternal age and race. Financial problems or food insecurity experienced by impoverished families cannot be equated with the ACEs like child abuse, domestic violence, or parental incarceration. Doing so may add different kinds of profiling to those practiced by law enforcement, immigration, or other public agencies(40, 41).

This study has several limitations. There was a relative lack of paternal data in CANDLE, thus precluding analysis. Future measures of socioeconomic adversity must include data from both parents. Maternal responses had fewer missing data (5–10%) and multiple imputation was used to estimate values for analysis. We used published evidence and expert opinion to select variables, rather than data-driven variable selection algorithms. We selected modifiable factors (not age/race), whereas data-driven approaches require a predefined construct and may also select irrelevant or non-modifiable factors. Some CANDLE variables did not have corresponding variables in NSCH, but all data elements required for calculating SAI values *were present* in NSCH. Despite these limitations, our approach for broadly defining socioeconomic adversity (to replace narrow income-based definitions of poverty) may be more useful for investigating the social determinants of health.

Conclusion

The Socioeconomic Adversity Index includes key social, familial, *and* economic variables associated with adversity in early life, identifies high-risk groups susceptible to the effects of early adversity, and more accurately predicts maternal/child outcomes than income-based SES measures. Measures of socioeconomic adversity should be developed specifically for different phases of the lifespan and for different geographically-defined populations.

We used CANDLE Study data to illustrate this principle, which includes those most vulnerable to the long-term effects of adversity, namely, pregnant women and young children. Composite indices for the perinatal, infancy/toddler and preschool periods included marital status, household structure, education, income, and health insurance. Various maternal and child-related outcomes differed significantly across the quintile groups defined by this index, and these differences were validated from a publicly available database. We propose further studies to establish the validity and utility of this novel approach.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Conflict of interest

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Abbreviations:

AUC	area under the curve
CANDLE	Conditions Affecting Neurocognitive Development and Learning in Early childhood
CAPI	Child Abuse Potential Inventory
CV	Clinic Visit
HV	Home Visit
NHB	Non-Hispanic Blacks
NHW	Non-Hispanic Whites
NSCH	National Survey of Children's Health
OPM	Official Poverty Measure
PCs	principal components
PCA	principal components analysis
Q-1	Quintile-1
Q-5	Quintile-5
ROC	Receiver Operating Characteristic curves
SAI	Socioeconomic Adversity Index
SES	socioeconomic status
SPM	Supplemental Poverty Measure
TN	Tennessee
US	United States

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Key Notes

- Traditionally, measures of socioeconomic status used economic data to assign social status, occasionally including education or employment.
- Social and familial factors significantly contribute to early life adversity, which leads to worse long-term physical/mental health outcomes.
- Factors predicting socioeconomic adversity in early life included: marital status, household structure, annual income, education, and health insurance; these were combined to develop composite numerical indices measuring adversity in the perinatal, infant/toddler, and preschool periods.

Figure 1:

CONSORT diagram for the CANDLE Study, showing the numbers of subjects enrolled and those evaluated at each follow-up visit. CANDLE enrolled 1503 women in the second trimester of pregnancy, with 1455 live births and some attrition in the infant/toddler (n=1241, 82.6%) and preschool (n=1208, 80.4%) groups because of missed clinic visits.

Figure 2:

Heatmap of the variables with absolute correlations of >0.1 with the SAI principal components at the perinatal (3 PCs), infant/toddler (5 PCs), and preschool (4 PCs) periods for the CANDLE cohort. Numbers below the PCs denote proportions of the total variation explained by that corresponding PC.

Figure 3:

Distribution of salient factors assessed at different contact points within CANDLE across the quintile (Q1-Q5) groups assigned by the ranks of their SAI scores; (2A) marital status, (2B) household structure, (2C) maternal education, and (2D) maternal income. Mothers in the lower quintile groups were more often unmarried, had more dependents, received less education, and had lower annual incomes than those in the higher quintile groups.

Figure 4:

Density plots showing the bimodal distribution of SAI values for the Perinatal (blue), Infant/Toddler (red), and Preschool (green) time periods in the CANDLE Study, and unimodal distributions of SAI scores for the US (black) and Tennessee (purple) populations in NSCH.

