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Original Article

Association Between Parental Educational Attainment and Children's Negative Urgency: Sex Differences

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Abstract

Background and aims: Negative urgency reflects a specific facet of impulsivity and correlates with a wide range of health-related risk behaviors, including, but not limited to, problematic substance use. Negative urgency is also shaped by family socioeconomic position (SEP), such as parental educational attainment (PEA). This study aimed to explore sex differences regarding protective effects of PEA on children's negative urgency in the US.

Methods: This cross-sectional study used the Adolescent Brain Cognitive Development (ABCD) study data. Baseline ABCD data included 10,535 American children in the age range of 9-10 years old. The independent variable was PEA, treated as a 5-level categorical variable. The primary outcome was negative urgency measured by the Urgency, Premeditation, Perseverance, Sensation Seeking, Positive Urgency, Impulsive Behavior Scale (UPPS-SS). Mixed-effects regression models were applied for data analysis.

Results: In sex-stratified regression models, high PEA was predictive of lower levels of negative urgency in female but not male children. In the overall sample, sex showed a statistically significant interaction with PEA on children's negative urgency, indicating a stronger protective effect of high PEA for female compared to male children.

Conclusion: PEA was a more salient determinant of negative urgency in female children than male ones. Our results also showed that American boys tend to have high levels of negative urgency, which is a risk factor of drug use, at all parental education levels.

Keywords: Personality, Negative urgency, Socioeconomic status, Children, Parental educational attainment

Introduction

Socioeconomic position (SEP) is among the most influential determinants of population health.[1-3] Parental educational attainment (PEA) is among various SEP indicators,[4] and it is one of the most salient social determinants of children's outcomes across various domains.[4] Families composed of highly educated parents report higher parental involvement levels, which improves children's outcomes across domains.[5-9]

PEA boosts children's positive outcomes across various domains.[4] Children from highly educated families experience fewer stressors and related consequences.[10-12] In part, parental education may explain why children's behavioral outcomes are different across social groups.[13-16] Closing the PEA gap is also one strategy for addressing social inequalities in childhood health and behaviors.[17,18]

However, parental education and other SEP indicators do not have equal effects on the outcomes of various demographic groups, indicating that parental education may be a source of inequalities across groups rather than closing them.[19-22] For example, the Marginalization-related Diminished Returns (MDRs) literature has shown that PEA and other SEP indicators have weaker effects in marginalized social groups.[23] As shown by MDRs,[24,25] due to social marginalization, some children remain at risk because their parental education generates less tangible behavioral outcomes for them. Differential effects of PEA are shown for race,[24-28] ethnicity,[23,29-31] sexual orientation,[32] nativity,[22] place,[33] and sex.[34-39] In all these cases, parental education's gradient or threshold effect is found to vary across subgroups of children based on a demographic factor.[23,29,40-42] This can be partly because social processes may interfere with some parts of society's ability to leverage the social resource (SEP) and turn them into tangible behavioral or health outcomes. As a result, that subgroup would show undesired outcomes regardless of availability of SEP resources.[25,26,43-46]

Some research has shown that SEP indicators, such as parental education, may show sex-specific effects on brain development.[47] Javanbakht et al[48] and [49] reported more potent PEA effects on the brain function of females than males. In contrast, Whittle et al[50] and Mcdermott et al[51] showed opposite results, where boys were more sensitive than girls to a variation in environmental inputs. Assari also showed sex differences in the effects of parental education on the depression of adolescents.[52,53] Although we know that sex differences exist in SEP effects on brain development, the magnitude and direction of such sex differences are still unclear.

