Intergenerational Health Disparities: Socioeconomic Status, Women's Health Conditions, and Child Behavior Problems

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SYNOPSIS

Objective. Relatively little is known about the intergenerational mechanisms that lead to social disparities in child health. We examined whether the association between low socioeconomic status (SES) and child behavior problems is mediated by maternal health conditions and behavior.

Methods. Prospective cohort data (1979–1998) on 2,677 children and their mothers were obtained from the National Longitudinal Survey of Youth. SES, the Child Behavior Problems Index (BPI), and maternal smoking, depressive symptoms, and alcohol use before, during, and after pregnancy were examined.

Results. Lower income and lower maternal education were associated with increased child BPI scores. Adjustment for maternal smoking, depressive symptoms, and alcohol use attenuated the associations between SES and child BPI by 26% to 49%. These maternal health conditions often occurred together, persisted over time, and were associated with the mother's own childhood SES and pre-pregnancy health.

Conclusions. Social disparities in women's health conditions may help shape the likelihood of behavior problems in the subsequent generation. Improved public health programs and services for disadvantaged women across the lifecourse may not only address their own urgent health needs, but reduce social disparities in the health and well-being of their children.

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The childhood origins of adult morbidity and mortality have received considerable recent attention.[1,2] Childhood socioeconomic status (SES) and health appear to contribute to adult health behaviors,[3] body mass index and pulmonary function,[4] coronary heart disease,[5] mental health,[6,7] and total and cause-specific mortality,[8,9] among other outcomes.

Yet the origins of child health disparities themselves remain poorly understood. In particular, little is known about intergenerational mechanisms that might shape child health disparities. Potential mechanisms must meet two criteria. These factors must influence child health, and they must themselves be associated with SES. Women's health conditions and behaviors may play such a mediating role. First, there is substantial evidence that maternal health conditions and behaviors influence a range of child health outcomes, including low birthweight,[10] behavior problems,[11–13] and asthma.[14,15] Second, women's health conditions have been clearly associated with SES.[7,16–20] A better understanding of how social gradients in women's health shape health disparities in the next generation may lead to new clinical and public health opportunities for disparity reduction.

This analysis uses data from the National Longitudinal Survey of Youth (NLSY) to assess the potential for such intergenerational influences on health. We examine whether social gradients in a central child health outcome, behavior problems, are mediated by social differences in maternal health conditions and behavior, specifically maternal smoking, depressive symptoms, and alcohol use. We then assess the women's own childhood SES and pre-pregnancy health to determine whether maternal health conditions have their antecedents earlier in life. This longitudinal or lifecourse perspective on the antecedents of maternal conditions offers insight into both the continuity of women's health conditions over time and the temporal ordering of low SES, maternal health, and child behavior, thus helping to frame the requirements for potential interventions.

METHODS

Sample and design

The NLSY began in 1979 as a national sample of young men and women aged 14–21 years, over-sampled for blacks, Hispanics, and low-income white, non-Hispanics. Eighty-four percent of the original respondents were still in the sample as of 1998.[21] Data on children of the women in the cohort have been collected every other year since 1986. We studied children aged 4 to 10 years old in 1996 (n=3113), of whom 436 (14.0%) were missing behavior outcome data, yielding a sample size of 2,677.

Study variables

Outcome. The main outcome in this analysis was parent report of child behavior problems in 1996 using the Behavior Problems Index (BPI). The BPI consists of 28 questions drawn largely from the Achenbach Child Behavior Checklist (CBCL).[22,23] We examined the BPI subscale focused on externalizing behaviors (e.g., bullying, impulsivity). The NLSY does not include diagnoses of specific externalizing disorders such as attention deficit hyperactivity disorder and conduct disorder. However, use of the broader externalizing classification helps accommodate the considerable comorbidity and developmental linkages among these disorders.[24–26] The approach is also consistent with prior studies of the association of child behavior problems with SES,[27] maternal smoking,[28] depressive symptoms,[29] and alcohol use.[30] The BPI externalizing subscale has good internal validity (Cronbach's alpha 0.85) and correlates well with the CBCL equivalent.[31] Scores are standardized to a mean (standard deviation [SD]) of 100 (±15). Higher scores indicate worse behavior problems.

Sociodemographic variables. Key variables included mother's highest education and the ratio of household income to the poverty line (adjusted for family size). Income averaged over the child's lifetime and as a single year window prior to the child outcome were each examined. Maternal race/ethnicity (Hispanic, black non-Hispanic, white non-Hispanic), marital status, maternal age at delivery, firstborn status, family size, child gender, and child age were also included based on prior literature.[32]

Maternal health variables. Maternal health variables examined in the analysis included smoking, depressive symptoms, and alcohol consumption measured at several points in time. Women who reported smoking cigarettes during pregnancy were considered prenatal smokers (collapsed to yes vs. no due to sample size). Postnatally, children whose mothers reported smoking daily (vs. occasionally/not at all) were considered exposed.

Depressive symptoms were assessed with the Center for Epidemiologic Studies-Depression (CES-D) scale.[33] The full 20-item CES-D was fielded initially, but an abbreviated seven-item version was used in the subsequent NLSY wave. The full 20-item CES-D and the seven-item results were highly correlated (r=0.90, p<0.0001), so for consistency we used the seven items throughout (Cronbach's alpha 0.83). Children whose mothers were in the top quartile of depressive symptoms were considered exposed.

Data on the frequency, but not the amount, of alcohol consumed during pregnancy was available. As children's externalizing behaviors have been associated with reported exposure to as little as one drink per week in utero,[30] women who reported drinking alcohol on at least "3 or 4 days per month" during pregnancy were categorized as prenatal drinkers. Postnatally, children whose mothers drank in the prior 30 days and had five or more drinks on an average drinking day were considered exposed to binge drinking.