Figure 5:

Receiver Operating Characteristic (ROC) curves comparing the SAI vs. SES measures in predicting maternal/child outcomes in the US NSCH data, with significant differences for maternal depression ($p < 0.0001$), maternal anxiety ($p < 0.0001$), parental incarceration ($p < 0.0001$), maternal drug abuse ($p < 0.0001$) and potential child abuse ($p < 0.0001$).

Table 1:

Demographic characteristics of the CANDLE and NSCH participants

	CANDLE N=1503	NSCH-TN N=885	NSCH-US N=50212
Maternal age	26 (21.5 – 30)	29 (25 – 33)	30 (26 – 34)
Race^I			
White	467 (31.1%)	715 (80.8%)	38,961 (77.6%)
Black	962 (64.1%)	76 (8.6%)	3,075 (6.1%)
Asian	19 (1.3%)	29 (3.3%)	2,769 (5.5%)
American Indian	33 (2.2%)	3 (0.3%)	374 (0.7%)
Native Hawaiian	5 (0.3%)	0 (0.0%)	148 (0.3%)
Other	15 (1.0%)	62 (7.0%)	4885 (9.7%)
Maternal Education			
< High School	184 (12.3%)	18 (2.0%)	1,096 (2.2%)
High School/GED	709 (47.2%)	164 (18.5%)	6,020 (12.0%)
Technical School	138 (9.2%)	210 (23.7%)	11,027 (22.0%)
College Degree or Higher	470 (31.3%)	468 (52.9%)	30,872 (61.5%)
Marital status			
Never married	614 (40.9%)	38 (4.3%)	2,163 (4.3%)
Divorced	23 (1.5%)	94 (10.6%)	4,381 (8.7%)
Separated	16 (1.1%)	17 (1.9%)	863 (1.7%)
Widowed	1 (0.1%)	16 (1.8%)	717 (1.4%)
Living with partner	285 (19.0%)	38 (4.3%)	2,124 (4.2%)
Married	563 (37.5%)	661 (74.7%)	38,754 (77.2%)
Household structure			
1 parent, 5+ individuals	234 (18.8%)	37 (4.2%)	1,768 (3.5%)
1 parent, 1–4 individuals	281 (22.5%)	163 (18.4%)	7,172 (14.3%)
2 parents, 5+ individuals	261 (20.9%)	161 (18.2%)	10,865 (21.6%)
2 parents, 2–4 individuals	471 (37.8%)	491 (55.5%)	28,432 (56.6%)
Income			
<25,000	599 (43.8%)	114 (12.9%)	5,030 (10.0%)
25,000–65,000	450 (32.9%)	249 (28.1%)	11,778 (23.5%)
>65,000	319 (23.3%)	522 (59.0%)	33,404 (66.5%)
Insurance			
Medicare, Medicaid, None	878 (58.4%)	275 (31.1%)	13,321 (26.5%)
VA, Employer, or Private	625 (41.6%)	608 (68.7%)	36,703 (73.1%)

NA: not assessed; CANDLE: Conditions Affecting Neurocognitive Development and Learning in Early childhood; NSCH: National Survey of Children's Health; GED: General Educational Development; VA: Veterans' Administration-

^I Mother's race was recorded in CANDLE, whereas child's race was reported in NSCH. Maternal Age is listed as Medians (IQR).

Table 2a:

