Research in Health Science
ISSN 2470-6205 (Print) ISSN 2470-6213 (Online)
Vol. 5, No. 3, 2020
www.scholink.org/ojs/index.php/rhs

Original Paper

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

Shervin Assari[1*]

[1] Department of Family Medicine, Charles R. Drew University of Medicine and Science, Los Angeles, CA, USA

[2] Department of Urban Public Health, Charles R. Drew University of Medicine and Science, Los Angeles, CA, USA

[*] Shervin Assari, E-mail: assari@umich.edu; Tel.: +(734)-232-0445; Fax: +734-615-873

Received: October 9, 2020 Accepted: October 30, 2020 Online Published: November 16, 2020

doi:10.22158/rhs.v5n3p129 URL: http://dx.doi.org/10.22158/rhs.v5n3p129

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; Aloi et al., 2020; Verdejo-Garcí a, Lozano, Moya, Alcázar, & Pérez-Garcí a, 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 $1/5^{th}$ 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 data set, 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-Garc á 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)

	All		White		African American		Asian		Other/Mixed		p	
	n = 11590		n =7475		n =1831		n =271		n =2013			
		Weighted		Weighted		Weighted		Weighted		Weighted		Weighted
	n (%)	%	n (%)	%	n (%)	%	n (%)	%	n (%)	%		
Sex												
Female	5537 (47.8)	(48.8)	3509 (46.9)	(47.9)	914 (49.9)	(51.1)	142 (52.4)	(52.9)	972 (48.3)	(49.6)	0.047	0.085
Male	6053 (52.2)	(51.2)	3966 (53.1)	(52.1)	917 (50.1)	(48.9)	129 (47.6)	(47.1)	1041 (51.7)	(50.4)		
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)		
Age (Months).	118.95 (7.47)	119.23(7.49)	119.04 (7.50)	119.32(7.50)	118.77 (7.27)	119.07(7.28)	119.51 (7.75)	119.82(7.76)	118.69 (7.48)	118.85(7.52)	0.115	0.100
Positive Urgency	7.98 (2.95)	8.04(2.98)	7.73 (2.84)	7.83(2.89)	8.72 (3.20)	8.71(3.20)	7.65 (2.64)	7.59(2.67)	8.29 (3.03)	8.48(3.08)	<0.001	<0.001
BMI	18.73 (3.97)	18.91(4.04)	18.24 (3.57)	18.51(3.73)	20.42 (4.87)	20.48(4.91)	17.61 (3.20)	17.72(3.23)	19.17 (4.09)	19.51(4.15)	<0.001	<0.001

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)

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

*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.