Negative urgency reflects a specific facet of impulsivity,[54] and is known to be a risk factor of a wide range of health-related risk behaviors, including problematic substance use.[55-57] Negative urgency is commonly measured by a scale called the Urgency, *Premeditation*, Perseverance, Sensation Seeking (UPPS).[58-62] Compared to children and adults with low negative urgency, subjects with high negative urgency respond undesirably to reward omission in tasks that use monetary incentives.[63-66] Following omission of an expected reward, subjects with high levels of negative urgency show frustration and display impulsive behaviors.[66]

This study compared the effects of PEA on negative urgency of male and female children in the US. While high PEA is expected to be associated with less negative urgency (Hypothesis 1), this effect may be stronger for males than females (Hypothesis 2). The stronger effects of SEP indicators for males than females have been shown in some studies.[50,51]

Materials and Methods

Design, Setting, and Sampling

This cross-sectional study was a secondary analysis of existing data. We borrowed data from the Adolescent Brain Cognitive Development (ABCD) study.[67-71] The ABCD is a national children's brain development study with broad diversity based on race, ethnicity, sex, and SEP.[67,72]

Participants were recruited from multiple cities across various states in the US. The sample was enrolled through the US school system. The recruitment catchment area of the ABCD, composed of 21 participating sites, encompasses over 20% of the entire US population of 9-10-year-old children. The ABCD applied a carefully designed sampling and recruitment process across various sites, described elsewhere,[67,68,70,72-87] to ensure that the results are generalizable. More details of the ABCD sample and sampling are available here.[88]

Analytical Sample

This study included 10,535 children (age range: 9-10 years old) who had data on study variables, including negative urgency. Children from any race or ethnicity were included. No additional eligibility was considered.

Measures

Outcome

Negative urgency. Negative urgency reflected impulsivity, and was measured by the Urgency, Premeditation (lack of), Perseverance (lack of), Sensation Seeking, Positive Urgency, Impulsive Behavior Scale (UPPS-SS).[89] Negative urgency in this study was treated as a continuous measure, with a higher score indicating a higher negative urgency (higher impulsivity). This measure is valid and reliable[62] (Supplementary file 1).

Moderator

Sex. Sex, 1 for males and 0 for females, was a dichotomous variable. This variable was the effect modifier.

Independent Variable

Parental educational attainment. PEA was a five-level categorical variable. Responses included 1= less than high school diploma; 2 = high school diploma or GED; 3 = some college; 4 = college degree; and 5 = some graduate education. The distribution of our PEA variable is shown in Supplementary file 1.

Confounders

Race. Race was self-identified by parents, and it was treated as a categorical variable: White (reference group), Black, Asian, and Other/Mixed race.

Ethnicity. Ethnicity, self-identified by the interviewed parents, was a categorical variable: Hispanics vs. non-Hispanics (reference category).

Age. The interviewed parents reported child age.

Parental marital status. The household's marital status was a dichotomous variable: married = 1 and non-married = 0.

Data Analysis

To describe our sample, we reported mean (SD) for continuous variables and frequencies and percentages for categorical variables in the pooled sample and by sex. We also used chi-square or independent sample *t* test for bivariate analysis. Our main analysis applied mixed (random) effect models that allowed adjusting for the data's nested nature. This analysis was performed in the Data Analysis and Exploration Portal (DEAP), National Data Archive (NDA), and National Institutes of Health (NIH). Participants were nested within families who were nested within 21 sites. As such, our models corrected for non-independence of our observations. Two mixed-effects multivariable models were performed. In both of these models, negative urgency was the outcome, sex was the moderator, PEA was the predictor, and covariates (race, ethnicity, age, and parental marital status), as well as site and family ID were controlled. *Model 1 (no interaction)* was estimated in the absence of the PEA by sex interaction term. *Model 2 (the interaction model)* added interaction terms between sex and PEA. Supplementary file 2 shows the formula used for *Model 1, Model 2,* and *Model 3* in the DEAP system. Regression coefficient (b), SE, and p-values were reported for each model. Supplementary file 1 shows the results of testing assumptions. Graphs reflecting these results are also shown.

Ethical Approval

For this study, we used a fully de-identified data set. As such, the study was exempted from a full review Institutional Review Board (IRB). However, the main study protocol, the ABCD, was approved by the IRB at the University of California, San Diego (UCSD), and several other institutions. Participants signed consent or assent depending on their age.[72]

Results

Table 1 depicts the summary statistics of the pooled sample and by sex. The current analysis was performed on 10,535 children (age range: 9-10 years old), from whom 52% were male (n = 5,481), and 48% were female (n = 5054).

