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INCLUSIVITY IN PEOPLE, METHODS, AND OUTCOMES

RESEARCH ARTICLE

## How Do Anger and Impulsivity Impact Fast-Food Consumption in Transitional Age Youth?



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**Introduction:** Consumption of fast food has been linked to psychiatric distress, violent behaviors, and impulsivity in adolescents. The relationship between eating fast food, anger, and impulsivity has not been widely investigated. The National Consortium on Alcohol and Neurodevelopment in Adolescence community-based cohort consists of 831 youth, half at elevated risk factors for substance use disorders during adolescence, followed annually.

**Methods:** Impulsivity using Urgency, Premeditation, Perseverance, and Sensation Seeking Impulsive Behavior scale from annual assessments was examined in relation to self-reported fast-food consumption frequency and mobile application questions of anger. This study tested the hypotheses that youth anger may be predicted by fast-food consumption frequency and impulsivity using multiple regression, in addition to whether adolescent fast-food consumption frequency may be predicted by anger and impulsivity.

**Results:** Among youth, higher anger levels and impulsivity predicted greater frequency of fast-food consumption, and greater fast-food consumption frequency and impulsivity predicted higher anger levels.

**Conclusions:** This study's longitudinal findings are consistent with those of other studies that have found fast-food consumption and anger associated with impulsivity and also reveal a bidirectional link between anger and fast-food consumption. These results may point attention to food selection considerations for those at risk of anger and poorer psychiatric outcomes.

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## INTRODUCTION

Much literature documents associations between unhealthy diets, negative moods, and behaviors. For example, consuming more added sugars and carbohydrates has been associated with an elevated risk of

depression,<sup>1</sup> and greater trans-fat intake has been linked with more aggressive behaviors.<sup>2</sup> Frequent junk food consumption has been associated with psychiatric distress and violent behaviors<sup>3</sup> as well as higher levels of impulsivity<sup>4</sup> in children and adolescents. Understanding

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the interactive effects of diet, mood, and impulsive behavior across development could point to helpful prevention strategies.

Some studies have found associations between fast-food consumption and mental distress (e.g., anger). In younger adults (aged 18–29 years), one group found that consuming fast food more than 3 times a week was associated with mental distress.<sup>5</sup> Noor et al.<sup>6</sup> found that intake of fast food in a group aged 17–23 years was associated with anger specifically. Other groups have suggested that fast-food consumption was only noted to be less frequently consumed by those with positive emotions in a group of first-year college students.<sup>7</sup> In this context, some clarification regarding the relationship between fast-food consumption frequency and anger is needed.

Given the obesity epidemic that has led to tripling of prevalence since 1975,<sup>8</sup> it is important to consider the role of impulsivity in the relationship between diet and mood. Personality traits that are stable over time such as impulsivity have been noted to be important predictors for health outcomes.<sup>9</sup> Some cross-sectional studies have suggested that low impulsivity levels are associated with increased control of food intake and body weight<sup>10,11</sup> and less frequent emotional eating. Higher impulsivity has also been associated with greater consumption of sugars, snacks, appetizers, and saturated fats.<sup>12,13</sup> The young adult population is thought to have reduced control over their emotions compared with mature adults on the basis of the fact that brain maturation may not be complete until age 30 years.<sup>14</sup> Therefore, examining this vulnerable age group is essential to better understanding anger, diet, and impulse control.

A type of impulsivity called lack of premeditation is particularly relevant because of its role in characterizing a lack of planning before action (e.g., consuming higher amounts of fast food or acting disproportionately angry without thought about consequences). Behavioral designing of healthy diet plans takes considerable amounts of planning in devising access to healthier and more affordable choices.<sup>15–17</sup> Similarly, healthy management of anger involves considerable planning to devise alternative approaches to reducing aggression and conflict when an intended goal is not met.<sup>18,19</sup>

Given the associations between an unhealthy diet, negative mood, and lack of premeditation, it is natural to raise the question of whether lack of premeditation may prospectively predict both unhealthy dietary choices and negative mood. It is also a natural extension of this question to investigate whether greater anger or fast-food consumption frequency predicts greater lack of premeditation; in addition, it would be helpful to understand fast-food consumption frequency as a function of

anger and lack of premeditation as well as lack of premeditation as a function of anger and fast-food consumption frequency. The National Consortium on Alcohol and Neurodevelopment in Adolescence (NCANDA) (N=449) (ages 12–21 years) provides an ideal community-based cohort to investigate the relationship between diet, mood, and lack of premeditation.

