Original Paper

Racial Variation in the Association between Positive Urgency and Body Mass Index among American Children

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Abstract

**Background:** Positive urgency reflects a specific facet of impulsivity and correlates with several health-related risk behaviors such as obesity, food addiction, and substance use. However, less is known about whether positive urgency is similarly or differently associated with high body mass index (BMI) across diverse racial groups. **Aim:** The aim of this study was to investigate racial differences in the associations between positive urgency and BMI in 9-10-year-old children in the US. **Materials and Methods:** This cross-sectional study used the Adolescent Brain Cognitive Development (ABCD) study. Participants were 11590 American children between ages 9 and 10 years old. The independent variable was positive urgency measured by the Urgency, Premeditation (lack of), Perseverance (lack of), Sensation Seeking, Positive Urgency, Impulsive Behavior Scale (UPPS-SS). The primary outcome was BMI. Race was the moderator. Demographic variables (age and sex) were covariates. Mixed-effects regression models were used for data analysis to adjust for the nested nature of the ABCD data. We also used weights (propensity score) to generate nationally representative results. **Results:** In the pooled sample, race showed a statistically significant interaction with positive urgency on children’s BMI, indicating a stronger effect of positive urgency on BMI for White children, compared to African American children. **Conclusion:** The association between positive urgency and BMI seems to be weaker in African American children than in White American children. The role of individual-level risk factors such as impulsive traits may be smaller for African American than White American children. Future research should study the role of obesogenic environments and other area level indicators in altering the effects of individual-level risk factors on BMI and obesity.
Keywords
personality, positive urgency, obesity, body mass index, population groups

1. Background
Positive urgency, a specific type of impulsivity, (Littlefield, Stevens, Ellingson, King, & Jackson, 2016) is a risk factor for a wide range of high-risk behaviors, food addiction, suicide, substance use, and high body mass index (BMI) (Cyders et al., 2010; Halcomb, Argyriou, & Cyders, 2019; Racine et al., 2013). One of the scales commonly used to measure positive urgency is called urgency, premeditation (lack of), perseverance (lack of), sensation seeking (UPPS) (Albein-Urios et al., 2013; Aloï et al., 2020; Verdejo-García, Lozano, Moya, Alcázar, & Pérez-García, 2010; F. L. Wang & Chassin, 2018; H. Wang, Wen, Cheng, & Li, 2017). Positive urgency is linked to interconnections between the prefrontal cortex, the amygdala, and the striatum (Bardo, Weiss, & Rebec, 2018).

Individuals with high positive urgency scores respond undesirably to anticipation of food-related cues, when compared to individuals with low positive urgency scores (Bardo et al., 2018; Mason, Dunton, Gearhardt, & Leventhal, 2020; Puhalla, Ammerman, Uyeji, Berman, & McCloskey, 2016; Racine et al., 2015). Positive urgency can also be measured via psychological and behavioral tasks that involve brain reactions to rewards, cues, and incentives (Bardo et al., 2018; Mason et al., 2020; Puhalla et al., 2016; Racine et al., 2015). Following cues that reflect a chance of a positive expected reward, individuals with high levels of positive urgency show higher levels of frustration than subjects with low positive urgency (Bardo et al., 2018). Similarly, compared to individuals with lower scores, those with higher scores display greater impulsive behaviors (Bardo et al., 2018).

Past work has also established a link between positive urgency and BMI (VanderBroek-Stice, Stojek, Beach, & MacKillop, 2017). However, we know almost nothing about racial and ethnic variation in the link between positive urgency and BMI. One recent study explored racial differences in the associations between positive urgency and suicide in American children. This study analyzed data of 10535 American children between ages 9 and 10 who were selected from the Adolescent Brain Cognitive Development (ABCD) study. The main outcome was positive urgency measured by the UPPS-SS. The independent variable was suicide history, and race was the moderator. The study applied mixed-effects regression models to control for the nested nature of the ABCD data. Overall, suicidality was linked to positive urgency in American children. However, race had a significant interaction with suicidal behaviors on children’s positive urgency, indicating a weaker link between suicidality and positive urgency for African American and Other/Mixed race children than White children. Authors concluded that in a low risk environment, there is some link between positive urgency and risk of suicide for White children. However, in high-risk environments, this link is not observed for African American children (Assari, 2020c). It is still unknown if the link between positive urgency and BMI also depends on race or not (Bardo et al., 2018).
1.1 Aims