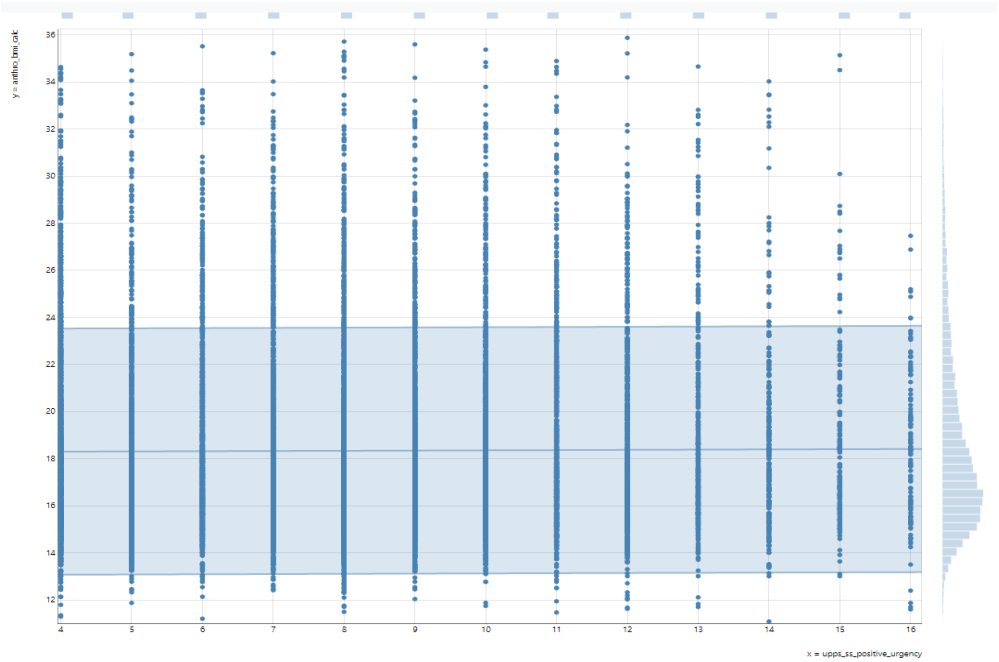


Figure 1. Overall Association between Children's Positive Urgency and Body Mass Index (n = 11590)

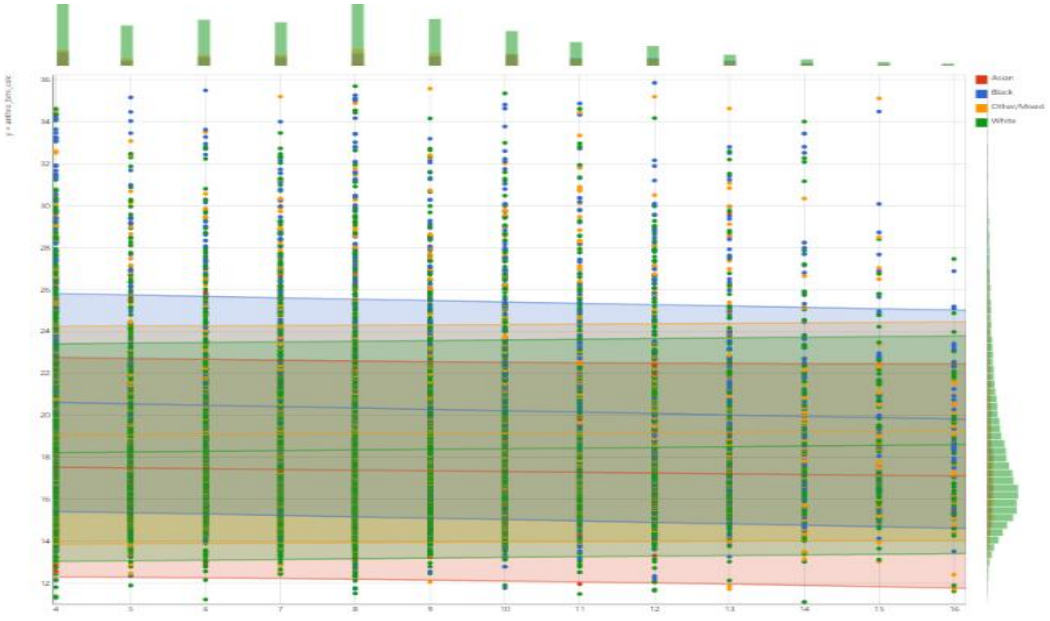


Figure 2. Race-specific Associations between 9-10-year-old Children's Positive Urgency and Body Mass Index (n = 11590)

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.

DEAP Acknowledgment: DEAP is a software provided by the Data Analysis and Informatics Center of ABCD located at the UC San Diego with generous support from the National Institutes of Health and the Centers for Disease Control and Prevention under award number U24DA041123. The DEAP project information and links to its source code are available under the resource identifier RRID: SCR_016158.

