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Income, family context and self-regulation in 5-year-old children

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Abstract

Objective—Self-regulation (SR) is a core aspect of child development with enduring effects on health and wellbeing across the lifespan. Early childhood poverty may shape SR development. This study examined the cross-sectional relations among family income, family context and SR in five-year-old children.

Method—140 five-year-old children and their mothers participated in the study. Children completed a battery of SR tasks; mothers completed questionnaires. Cognitive and emotional SR composite scores were generated based on a principal component analysis of the SR tasks. SR scores were first regressed on family income (in 10 levels ranging from <5,000 to 150,000+) adjusting for age, sex and race of the child; family context variables were subsequently added to the models.

Results—Controlling for age, sex and race, each level increase in family income was associated with 0.04 standard deviation (SD) increase in emotional SR (p=0.32) and 0.08 SD increase in cognitive SR (p=0.01). In fully adjusted models, exposure to household instability and experiencing 10 or more negative life events was associated with worse emotional SR; exposure to mother's depressive symptoms was associated with worse cognitive SR. Higher income buffered children's SR from some contextual risk factors. Family contextual variables explained 62% of the correlation between higher income and better cognitive SR scores.

Conclusions—Income-based cognitive SR disparities were associated with family contextual factors. Screening for family adversity in pediatric care and linking families to needed resources may protect children's developing SR capacities, with benefits to health and well-being.

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Key Terms

poverty; self-regulation; behavioral assessment

Health over the life course is a result of interactions between environmental input and adaptations in the biobehavioral regulatory systems.[1] These regulatory systems are developmentally programmed by experiences during critical and sensitive periods, particularly in early life.[1] One such set of regulatory capacities is self-regulation (SR) – the cognitive, physiological, and behavioral processes through which an individual maintains levels of arousal that are conducive to positive adjustment and adaptation.[2] SR in children contributes to emerging social competence,[3] academic achievement[4] and resilience,[5] and is a robust predictor of health and well-being in adulthood.[6] Conversely, inadequate SR in childhood and adolescence is linked to a wide range of mental and behavioral problems, including substance dependence[7] and antisocial behaviors.[8]

Children growing up in poverty are more likely to experience chronic stressors in their physical and social environments. These stressors may include household crowding and noise, residential instability, neighborhood disorder, family dissolution, parental harshness and parental depression.[9] While a moderate amount of adversity may be tolerated or even provide opportunities for children to exercise and improve their adaptive function,[10] frequent or prolonged exposure to stress in early life may compromise the development of brain areas supporting cognitive and emotional regulation (e.g., hippocampus, amygdala, prefrontal cortex).[11] Further, families with lower incomes are less able to afford books, toys, quality childcare for their children. This lack of cognitive stimulation in and outside of the home may compromise children's general cognitive development.[12]

There is evidence that children from lower socioeconomic status (SES) families, on average, demonstrate poorer executive functions, a set of neurological processes key to cognitive SR,[13] than their higher SES peers. However, few studies have examined the specific aspects of the family context related to the experience of poverty that may affect the development of SR. Studies explicitly examining mediators of the income-SR relationship identified parenting quality,[14] housing conditions (crowding, safety and noise),[14,15] and lack of daily routine[15] as important factors linking income to child SR capabilities. Parental factors well known to be correlated with family income, such as parental mental health[16,17] and parenting style,[16,17] are also frequently linked to child SR ability. The role of broader socioeconomic indicators such as maternal education[16,18,19] and minority status,[18,19] in child SR has also been evaluated. These factors, however, have not been found to consistently correlate with child SR – perhaps because their effects, if any, are likely to operate through other mediating pathways. In general, existing studies have not been able to completely characterize the family contextual factors that may explain the SR gap between children of higher and lower SES. As aspects of the family context are highly correlated, results from previous studies assessing select aspects of the family context are likely confounded by unmeasured factors. In addition, previous studies have used different measurement paradigms for child SR (e.g., the executive function paradigm vs. the effortful control paradigm), which complicates efforts to compare findings across studies. A

systematic investigation of aspects of the family context related to poverty and their relations with comprehensive child SR measures is needed. Such an investigation could help identify targets for intervention that promote resilience and optimize SR at an early age. Furthermore, findings could be used by clinicians to help detect and aid in the management of family social and economic factors that put children to risk for disorders related to SR deficits.