We borrowed data from the Adolescent Brain Cognitive Development (ABCD) study, which has a large, diverse, national sample of 9-10-year-old children (Alcohol Research: Current Reviews Editorial, 2018; Casey et al., 2018; Karcher, O’Brien, Kandala, & Barch, 2019; Lisdahl et al., 2018; Luciana et al., 2018), in order to conduct a study with the following two aims. First, to see if there is any association between positive urgency and BMI in American children. Second, to compare the association between positive urgency and BMI by race. We expected high positive urgency to be linked to higher BMI (Hypothesis 1), but we expected this association to be weaker for African American than White children (Hypothesis 2). Our expected stronger association between impulsive personality and BMI in White than African American children was based on previously published work on the weaker effect of positive urgency on BMI in African American than White children (Assari, 2020c).

2. Materials and Methods

2.1 Design and Setting

For this cross-sectional study, we conducted a secondary analysis of existing data. We borrowed data from the Adolescent Brain Cognitive Development (ABCD) study (Alcohol Research: Current Reviews Editorial, 2018; Casey et al., 2018; Karcher et al., 2019; Lisdahl et al., 2018; Luciana et al., 2018). The ABCD is a national study of children’s brain development in the US (Alcohol Research: Current Reviews Editorial, 2018; Auchter et al., 2018). The ABCD study protocol was approved by the Institutional Review Board (IRB) at the University of California, San Diego (UCSD), as well as several other institutions. The ABCD participants signed consent or assent, depending on their age (Auchter et al., 2018).

2.2 Sample and Sampling

Participants in the ABCD study are diverse and represent race, ethnicity, sex, and SEP of the US population. ABCD participants were recruited across 21 participating sites that encompass over 1/5th of the US population of 9-10-year-old children. The sampling and recruitment to the ABCD study are described elsewhere (ABCD; Alcohol Research: Current Reviews Editorial, 2018; Asaad & Bjarkam, 2019; Auchter et al., 2018; Beauchaine, 2020; Buscemi et al., 2018; Casey et al., 2018; Dick et al., 2019a, 2019b, 2019c; Exuperio et al., 2019; Feldstein Ewing et al., 2018; Fine et al., 2019; Garavan et al., 2018; Gray, Schvey, & Tanofsky-Kraff, 2019; Hoffman, Howlett, Breslin, & Dowling, 2018; Lisdahl et al., 2018; Lynch et al., 2019; Michelini et al., 2019; Werneck et al., 2018). The ABCD efforts in sampling yielded a final sample that approximates the national composition of race and ethnicity, age, sex, SEP, and urbanicity, for 9-10-year-old children.

The current analysis included 11590 9-10 years old children who had data on our study variables, including baseline BMI and positive urgency. Children were included regardless of their race or ethnicity. No additional eligibility was considered for this analysis. As we used a fully de-identified dataset, our study was exempt from a full review by the Institutional Review Board (IRB).
2.3 Measures and Measurements

Positive urgency was measured using UPPS-SS (Lynam, Smith, Whiteside, & Cyders, 2006). Positive urgency is a construct that reflects an aspect of impulsivity. In this study, positive urgency was treated as a continuous measure, with a higher score indicating higher positive urgency traits (higher impulsivity). The UPPS-SS is a valid and reliable measure (Verdejo-García et al., 2010). Figure 1 shows the distribution of the predictor and outcomes. Race identified by the parents was a categorical variable: African American, Asian, other/mixed race, and White (reference group). Racial variation in sense of urgency is well described (Holochwost et al., 2016). Age was a continuous measure in months. Sex, 1 for males and 0 for females, was a dichotomous variable. Parents reported the age of the children.