ABCD Funding: Data used in the preparation of this article were obtained from the Adolescent Brain Cognitive Development (ABCD) Study (https://abcdstudy.org), held in the NIMH Data Archive (NDA). The ABCD Study is supported by the National Institutes of Health (NIH) and additional federal partners under award numbers U01DA041022, U01DA041025, U01DA041028, U01DA041048, U01DA041089, U01DA041093, U01DA041106, U01DA041117, U01DA041120, U01DA041134, U01DA041148, U01DA041156, U01DA041174, U24DA041123, and U24DA041147. A full list of federal partners is available at https://abcdstudy.org/federal-partners.html. A listing of participating sites and a complete listing of the study investigators can be found at https://abcdstudy.org/principal-investigators.html. This manuscript reflects the views of the authors 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.

Author Funding: Shervin Assari is supported by the grants with the numbers CA201415 02, DA035811-05, U54MD007598, U54MD008149, D084526-03, and U54CA229974 by the National Institutes of Health (NIH).

Author Acknowledgment: Author wishes to thank Natalie Ortiz for her contributions to this paper.

References

ABCD. ABCD Protocl Brocure - Baseline. Retrieved from https://abcdstudy.org/images/Protocol-Brochure-Baseline.pdf

Albein-Urios, N., Martinez-Gonzalez, J. M., Lozano, O., Moreno-Lopez, L., Soriano-Mas, C., & Verdejo-Garcia, A. (2013). Negative urgency, disinhibition and reduced temporal pole gray matter characterize the comorbidity of cocaine dependence and personality disorders. *Drug Alcohol Depend*, *132*(1-2), 231-237. https://doi.org/10.1016/j.drugalcdep.2013.02.008

Alcohol Research: Current Reviews Editorial, S. (2018). NIH's Adolescent Brain Cognitive Development (ABCD) Study. *Alcohol Res*, *39*(1), 97.

Aloi, M., Rania, M., Carbone, E. A., Calabro, G., Caroleo, M., Carcione, A., . . . Segura-Garcia, C. (2020). The role of self-monitoring metacognition sub-function and negative urgency related to binge severity. *Eur Eat Disord Rev, 28*(5), 580-586. https://doi.org/10.1002/erv.2742

Asaad, S. K., & Bjarkam, C. R. (2019). The Aalborg Bolt-Connected Drain (ABCD) study: A prospective comparison of tunnelled and bolt-connected external ventricular drains. *Acta Neurochir (Wien), 161*(1), 33-39. https://doi.org/10.1007/s00701-018-3737-z

Assari, S. (2014). Additive Effects of Anxiety and Depression on Body Mass Index among Blacks: Role of Ethnicity and Gender. *Int Cardiovasc Res J, 8*(2), 44-51.

Assari, S. (2018). Family Income Reduces Risk of Obesity for White but Not Black Children. *Children (Basel), 5*(6). https://doi.org/10.3390/children5060073

Assari, S. (2019a). Baseline Body Mass Predicts Average Depressive Symptoms over the Next Two Decades for White but Not Black Older Adults. *Geriatrics (Basel), 4*(1). https://doi.org/10.3390/geriatrics4010014

Assari, S. (2019b). Education Attainment and ObesityDifferential Returns Based on Sexual Orientation. *Behav Sci (Basel), 9*(2). https://doi.org/10.3390/bs9020016

Assari, S. (2020). Income and Mental Well-Being of Middle-Aged and Older Americans: Immigrants' Diminished Returns. *International Journal of Travel Medicine and Global Health, 8*(1), 37-43. https://doi.org/10.34172/ijtmgh.2020.06

Assari, S. (2020a). College Graduation and Wealth Accumulation: Blacks' Diminished Returns. *World J Educ Res, 7*(3), 1-18. https://doi.org/10.22158/wjer.v7n3p1

Assari, S. (2020b). Differential Association between Actual and Perceived Obesity between African Americans and Whites in the United States. *Int J Epidemiol Res, 7*(3), 107-114. https://doi.org/10.34172/ijer.2020.19

Assari, S. (2020c). Racial Variation in the Association between Suicidal History and Positive and Negative Urgency among American Children. *J Educ Cult Stud, 4*(4), 39-53. https://doi.org/10.22158/jecs.v4n4p39

Assari, S., & Caldwell, C. H. (2015). Gender and Ethnic Differences in the Association Between Obesity and Depression Among Black Adolescents. *J Racial Ethn Health Disparities, 2*(4), 481-493. https://doi.org/10.1007/s40615-015-0096-9

Assari, S., Caldwell, C. H., & Bazargan, M. (2019). Association Between Parental Educational Attainment and Youth Outcomes and Role of Race/Ethnicity. *JAMA Netw Open, 2*(11), e1916018.