The authors of this study hypothesize that higher levels of anger will predict greater future fast-food consumption frequency and that increased fast-food consumption frequency will predict greater subsequent anger; they also posit that greater anger and higher fast-food consumption frequency will be predicted by lack of premeditation. In addition, they hypothesize that a higher lack of premeditation may moderate the relationship between greater anger and higher fast-food consumption frequency in both directions. Specifically, they hypothesize that (1) there may be an interaction effect between higher lack of premeditation and greater anger leading to higher fast-food consumption and (2) there may be an interaction effect between higher lack of premeditation and greater fast-food consumption leading to greater anger. Finally, they hypothesized that greater anger or fast-food consumption would not predict a greater lack of premeditation.

## METHODS

### Study Sample

Data were drawn from the NCANDA (NCANDA.org), a cohort-sequential study with community-based participants from 5 sites (University of California San Diego, SRI International, Duke University, University of Pittsburgh, and Oregon Health & Science University)<sup>20</sup> Present analyses included data from 449 participants who were aged 18–28 years with complete mobile NCANDA (mNCANDA) and alignment with interview data from follow-up year 4 (i.e., baseline through Year 3 data were not utilized owing to lack of mNCANDA data); the authors partitioned mNCANDA data into 2 groups, described as average Time 1 (T1) and Time 2 (T2), separated by a period of 56 weeks owing to anger and fast-food consumption frequency data only being collected in alternating weeks, and then averaged over each metric. Participants with missing data from any variable of interest (e.g., lack of premeditation, fast-food consumption frequency, anger) were excluded from the analyses.

Age, sex, and SES have been found in the literature to affect both the predictor and outcome (anger, fast-food frequency) and have been included in all analyses conducted as potential confounders. Specifically, fast-food frequency (page 320 of Fryar and colleagues<sup>21</sup>) and anger<sup>22</sup> have both been found to reduce with age. Higher

rates of fast-food consumption<sup>23</sup> and anger<sup>24</sup> have been predicted by male sex. Fast-food consumption frequency has been predicted to be higher in those with higher SES,<sup>25</sup> whereas higher rates of anger have been predicted by lower SES.<sup>26</sup>

All procedures performed in studies involving human participants were done in accordance with the ethical standards of the institutional human studies review boards and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards, including those of the University of California San Diego Human Research Protections Program. Informed consent was initially obtained from the parents/guardians of participants who initiated the study at ages 12–17 years, and minors provided informed assent. Informed consent was provided for those who entered the study at age  $\geq 18$  years. At annual follow-ups, the assent and consent processes were repeated with all those in this study providing independent consent.

## Measures

**Impulsivity (through annual assessment).** Participant impulsivity at T1 was assessed with the short form of the Urgency, Premeditation, Perseverance, and Sensation Seeking (UPPS) scale.<sup>27,28</sup> The authors used the lack of premeditation subscale, which assesses responses to 4 statements: (1) My thinking is usually careful and purposeful; (2) I like to stop and think things over before I do them; (3) I tend to value and follow a rationale, sensible approach to things; and (4) I usually think carefully before doing anything. Reliability using this subscale has been demonstrated (Cronbach  $\alpha=0.85$ ).<sup>28</sup> A high score for lack of premeditation would suggest difficulty thinking through situations (i.e., planning) before acting, whereas a low score would suggest a honed ability to think through situations before taking action.

**Fast-food consumption frequency (through mNCANDA).** Participant fast-food consumption frequency was assessed at T1 and T2, and participant anger was assessed at T1 and T2 by questions securely transmitted through NCANDA's mobile data application.<sup>29</sup> Fast-food consumption was assessed with the question, *How many times did you eat fast-food in the past week?* with available response options ranging from 0 to 64.

**Anger (through mNCANDA).** Anger was assessed using an item from the Perceive Stress Scale (Cronbach  $\alpha=0.80$ )<sup>30</sup>: *During the previous 7 days, have you been angered because of things that were outside of your control?* with response options of *never, almost never, sometimes, fairly often, or very often* or a numerical range from 0 to 4.