2.4 Data Analysis

This analysis was performed in the Data Analysis and Exploration Portal (DEAP), National Data Archive (NDA), and the National Institutes of Health (NIH). We reported both weighted and unweighted mean (SD) and frequencies (%) for continuous and categorical variables in the pooled sample and by race to summarize our descriptive statistics. Weights (propensity scores) were applied to generate nationally representative results. We also used Chi-square and Analysis of Variance (ANOVA) for comparison of racial groups. This study applied mixed (random) effects models to address the data’s nested nature for our main analysis. As participants were nested within families, who were themselves nested within 21 sites, we corrected for non-independence of our sample. Two mixed-effects models were performed. Appendix 1 shows the result of testing assumptions. In both models, positive urgency was the predictor, BMI was the outcome, race was the moderator, and covariates included sex, age, family, site, and propensity score. Model 1 (no interaction) was our model in the absence of any interaction terms. Model 2 (the interaction model) was our model that also included interaction terms between race and positive urgency. Appendix 2 shows the formula used for Model 1 and Model 2 in the DEAP system. Regression coefficient (b), standard error (SE), and p-values were reported for our parameters.

3. Results

3.1 Study Variables by Race

Table 1 depicts the summary statistics of the pooled sample and by race. The current analysis was performed on 11590 9-10-year-old children, of which 51.2% were male and 48.8% were female. From this number, 7475 were White (unweighted 64.5%, weighted 67.3%), 1831 were African American (unweighted 15.8% weighted 14.4%), 271 were Asian (unweighted 2.3%, weighted 3.8%), and 2013 were other/mixed race (unweighted 17.4, weighted 14.4%).
Table 1. Descriptive Data overall and by Race (n = 11590)

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>White</th>
<th>African American</th>
<th>Asian</th>
<th>Other/Mixed</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 11590</td>
<td>n=7475</td>
<td>n =1831</td>
<td>n =271</td>
<td>n =2013</td>
<td></td>
</tr>
<tr>
<td>Weighted n (%)</td>
<td>%</td>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>5537 (47.8)</td>
<td>(48.8)</td>
<td>3509 (46.9)</td>
<td>(47.9)</td>
<td>914 (49.9)</td>
<td>(51.1)</td>
</tr>
<tr>
<td>Male</td>
<td>6053 (52.2)</td>
<td>(51.2)</td>
<td>3966 (53.1)</td>
<td>(52.1)</td>
<td>917 (50.1)</td>
<td>(48.9)</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (Months)</td>
<td>118.95 (7.47)</td>
<td>119.23(7.49)</td>
<td>119.04 (7.50)</td>
<td>119.32(7.50)</td>
<td>118.77 (7.27)</td>
<td>119.07(7.28)</td>
</tr>
<tr>
<td>Positive Urgency</td>
<td>7.98 (2.95)</td>
<td>8.04(2.98)</td>
<td>7.73 (2.84)</td>
<td>7.83(2.89)</td>
<td>8.72 (3.20)</td>
<td>8.71(3.20)</td>
</tr>
<tr>
<td>BMI</td>
<td>18.73 (3.97)</td>
<td>18.91(4.04)</td>
<td>18.24 (3.57)</td>
<td>18.51(3.73)</td>
<td>20.42 (4.87)</td>
<td>20.48(4.91)</td>
</tr>
</tbody>
</table>

BMI: Body Mass Index

3.2 Mixed Effects Models

Table 2 summarizes our mixed-effects regression models in the overall (pooled) sample. Model 1 did not show an overall effect of positive urgency on BMI in the pooled sample. This table also summarizes our mixed-effects regression model which included interaction terms between race and positive urgency. Model 2 (Interaction Model) showed a significant interaction between race and positive urgency on BMI in the pooled sample.