Assari, S., Thomas, A., Caldwell, C. H., & Mincy, R. B. (2018). Blacks' Diminished Health Return of Family Structure and Socioeconomic Status; 15 Years of Follow-up of a National Urban Sample of Youth. *J Urban Health, 95*(1), 21-35. https://doi.org/10.1007/s11524-017-0217-3

Auchter, A. M., Hernandez Mejia, M., Heyser, C. J., Shilling, P. D., Jernigan, T. L., Brown, S. A., . . . Dowling, G. J. (2018). A description of the ABCD organizational structure and communication framework. *Dev Cogn Neurosci, 32*, 8-15. https://doi.org/10.1016/j.dcn.2018.04.003

Bardo, M. T., Weiss, V. G., & Rebec, G. V. (2018). Using preclinical models to understand the neural basis of negative urgency. In *Neurobiology of Abnormal Emotion and Motivated Behaviors* (pp. 2-20). Elsevier.

Beauchaine, T. P. (2020). Editorial: Family History of Depression and Child Striatal Volumes in the ABCD Study: Promise and Perils of Neuroimaging Research With Large Samples. *J Am Acad Child Adolesc Psychiatry*. https://doi.org/10.1016/j.jaac.2020.01.002

Black, C., Moon, G., & Baird, J. (2014). Dietary inequalities: What is the evidence for the effect of the neighbourhood food environment? *Health & place*, *27*, 229-242. https://doi.org/10.1016/j.healthplace.2013.09.015

Buscemi, S., Corleo, D., Vasto, S., Buscemi, C., Massenti, M. F., Nuzzo, D., . . . Giordano, C. (2018). Factors associated with circulating concentrations of irisin in the general population cohort of the ABCD study. *Int J Obes (Lond)*, *42*(3), 398-404. https://doi.org/10.1038/ijo.2017.255

Carter, J. D., & Assari, S. (2016). Sustained Obesity and Depressive Symptoms over 6 Years: Race by Gender Differences in the Health and Retirement Study. *Front Aging Neurosci*, *8*, 312. https://doi.org/10.3389/fnagi.2016.00312

Casey, B. J., Cannonier, T., Conley, M. I., Cohen, A. O., Barch, D. M., Heitzeg, M. M., . . . Workgroup, A. I. A. (2018). The Adolescent Brain Cognitive Development (ABCD) study: Imaging acquisition across 21 sites. *Dev Cogn Neurosci*, *32*, 43-54. https://doi.org/10.1016/j.dcn.2018.03.001

Connor, D. J. (2006). Michael's story: "I get into so much trouble just by walking": Narrative knowing and life at the intersections of learning disability, race, and class. *Equity & Excellence in Education*, *39*(2), 154-165. https://doi.org/10.1080/10665680500533942

Cummins, C. B., Bowen-Jallow, K., Tasnim, S., Prochaska, J., Jupiter, D., Wright, A., . . . Glaser, A. (2020). One Size Does Not Fit All: Sociodemographic Factors Affecting Weight Loss in Adolescents. *Journal of Obesity*, *2020*.