**Demographics (through annual assessment).** SES, evaluated at T1 with a modified version of the

MacArthur Sociodemographic Questionnaire,<sup>31</sup> reflected parental family income for those living with parents and youths' SES if living independently at T1. Annual household income responses corresponding to the SES scale were subdivided from lowest to highest into 0 (not available) (i.e., missing), 1 (<\$5,000), 2 (\$5,000–\$11,999), 3 (\$12,000–\$15,999), 4 (\$16,000–\$24,999), 5 (\$25,000–\$34,999), 6 (\$35,000–\$49,999), 7 (\$50,000–\$74,999), 8 (\$75,000–\$99,999), 9 (\$100,000–\$199,999), and 10 ( $\geq$ \$200,000). A total of 11% of the sample did not know or declined to provide income data.<sup>20</sup> Participants self-reported race at T1 and included choices of White, Asian, Black, Pacific Islander, and American Indian.

After completing the baseline assessment, participants were invited for annual follow-ups. Training for reliability across sites and over time was provided through detailed training manuals and standard operating procedures, mock and practice sessions, direct observations of standard assessments, monthly all-site staff meetings, and annual site visits to check for interviewer drift and protocol adherence.<sup>20</sup> mNCANDA data were collected by questions securely transmitted through NCANDA's mobile data application, installed on phones of willing participants (64% of total participants).<sup>29</sup>

## Statistical Analysis

First, T1 lack of premeditation (from UPPS defined earlier), T1 and T2 fast-food consumption frequency, T1 and T2 anger scores, and T1 demographic characteristics (Table 1) were screened for outliers. Next, bivariate correlations between variables were determined. After that, authors tested a model of T2 anger predicted by T1 fast-food consumption frequency and lack of premeditation,

**Table 1.** Participant Characteristics at the Start of Mobile NCANDA Data Collection Period (N=449)

Characteristics	Mean $\pm$ SD or %	Range
Age, years	22.36 $\pm$ 2.90	18–28
SES <sup>a</sup>	1.24 $\pm$ 2.15	0–10
Sex (% female)	58%	—
Race (% White)	72%	—
Lack of premeditation at T1	1.63 $\pm$ 0.59	1–4
Lack of premeditation at T2	1.61 $\pm$ 0.58	1–4
Fast-food consumption frequency at T1	7.47 $\pm$ 8.73	0–64
Fast-food consumption frequency at T2	5.00 $\pm$ 6.57	0–42
Anger at T1	3.49 $\pm$ 3.60	0–14
Anger at T2 (56 weeks later)	4.62 $\pm$ 4.22	0–23

<sup>a</sup>SES mean of 1.24 corresponded to a value between \$0 and \$5,000 on the basis of the modified version of the MacArthur Sociodemographic Questionnaire.

NCANDA, National Consortium on Alcohol and Neurodevelopment in Adolescence; T1, Time 1; T2, Time 2.

controlling for age, sex, SES, and race/ethnicity. They also constructed a similar model with T2 fast-food consumption frequency predicted by T1 anger and lack of premeditation. In these 2 models, they tested for moderation by adding an interaction term to account for a possible interaction effect between a higher lack of premeditation and greater fast-food consumption leading to greater anger and an interaction effect between a higher lack of premeditation and greater anger leading to higher fast-food consumption, respectively. Supplementary analyses were also conducted looking at lack of premeditation at T2 as a function of anger at T1 and fast-food consumption frequency at T1 (Appendix Table 1, available online), fast-food consumption frequency as a function of anger and lack of premeditation using only data collected at T2 (Appendix Table 2, available online), as well as anger as a function of fast-food consumption frequency and lack of premeditation using only data collected at T2 (Appendix Table 3, available online). Finally, the authors analyzed lack of premeditation as a function of anger and fast-food consumption frequency using only data collected at T2 (Appendix Table 4, available online).

All analyses were conducted in R.<sup>32</sup> A significance threshold of  $<0.05$  was required. Effect sizes were interpreted using differences in variance accounted for between models (i.e.,  $\Delta R^2$ ), with values greater than 0.02, 0.13, and 0.26 interpreted as the cutoffs for small, medium, and large, respectively.<sup>33</sup> Data used in this study are from the data release NCANDA\_RELEASE\_6Y\_REDCAP\_MEASUREMENTS\_V02<sup>34</sup> distributed to the public according to the NCANDA Data Distribution agreement: [www.niaaa.nih.gov/research/major-initiatives/national-consortium-alcohol-and-neurodevelopment-adolescence/ncanda-data](http://www.niaaa.nih.gov/research/major-initiatives/national-consortium-alcohol-and-neurodevelopment-adolescence/ncanda-data).