This study is a cross-sectional investigation of relations among family income, family context and child SR in a group of 5-year-old children. We assessed child SR using a battery of developmental assessments designed to capture both cognitive and emotional aspects of SR. We then examined whether income and each family context variable were associated with child SR, and whether any income-based disparity in SR could be explained by variations in family contextual variables. Aspects of the family context under investigation reflect specific stressors in psychological (i.e., family dissolution, parental depression) and physical (i.e., housing crowding and residential instability) domains, the cumulative number of stressful life events experienced by the child, and indices of child cognitive stimulation in and outside of the home (i.e., number of siblings, and school attendance). We hypothesized that both high levels of stress and lack of cognitive stimulation would be correlated with worse child SR. As cognitive and emotional aspects of SR have shared as well as unique neurological foundations,[20] the two aspects of SR might be differentially affected by family income and context. Informed by the relations between income and general cognitive and emotional development,[12] we expected cognitive SR to be more strongly correlated with family income and cognitive stimulation, and emotional SR to be more strongly correlated with stressors.

METHODS

Participants and Procedures

Five-year-old children and their mothers participated in the study. The study sample was recruited from two sources. One group of mothers was recruited as part of a 5-year follow-up of children who had participated in a fetal development study. [21] Eligibility was restricted to non-smokers with healthy, uncomplicated, singleton pregnancies. This group of mothers was re-contacted for the current study when the children were five years old (n=73). To enrich the socioeconomic diversity of this sample, which represented a majority of middle- and higher-income families, another group of mothers with five-year-old children was recruited via fliers in the community (libraries, laundromats and childcare centers) (n=93). In order to participate, children from both sources could not have conditions that affected cognitive or motor development, or regulatory functioning (e.g. autism, cystic fibrosis, intellectual disability), and had to be fluent in English. All mothers provided written informed consent, and the study was approved by the Institutional Review Board. All data used in the current study were collected when children were five years old.

During a 90-minute study visit in a child development lab, children were administered a battery of assessments of self-regulation (SR) and an assessment of receptive vocabulary. In a separate room, mothers completed self-administered questionnaires assessing family socio-demographics and maternal psychosocial stress. All child assessments were video and

audio recorded. Among the 166 children enrolled, 140 were included in the current analysis (52 fetal development study participants and 88 community participants). Children were excluded from the current analysis if they 1) moved out of the area and were unavailable for the in-person assessments (n=15), 2) were unable to complete the study appointment (n=3), or 3) had a corrupted video file from the study appointment that prevented systematic coding of SR outcomes (n=8).

Measures

Assessment of Self-Regulation

Executive Function Battery: This battery consists of two tasks from the Family Life Project designed to assess the child's working memory and cognitive inhibition. These tasks are valid and reliable measures of executive function in this age group.[22] The first task, The Silly Sounds Game, is an auditory Stroop task, which assesses a child's ability to inhibit an automatic response. In this task, the child is asked to "meow" in response to a picture of a dog, and to "bark" in response to a picture of a cat. The task was scored as the proportion of correct responses out of 36 trials. The second task, The Pig Game, is a go/no-go task, which tests inhibitory control. In this task, the child pushes a button in response to a picture of an animal ("go" stimulus), except if the animal is a pig ("no-go" stimulus). The task was scored as the proportion of correct responses out of 24 trials.

The Disappointing Gift Task assesses a child's response to disappointment.[23] In this task, the child is asked to rank six small toys in order from the most to the least desirable and told that he/she will receive a prize later in the appointment. Later, the child is given his or her least favorite prize in a sealed gift bag. The intensity of child's emotional display and the number of behavioral reactions in the 60 seconds after receiving the prize were systematically coded using audio and video recordings. Trained staff coded the intensity of a child's emotional display as: 1: unconcerned (no discernible display of emotion), 2: managed (visibly suppressing an emotional reaction such as smiling while pushing the gift away) or 3: visible (an unambiguous display of emotion such as hiding his/her face on the table, or a visible facial expression of distress). Two coders worked together to reach consensus and reviewed codes with a third coder to ensure consistency. In addition, the number of behavioral reactions in the 60 seconds after receiving the prize was noted by the investigators using three categories of behavioral reactions: 1) rejected the gift nonverbally; 2) vocalized displeasure; and/or 3) stated that the gift was wrong. The number of behavioral reactions was summed into a score from 0 to 3.