Table 2 summarizes our mixed-method regression models in the overall (pooled) sample. *Model 1* (Main Effect Model) did not show any association between PEA and negative urgency in the pooled sample. *Model 2* (Interaction Model) showed an interaction term between sex and PEA on negative urgency, suggesting that the effect of PEA on negative urgency was weaker for males than females. *Model 3* showed an inverse association between PEA and negative urgency in females.

Figure 1 shows no effect of PEA on negative urgency in the pooled sample. Figure 2 shows the effect of PEA on negative urgency for females. As this figure shows, there was a stepwise association between PEA and female children's negative urgency. Female children whose parents had the highest education levels showed the lowest levels of negative urgency, and those with the lowest PEA showed the highest negative urgency. Figure 3 shows interactions between PEA and child's sex on negative urgency in the pooled sample. As this figure shows, a decline in negative urgency due to high PEA was smaller for male than female children.

Discussion

Our findings showed that high parental education reduces negative urgency for female but not male children, indicating that sex alters the effect of parental education on negative urgency. We also found interactions that were suggestive of more potent effects of PEA on negative urgency for female than male American children.

The literature on sex differences may explain the results. Sex differences are due to the biology of being male or female. Environmental input (e.g., SEP) may show some sex-specific patterns of effects on brain development.[47] A study showed that SEP (i.e., income) might have a larger effect on the development of certain brain structures (e.g., amygdala) of female than male participants.[48] Another study among children aged 6-11 years old found that PEA predicted females' structural brain network efficiency but not males' structural brain network efficiency.[49]

Other studies have provided opposing results. For example, a study documented a more salient SEP effect

Table 1. Descriptive Data Overall and by Sex

Level	All	Female	Male	*P*
	N=10535	n=5054	n=5481	
Age (mon), mean (SD)	118.97 (7.46)	118.79 (7.44)	119.13 (7.48)	0.021
Negative Urgency, mean (SD)	8.49 (2.63)	8.26 (2.63)	8.69 (2.61)	<0.001
Parental education, No. (%)				
<HS Diploma	391 (3.7)	198 (3.9)	193 (3.5)	0.72
HS Diploma/GED	872 (8.3)	412 (8.2)	460 (8.4)	
Some College	2702 (25.6)	1281 (25.3)	1421 (25.9)	
Bachelor	2794 (26.5)	1333 (26.4)	1461 (26.7)	
Post graduate degree	3776 (35.8)	1830 (36.2)	1946 (35.5)	
Race, No. (%)				
White	6974 (66.2)	3292 (65.1)	3682 (67.2)	0.144
Black	1539 (14.6)	771 (15.3)	768 (14.0)	
Asian	234 (2.2)	117 (2.3)	117 (2.1)	
Other/Mixed	1788 (17.0)	874 (17.3)	914 (16.7)	
Married family, No. (%)				
No	3205 (30.4)	1580 (31.3)	1625 (29.6)	0.075
Yes	7330 (69.6)	3474 (68.7)	3856 (70.4)	
Hispanic, No. (%)				
No	8552 (81.2)	4111 (81.3)	4441 (81.0)	0.697
Yes	1983 (18.8)	943 (18.7)	1040 (19.0)	

Table 2. The Results of Our Mixed Effect Models

	All			All			Females		
	b	SE	*P*	b	SE	p	b	SE	*P*
Parental education (HS Diploma/ GED)	0.18675	0.16363	0.2537585	-0.24328	0.22919	0.288503	-0.24926	0.23248	0.2836748
Parental education (some college)	0.03376	0.14963	0.8215028	-0.4512*	0.20505	0.0277997	-0.47028*	0.21075	0.0256967
Parental education (bachelor)	-0.10142	0.15918	0.5240414	-0.42775*	0.21215	0.0437949	-0.46486*	0.22593	0.0396825
Parental education (post graduate degree)	-0.12890	0.16118	0.4239005	-0.57307**	0.21206	0.0068951	-0.60609**	0.22936	0.0082545
Sex (Male)				-0.39349	0.26425	0.1364957			
Parental education (HS diploma/ GED) x sex (male)				0.87007**	0.31827	0.0062722			
Parental education (some college) x sex (male)				0.97683***	0.28307	0.0005611			
Parental education (bachelor) x sex (male)				0.67624*	0.28254	0.016707			
Parental education (post graduate degree) x sex (male)				0.9027**	0.27782	0.0011606			