Postnatal smoking, depressive symptoms, and binge drinking were all assessed in both 1992 and 1994. To capture more accurately the duration of the child's exposure, mothers positive for a condition in both 1992 and 1994 were considered persistently affected; those positive in 1992 or 1994 were considered intermittently affected; and those negative in 1992 and 1994 were the reference group. A cumulative risk variable indicated the number of conditions (0–3) that a mother ever reported.

Women's early lifecourse SES and pre-pregnancy health variables. The mother's earlier lifecourse SES was assessed using the highest education achieved by the maternal grandfather.

Grandmother's marital status and the average household income between the start of the survey (1979) and the year prior to pregnancy were also examined. Women's pre-pregnancy health included daily smoking in 1984, Rosenberg Self-Esteem scale[34] in 1980 (the best pre-pregnancy proxy for depression[35] available in the NLSY), and binge drinking on more than one occasion in the past month in 1984.

Child mental health care and school outcome variables. The association of child behavior problems (BPI) in 1996 with child mental health care and school outcomes two years later was also examined. Maternal responses to four questions were included: (*1*) whether the child had seen a psychiatrist, psychologist, or counselor in the prior 12 months about any behavioral, emotional, or mental problems; (*2*) whether the child regularly took any medicines to help control his or her behavior; (*3*) whether the child ever had any behavior problems at school resulting in notification from the teacher or principal; and (*4*) whether the child had ever been suspended or expelled.

Analysis

Analysis of variance was used to determine the bivariate relationships between sociodemographic and maternal health and the continuous child behavior outcome. We tested whether maternal health conditions mediated the effect of SES on child behavior following the approach of Baron and Kenny.[36] First, we examined the associations between SES and the presumed maternal health mediators. Second, we examined the association between SES and child BPI. Third, we assessed how the relationship between SES and BPI changed after adjusting for the maternal health conditions. The changes in the unstandardized beta coefficients for income and education indicated the extent to which the maternal conditions mediated the effects of income and education on child behavior.[36] Diagnostics were run to rule out colinearity. Two additional regression models examined the cumulative risk associated with multiple maternal health conditions and the effect of a one-year window of income rather than income over the child's lifetime. The latter assessed the potential for missing SES disparities when using a single time point for childhood income.

To help clarify the temporal ordering of SES, maternal health, and child behavior problems, we used logistic regression to examine the early lifecourse antecedents of maternal health. We examined the association between the mother's childhood SES (as indicated by the maternal grandfather's education) and her pre-pregnancy health and, in turn, the association of her pre-pregnancy health with postnatal health. Finally, we examined whether the woman's pre-pregnancy health was associated with child BPI. To determine if pre-pregnancy health effects on child BPI were mediated by postnatal health, we modeled pre-pregnancy health on child BPI before and after controlling for later maternal health. Viewed from another perspective, this last model also offered a more conservative estimate of maternal postnatal health effects. That is, one common argument is that other unmeasured maternal factors (e.g., maternal traits) could confound the association between maternal poor postnatal health and child behavior. Pre-pregnancy health offers a potential proxy for such unmeasured factors; by including pre-pregnancy health variables in the model, we sought to obtain a less biased estimate of maternal postnatal health effects on child behavior.

A final analysis sought to address the potential bias introduced by a depressed mother rating her own child's behavior, i.e., that depressed mothers may exaggerate the behavior problems. We examined the correlations between the child's BPI score and potentially corroborating variables, child mental health and school outcomes, to determine if these correlations were weaker for children whose mothers had depressive symptoms.[37] While mothers reported on all outcomes, we reasoned that reported school suspensions or expulsions, for example, may be less susceptible to biased maternal reporting.

The NLSY design used a complex sampling procedure. Using SUDAAN 8.0, statistical analyses adjusted for the initial sampling design and the fact that two or more children could be from the same household.[38] SAS 8.1 was used for models predicting maternal health outcomes.[39]

RESULTS

SES, maternal health, and child BPI: univariate and bivariate results

Maternal age at delivery was 27.0 years (SD 2.8) and child age at the 1996 assessment was 7.1 years (SD 2.0). The average child BPI score was 102.5 (SD 14.9) (Table 1). Approximately 58% of children had mothers affected by at least one health condition and 20.8% had mothers with two or more conditions. For example, over half of persistent smokers also reported depressive symptoms in 1992 and/or 1994. Compared to children with behavior outcome data, children missing outcome data were more likely to be from low income, single parent, and non-white households (data not shown).

Children of women who did not graduate from high school had BPI scores approximately 10 points, or ~2/3 SD, higher than children of women with a college degree (107.5 vs. 97.9, $p<0.0001$). More persistent maternal smoking, depressive symptoms, and binge drinking were each associated with significant increases in child behavior problems.

Lower household income was associated with increased prevalence of all three maternal health conditions. Compared to women with incomes above four times the poverty line, women with incomes below the poverty line were more likely to report persistent maternal smoking (25% vs. 9%, $p<0.0001$), depressive symptoms (22% vs. 4%, $p<0.0001$), and binge drinking (5% vs. 1%, $p<0.001$). Health differences of similar magnitude existed between women without a high school degree and those with at least some college education. Forty percent of women living in poverty reported experiencing two or more conditions over this time.