The Not Sharing Task evaluates emotion regulation in response to unfairness.[24] In this task, an evaluator is given 18 pieces of candy and asked to share them equally with the child. In a series of six steps, the evaluator allocates the candy unequally between herself and the child, until the investigator has all of the candy. At steps 1, 2, and 5, the evaluator pauses to ask the child "what do you think about that?" to solicit reactions to the unfairness. The intensity of the child's overall emotional display during the task was coded as 1: unconcerned, 2: managed or 3: visible, as above. In addition, a child's tolerance for unfairness was assessed by recording the step in the task at which the child first expressed displeasure (i.e., steps 1–

6), with higher scores indicating a higher tolerance for disappointment. Children who never voiced displeasure were assigned a score of 7.

Mischel's Delay of Gratification Task is frequently used to assess effortful control and has been extensively validated in young children.[25] In this task, the evaluator tells the child she has to leave the room, and before leaving the room, the evaluator offers the child one food treat (marshmallow or pretzel, chosen by the child). The child is told that if s/he waits to eat the food treat until the evaluator returns, s/he will receive two treats, otherwise s/he will receive one treat. The child was left alone for up to eight minutes, or until s/he ate the treat or summoned the evaluator. The task was scored according to the total time the child waited. Because more than half of the children in the current study waited for the full eight minutes, wait time was categorized as: <1 minute, 1–7 minutes, and 8 minutes.

Assessment of Receptive Vocabulary—*The Peabody Picture Vocabulary Test (PPVT)* measures child receptive vocabulary.[26] In this task, the child is read a series of words and asked to point to the pictures the words describe. Due to time constraints of the current study, we concluded the PPVT when the child made six errors in one assessment block, rather than the standard PPVT administration which requires eight errors. Thus, percentile scores in this study are internally comparable but not comparable with external PPVT norms.

Child Characteristics, Family Income and Family Context—Mothers reported on child characteristics including age (in months), sex (male vs. female) and race (African American vs. White/Asian). Mothers also reported on annual family income (in 10 categories approximating a log scale, ranging from <$5,000 to $150,000+), their own level of education (in 8 categories), their relationship with the child's biological father (divorced, separated or no relationship vs. married or in a romantic relationship), the number of children in their household, family housing instability (number of household moves since the child was born), household crowding (number of rooms per household member), and child care situation (whether the target child was attending any school or daycare outside of the home).

A *household instability score* was generated to represent the experience of changes in family structure and the subsequent hardships in economic and housing situations. Such experiences are known to disrupt family routines, heighten family stress, and have deep and lasting impacts on children's development.[27] The score was generated from a principal components analysis (PCA) that included the mother's relationship with the child's biological father, housing instability and household crowding (Pearson's r range from 0.35 to 0.69, all p-values<=0.05), and standardized with a mean of zero and standard deviation (SD) of 1.

Negative life events may contribute to a child's overall level of stress. The Coddington Life Events Scale (CLES) was used to measure the frequency of major life events in the child's life. Examples of the items in the scale are parental divorce, birth of a sibling, and having family members fight more than usual. The reliability and validity of the CLES has been previously demonstrated for the adolescent and child versions of the scale.[28] This study used

the preschool version. Mothers reported whether the child experienced each of the events in his/her lifetime. A total of 26 negative events are included in the CLES. The total number of negative events experienced by the child was summed and included in the current study as a measure of lifetime stressors.

The Center for Epidemiologic Studies Depression Scale Revised (CESD-R) is a widely used self-administered tool for measuring depressive symptoms that has good psychometric properties.[29] Mothers completed the CESD-R and a sum of score of the 20 items was generated for each mother (scores can range from 0–60).

Missing Data

Among the 140 children, 14 were missing family income, 11 were missing their exact age in months (although all were five years old), and 1 was missing the housing instability measure. Missing values were imputed with chained equations.[30] Twenty datasets were imputed, and analyses were performed on the multiply imputed data.

Statistical Analysis

We conducted a PCA on the SR performance indicators. Guided by a scree plot and the parallel analysis[31] (see Supplemental Figure 1), we extracted two components corresponding to a cognitive and an emotional aspect of SR respectively. Promax rotation was used to allow the two components to be correlated, and the resulting SR scores were standardized (mean = 0, SD = 1).