Cyders, M. A., Zapolski, T. C., Combs, J. L., Settles, R. F., Fillmore, M. T., & Smith, G. T. (2010). Experimental effect of positive urgency on negative outcomes from risk taking and on increased alcohol consumption. *Psychol Addict Behav*, *24*(3), 367-375. https://doi.org/10.1037/a0019494

Dick, A. S., Garcia, N. L., Pruden, S. M., Thompson, W. K., Hawes, S. W., Sutherland, M. T., . . . Gonzalez, R. (2019a). Author Correction: No evidence for a bilingual executive function advantage in the ABCD study. *Nat Hum Behav*, *3*(10), 1124. https://doi.org/10.1038/s41562-019-0756-6

Dick, A. S., Garcia, N. L., Pruden, S. M., Thompson, W. K., Hawes, S. W., Sutherland, M. T., . . . Gonzalez, R. (2019b). Author Correction: No evidence for a bilingual executive function advantage in the nationally representative ABCD study. *Nat Hum Behav*, *3*(9), 999. https://doi.org/10.1038/s41562-019-0709-0

Dick, A. S., Garcia, N. L., Pruden, S. M., Thompson, W. K., Hawes, S. W., Sutherland, M. T., . . . Gonzalez, R. (2019c). No evidence for a bilingual executive function advantage in the nationally representative ABCD study. *Nat Hum Behav*, *3*(7), 692-701. https://doi.org/10.1038/s41562-019-0609-3

Exuperio, I. N., Agostinete, R. R., Werneck, A. O., Maillane-Vanegas, S., Luiz-de-Marco, R., Mesquita, E. D. L., . . . Fernandes, R. A. (2019). Impact of Artistic Gymnastics on Bone Formation Marker, Density and Geometry in Female Adolescents: ABCD-Growth Study. *J Bone Metab*, *26*(2), 75-82. https://doi.org/10.11005/jbm.2019.26.2.75

Feldstein Ewing, S. W., Chang, L., Cottler, L. B., Tapert, S. F., Dowling, G. J., & Brown, S. A. (2018). Approaching Retention within the ABCD Study. *Dev Cogn Neurosci*, *32*, 130-137. https://doi.org/10.1016/j.dcn.2017.11.004

Field, A. E., Camargo, C. A., & Ogino, S. (2013). The merits of subtyping obesity: One size does not fit all. *JAMA*, *310*(20), 2147-2148.

Fine, J. D., Moreau, A. L., Karcher, N. R., Agrawal, A., Rogers, C. E., Barch, D. M., & Bogdan, R. (2019). Association of Prenatal Cannabis Exposure With Psychosis Proneness Among Children in the Adolescent Brain Cognitive Development (ABCD) Study. *JAMA Psychiatry*, *76*(7), 762-764. https://doi.org/10.1001/jamapsychiatry.2019.0076

Fleischhacker, S. E., Evenson, K. R., Rodriguez, D. A., & Ammerman, A. S. (2011). A systematic review of fast food access studies. *Obesity reviews*, *12*(5), e460-e471.

Frisco, M. L., Quiros, S., & Van Hook, J. (2016). One size may not fit all: How obesity among Mexican-origin youth varies by generation, gender, and age. *Demography*, *53*(6), 2031-2043.

Garavan, H., Bartsch, H., Conway, K., Decastro, A., Goldstein, R. Z., Heeringa, S., . . . Zahs, D. (2018). Recruiting the ABCD sample: Design considerations and procedures. *Dev Cogn Neurosci*, *32*, 16-22. https://doi.org/10.1016/j.dcn.2018.04.004

Gray, J. C., Schvey, N. A., & Tanofsky-Kraff, M. (2019). Demographic, psychological, behavioral, and cognitive correlates of BMI in youth: Findings from the Adolescent Brain Cognitive Development (ABCD) study. *Psychol Med*, 1-9. https://doi.org/10.1017/S0033291719001545

Halcomb, M., Argyriou, E., & Cyders, M. A. (2019). Integrating Preclinical and Clinical Models of Negative Urgency. *Front Psychiatry*, *10*, 324. https://doi.org/10.3389/fpsyt.2019.00324