Maternal/child outcomes by SAI quintiles in the CANDLE cohort

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	P-value
	CANDLE n=383	CANDLE n=219	CANDLE n=301	CANDLE n=318	CANDLE n=282	
Maternal age	22.0 (19.0 – 25.0)	22.0 (20.0 – 26.0)	25.0 (21.0 – 28.0)	28.0 (25.0 – 31.0)	31.0 (29.0 – 34.0)	<0.0001
Maternal race: White	15 (3.9%)	20 (9.1%)	55 (18.3%)	162 (50.9%)	215 (76.2%)	<0.0001
Black	353 (92.2%)	186 (84.9%)	226 (75.1%)	145 (45.6%)	52 (18.4%)	
Asian	0 (0.0%)	1 (0.5%)	2 (0.7%)	3 (0.9%)	13 (4.6%)	
American Indian	11 (2.9%)	8 (3.7%)	10 (3.3%)	3 (0.9%)	1 (0.4%)	
Native Hawaiian	1 (0.3%)	1 (0.5%)	2 (0.7%)	1 (0.3%)	0 (0.0%)	
Other	2 (0.5%)	3 (1.4%)	5 (1.7%)	4 (1.3%)	1 (0.4%)	
Post-natal depression	17 (4.4%)	15 (6.8%)	14 (4.7%)	6 (1.9%)	7 (2.5%)	<0.0001
Maternal anxiety	38.0 (38.0 – 45.0)	38.0 (38.0 – 45.0)	38.0 (38.0 – 51.0)	38.0 (38.0 – 45.0)	38.0 (38.0 – 49.5)	0.7
Parent ever in jail	103 (26.9%)	69 (31.5%)	46 (15.3%)	18 (5.7%)	3 (1.1%)	<0.0001
STD history^a	167 (43.6%)	97 (44.3%)	115 (38.2%)	72 (22.6%)	29 (10.3%)	<0.0001
Drug abuse history^b	73 (19.1%)	64 (29.2%)	98 (32.6%)	98 (30.8%)	83 (29.4%)	0.0005
Birth Weight (grams)	3101.0 (2812.5 – 3354.0)	3120.0 (2906.0 – 3460.0)	3203.2 (2913.2 – 3512.5)	3380.0 (3085.0 – 3684.5)	3413.5 (3098.5 – 3726.5)	<0.0001
Child abuse likely	38 (9.9%)	19 (8.7%)	25 (8.3%)	12 (3.8%)	2 (0.7%)	<0.0001

Notes: One-way ANOVA for continuous variables, Fisher's exact test for categorical variables comparing differences across SAI quintiles within the CANDLE databases;

^aSTD: sexually transmitted diseases included herpes, gonorrhea, chlamydia, or trichomonas

^bDrug abuse included injected drugs, marijuana, cocaine, or other recreational drug abuse; Child Abuse in the CANDLE cohort was likely if the CAPI Abuse Scale scores were >263 in any of the assessments performed at 1, 2, and 3 years.

Table 2b:

Maternal/child outcomes by SAI quintiles in the NSCH-TN cohort

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	P-value
	NSCH-TN n=177	NSCH-TN n=177	NSCH-TN n=213	NSCH-TN n=213	NSCH-TN n=105	
Maternal age	39.0 (28.0 – 50.0)	40.0 (34.0 – 48.0)	42.0 (36.0 – 48.0)	42.0 (37.0 – 47.0)	44.5 (37.0 – 50.0)	0.075
Maternal race: White	126 (71.2%)	147 (83.1%)	173 (81.2%)	176 (82.6%)	93 (88.6%)	<0.0001
Black	40 (22.6%)	12 (6.8%)	13 (6.1%)	10 (4.7%)	1 (1.0%)	
Asian	1 (0.6%)	3 (1.7%)	6 (2.8%)	12 (5.6%)	7 (6.7%)	
American Indian	1 (0.6%)	0 (0.0%)	1 (0.5%)	1 (0.5%)	0 (0.0%)	
Native Hawaiian	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
Other	9 (5.1%)	15 (8.5%)	20 (9.4%)	14 (6.6%)	4 (3.8%)	
Post-natal depression	10 (5.6%)	6 (3.4%)	5 (2.3%)	3 (1.4%)	9 (8.6%)	0.014
Maternal anxiety	15 (8.5%)	17 (9.6%)	18 (8.5%)	8 (3.8%)	16 (15.2%)	0.01
Parent ever in jail	47 (26.6%)	27 (15.3%)	7 (3.3%)	3 (1.4%)	3 (2.9%)	<0.0001
STD history^a	NA	NA	NA	NA	NA	NA
Drug abuse history^b	2 (1.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.053
Birth Weight (grams)	3203.5 (2891.7 – 3472.8)	3189.3 (2948.4 – 3543.7)	3345.2 (3005.0 – 3685.4)	3345.2 (3005.0 – 3628.7)	3458.6 (3033.4 – 3855.5)	0.002
Child abuse likely	15 (8.5%)	7 (4.0%)	5 (2.3%)	1 (0.5%)	4 (3.8%)	0.0005