We evaluated the bivariate correlation between each covariate (child characteristics, family income, mother's level of education, number of children in the house, household instability score, child negative life events, mother's CESD-R score) and the cognitive and emotional SR scores separately in univariate regression models. Both a linear term and a quadratic term for negative life events were included to account for the possibility of a curvilinear relationship – high-levels of stress may lead to negative developmental outcomes, whereas moderate levels of stress may confer resilience to later stressors.[10]

Finally, we used multivariate analysis to examine the independent associations between the covariates and child cognitive and emotional SR scores. First, we built baseline models which regressed SR scores on family income controlling for child age, sex and race. Next, we built fully adjusted models by adding the PPVT score and all family context variables. Two-way interactions (between income level and each family context variable) were also included in the fully adjusted models simultaneously to test for effect modification by income. Interaction terms with $p \leq 0.05$ were eventually retained. These interaction terms were further examined to determine the effects on different income levels. The post-hoc probing of interaction effects was completed using simple slopes regression modeling[32] with the same predictors and covariates as the main effects models. The extent to which family context variables accounted for the income-related gap in SR scores was examined by comparing the regression coefficients for family income in the baseline model to that in the full adjusted model. The analyses were conducted using Stata Version 12[33] and R[34].

RESULTS

Sample Characteristics and Self-Regulation Task Performance

The characteristics of the study sample are shown in Table 1. Children in the study were about five and a-half years old and largely gender balanced. About one-third of the children were white or Asian (only one child was Asian), and two-thirds were African American. The income levels of the families in the study covered a wide range from < $5,000 to $150,000 +, and large proportions of children were in both the top and the bottom of the income distribution. Mothers' education and family housing conditions were also consistent with their diverse socioeconomic backgrounds. Sixty percent of the mothers were married or romantically involved with the child's biological father; the rest were separated, divorced or had no relationship with the child's biological father. The majority of the children were attending school or daycare. On average, children had experienced 5.8 negative life events. Mothers, on average, had depression scores of 13.2 points, whereas a score ≥ 16 indicates a person is at risk for clinical depression

Table 2 summarizes children's SR task performance. On average, children scored 94% correct on the Pig Game and 66% correct on the Silly Sounds Game. In the Delay of Gratification task, one-fifth of children waited less than 1 minute, one-fifth waited more than 1 minute to < 8 minutes, and three-fifths waited the full 8 minutes. Children, on average, expressed 1.57 (of possible 3) behavioral reactions to the Disappointing Gift task, and reacted to unfairness on the third step out of the six steps in the Not Sharing task. In both of these tasks, very few children appeared to be unconcerned during the task administration, about two-thirds appeared to be suppressing their emotional reactions, and about one-quarter had unambiguous emotional displays.

Constructing Cognitive and Emotional Self-Regulation Scores

The principal component analysis of SR task scores yielded two components that corresponded to an emotional and a cognitive aspect of self-regulation (SR). The two components accounted for 30% and 20% of the total variance of the task scores, respectively, and were not significantly correlated ($r = 0.13$, $p = .16$). The Not Sharing and Disappointing Gift task scores primarily loaded on the emotional component, while the Silly Sounds Game, Pig Game, and Delay of Gratification task scores primarily loaded on the cognitive component (see Supplemental Table 1).

Family Income, Family Context and Self-Regulation

Emotional SR—Results from the bivariate analyses between the covariates and SR scores are shown in Table 3. Each level increase in family income was associated with 0.04 standard deviation (SD) increase in emotional SR, but this relationship was not significant ($p = 0.16$). Among family contextual variables, household instability was significantly associated with worse emotional SR. The number of negative life events was associated with better emotional SR when there were few events experienced. However, the marginal benefit of an additional negative event decreased with increasing numbers of negative events; the number of events started to have negative effects on emotional SR beginning at the ninth

event. Other family contextual variables were not significantly associated with emotional SR.