Hoffman, E. A., Howlett, K. D., Breslin, F., & Dowling, G. J. (2018). Outreach and innovation: Communication strategies for the ABCD Study. *Dev Cogn Neurosci*, *32*, 138-142. https://doi.org/10.1016/j.dcn.2018.04.001

Holochwost, S. J., Gariépy, J.-L., Propper, C. B., Gardner-Neblett, N., Volpe, V., Neblett, E., & Mills-Koonce, W. R. (2016). Sociodemographic risk, parenting, and executive functions in early childhood: The role of ethnicity. *Early Childhood Research Quarterly*, *36*, 537-549. https://doi.org/10.1016/j.ecresq.2016.02.001

Hunte, H. E., & Williams, D. R. (2009). The association between perceived discrimination and obesity in a population-based multiracial and multiethnic adult sample. *Am J Public Health*, *99*(7), 1285-1292. https://doi.org/10.2105/AJPH.2007.128090

Johnson, P., Risica, P. M., Gans, K. M., Kirtania, U., & Kumanyika, S. K. (2012). Association of perceived racial discrimination with eating behaviors and obesity among participants of the SisterTalk study. *J Natl Black Nurses Assoc*, *23*(1), 34-40.

Karcher, N. R., O'Brien, K. J., Kandala, S., & Barch, D. M. (2019). Resting-State Functional Connectivity and Psychotic-like Experiences in Childhood: Results From the Adolescent Brain Cognitive Development Study. *Biol Psychiatry*, *86*(1), 7-15. https://doi.org/10.1016/j.biopsych.2019.01.013

Kwate, N. O. A. (2008). Fried chicken and fresh apples: Racial segregation as a fundamental cause of fast food density in black neighborhoods. *Health & place*, *14*(1), 32-44. https://doi.org/10.1016/j.healthplace.2007.04.001

Lisdahl, K. M., Sher, K. J., Conway, K. P., Gonzalez, R., Feldstein Ewing, S. W., Nixon, S. J., . . . Heitzeg, M. (2018). Adolescent brain cognitive development (ABCD) study: Overview of substance use assessment methods. *Dev Cogn Neurosci*, *32*, 80-96. https://doi.org/10.1016/j.dcn.2018.02.007

Littlefield, A. K., Stevens, A. K., Ellingson, J. M., King, K. M., & Jackson, K. M. (2016). Changes in negative urgency, positive urgency, and sensation seeking across adolescence. *Pers Individ Dif*, *90*, 332-337. https://doi.org/10.1016/j.paid.2015.11.024

Lopez, R. P., & Hynes, H. P. (2006). Obesity, physical activity, and the urban environment: public health research needs. *Environmental Health*, *5*(1), 1-10. https://doi.org/10.1186/1476-069X-5-25

Luciana, M., Bjork, J. M., Nagel, B. J., Barch, D. M., Gonzalez, R., Nixon, S. J., & Banich, M. T. (2018). Adolescent neurocognitive development and impacts of substance use: Overview of the adolescent brain cognitive development (ABCD) baseline neurocognition battery. *Dev Cogn Neurosci*, *32*, 67-79. https://doi.org/10.1016/j.dcn.2018.02.006

Lynam, D. R., Smith, G. T., Whiteside, S. P., & Cyders, M. A. (2006). The UPPS-P: Assessing five personality pathways to impulsive behavior. *West Lafayette, IN: Purdue University*.

Lynch, K. R., Anokye, N. K., Vlachopoulos, D., Barbieri, F. A., Turi-Lynch, B. C., Codogno, J. S., . . . Fernandes, R. A. (2019). Impact of sports participation on incidence of bone traumatic fractures and health-care costs among adolescents: ABCD - Growth Study. *Phys Sportsmed*, 1-6. https://doi.org/10.1080/00913847.2019.1685859

Mason, T. B., Dunton, G. F., Gearhardt, A. N., & Leventhal, A. M. (2020). Emotional disorder symptoms, anhedonia, and negative urgency as predictors of hedonic hunger in adolescents. *Eat Behav*, *36*, 101343. https://doi.org/10.1016/j.eatbeh.2019.101343

McNeill, L. H., Kreuter, M. W., & Subramanian, S. (2006). Social environment and physical activity: A review of concepts and evidence. *Social science & medicine*, *63*(4), 1011-1022.