Notes: National Survey of Children's Health data are presented for Tennessee (NSCH-TN)); One-way ANOVA for continuous variables, Fisher's exact test for categorical variables comparing differences across SAI quintiles within the NSCH-TN

^aSTD: sexually transmitted diseases included herpes, gonorrhea, chlamydia, or trichomonas

^bDrug abuse included injected drugs, marijuana, cocaine, or other recreational drug abuse; Child Abuse in the CANDLE cohort was likely if the CAPI Abuse Scale scores were >263 in any of the assessments performed at 1, 2, and 3 years.

Table 2c:

Maternal/child outcomes by SAI quintiles in the NSCH-US cohort

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	P-value
	NSCH-US n=10046	NSCH-US n=10061	NSCH-US n=10033	NSCH-US n=14793	NSCH-US n=5279	
Maternal age	41.0 (33.0 – 52.0)	41.0 (35.0 – 48.0)	42.0 (37.0 – 48.0)	42.0 (36.0 – 48.0)	42.0 (36.0 – 48.0)	<0.0001
Maternal race: White	6,666 (66.4%)	7,791 (77.4%)	8,196 (81.7%)	12,325 (83.3%)	3,983 (75.4%)	<0.0001
Black	1,490 (14.8%)	598 (5.9%)	355 (3.5%)	434 (2.9%)	198 (3.8%)	
Asian	336 (3.3%)	504 (5.0%)	574 (5.7%)	796 (5.4%)	559 (10.6%)	
American Indian	131 (1.3%)	97 (1.0%)	60 (0.6%)	52 (0.4%)	34 (0.6%)	
Native Hawaiian	60 (0.6%)	24 (0.2%)	33 (0.3%)	24 (0.2%)	7 (0.1%)	
Other	1,363 (13.6%)	1,047 (10.4%)	815 (8.1%)	1,162 (7.9%)	498 (9.4%)	
Post-natal depression	773 (7.7%)	472 (4.7%)	384 (3.8%)	417 (2.8%)	173 (3.3%)	<0.0001
Maternal anxiety	1,251 (12.5%)	921 (9.2%)	851 (8.5%)	1,082 (7.3%)	396 (7.5%)	<0.0001
Parent ever in jail	1,650 (16.4%)	666 (6.6%)	227 (2.3%)	196 (1.3%)	129 (2.4%)	<0.0001
STD history^a	NA	NA	NA	NA	NA	NA
Drug abuse history^b	47 (0.5%)	20 (0.2%)	18 (0.2%)	17 (0.1%)	10 (0.2%)	<0.0001
Birth Weight (grams)	3316.9 (2920.0 – 3628.7)	3345.2 (3005.0 – 3685.4)	3401.9 (3033.4 – 3713.8)	3401.9 (3033.4 – 3713.8)	3373.6 (3005.0 – 3713.8)	<0.0001
Child abuse likely	752 (7.5%)	321 (3.2%)	203 (2.0%)	186 (1.3%)	83 (1.6%)	<0.0001

Notes: Outcomes are presented for the CANDLE cohort and National Survey of Children's Health data for Tennessee (NSCH-TN) and all 50 states (NSCH-US); One-way ANOVA for continuous variables, Fisher's exact test for categorical variables comparing differences across the SAI quintiles within the

^aCANDLE

^bNSCH-TN, and

^cNSCH-US databases

^dSTD: sexually transmitted diseases included herpes, gonorrhea, chlamydia, or trichomonas

^eDrug abuse included injected drugs, marijuana, cocaine, or other recreational drug abuse; Child Abuse in the CANDLE cohort was likely if the CAPI Abuse Scale scores were >263 in any of the assessments performed at 1, 2, or 3 years (this cut-off value is characteristic of adults associated with confirmed child abuse); in the NSCH database, participants were asked if their child was exposed to child abuse or not.