SES, maternal health, and child BPI: multivariate results

Children whose mothers had less than a high school degree scored 6.7 points higher (worse) on the BPI than children whose mothers were college graduates, after adjusting for sociodemographic covariates (Table 2, Model 1). Lower

Table 1. Sociodemographic and maternal health variables and association with child BPI scores

Predictor	N	*Percent*	*Mean BPI*	p *value*
All	2,677	100%	102.5	
Sociodemographic variables				
Child gender				
Male	1,382	51.6	104.4	
Female	1,295	48.4	100.5	<0.0001
Maternal race/ethnicity				
Black, non-Hispanic	745	27.8	104.3	
Hispanic	578	21.6	102.8	0.002
White, non-Hispanic	1,354	50.6	101.4	
Maternal education (years)				
Less than 12	488	18.4	107.5	
12	941	35.2	102.7	<0.0001
12 to 16	739	27.6	102.1	
>16	509	19.0	97.9	
Income to poverty line ratio				
Less then 1.0	414	15.5	105.9	
1.0–1.99	743	27.8	105.6	<0.0001
2.0–3.99	1,015	37.8	100.7	
4.0–	505	19.0	98.7	
Marital status				
Never married	325	12.1	105.1	
Divorced, separated, widowed	535	20.0	106.4	<0.0001
Married	1,817	67.9	100.9	
Maternal health variables				
Prenatal smoking				
Yes	598	23.7	107.3	<0.0001
No	1,930	76.3	101.5	
Prenatal alcohol use				
Yes	219	9.5	106.1	0.0006
No	2,315	90.5	102.2	
Postnatal smoking				
Persistent	479	17.9	107.5	
Intermittent	204	7.6	104.6	<0.0001
Reference	1,994	74.5	101.1	
Postnatal depressive symptoms (CES-D)				
Persistent	340	12.7	110.1	
Intermittent	677	25.3	105.1	<0.0001
Reference	1,621	62.0	99.9	
Postnatal binge drinking				
Persistent	44	1.6	112.2	
Intermittent	155	5.8	106.0	0.0006
Reference	2,478	93.0	102.1	
Maternal cumulative risk[a]				
3 conditions	100	3.7	114.4	<0.0001
2 conditions	456	17.0	107.8	
1 condition	1,007	37.6	103.2	
0	1,114	41.6	98.7	

[a]Cumulative conditions reflect a child's mother ever reporting smoking, depressive symptoms, or drinking.

BPI = Behavior Problems Index

CES-D = Center for Epidemiologic Studies-Depression scale

NOTE: *N*s may vary due to missing data

household income was also significantly associated with higher BPI scores.

Model 2 included the three maternal health conditions (Table 2). The model increased the explained variance in child behavior (R^2 0.09 to R^2 0.15, $p<0.0001$). Prenatal alcohol drinking was significantly associated with increased behavior problems, and the effect of prenatal smoking approached significance. Children with mothers in the top quartile of depressive symptoms in 1992 and 1994 scored 8.3 points, or >1/2 SD, higher on the BPI. Persistent maternal

Table 2. Association between socioeconomic status, maternal health, and child BPI scores, linear regression unstandardized coefficients (*N*=2,520)[a]

	Model 1 Lifetime SES[b]		*Model 2 Lifetime SES + maternal health*		*Model 1→2 decrease in estimate*	*Model 3 Cumulative health risk*		*Model 4 Current SES*[b]	
R-squared	0.09		0.15			0.13		0.12	
	β (SE)	*p* value	β (SE)	*p* value	Percent	β (SE)	*p* value	β (SE)	*p* value
Sociodemographic variables									
Maternal education									
Less than 12 years	6.7 (1.3)	<0.001	3.9 (1.3)	<0.01	41	4.4 (1.3)	<0.001	7.7 (1.3)	<0.0001
High school graduate	3.0 (0.9)	<0.01	1.5 (0.9)	0.10	49	1.6 (0.9)	0.09	3.6 (0.9)	0.0001
Some college	2.7 (0.9)	<0.01	1.9 (0.9)	<0.05	29	1.9 (0.9)	0.03	3.0 (0.9)	<0.01
College graduate	ref	ref	ref	ref					
Income to poverty line ratio									
<1.0	3.7 (1.5)	<0.05	2.3 (1.4)	0.10	37	2.8 (1.4)	0.05	0.6 (1.0)	0.55
1.0–1.99	3.8 (1.1)	<0.001	2.8 (1.1)	<0.01	26	3.2 (1.1)	<0.01	1.2 (1.1)	0.22
2.0–3.99	0.2 (0.8)	0.77	−0.2 (0.8)	0.83	—	0.1 (0.8)	0.87	−0.7 (0.9)	0.45
4.0 or more	ref		ref			ref		ref	
Maternal health variables									
Prenatal smoker			1.9 (1.0)	0.06					
Prenatal alcohol use			2.2 (1.1)	<0.05					
Postnatal smoking									
Persistent			2.4 (1.2)	<0.05					
Intermittent			1.5 (1.2)	0.20					
Reference			ref						
Postnatal depressive symptoms									
Persistent			8.3 (1.0)	<0.0001					
Intermittent			3.7 (0.8)	<0.0001					
Reference			ref						
Postnatal binge drinking									
Persistent			4.9 (3.3)	0.14					
Intermittent			0.3 (1.3)	0.84					
Reference			ref						
Maternal cumulative risk									
3 conditions						12.7 (1.9)	<0.0001		
2 conditions						6.9 (1.0)	<0.0001		
1 condition						3.3 (0.7)	<0.0001		
0						ref			

[a]All models also control for marital status, family size, maternal age at delivery, maternal race/ethnicity, gender, first-born status, and age in months.

[b]Lifetime SES uses household income averaged over the child's lifetime and current SES uses single-year income at the time of the 1996 BPI assessment.