Results from the multivariate analyses are reported in Table 4. In the baseline model, controlling for age, sex and race, each level increase in family income was associated with 0.04 SD increase in emotional SR, but the relationship was not significant ($p = 0.32$). After accounting for all other covariates, there was no evidence of a positive relationship between family income and emotional SR ($b = -0.04$, $p = 0.42$). In the fully adjusted model, there was a significant interaction between household instability and family income on emotional SR. Each SD increase in household instability was associated with 0.86 SD lower emotional SR in children in the lowest income category ($p < 0.001$). The detrimental effect of household instability on emotional SR, however, was buffered by family income, such that, for each level increase in family income, the effect was reduced by 0.10 SD ($p = 0.04$). In fact, the simple slopes regression model demonstrated that, for families with an income of $35,000 or more, the detrimental effect of household instability was no longer statistically significant. Negative life events were associated with emotional SR in a curvilinear fashion. The first negative life event was associated with improved emotional SR by 0.20 SD ($p = 0.009$), but the marginal benefit of an additional negative event decreased as number of negative events increased. The number of negative life events experienced by a child started to have detrimental effects beginning at the tenth negative event.

Cognitive SR—In the bivariate analyses (Table 3), each level increase in family income was associated with 0.10 SD increase in cognitive SR ($p < 0.001$). Being female, white/Asian, having better receptive vocabulary, and attending school/daycare were all significantly associated with better cognitive SR in bivariate analyses. In addition, higher levels of maternal education were associated with better cognitive SR in children, while higher levels of household instability and more maternal depressive symptoms were associated with worse cognitive SR in children.

In the multivariate analyses (Table 4), the baseline model adjusting for child age, sex and race showed that each level increase in family income was associated with 0.08 SD increase in cognitive SR ($p = 0.01$). In the fully adjusted model, the association between higher income and better cognitive SR was largely reduced and was no longer statistically significant ($b = 0.03$, $p = 0.51$). In the fully adjusted model, every 10 point increase in maternal depressive symptoms score was associated with a 0.20 SD decrease in cognitive SR ($p = 0.006$). Also, there was a significant interaction between the number of children in the household and family income on cognitive SR. Each additional child in the household was associated with 0.15 SD lower cognitive SR among children in the lowest income category ($p = 0.02$). Higher family income, however, buffered and reversed the detrimental relationship between more children in the household and cognitive SR ($b = 0.06$, $p = 0.006$). The simple slopes regression model demonstrated that more children in the household was significantly associated with better cognitive SR for families earning at least $35,000 dollars a year. In addition, being female was associated with two-third SD increase in cognitive SR in both the baseline and the full model.

DISCUSSION

Using a battery of SR assessments with a group of five-year-old children, we identified a cognitive and an emotional aspect of SR. Higher family income was associated with significantly better child cognitive SR, but we found no evidence that family income was associated with child emotional SR. Independent of other child- and family-level covariates and controlling for family income, exposure to household instability and experiencing many negative life events were associated with worse child emotional SR, whereas exposure to a mother's depressive symptoms was associated with worse cognitive SR. Higher income buffered the detrimental effects of some of the family contextual characteristics on SR functions, such that family instability had increasingly smaller negative effects on emotional SR as family income increased, and more children in the household was associated with worse cognitive SR in lower-income families but better cognitive SR in higher-income families. Income-based disparities in cognitive SR were largely accounted for by the family contextual variables examined.

Analyzing cognitive and emotional aspects of SR in parallel, we found cognitive SR was more strongly correlated with income than emotional SR. This is consistent with the notion that income is more relevant for cognitive development than emotional development in general,[12] as the income effect on the latter is usually mediated by family relations and interactions.[35] The income-based disparities in cognitive SR translate to a 0.40 SD difference between children in the lowest income category (families earning less than $5,000 a year) and those living just above the federal poverty level (FPL) for family of four (family income of $25,000 to $34,999), or between the children living just above the FPL and those in the highest income category (150,000+). The poorer cognitive SR we observed in lower-income children is resonant of the higher prevalence of attention deficit hyperactivity disorder (ADHD) among low-income children.[36] However, behavioral dysfunction is also affected by many factors in addition to the basic mental processes of SR. These include, for example, characteristics of the home and school environment, or the child's motivation. Thus, determining whether compromised SR in lower income children contributes to higher rates of ADHD in this group is complicated by the fact that low income children's daily environments are challenging and chaotic. Our findings suggest there are important relationships between children's regulatory functioning and their family environments, in particular, which may contribute to higher prevalence of ADHD diagnosis in this group.