Michelini, G., Barch, D. M., Tian, Y., Watson, D., Klein, D. N., & Kotov, R. (2019). Delineating and validating higher-order dimensions of psychopathology in the Adolescent Brain Cognitive Development (ABCD) study. *Transl Psychiatry*, *9*(1), 261. https://doi.org/10.1038/s41398-019-0593-4

Norman, Å., Nyberg, G., Elinder, L. S., & Berlin, A. (2015). One size does not fit all–qualitative process evaluation of the Healthy School Start parental support programme to prevent overweight and obesity among children in disadvantaged areas in Sweden. *BMC Public Health*, *16*(1), 1-11. https://doi.org/10.1186/s12889-016-2701-1

Puhalla, A. A., Ammerman, B. A., Uyeji, L. L., Berman, M. E., & McCloskey, M. S. (2016). Negative urgency and reward/punishment sensitivity in intermittent explosive disorder. *J Affect Disord*, *201*, 8-14. https://doi.org/10.1016/j.jad.2016.04.045

Quinto, K. B., Zuraw, B. L., Poon, K.-Y. T., Chen, W., Schatz, M., & Christiansen, S. C. (2011). The association of obesity and asthma severity and control in children. *Journal of Allergy and Clinical Immunology*, *128*(5), 964-969. https://doi.org/10.1016/j.jaci.2011.06.031

Racine, S. E., Burt, S. A., Keel, P. K., Sisk, C. L., Neale, M. C., Boker, S., & Klump, K. L. (2015). Examining associations between negative urgency and key components of objective binge episodes. *Int J Eat Disord*, *48*(5), 527-531. https://doi.org/10.1002/eat.22412

Racine, S. E., Keel, P. K., Burt, S. A., Sisk, C. L., Neale, M., Boker, S., & Klump, K. L. (2013). Exploring the relationship between negative urgency and dysregulated eating: Etiologic associations and the role of negative affect. *J Abnorm Psychol*, *122*(2), 433-444. https://doi.org/10.1037/a0031250

Schmengler, H., Ikram, U. Z., Snijder, M. B., Kunst, A. E., & Agyemang, C. (2017). Association of perceived ethnic discrimination with general and abdominal obesity in ethnic minority groups: the HELIUS study. *J Epidemiol Community Health*, *71*(5), 453-460. https://doi.org/10.1136/jech-2016-207875

VanderBroek-Stice, L., Stojek, M. K., Beach, S. R., & MacKillop, J. (2017). Multidimensional assessment of impulsivity in relation to obesity and food addiction. *Appetite*, *112*, 59-68. https://doi.org/10.1016/j.appet.2017.01.009