BPI = Behavior Problems Index

SES = socioeconomic status

SE = standard error

ref = reference category

health conditions were associated with a greater increase in behavior problems than intermittent conditions. The education and income effect estimates decreased substantially when the maternal health conditions were added (range 26% to 49%). Standard errors (SE) remained stable when the maternal health variables were entered, and correlation analyses (data not shown) and regression diagnostics also suggested no evidence of colinearity. Inclusion of maternal depressive symptoms in an otherwise fully adjusted model led more specifically to reductions in income effects, while the addition of smoking led to reductions in education effects.

Older child age and male gender were significantly associated with increased child BPI scores, whereas maternal race/ethnicity and marital status were not associated with BPI. In analyses stratified by maternal race/ethnicity, however, maternal health was significantly associated with child BPI in all three racial/ethnic groups.

The cumulative number of maternal conditions was associated with increased child behavior problems (Table 2, Model 3). Compared to children of women without these health problems, children of women reporting two and three conditions had 6.9-point (~1/2 SD) and 12.7-point (>4/5 SD) BPI increases, respectively. When only current year

(1996) household income was used, low income was no longer significantly associated with child behavior problems (Table 2, Model 4 vs. Model 1).

Early lifecourse SES and subsequent maternal health

A woman's own childhood SES was associated with her pre-pregnancy health, which, in turn, was associated with postnatal health (Table 3). Compared to women whose fathers had a college degree, women whose fathers had a high school degree or less were more likely to smoke and to have low self-esteem. The association between low childhood SES and binge drinking prior to pregnancy was marginal. These pre-pregnancy health conditions were, in turn, strongly associated with postnatal health. Given pre-pregnancy smoking, poorer self-esteem, and binge drinking, the odds ratios for postnatal smoking, depressive symptoms, and binge drinking were 20.2 (95% confidence interval [CI] 15.2, 26.9), 1.8 (95% CI 1.4, 2.3), and 6.1 (95% CI 4.0, 9.2), respectively.

To examine whether postnatal health might mediate prenatal health effects, we assessed the association between pre-pregnancy health and child behavior, examining the coefficients before and after adjusting for postnatal health. Adjusting for postnatal health did reduce the effect estimates for pre-pregnancy low self-esteem (β 0.5, SE 0.08, $p<0.0001$ to β 0.4, SE 0.08 $p<0.0001$) and pre-pregnancy smoking (β 3.7, SE 0.7, $p<0.0001$ to β 1.8, SE 0.9, $p<0.04$) on child behavior problems. This model with both pre-pregnancy and postnatal health also offers a "conservative" estimate of postnatal health effects, as pre-pregnancy health may also be viewed as proxy for unmeasured maternal confounders. Importantly, postnatal smoking and depressive symptoms effects were essentially unchanged when pre-pregnancy health variables were entered into the model, suggesting the postnatal health coefficients are reasonably unbiased estimates.

Association of child BPI with mental health service and school outcomes

Children rated in the worst quartile of BPI scores in 1996 were significantly more likely to have poor mental health and school outcomes as reported in 1998, compared to children in the best quartile (Table 4). Further, mothers with depressive symptoms did not appear to overestimate their children's behavior problems. Children rated in the worst BPI quartile by depressed mothers were as likely to use mental health services and have school problems as those rated in the worst quartile by non-depressed mothers. Children whose depressed mothers rated them with few behavior problems (best quartile) were more likely to have had poor mental health care and school outcomes, suggesting these affected mothers may actually underestimate their child's behavior problems.

Table 3. Association between women's pre-pregnancy SES, pre-pregnancy health, and post-pregnancy health,[a] logistic regression, OR (95% CI)

	Smoking		*Poor mental health*[b]		*Binge alcohol drinking*	
Variables	*Pre-pregnancy*	*Post-pregnancy*	*Pre-pregnancy*	*Post-pregnancy*	*Pre-pregnancy*	*Post-pregnancy*
Pre-pregnancy SES						
Grandfather education						
Less than 12 years	1.7 (1.2, 2.4)	1.7 (1.0, 2.9)	2.8 (1.7, 4.5)	1.1 (0.8, 1.7)	1.5 (0.9, 2.4)	1.6 (0.6, 4.4)
High school graduate	1.8 (1.3, 2.5)	1.5 (0.9, 2.5)	2.1 (1.3, 3.4)	1.0 (0.7, 1.5)	1.6 (1.0, 2.6)	1.7 (0.6, 4.5)
Some college	1.6 (1.0, 2.5)	1.5 (0.8, 2.8)	1.5 (0.8, 2.7)	1.0 (0.6, 1.7)	1.5 (0.8, 2.7)	0.6 (0.1, 2.5)
College graduate	reference	reference	reference	reference	reference	reference
Income to poverty line ratio[c]						
<1.0		2.8 (1.7, 4.7)		2.0 (1.3, 3.0)		4.3 (1.7, 11.1)
1.0–1.99		2.7 (1.7, 4.4)		1.4 (1.0, 2.0)		2.7 (1.1, 6.5)
2.0–3.99		2.2 (1.5, 3.4)		1.1 (0.8, 1.6)		1.9 (0.8, 4.4)
4.0 or more		reference		reference		reference
Pre-pregnancy health						
Smoking		20.2 (15.2, 26.9)				
Low self-esteem				1.8 (1.4, 2.3)		
Binge drinking						6.1 (4.0, 9.2)

[a]All models also adjust for grandparent's marital status, maternal age, and maternal race/ethnicity.

[b]Pre-pregnancy mental health reflects being in the worst quartile of Rosenberg Self-Esteem scores; post-pregnancy mental health reflects being in the worst quartile of CES-D scores.