## RESULTS

Participants' ages ranged from 18 to 28 years at the start of the mNCANDA study, on the basis of complete mNCANDA data, and the sample contained slightly more females than males (Table 1). No variables other than anger at T1 and T2, fast-food consumption frequency at T1 and T2, lack of premeditation at T1 and T2, and age and SES showed a significant correlation with one another (Figure 1). Fast-food consumption frequency at T2 was predicted by lack of premeditation at T1 (standardized beta=1.52,  $p=0.014$ ;  $\Delta R^2=0.01$  or small effect size) while controlling for age, sex, race, and SES in the first-level demographics model. Fast-food consumption frequency at T2 was predicted by anger at T1 (standardized beta=0.67,  $p<0.001$ ;  $\Delta R^2=0.10$  or small-medium effect size) while controlling for age, sex, race,

and SES (Table 2). This study did not find higher impulsivity, specifically lack of premeditation, to moderate the relationship between greater fast-food consumption frequency and higher anger (Table 2).

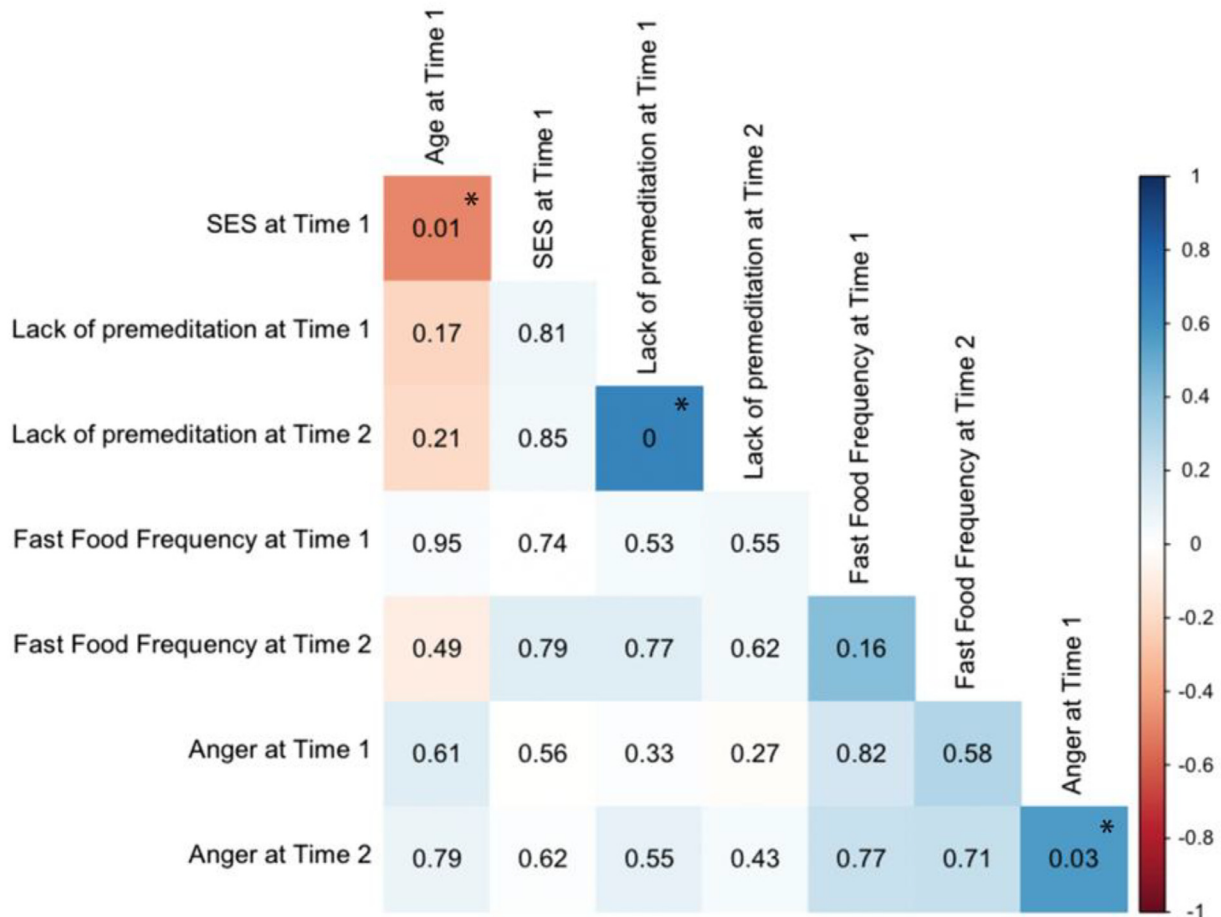
In a separate, independent model, anger at T2 was predicted by lack of premeditation at T1 (standardized beta=0.95,  $p=0.009$ ;  $\Delta R^2=0.02$  or small effect size) while controlling for age, sex, race, and SES. Anger at T2 was predicted by fast-food frequency at T1 (standardized beta=0.10,  $p<0.001$ ;  $\Delta R^2=0.05$  or small-medium effect size) while controlling for age, sex, race, and SES (Table 3). This study did not find higher impulsivity, specifically lack of premeditation, to moderate the relationship between higher anger and greater fast-food consumption frequency (Table 3). Overall model findings have been summarized in Figure 2.