Age, marital status, race, and ethnicity (Hispanic) are controlled in both models.
**P*<0.05, ***P* <0.01

on the cortical surface of male than female participants.[51] A study showed that positive parenting and caregiving better predict the amygdala's volumetric growth and the cortical thinning of the right anterior cingulate for males than females.[50] Thus, sex differences in the effects of SEP on brain development exist. However, the directionality of these sex differences is still unknown.[90]

The literature on gender differences may also explain the findings. Gender, different from sex, is a social construct and refers to the difference due to the variation in the social experiences of males and females. Gender differences can be shaped by differences between males' and females' social networks, culture, norms, parents, and friends. The impact of parents, teachers, and peers may differ across SEP levels for boys and girls. Some SEP indicators have a larger impact on girls' opportunities and experiences than boys. While boys of high- and low-income families develop similarly, high- and low-income girls receive vastly

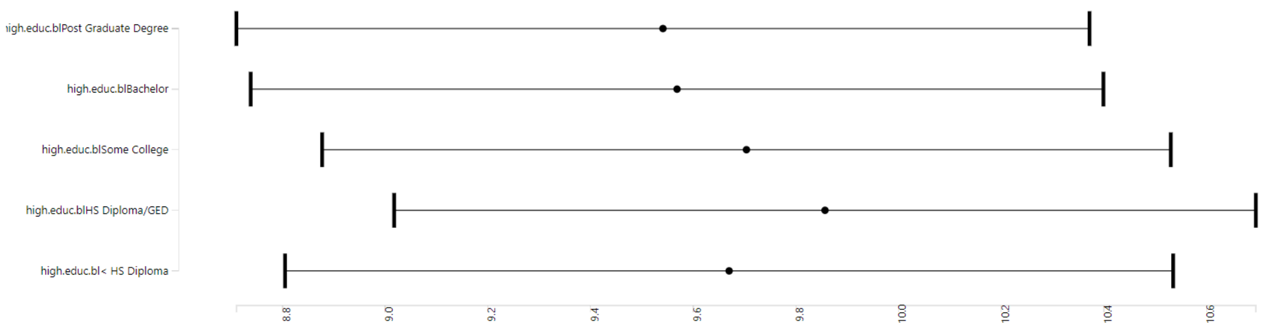

Figure 1. Association Between Parental Educational Attainment and Children Negative Urgency Overall.

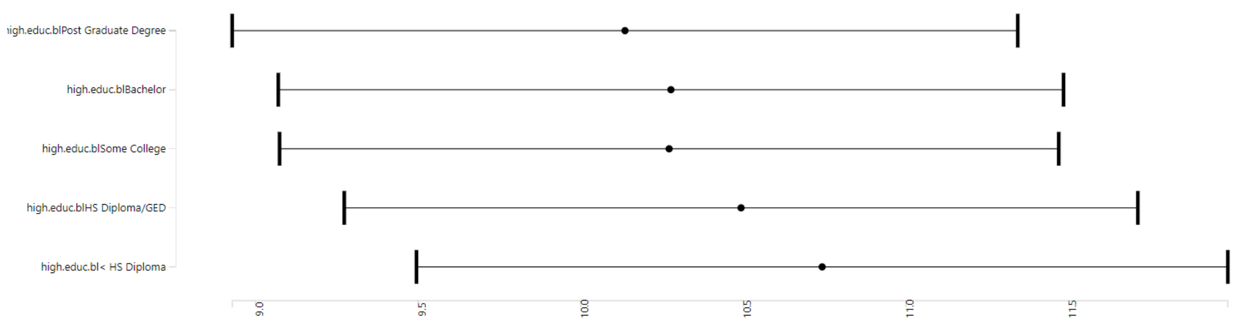

Figure 2. Association Between Parental Educational Attainment and Children Negative Urgency in Females.