Table 2. The Results of Mixed-effects Regression Models without and with the Interaction Terms (n = 11590)

<table>
<thead>
<tr>
<th></th>
<th>b</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Urgency</td>
<td>0.01</td>
<td>0.01</td>
<td>0.421</td>
</tr>
<tr>
<td>Model 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Urgency</td>
<td>0.03*</td>
<td>0.01</td>
<td>0.030</td>
</tr>
<tr>
<td>Race (African American)</td>
<td>2.78***</td>
<td>0.28</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Race (Asian)</td>
<td>-0.43</td>
<td>0.62</td>
<td>0.489</td>
</tr>
<tr>
<td>Race (Other/Mixed)</td>
<td>0.90**</td>
<td>0.30</td>
<td>0.002</td>
</tr>
<tr>
<td>Race (African American) × Positive Urgency</td>
<td>-0.10**</td>
<td>0.03</td>
<td>0.001</td>
</tr>
<tr>
<td>Race (Asian) × Positive Urgency</td>
<td>-0.07</td>
<td>0.08</td>
<td>0.378</td>
</tr>
<tr>
<td>Race (Other/Mixed) × Positive Urgency</td>
<td>-0.02</td>
<td>0.03</td>
<td>0.626</td>
</tr>
</tbody>
</table>

*P < 0.05, **P < 0.01, ***P < 0.001, Age, sex, site, and propensity score are controlled in both models.
3.3 Overall Associations and Racial Variations

Figure 1 explored the association between positive urgency and BMI in the pooled sample. As this figure shows, we could not find an overall effect of positive urgency on BMI in the pooled sample. Figure 2 shows an interaction between race and positive urgency on BMI in the pooled sample. This figure showed a significant interaction between race and positive urgency on BMI in the pooled sample.

Figure 1. Overall Association between Children’s Positive Urgency and Body Mass Index (n = 11590)

Figure 2. Race-specific Associations between 9-10-year-old Children’s Positive Urgency and Body Mass Index (n = 11590)
4. Discussion
Our findings showed a stronger link between higher positive urgency and BMI in White than African American adolescents. While higher scores on positive urgency were associated with higher BMI levels in White children, positive urgency was less relevant to the BMI levels of African American children. As mentioned before, literature has established a link between positive urgency and BMI (VanderBroek-Stice et al., 2017). Our main contribution was to document racial variation in this link. We are only aware of one study that has explored racial variation in the effect of positive urgency on health outcomes. Using the Adolescent Brain Cognitive Development (ABCD) study data, race is found to interact with suicidal behaviors on children’s positive urgency, indicating a weaker link between suicidality and positive urgency for African American and other/mixed race children compared to their White counterparts (Assari, 2020c). To our knowledge, this is the first study that documents racial variation in the positive urgency-BMI link in children.
This is, however, not the first study to find weaker effects of economic and psychological risk factors on BMI of African American compared to White individuals. In various studies, these factors have been shown to have a stronger effect on BMI for White individuals (Assari, 2014, 2019a; Assari, 2020b; Assari & Caldwell, 2015; Carter & Assari, 2016). For example, sustained obesity has been correlated with sustained depression in White but not African American people (Carter & Assari, 2016). A study concluded that emotion regulation may be of highest salience as a predictor of obesity for White females than any other race by sex group (Carter & Assari, 2016). In other studies, high SES had a stronger association with BMI for White than African American children (Assari, 2018; Assari, Caldwell, & Bazargan, 2019; Assari, Thomas, Caldwell, & Mincy, 2018) and adults. It has been suggested that any source of social marginalization may reduce the salience of individual level risk factors on BMI and obesity (Assari, 2019b). Thus, although many previous studies have shown differential correlates of BMI by race, this is one of the first papers to document racial differences in the association between positive urgency and BMI in 9-10-year-old children.
4.1 Future Directions
A wide range of structural and environmental factors increase risk of obesity in African American communities. Such structural factors may be why we observe a diminished effect of individual-level risk factors such as a higher score on the positive urgency trait. For example, Kwate (2008) showed that, due to racial and residential segregation, food options for African American and White children are fried chicken and apples, respectively. Review studies have shown that a higher density of fast food stores may increase obesity in sections of society, regardless of personal risk factors (Fleischhacker, Evenson, Rodriguez, & Ammerman, 2011). Thus, some BMI inequalities are due to structural inequalities in food options (Black, Moon, & Baird, 2014). The same inequalities exist for exercise (Lopez & Hynes, 2006; McNeill, Kreuter, & Subramanian, 2006) and walking (Connor, 2006). A unique set of social and psychological risk factors may be particularly relevant to the risk of obesity in African American communities and can potentially explain the weaker effect potential urgency has on...
BMI. While discrimination is a significant predictor of BMI in African American children (Hunte & Williams, 2009; Johnson, Risica, Gans, Kirtania, & Kumanyika, 2012; Schmengler, Ikram, Snijder, Kunst, & Agyemang, 2017), discrimination does not seem to play a major role for White children. Similarly, environmental influences may be a larger cause of obesity in African American than White families. In this view, individual-level predictors lose some of their effects, while structural factors show stronger influences on African American individuals outcomes such as obesity (Assari, 2020a; Assari, 2020).