We found that household instability and experiencing many negative life events were associated with worse emotional SR. However, as family income increased, the negative association between household instability and emotional SR became smaller, suggesting that families with higher incomes may have other resources to buffer the potential impact of instability on the child's development.[5] The relationship between emotional SR and negative life events was curvilinear, which is consistent with the notion that moderate exposure to adversity may be health-promoting or "steeling",[10] but intense or frequent exposure to adversity may overwhelm a child's adaptive functioning. These findings support the hypothesis that early-life chronic stress influences neurodevelopmental processes underlying SR functions.[37] Previously, Evans and colleagues found that physical and psychological chaos in daily living was associated with poorer effortful control.[15] The current study

complements their focus on family processes with a focus on family context. After accounting for these family contextual variables, higher income was no longer associated with better cognitive SR.

Although many variables related to families' socioeconomic status – such as race, maternal education, child receptive vocabulary and household instability – were associated with cognitive SR in the bivariate analyses, most of the associations were no longer significant after accounting for family contextual variables and family income. This suggests that the effects of these variables were confounded by other variables. In the multivariate model, having more children in the household had detrimental, though not statistically significant, effects on cognitive SR in lower-income families, but beneficial effects in higher-income families. It is likely that having more children in the household provides opportunities for social interaction, stimulation, and enrichment that support the development of cognitive SR. Among poor families, however, the benefit of more children may be offset by the strains multiple children place on a family's resources and routines. Maternal depressive symptoms were also associated with poorer cognitive SR. This is consistent with the current evidence that maternal depression contributes to hostile or withdrawn parenting behaviors and compromises children's cognitive development,[38] particularly, executive functioning.[39] The protracted developmental window of executive function may help explain why the effect of maternal depressive symptoms is unique to cognitive, but not emotional, SR. After accounting for the family contextual variables, the association between higher income and better cognitive SR was reduced and no longer statistically significant.

A unique strength of this study is our examination of cognitive and emotional SR in an integrated framework using pre-existing and widely used SR assessments. Informed by theory[20,40] and guided by principal component analysis, we were able to identify two distinct aspects of SR from the data. This integrated evaluation of SR provides rare and valuable links between the separate literatures on executive function and effortful control. Analyzing the two aspects of SR in parallel provides unique opportunities to compare and contrast these aspects of SR.

In contrast to widely used clinical and research tools (e.g., clinical ADHD rating scales, the Child Behavior Checklist) which usually capture behavioral problems related to SR deficit, the current approach offers a more granular measure of SR *per se*. The popular existing tools measure the behaviors in daily life, which can have multi-factorial influences. In contrast, the current approach directly observed the basic mental processes of SR (i.e., inhibition, attention and response to disappointment) in a controlled laboratory environment. Thus, depending on the outcome of interest, one measurement approach may be more suitable than the other. The advantage of the current approach is that it involves direct observation of children's behaviors, bypassing parental/teacher bias resulting from their own functional state (e.g. depression, anxiety) and frames of reference. Nonetheless, the current assessments are more difficult and costly to implement than standard parent/teacher questionnaire measures and may be less reflective of the multifactorial influences on child behavior that may be noted at home and at school.

Limitations

This study relied on two different participant pools (a prenatal follow-up study and a community sample) to create a study sample with wide variations in family income. Although participants drawn from the two pools may be different on a multitude of factors that may confound the observed relations between income and SR, in sensitivity analyses, we were able to test some key suspected confounders, including maternal smoking status and child low birth weight, and did not find evidence supporting this possibility. Still, as with most observational studies, this study is subject to risk of confounding from unmeasured sources. Further, our sampling approach may limit the generalizibility of our findings to a different population. Intervention studies targeting family socioeconomic adversity may help further explain and validate the effects of the family contextual variables on child SR. Finally, performance on two SR assessments (Delay of Gratification and Pig Game) was generally very high, which could have resulted in a ceiling effect. The use of composite scores to measure SR should have helped to ameliorate the impact of potential ceiling effects on our findings.

Implications

Population level efforts to directly support the development of child SR are essential to address income-based disparities in SR in early life. Many public preschool programs such as Head Start include socioemotional skills development curricula that benefit children's self-regulatory skills,[41,42] but currently these programs only cover about one third of children in poverty. Clinical settings offer the opportunity to reach a greater proportion of children and families. The American Academy of Pediatrics (AAP) has recommended ways pediatric clinicians can help address the social determinants of health when caring for children who live in poverty, including screening for socioeconomic adversities, linking needy families with community resources, and including routine screenings for maternal depression during the first year of life.[43] There is evidence that screening and referral for unmet social needs improves families' ability to access the services that can improve family stability.[44] The current study highlights the potential benefits of these efforts in supporting basic regulatory development, a key contributor to children's future health and well-being.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Child characteristics and family context variables (n = 140)