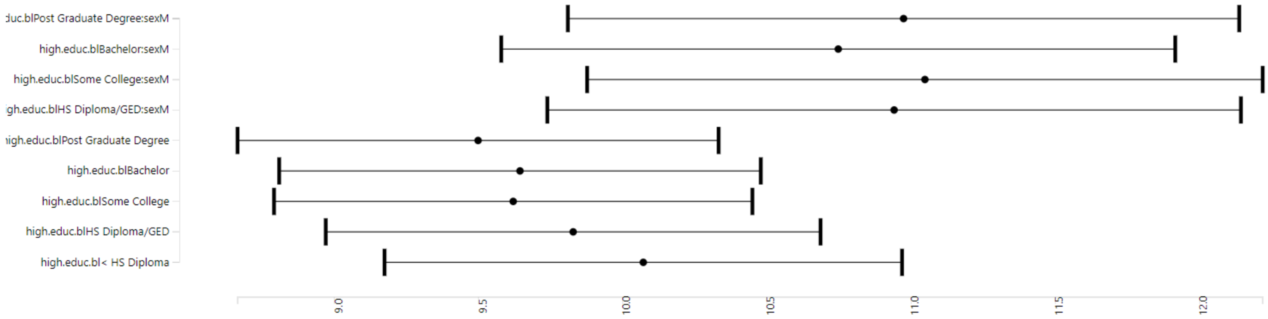

Figure 3. Association Between Parental Educational Attainment and Children Negative Urgency by Child's Sex.

different parenting, stress, peers, and social risk. High- and low-SEP parents may socialize or monitor their boys and girls differently.[91-93] The influence of peers may also differ for males and females.[94] Finally, gender shapes how people cope with stress.[95] These may all result in gender differences in SEP's effects on daily experiences and exposures that shape negative urgency and other aspects of brain function and development.

Gender and sex differences are rules rather than exceptions. Although not supported here, there are studies showing stronger SEP effects (e.g., income and parental education) for males than females among adults. This might be due to the fact that society has a stronger expectation from males than females to be bread-winners and provide for their families.[96-101] We, however, found stronger SEP effects for females than males.

Research that investigates brain development should not limit itself to controlling for sex and gender. The same is true for any studies that explore SEP effects on the brain development of children. Most of the research has traditionally "controlled" the statistical effect of sex, gender, and SEP. Researchers should be aware that sex/gender and SEP interact, meaning that sex alters the SEP effect, and SEP changes the effect of sex on behaviors and brain function and development.

Additional research is needed on the underlying mechanisms that explain why sex or gender alter the effects of SEP indicators such as PEA on children's negative urgency. We know that family SEP may differently impact children's outcomes across demographic groups.[102] Also, not only sex but other factors such as race, place, and class may alter the effect of parental education on children's outcomes.[103] These complexities should be addressed in further research.

Cross-sectional studies are limited in their design. We cannot make any causal inferences between parental education and negative urgency. This study only investigated one SEP indicator, namely PEA. It is unknown if the effects of other SEP indicators such as wealth, income, parental marital status, and parental employment are similar for male and female students. Moreover, it is not clear whether higher-level SEP indicators such as neighborhood SEP have similar or differential effects on children's negative urgency. Our research did not study other personality traits or aspects of impulsivity. It also did not study other risk factors of substance use, such as peers, norms, expectations, parenting, and knowledge about drugs' harm. We also did not study why PEA differently influences male and female children's negative urgency.

Conclusion

According to our results, high PEA impacted negative urgency in girls but not boys. This means that girls with highly educated parents would have low negative urgency. However, boys with high and low parental education do not vary much in their negative urgency, and they all have high levels of negative urgency. The result is essential given the role of negative urgency on health risk behaviors such as drug use.

Conflict of Interest Disclosures

The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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principal-investigators.html.

Disclaimer

This manuscript reflects the views of the author and may not reflect the opinions or views of the NIH or ABCD consortium investigators. ABCD consortium investigators designed and implemented the study and/or provided data but did not necessarily participate in analysis or writing of this report.

Supplementary files

Supplementary file 1. Distribution of the predictor, outcome, residuals, and quantiles.
Supplementary file 2. Model formula for our main models.

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