4.2 Study Limitations
Like other studies, our study had a few limitations. Since the design was cross-sectional, the results do not imply causations but associations. This study did not measure all factors that could impact BMI and positive urgency. These include SES as well as access to food, diet, exercise, and health. Although the sample was not entirely random, by applying the ABCD propensity score (weights), our results are generalizable to 9-10-year-old children in the US. We also did not measure parents’ BMI or feeding habits. Our sample size was unequal across racial groups, with a larger n in White, and smaller n in other racial groups. None of these limitations, however, are fatal flaws.

4.3 Implications for Policy and Practice
Our results may have implications for psychological and public health interventions and programs that aim to prevent obesity among racially diverse samples of American children. The results also have clinical implications for working with African American children at risk of obesity. Emotion regulation, impulsivity, and positive urgency may have less salient effects for a high BMI in African American than White children (Cummins et al., 2020; Frisco, Quiros, & Van Hook, 2016). Investing and addressing such impulsive traits may have a larger return for preventing high BMI in White than African American children. That means our results advocate for tailoring existing BMI prevention strategies across racial groups of children.

4.4 Research Implications
The observed racial differences also have research implications. Researchers tend to treat race as a control variable in BMI research (Quinto et al., 2011). This practice assumes that BMI and obesity correlates are similar across racial groups (Norman, Nyberg, Elinder, & Berlin, 2015). One size, however, does not fit all (Field, Camargo, & Ogino, 2013). Although race has a direct effect on BMI, it also alters the correlates of BMI. Thus, race should not be reduced to a control variable. Instead, intersections of race, sex, SES, and risk and protective factors should be investigated.

5. Conclusions
Positive urgency contributes differently to children’s high BMI across racial groups. As our results showed, positive urgency may be a less salient psychological determinant of BMI for African American children, compared to White children. The results are of importance given racial variation in childhood BMI. More research is needed to understand why psychological risk factors such as positive urgency...
may show diminished effects on BMI of African American than White children. One hypothesis that requires future work is that African American families live in more obesogenic neighborhoods, so an individual-level risk factor becomes less influential in such high-risk contexts. Future research should test if social and physical environment, food options, and availability of green areas and parks can explain the diminished role of psychological risk factors on the prevalence of high BMI and obesity in African American communities.

**Conflicts of Interest:** The author declares no conflicts of interest.

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**References**


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**Appendix 1. Distribution of the Predictor (a), Outcome (b), Residuals (c), and Quantiles (d)**

![Graphs showing distribution and quantiles](image)

**Appendix 2. Model Formula**

**Model 1**

\[
\text{anthro_bmi_calc} \sim \text{upps_ss_positive_urgency} + \text{race.4level} + \text{sex} + \text{age} +
\]

Random: \(~(1|abcd\_site/rel\_family\_id)\)

**Model 2**

\[
\text{anthro_bmi_calc} \sim \text{upps_ss_positive_urgency} + \text{race.4level} + \text{sex} + \text{age} + \text{upps_ss_positive_urgency} * \text{race.4level}
\]

Random: \(~(1|abcd\_site/rel\_family\_id)\)