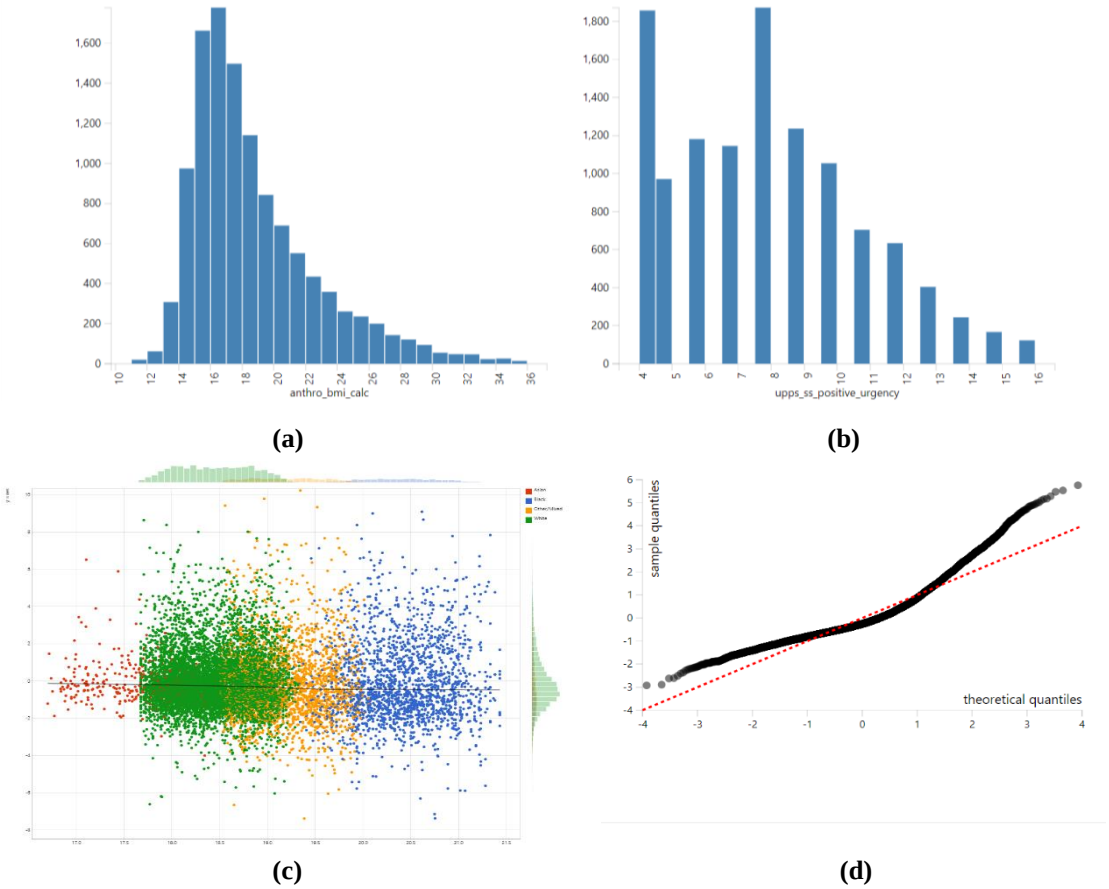
Verdejo-García, A., Lozano, Ó., Moya, M., Alcázar, M. Á., & Pérez-García, M. (2010). Psychometric properties of a spanish version of the UPPS–P impulsive behavior scale: Reliability, validity and association with trait and cognitive impulsivity. *Journal of personality assessment*, *92*(1), 70-77.

Wang, F. L., & Chassin, L. (2018). Negative Urgency Mediates the Relation between Genetically-Influenced Serotonin Functioning and Alcohol Problems. *Clin Psychol Sci*, *6*(1), 106-122. https://doi.org/10.1177/2167702617733817

Wang, H., Wen, B., Cheng, J., & Li, H. (2017). Brain Structural Differences between Normal and Obese Adults and their Links with Lack of Perseverance, Negative Urgency, and Sensation Seeking. *Sci Rep*, *7*, 40595. https://doi.org/10.1038/srep40595

Werneck, A. O., Agostinete, R. R., Cayres, S. U., Urban, J. B., Wigna, A., Chagas, L. G. M., . . . Fernandes, R. A. (2018). Association between Cluster of Lifestyle Behaviors and HOMA-IR among Adolescents: ABCD Growth Study. *Medicina (Kaunas)*, *54*(6). https://doi.org/10.3390/medicina54060096

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



(a) **(b)**

(c) **(d)**

Appendix 2. Model Formula

Model 1

anthro_bmi_calc ~ upps_ss_positive_urgency + race.4level + sex + age +

Random: ~(1|abcd_site/rel_family_id)

Model 2

anthro_bmi_calc ~ upps_ss_positive_urgency + race.4level + sex + age + upps_ss_positive_urgency * race.4level

Random: ~(1|abcd_site/rel_family_id)