Supplementary analyses showed that greater anger at T1 (standardized beta=0.00,  $p=0.95$ ) or fast-food consumption frequency at T1 (standardized beta=0.00,  $p=0.16$ ) did not predict greater lack of premeditation at T2 (Appendix Table 1, available online). In addition, greater anger at T2 (standardized beta=0.42,  $p<0.001$ ,  $\Delta R^2=0.05$  or small-medium effect size) but not greater lack of premeditation at T2 (standardized beta=0.44,  $p=0.51$ ) predicted greater fast-food consumption frequency at T2 (Appendix Table 2, available online). Greater fast-food consumption frequency at T2 (standardized beta=0.12,  $p<0.001$ ,  $\Delta R^2=0.06$  or small-medium effect size) but not greater lack of premeditation at T2 (standardized beta=0.50,  $p=0.17$ ) predicted greater anger at T2 (Appendix Table 3, available online). Greater anger at T2 (standardized beta=0.01,  $p=0.17$ ) and greater fast-food consumption frequency at T2 (standardized beta=0.00,  $p=0.51$ ) did not predict a greater lack of premeditation at T2 (Appendix Table 4, available online).

## DISCUSSION

This study examined the relationship between anger, fast-food consumption frequency, and lack of premeditation in a large, diverse, prospectively followed sample of transitional-age youth from the NCANDA study. The study found that anger was predicted by more frequent fast-food consumption and that increased fast-food consumption frequency was predicted by greater anger, as hypothesized. Thus, the relationship between anger and fast-food frequency was noted to be a bidirectional relationship over time. The authors also noted that greater impulsivity, as measured by UPPS lack of premeditation, predicted both future anger and fast-food consumption frequency.





**Figure 1.** Correlation matrix of key variables.

Mobile NCANDA data were partitioned into 2 groups, described as average T1 and T2, separated by a period of 56 weeks. The asterisk (\*) denotes significance at the  $p < 0.05$  level.

NCANDA, National Consortium on Alcohol and Neurodevelopment in Adolescence; T1, Time 1; T2, Time 2.

This work expands on the existing literature findings that associate anger with fast-food consumption. This study found that anger was predicted by fast-food consumption frequency with a small-medium effect size in the large prospective sample of the NCANDA study, in agreement with findings from Zahedi et al.<sup>3</sup> that found that junk food consumption was significantly associated with psychiatric distress (e.g., aggression) in a national sample of  $n=13,486$  Iranian children and adolescents; however, this population differed in age and culture from that of the NCANDA study. Trans-fats are used for fast-food preparation owing to cost and long-term storage properties.<sup>2</sup> Greater dietary trans-fat consumption has been linked to greater aggression and anger in a study of 945 adult men and women,<sup>2</sup> in agreement with the association from the present study; this trans-fat study differed by its focus on an adult population in the U.S. Therefore, although the NCANDA sample study

results are in agreement with those of other studies in other populations, it reveals a similar trend in a new, less studied age group in the U.S.