Characteristics	Estimate	SE
Child characteristics		
Child age in months, mean	65.5	0.4
Child sex, %		
Male	47.1	4.2
Female	52.9	4.2
Child race, %		
White/Asian	36.4	4.1
African American	63.6	4.1
Child PPVT standard score, mean	99.0	1.3
Family context variables		
Family income (US dollars), %		
<5,000	13.3	3.1
5,000–11,999	13.6	3.2
12,000–15,999	7.9	2.5
16,000–24,999	8.6	2.7
25,000–34,999	5.8	2.1
35,000–49,999	3.8	1.7
50,000–74,999	7.6	2.3
75,000–99,999	2.9	1.4
100,000–149,999	20.8	3.4
150,000+	15.7	3.1
Mother’s education, %		
High school or less	32.9	4.0
Any college	44.3	4.2
Graduate degree	22.9	3.6
Number of children in the household, %		
1	15.0	3.0
2	43.6	4.2
3	25.7	3.7
4 or more	15.7	3.1
Mother’s relationship with the child’s biological father, %		
Married or romantically involved with father	60.0	4.2
Separated, divorced/no relationship with father	40.0	4.2
# household moves, %		
0	25.8	3.7
1	32.4	4.0
2	16.0	3.1
3	15.1	3.0
4 or more	10.7	2.6

Characteristics	Estimate	SE
Number of persons per room, %		
1	50.0	4.2
2	40.0	4.2
3	10.0	2.5
Child care, %		
Not attending school/daycare	7.9	2.3
Attending any school/daycare	92.1	2.3
Household instability score,[a] mean	0.0	8.5
CLES negative event count, mean	5.8	0.3
CESD-R score, mean	13.2	0.9

SE, standard error; PPVT, Peabody Picture Vocabulary Test; CLES, Coddington Life Events Scales; CESD-R, the Center for Epidemiologic Studies Depression Scale Revised.

[a]A linear combination of mother's relationship with the child's biological father, number of household moves, and persons per room generated from a principal component analysis.

Table 2

Self-regulatory (SR) battery performance among five-year-old children (n = 140)

Items	Estimate	SE
SR battery performance		
Pig Game (go/no-go inhibition): mean proportion of correct responses	0.94	0.01
Silly Sounds Game (attention/inhibition): mean proportion of correct responses	0.66	0.02
Delay of Gratification: total time waited, %		
< 1 minute	20.0	3.4
1 minute - 7 minutes 59 seconds	18.6	3.3
8 minutes	61.4	4.1
Disappointing Gift (response to disappointment): mean number of emotional responses	1.57	0.08
Disappointing Gift (response to disappointment): intensity of display, %		
Unconcerned	5.0	1.4
Managed	65.7	4.0
Visible	29.3	3.9
Not Sharing (emotion regulation): mean threshold of reaction	3.23	0.19
Not Sharing (emotion regulation): intensity of display, %		
Unconcerned	2.9	1.4
Managed	71.4	3.8
Visible	25.7	3.7

SE, standard error.

Table 3

Univariate relations of self-regulation (SR) scores with family income, child characteristics and family context variables among five-year-old children (n =140)

	Emotional SR[a]		Cognitive SR[a]	
	Coef (SE)	**p-value**	**Coef (SE)**	**p-value**
Family income[b]	0.04 (0.03)	0.16	0.10 (0.02)	<0.001
Child age (per month)	0.02 (0.02)	0.36	−0.01 (0.02)	0.72
Child sex				
Male	ref.		ref.	
Female	0.07 (0.17)	0.69	0.70 (0.16)	<0.001
Child race				
White/Asian[c]	ref.		ref.	
African American	−0.20 (0.18)	0.25	−0.52 (0.17)	0.003
Child PPVT standard score (per 10 points)	0.09 (0.06)	0.87	0.23 (0.05)	<0.001
Mother's education[d] (per 1 level)	0.06 (0.05)	0.22	0.15 (0.04)	0.001
# children in the household	0.11 (0.07)	0.13	−0.05 (0.07)	0.51
Child care				
Not attending school/daycare	ref.		ref.	
Attending any school/daycare	−0.08 (0.32)	0.80	0.82 (0.31)	0.008
Household instability score[e]	−0.23 (0.09)	0.009	−0.26 (0.09)	0.002
Child's CLES negative events				
Linear term	0.17 (0.08)	0.03	0.10 (0.08)	0.20
Quadratic term	−0.01 (0.00)	0.02	−0.01 (0.01)	0.20
Mother's CESD-R score (per 10 points)	−0.10 (0.07)	0.23	−0.02 (0.01)	0.007