[c]Average household income between 1979 and year prior to pregnancy.

OR = odds ratio

CI = confidence interval

SES = socioeconomic status

DISCUSSION

Though much of the recent literature focuses on the childhood origins of adult health disparities, this study offers a complementary intergenerational perspective: adult health disparities may themselves shape child health outcomes. In particular, we found that the relationship between household SES and child behavior problems was mediated substantially by maternal smoking, depressive symptoms, and alcohol use. These maternal health conditions often occurred together, persisted over the child's early years, and were themselves significantly associated with the mother's own childhood SES and pre-pregnancy health. These findings suggest that efforts to reduce disparities in women's health through continuous and comprehensive health services and programs may not only address women's own unmet health needs, but may also reduce disparities in child health.

SES, maternal health, and child behavior problems

Lower household income was associated with a significant increase (~1/4 SD) in child behavior problems, as found in prior literature.[27,32,40–42] In contrast to income measured over the child's lifetime, a measure of current household income was not significantly associated with behavior problems. This finding is generally consistent with some,[27,32] but not all, prior work. Household income clearly varies over the course of a child's life.[27] Studies that assess childhood socioeconomic position at only one point in time may fail to identify social disparities in child health. The importance of assessing income over an adult's lifetime has been recognized;[16,43] similar efforts may need to be pursued even across the span of childhood.

Our findings are consistent with other studies linking smoking, depressive symptoms, and alcohol use to child behavior.[11–13,28–30,44–47] Plausible mechanisms exist. Maternal depression is associated with increased negative and coercive parenting and greater disengagement from child interaction.[48] Prenatal nicotine exposure upregulates nicotine receptors,[49] affects neurotransmitters related to behavior, and may interact with genetic susceptibility.[50] The evidence linking postnatal smoking exposure to child behavior is not as strong, but both animal models[51] and epidemiologic studies[28] offer some support. Alternatively, postnatal smoking may in part be a proxy for other household or parenting factors. Prenatal alcohol has been shown to increase externalizing behavior,[13] possibly through effects on midbrain dopaminergic systems.[52,53]

Few studies, however, have focused on the cumulative risk from multiple, linked maternal health conditions. Broadened attention to multiple health conditions not only reduces potential misinterpretation of research findings (e.g., assigning unmeasured maternal depression effects to smoking) but more importantly, it highlights the need for comprehensive services to address the full range of women's health needs.[19] The continuity of the maternal health conditions is similarly notable. We cannot ascertain whether the conditions were persistent or recurrent; nevertheless, clinical efforts that focus simply on prenatal interventions for maternal smoking, or postpartum interventions for maternal depression, do not reflect the continuing relevance of these conditions before, during, and after pregnancy.[54] Further, failing to account for the persistence or duration of a child's exposure may underestimate the impact on the child of these maternal health conditions.

Maternal conditions may mediate the effect of low SES on child behavior

Our findings not only suggest that these maternal conditions may occur together and persist over time, but also strongly highlight their role in the pathway between low SES

Table 4. Association between child 1996 BPI (in quartiles) and 1998 reported child mental health and school outcomes, by maternal depressive symptoms

	Seen a psychiatrist past 12 months		*Currently on medicine for behavior*		*Received note from teacher or principle*		*Ever suspended or expelled*	
	Percent	p *value*	*Percent*	p *value*	*Percent*	p *value*	*Percent*	p *value*
Child in worst quartile BPI	12.1	0.0001	12.8	0.0001	41.9	0.0001	14.7	0.0001
Child in best quartile BPI	3.8		1.4		12.3		4.2	
Child in worst quartile BPI								
Persistent maternal depressive symptoms	14.0	ns	16.9	ns	50.0	ns	19.4	ns
Absent maternal depressive symptoms	11.4		12.1		40.2		12.9	
Child in best quartile BPI								
Persistent maternal depressive symptoms	9.7	ns	6.5	0.08	24.6	0.02	8.9	ns
Absent maternal depressive symptoms	3.4		0.9		10.5		3.9	

BPI = Behavior Problems Index

ns = not significant

and child behavior problems. We found that the effects of low income and education on child behavior decreased 26% to 49% when the three maternal conditions were added to the model. Previous studies provide some indirect support for these conditions playing such a role.[27,55] Considerable prior work has also focused on the role of harsh parenting in mediating the relationship between financial strain and child behavior.[56] Our focus on maternal health conditions is complementary. These maternal conditions may actually lie in the pathway between financial strain and harsh parenting[48,57] and thus may be additional components of a more complete set of pathways. In addition, by focusing on mechanisms directly relevant to clinical and public health audiences, we hope to broaden the collective attention centered on intergenerational risks for behavior problems. It should also be noted, however, that our proposed mechanisms may generalize beyond disparities in child behavior problems. For example, maternal smoking and depression are associated with child asthma morbidity.[14,15] Thus, a similar pathway might link social disparities in these maternal conditions to disparate child asthma outcomes as well.

Intergenerational health disparities

We found that the relationship between childhood SES and child behavior problems had its antecedents in the health disparities of women of reproductive age. Childhood socioeconomic position has been a focal point in recent studies of lifecourse SES and health[4,9,58] and these studies informed the objectives of this analysis. However, the association between childhood SES and child behavior was to a significant extent mediated by disparities in maternal health, which were themselves rooted in the mother's own childhood SES. That is, childhood SES may help shape women's health during their reproductive years and these health disparities, in turn, help shape the health trajectory of the subsequent generation. Thus, the choice to frame childhood as a starting point for social disparities in health may be an arbitrary one; the findings suggest that a more continuous, intergenerational perspective may be more constructive.