Fast-food consumption frequency was also predicted by anger with a small-medium effect size. The bidirectional finding of fast-food consumption frequency and anger predicting each other at different time points can be explained as follows: youth may use fast-food consumption as a self-soothing mechanism or engage in emotional eating when they feel angry. This strategy may have the unintended inflammatory effect of exacerbating the participants' anger further, which then encourages the participant to self-soothe further by consumption of fast food.<sup>35–38</sup>

A variety of biological mechanisms may explain how diet could influence mood, including the production of neurotransmitters such as serotonin or glutamergic signaling, immune-inflammatory effects such as

**Table 2.** Fast-Food Consumption Frequency as a Function of Anger and Lack of Premeditation at T1 and Moderation by Lack of Premeditation at T1

Variable	Beta	SE	p-value	95% CI
Fast-food consumption frequency as a function of anger and lack of premeditation at T1				
Age	-0.08	0.15	0.59	-0.37, 0.21
SES	0.23	0.12	0.05	0.00, 0.47
Sex (female)	-2.59	0.66	<b>&lt;0.001</b>	-3.89, -1.30
Race (White)	0.54	0.72	0.45	-0.88, 1.96
Anger at T1	0.67	0.10	<b>&lt;0.001</b>	0.48, 0.86
Lack of premeditation at T1	1.52	0.62	<b>0.01</b>	0.30, 2.73
Fast-food consumption frequency moderation by lack of premeditation at T1				
Age	-0.06	0.15	0.68	-0.36, 0.23
SES	0.23	0.12	0.06	-0.01, 0.46
Sex (female)	-2.58	0.66	<b>&lt;0.001</b>	-3.87, -1.29
Race (White)	0.53	0.72	0.47	-0.90, 1.94
Anger at T1	0.35	0.32	0.28	-0.28, 0.99
Lack of premeditation at T1	1.51	0.62	<b>0.01</b>	0.30, 2.73
Anger X lack of premeditation at T1	0.19	0.19	0.31	-0.18, 0.57

Note: Boldface indicates statistical significance ( $p < 0.05$ ).  
T1, Time 1.

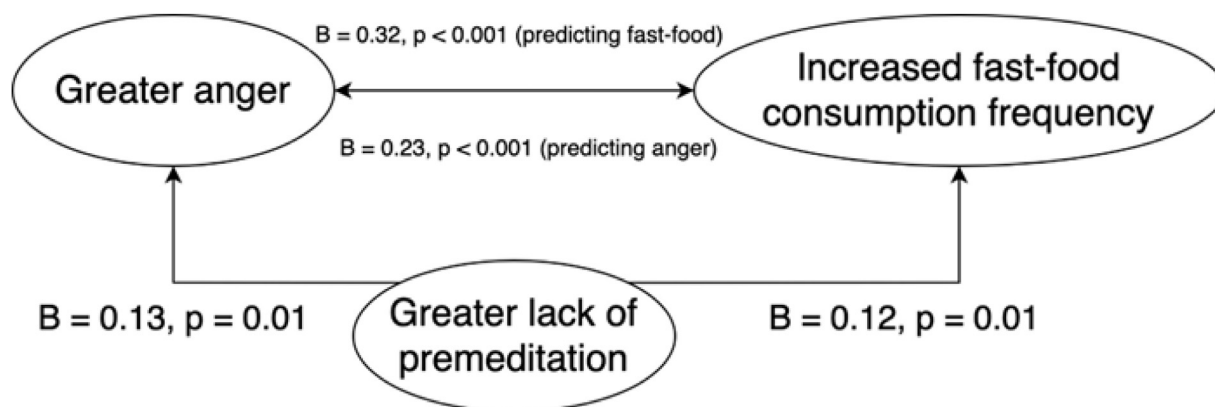
oxidative and nitrosative pathways, neuroinflammation (e.g., microglial activation), altered vagus nerve tone, and alterations of the hypothalamic–pituitary–adrenal system.<sup>35–48</sup> Diets with higher fast-food consumption frequency provide fewer essential micronutrients (e.g., zinc; magnesium; selenium; iron; and vitamins D, B12, B6, E, and folate) that can be deficient in those with increased irritability and anger.<sup>35,49,50</sup> Diets with anti-inflammatory properties (e.g., the Mediterranean diet) may improve mood by reducing inflammation.<sup>51</sup>

Increased impulsivity or specifically lack of premeditation predicted both greater anger and fast-food consumption frequency with a small effect size; this was not a bidirectional relationship because greater anger or fast-food consumption frequency did not predict greater future lack of premeditation. However, a higher lack of premeditation did not moderate either greater anger or fast-food consumption frequency at a statistically significant level ( $p < 0.05$ ). The standardized beta ( $B = 0.19$ ) for fast-food frequency moderation by lack of premeditation