SR, self-regulation; coef, coefficient; SE, standard error; PPVT, Peabody Picture Vocabulary Test; CLES, Coddington Life Events Scales; CESD-R, the Center for Epidemiologic Studies Depression Scale Revised; ref., reference.

[a] Emotional SR and cognitive SR were generated by principal component analysis as a linear combination of SR task performance.

[b] Measured in 10 levels from <$5,000 to ≥$150,000. See Table 1 for categories.

[c] There was only 1 Asian child in the study sample.

[d] Measured in 8 categories from less than high school to professional school.

[e] A linear combination of single parenthood, number of household moves, and number of person per room generated from a principal component analysis.

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Table 4

Multivariate regressions of self-regulation (SR) scores on family income, child characteristics and family context variables among five-year-old children (n = 140)

Characteristics	Emotional SR[a]				Cognitive SR[a]			
	Baseline model		Fully adjusted model		Baseline model		Fully adjusted model	
	Coef (SE)	*p*-value	Coef (SE)	*p*-value	Coef (SE)	*p*-value	Coef (SE)	*p*-value
Main effects								
Family income[b]	0.04 (0.04)	0.32	−0.04 (0.05)	0.42	0.08 (0.03)	0.01	0.03 (0.05)	0.51
Child age (per month)	0.03 (0.02)	0.18	0.02 (0.02)	0.47	0.01 (0.02)	0.51	0.01 (0.02)	0.63
Child sex								
Male	ref.		ref.		ref.		ref.	
Female	0.05 (0.17)	0.76	0.11 (0.16)	0.47	0.67 (0.15)	<0.001	0.68 (0.15)	<0.001
Child race								
White/Asian[c]	ref.		ref.		ref.		ref.	
African American	−0.09 (0.25)	0.71	−0.40 (0.15)	0.15	−0.14 (0.22)	0.54	−0.24 (0.24)	0.31
Child PPVT standard score (per 10 points)	-	-	−0.01 (0.01)	0.39	-	-	0.01 (0.01)	0.08
Mother's education (per 1 level)[d]	-	-	0.04 (0.08)	0.65	-	-	−0.06 (0.08)	0.47
# children in household[e]	-	-	0.13 (0.08)	0.09	-	-	−0.15 (0.12)	0.21
Child care								
Not attending school/daycare	-	-	ref.		-	-	ref.	
Attending any school/daycare	-	-	−0.61 (0.34)	0.08	-	-	0.21 (0.32)	0.50
Household instability score[f]	-	-	−0.86 (0.22)	<0.001	-	-	−0.13 (0.12)	0.31
Child's CLES negative events								
Linear term	-	-	0.20 (0.08)	0.009	-	-	0.13 (0.07)	0.06
Quadratic term	-	-	−0.01 (0.00)	0.04	-	-	−0.01 (0.00)	0.19
Mother's CESD-R score (per 10 point)	-	-	−0.08 (0.09)	0.40	-	-	−0.20 (0.01)	0.03
Interactions[g]								
Family income × household instability scored[f]	-	-	0.10 (0.04)	0.02	-	-	-	-
Family income × # children in household[e]	-	-	-	-	-	-	0.06 (0.02)	0.006

SR, self-regulation; coef, coefficient; SE, standard error; PPVT, peabody Picture Vocabulary Test; CLES, Coddington Life Events Scales; CESD-R, the Center for Epidemiologic Studies Depression Scale Revised; ref., reference.

[a] Emotional SR and cognitive SR were generated by principal component analysis as a linear combination of SR task performance.

[b] Measured in 8 categories from less than high school to professional school. See table 2 for categories.

[c] There was only 1 Asian child in the study sample.

[d] Measured in 8 categories from less than high school to professional school.

[e] Centered at mean.

[f] A linear combination of single parenthood, number of household moves, and number of person per room generated from a principal component analysis.

[g] Only interaction terms with $p < 0.05$ were retained in the model.