Implications

The findings of this study suggest that women's health conditions before, during, and after pregnancy are central determinants of social disparities in child behavior problems. Effective interventions for smoking,[59–61] depression,[62] and excessive alcohol use[63,64] exist. However, the traditional maternal health focus on these issues in pregnancy and the immediate postnatal period may not provide sufficient opportunity to seriously alter the health of disadvantaged women. After pregnancy, many pregnancy-related health gains are quickly lost. For example, postpartum smoking relapse rates exceed 70%.[54] Pediatricians and other child health clinicians have relatively frequent contact with mothers and should assist in connecting or reconnecting mothers to a source of comprehensive and continuous adult primary care.[65] Discontinuities in health insurance are also common among lower income mothers,[66] suggesting the need to move beyond child-focused insurance expansions to include their uninsured parents.[67]

Potential limitations

First, child behavior was not measured using standard Diagnostic and Statistical Manual of Mental Disorders-Fourth Editon (DSM-IV) criteria and it was assessed by the mother only. The BPI, however, demonstrates strong internal and predictive validity, and correlates well with the CBCL.[31] Further, depressed mothers did not appear to exaggerate child behavior problems. Second, our measures of women's health were not optimal; we did not have biological markers of maternal smoking or DSM-IV diagnoses of depression, and self-esteem was used as a proxy for pre-pregnancy mental health. Misclassification, however, would likely bias results toward the null hypothesis. This may explain why maternal drinking was not such a robust predictor of behavior problems. Further, no maternal physical health conditions were assessed. Third, maternal health conditions may in part confound the relationship between SES and child behavior, rather than being mediators in a causal chain. While the longitudinal design offered some information on temporal ordering, randomized controlled intervention trials to improve maternal health are ultimately required to test causal relationships. Fourth, unmeasured variables, such as maternal traits or attitudes, may explain some of the associations between maternal health and child behavior. We sought to address this in part by adjusting for pre-pregnancy health as a proxy for such unmeasured variables. Importantly, paternal health may also confound or modify the associations between maternal and child health.[68] Fifth, cohorts with more frequent, consistent health measures are required to model the complex reciprocal relationships between SES, maternal health, and child well-being over time. Sixth, loss to follow-up may have biased estimates. Given that children without behavioral outcome data were more likely from poor families, our findings may be biased toward the null hypothesis. Finally, we examined only one child health outcome in one large sample. Future work should examine the generalizablity of these pathways to other child health conditions within nationally representative samples of children. Overall, the strength of the findings, drawing on 20 years of SES data and incorporating multiple maternal health conditions assessed several times, makes it unlikely that the limitations substantially undermine the basic conclusions reported here.

These findings underscore the utility of an intergenerational approach to social disparities in child health. We found that maternal smoking, depressive symptoms, and alcohol use explained a substantial portion of the association between lower household SES and children's behavior problems. Taken together, a woman's lifecourse SES appeared to shape her health during the reproductive years, and her health, in turn, may help shape the behavioral health of her children. These findings suggest that improved health services and health insurance coverage for disadvantaged women may not only address their own urgent health needs but might also reduce social disparities in the health and well-being of their children.