**Table 3.** Anger as a Function of Fast-Food Frequency and Lack of Premeditation at T1 and Moderation by Lack of Premeditation at T1

Variable	Beta	SE	p-value	95% CI
Anger as a function of fast-food consumption frequency and lack of premeditation at T1				
Age	0.14	0.09	0.11	-0.03, 0.31
SES	0.08	0.07	0.27	-0.06, 0.21
Sex (female)	1.46	0.38	<b>&lt;0.001</b>	0.71, 2.21
Race (White)	0.36	0.42	0.40	-0.47, 1.18
Fast-food consumption frequency at T1	0.10	0.02	<b>&lt;0.001</b>	0.06, 0.14
Lack of premeditation at T1	0.95	0.36	0.01	0.24, 1.66
Anger moderation by lack of premeditation at T1				
Age	0.14	0.09	<b>0.10</b>	-0.03, 0.32
SES	0.08	0.07	0.26	-0.06, 0.21
Sex (female)	1.46	0.38	<b>&lt;0.001</b>	0.71, 2.21
Race (White)	0.36	0.42	0.39	-0.47, 1.19
Fast-food consumption frequency at T1	0.14	0.07	<b>0.05</b>	0.00, 0.28
Lack of premeditation at T1	0.96	0.36	<b>0.01</b>	0.25, 1.67
Fast-food consumption frequency X lack of premeditation at T1	-0.02	0.04	<b>0.57</b>	-0.11, 0.06

Note: Boldface indicates statistical significance ( $p < 0.05$ ).  
T1, Time 1.



**Figure 2.** Summary of directions of prediction using hierarchical linear regression models. B=standardized estimate.

at T1 could be suggestive of a small effect size that was underpowered. This result would be consistent with those of studies from a number of groups looking at impulsivity and its relation to control over food intake.<sup>9</sup><sup>-11</sup> Greater impulsivity has been associated with increased consumption of sugars, snacks, appetizers, and saturated fats<sup>12,13</sup> by some groups. Appelhans and colleagues<sup>52</sup> found that impulsivity was related to the quantity of away-from-home and ready-to-eat foods consumed in women with overweight and obesity. Garza et al.<sup>4</sup> found that fast-food consumption (e.g., eating at a fast-food restaurant or pizza place in the past week) was correlated with greater impulsivity in a cross-sectional study of  $n=478$  adults. Higher levels of impulsivity in both children and adolescents<sup>4</sup> have also been associated with increased junk food consumption and anger. One explanation could be related to the experience of stress that is associated with negative emotions such as anger. Oliver and colleagues<sup>53</sup> have suggested that when participants experience stress, they may experience anger, and this has been associated with greater food intake. Unfortunately, stressful events were not captured with the temporal resolution necessary to investigate this same relationship in this study. Future studies will be necessary to further clarify the relationship between lack of premeditation and anger and fast-food consumption frequency in other populations and their relationship with other metrics such as stressful events.

### Limitations

Although this work investigated the relationship between anger and fast-food consumption frequency for the first time in the large, prospective NCANDA sample, it also utilized youth self-report for all variables and diet recall over the past week, which may be less accurate than more frequent assessments. Associations between

anger and fast-food frequency were small medium, and thus the findings may not reproduce in smaller samples using comparable measures. However, these effects should not be ignored, particularly when the number of people impacted (i.e., young adults consuming fast food) is high<sup>54</sup> in the context of the ongoing obesity epidemic.<sup>8,55</sup> Finally, it is noteworthy that data were collected from adolescents and young adults aged between 18 and 28 years, a time overlapping with cerebral maturation when impulsivity diminishes; this could lead to heterogeneous results.

### CONCLUSIONS

This study provides a novel investigation of the longitudinal relationship between fast-food consumption frequency, anger, and lack of premeditation while controlling for covariates of sex, age, SES, and race in the large and prospectively followed NCANDA sample. The results extend prior research linking fast-food consumption frequency with anger and their relationship to impulsivity; the bidirectional relationship between anger and fast-food consumption frequency is novel and presents an important, unexplored facet with clinical relevance to frontline providers such as general practitioners for reducing the risk of obesity and improving mental health outcomes. Future studies can build upon this research to determine whether other elements of diet may be related to changes in mood or moderated by facets of mood, impulsivity, and related factors.

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Declaration of interest: none.

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## SUPPLEMENTARY MATERIALS

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