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REFERENCES

1. Halfon N, Hochstein M. Life course health development: an integrated framework for developing health, policy, and research. Milbank Q 2002;80:433-79.
2. Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. Int J Epidemiol 2002;31:285-93.
3. Lynch JW, Kaplan GA, Salonen JT. Why do poor people behave poorly? Variation in adult health behaviours and psychosocial characteristics by stages of the socioeconomic lifecourse. Soc Sci Med 1997;44:809-19.
4. Blane D, Hart CL, Smith GD, Gillis CR, Hole DJ, Hawthorne VM. Association of cardiovascular disease risk factors with socioeconomic position during childhood and during adulthood. BMJ 1996;313:1434-8.
5. Wamala SP, Lynch J, Kaplan GA. Women's exposure to early and later life socioeconomic disadvantage and coronary heart disease risk: the Stockholm Female Coronary Risk Study. Int J Epidemiol 2001;30:275-84.
6. Gilman SE, Kawachi I, Fitzmaurice GM, Buka SL. Socioeconomic status in childhood and the lifetime risk of major depression. Int J Epidemiol 2002;31:359-67.
7. Power C, Stansfeld SA, Matthews S, Manor O, Hope S. Childhood and adulthood risk factors for socio-economic differentials in psychological distress: evidence from the 1958 British birth cohort. Soc Sci Med 2002;55:1989-2004.
8. Kuh D, Hardy R, Langenberg C, Richards M, Wadsworth ME. Mortality in adults aged 26–54 years related to socioeconomic conditions in childhood and adulthood: post war birth cohort study. BMJ 2002;325:1076-80.
9. Smith GD, Hart C, Blane D, Hole D. Adverse socioeconomic conditions in childhood and cause specific adult mortality: prospective observational study. BMJ 1998;316:1631-5.
10. Wang X, Tager IB, Van Vunakis H, Speizer FE, Hanrahan JP. Maternal smoking during pregnancy, urine cotinine concentrations, and birth outcomes. A prospective cohort study. Int J Epidemiol 1997;26:978-88.
11. Fried PA, Watkinson B, Gray R. A follow-up study of attentional behavior in 6-year-old children exposed prenatally to marihuana, cigarettes, and alcohol. Neurotoxicol Teratol 1992;14:299-311.
12. Radke-Yarrow M, Nottelmann E, Martinez P, Fox MB, Belmont B. Young children of affectively ill parents: a longitudinal study of psychosocial development. J Am Acad Child Adolesc Psychiatry 1992;31:68-77.
13. Olson HC, Streissguth AP, Sampson PD, Barr HM, Bookstein FL, Thiede K. Association of prenatal alcohol exposure with behavioral and learning problems in early adolescence. J Am Acad Child Adolesc Psychiatry 1997;36:1187-94.
14. Weil CM, Wade SL, Bauman LJ, Lynn H, Mitchell H, Lavigne J. The relationship between psychosocial factors and asthma morbidity in inner-city children with asthma. Pediatrics 1999;104:1274-80.
15. Chilmonczyk BA, Salmun LM, Megathlin KN, Neveux LM, Palomaki GE, Knight GJ, et al. Association between exposure to environmental tobacco smoke and exacerbations of asthma in children. N Engl J Med 1993;328:1665-9.
16. Smith GD, Hart C, Blane D, Gillis C, Hawthorne V. Lifetime socioeconomic position and mortality: prospective observational study [published erratum appears in BMJ 1997 Apr 5;314(7086):1012]. BMJ 1997;314:547-52.
17. Winkleby MA, Kraemer HC, Ahn DK, Varady AN. Ethnic and socioeconomic differences in cardiovascular disease risk factors: findings for women from the Third National Health and Nutrition Examination Survey, 1988–1994. JAMA 1998;280:356-62.
18. Marmot M, Ryff CD, Bumpass LL, Shipley M, Marks NF. Social inequalities in health: next questions and converging evidence. Soc Sci Med 1997;44:901-10.
19. Kahn RS, Zuckerman B, Bauchner H, Homer CJ, Wise PH. Women's health after pregnancy and child outcomes at age 3 years: a prospective cohort study. Am J Public Health 2002;92:1312-8.
20. Schoenborn CA, Adams PF. Alcohol use among adults: United States, 1997–98. Adv Data 2001;324:1-20. Also available from: URL: http://www.cdc.gov/nchs/pressroom/01facts/alcoholuse.htm
21. Center for Human Resource Research. NLSY79 User's Guide. Columbus: Ohio State University; 1999.
22. Peterson J, Zill N. Marital disruption, parent-child relationships, and behavioral problems in children. J Marriage Family 1986;48:295-307.
23. Achenbach TM, Edelbrock CS. Behavioral problems and competencies reported by parents of normal and disturbed children aged four through sixteen. Monogr Soc Res Child Dev 1981;46:1-82.
24. Costello EJ, Mustillo S, Erkanli A, Keeler G, Angold A. Prevalence and development of psychiatric disorders in childhood and adolescence. Arch Gen Psychiatry 2003;60:837-44.
25. Burke JD, Loeber R, Birmaher B. Oppositional defiant disorder and conduct disorder: a review of the past 10 years, part II. J Am Acad Child Adolesc Psychiatry 2002;41:1275-93.
26. Lahey BB, Loeber R, Burke J, Rathouz PJ, McBurnett K. Waxing and waning in concert: dynamic comorbidity of conduct disorder with other disruptive and emotional problems over 7 years among clinic-referred boys. J Abnorm Psychol 2002;111:556-67.
27. Duncan GJ, Brooks-Gunn J, Klebanov PK. Economic deprivation and early childhood development. Child Dev 1994;65(2 Spec No):296-318.
28. Williams GM, O'Callaghan M, Najman JM, Bor W, Andersen MJ, Richards D, et al. Maternal cigarette smoking and child psychiatric morbidity: a longitudinal study. Pediatrics 1998;102:e11.
29. Luoma I, Tamminen T, Kaukonen P, Laippala P, Puura K, Salmelin R, et al. Longitudinal study of maternal depressive symptoms and child well-being. J Am Acad Child Adolesc Psychiatry 2001;40:1367-74.
30. Sood B, Delaney-Black V, Covington C, Nordstrom-Klee B, Ager J, Templin T, et al. Prenatal alcohol exposure and childhood behavior at age 6 to 7 years: I. dose-response effect. Pediatrics 2001;108:E34.
31. Spieker SJ, Larson NC, Lewis SM, Keller TE, Gilchrist L. Developmental trajectories of disruptive behavior problems in preschool children of adolescent mothers. Child Dev 1999;70:443-58.
32. Blau DM. The effect of income on child development. Rev Econ Stat 1999;81:261-76.
33. Weissman MM, Sholomskas D, Pottenger M, Prusoff BA, Locke BZ. Assessing depressive symptoms in five psychiatric populations: a validation study. Am J Epidemiol 1977;106:203-14.
34. Rosenberg M. Society and the adolescent self-image. Princeton (NJ): Princeton University Press; 1965.
35. Kendler KS, Gardner CO, Prescott CA. A population-based twin study of self-esteem and gender. Psychol Med 1998;28:1403-9.
36. Baron R, Kenny D. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J Pers Soc Psych 1986;51:1173-82.
37. Richters J. Depressed mothers as informants about their children: a critical review of the evidence for distortion. Psych Bull 1992; 112:485-99.
38. Research Triangle Institute. SUDAAN software for statistical analysis of correlated data. Release 8.0. Research Triangle Park (NC): Research Triangle Institute; 2001.
39. SAS Institute, Inc. SAS: Release 8.1. Cary (NC): SAS Institute Inc.; 2000.
40. Korenman S, Miller J, Sjaastad J. Long-term poverty and child development in the United States: results from the NLSY. Child Youth Serv Rev 1995;17:127-55.
41. McLeod J, Shanahan M. Poverty, parenting and children's mental health. Amer Soc Rev 1993;58:351-66.
42. Costello EJ, Compton SN, Keeler G, Angold A. Relationships between poverty and psychopathology: a natural experiment. JAMA 2003;290:2023-9.
43. Lynch JW, Kaplan GA, Shema SJ. Cumulative impact of sustained economic hardship on physical, cognitive, psychological, and social functioning. N Engl J Med 1997;337:1889-95.
44. Fergusson DM, Horwood LJ, Lynskey MT. Maternal smoking before and after pregnancy: effects on behavioral outcomes in middle childhood. Pediatrics 1993;92:815-22.
45. Wakschlag LS, Lahey BB, Loeber R, Green SM, Gordon RA, Leventhal BL. Maternal smoking during pregnancy and the risk of conduct disorder in boys. Arch Gen Psychiatry 1997;54:670-6.
46. McMunn AM, Nazroo JY, Marmot MG, Boreham R, Goodman R. Children's emotional and behavioural well-being and the family environment: findings from the Health Survey for England. Soc Sci Med 2001;53:423-40.
47. Mick E, Biederman J, Faraone SV, Sayer J, Kleinman S. Case-control study of attention-deficit hyperactivity disorder and maternal

smoking, alcohol use, and drug use during pregnancy. J Am Acad Child Adolesc Psychiatry 2002;41:378-85.
48. Lovejoy MC, Graczyk PA, O'Hare E, Neuman G. Maternal depression and parenting behavior: a meta-analytic review. Clin Psychol Rev 2000;20:561-92.
49. Slotkin TA. Fetal nicotine or cocaine exposure: which one is worse? J Pharmacol Exp Ther 1998;285:931-45.
50. Kahn RS, Khoury J, Nichols WC, Lanphear BP. Role of dopamine transporter genotype and maternal prenatal smoking in childhood hyperactive-impulsive, inattentive, and oppositional behaviors. J Pediatr 2003;143:104-10.
51. Abreu-Villaca Y, Seidler FJ, Tate CA, Slotkin TA. Nicotine is a neurotoxin in the adolescent brain: critical periods, patterns of exposure, regional selectivity, and dose thresholds for macromolecular alterations. Brain Res 2003;979:114-28.
52. Shen RY, Hannigan JH, Kapatos G. Prenatal ethanol reduces the activity of adult midbrain dopamine neurons. Alcohol Clin Exp Res 1999;23:1801-7.
53. Szot P, White SS, Veith RC, Rasmussen DD. Reduced gene expression for dopamine biosynthesis and transport in midbrain neurons of adult male rats exposed prenatally to ethanol. Alcohol Clin Exp Res 1999;23:1643-9.
54. Kahn RS, Certain L, Whitaker RC. A reexamination of smoking before, during, and after pregnancy. Am J Public Health 2002; 92:1801-8.
55. McCormick MC, Workman-Daniels K, Brooks-Gunn J. The behavioral and emotional well-being of school-age children with different birth weights. Pediatrics 1996;97:18-25.
56. Conger RD, Ge X, Elder GH Jr., Lorenz FO, Simons RL. Economic stress, coercive family process, and developmental problems of adolescents. Child Dev 1994;65(2 Spec No):541-61.
57. Jackson AP, Brooks-Gunn J, Huang CC, Glassman M. Single mothers in low-wage jobs: financial strain, parenting, and preschoolers' outcomes. Child Dev 2000;71:1409-23.
58. Lawlor DA, Ebrahim S, Davey Smith G. Socioeconomic position in childhood and adulthood and insulin resistance: cross sectional survey using data from British women's heart and health study. BMJ 2002;325:805. (Erratum published in BMJ 2003;326:488.)
59. Hughes JR, Goldstein MG, Hurt RD, Shiffman S. Recent advances in the pharmacotherapy of smoking. JAMA 1999;281:72-6.
60. Jorenby DE, Leischow SJ, Nides MA, Rennard SI, Johnston JA, Hughes AR, et al. A controlled trial of sustained-release bupropion, a nicotine patch, or both for smoking cessation. N Engl J Med 1999;340:685-91.
61. Biener L, Harris JE, Hamilton W. Impact of the Massachusetts tobacco control programme: population based trend analysis. BMJ 2000;321:351-4.
62. Agency for Health Care Policy and Research. Treatment of depression—newer pharmacotherapies. Summary, Evidence Report/Technology Assessment: Number 7; March 1999 [cited 2002 May 29]. Available from: URL: http://www.ahrq.gov/clinic/epcsums/deprsumm.htm
63. Weisner C, Mertens J, Parthasarathy S, Moore C, Lu Y. Integrating primary medical care with addiction treatment: a randomized controlled trial. JAMA 2001;286:1715-23.
64. Fleming MF, Barry KL, Manwell LB, Johnson K, London R. Brief physician advice for problem alcohol drinkers. A randomized controlled trial in community-based primary care practices. JAMA 1997;277:1039-45.
65. Kahn RS, Wise P, Finkelstein J, Bernstein H, Lowe J, Homer C. The scope of unmet maternal health needs in pediatric settings. Pediatrics 1999;103:576-81.
66. Lambrew JM. Health insurance: a family affair: a national profile and state-by-state analysis of uninsured parents and their children. New York: The Commonwealth Fund; 2001.
67. Library of Congress. Bill summary and status for the 107th Congress. Summary: FamilyCare Act of 2001 [cited 2003 Nov 20]. Available from: URL: http://rs9.loc.gov/cgi-bin/bdquery/z?d107:SN01244:@@@L&summ2=m&#summary
68. Connell AM, Goodman SH. The association between psychopathology in fathers versus mothers and children's internalizing and externalizing behavior problems: a meta-analysis. Psychol Bull 2002;128:746-73.