Dysfunctional Eating Patterns of Adults With Attention Deficit Hyperactivity Disorder

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Abstract: This study aimed to examine whether adult attention deficit hyperactivity disorder (ADHD) in students is associated with overeating or with unhealthy food choices. Sixty university students with and without ADHD, aged 20 to 30 years, completed the Food Frequency Questionnaire and reported their height and weight. Students with ADHD had a higher body mass index compared with students without ADHD. Although participants in both groups consumed similar amounts of servings, calories, and nutrients, students with ADHD reported lower healthy/unhealthy food consumption ratio. These findings suggest that ADHD in students is not associated with general overeating, but with a biased proportion of unhealthy versus healthy food consumption.

Key Words: ADHD, BMI, students, eating patterns, obesity

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Attention deficit hyperactivity disorder (ADHD) is a highly prevalent neurodevelopmental condition characterized by a persistent pattern of inattentive, hyperactive, and impulsive behavior, leading to functional impairment (American Psychiatric Association, 2013; Faraone et al., 2015). Whereas ADHD-related impairment in academic, occupational, and social domains has already been well established, only in recent years was attention devoted to health impairment, for example, sleep difficulties, physical injuries, hypertension, and obesity (Nigg, 2013; Spencer et al., 2014).

Both clinical and epidemiological samples have shown that individuals with ADHD have higher body mass index (BMI) and a higher prevalence of obesity than controls. Two recent meta-analyses confirmed the risk of obesity in individuals with ADHD, with odds ratio increasing with age (Cortese et al., 2016; Nigg et al., 2016). Excessive weight is a major risk factor for a range of preventable diseases, such as cardiovascular disease, cancer, osteoarthritis, and diabetes (World Health Organization. Office of Health Communications and Public Relations, 2006), urging to study what makes ADHD a risk factor for overweight and obesity.

Several mechanisms have been suggested to account for the association between ADHD and obesity, including shared genetic transmission, altered metabolism, low participation in physical activity, and the simplest possibility—poor eating habits directly leading to excess weight gain (Cortese and Vincenzi, 2012; Nigg, 2013). The current study focused on this last suggestion.

A number of studies suggested that ADHD is linked to overeating (Kaisari et al., 2017). For instance, Davis et al. (2006), in a sample of adult healthy women, found that symptoms of ADHD were positively correlated with aspects of overeating, including emotional eating, external eating, and binge eating, and overeating correlated with higher BMI. Similarly, in a sample of healthy adult males, a positive association between symptoms of ADHD and overeating behavior was observed, which positively correlated with BMI (Strimas et al., 2008).

A different set of studies focused not on overall amount of eating but on the types of food that people with ADHD eat. It was found that Australian adolescents with ADHD consumed foods with less nutrient density and more total fat (Howard et al., 2011), Iranian children with ADHD adhered more often to the sweet- and fast-food diet (Azadbakht and Esmaillzadeh, 2012), and Korean children with higher odds of having ADHD endorsed the traditional Western pattern (Woo et al., 2014b). Finally, a large-sample study revealed associations between ADHD and both number of overeating episodes and unhealthy food consumption in children (*e.g.*, soft drinks and Westernized fast food) (Kim et al., 2014).

Given these different explanations, the main aim of this study was to examine whether ADHD in students was associated with overeating or rather with unhealthy food choices.

METHODS

Participants and Protocol

The study was approved by the institutional review board of the Hebrew University. Sixty university undergraduate students were recruited, aged 20 to 30 years, from the Faculty of Agriculture, Food and Environment, of The Hebrew University of Jerusalem (36 men and 24 women). University students were chosen because their lifestyle includes making independent food decisions (Marquis, 2005). Exclusion criteria were any specific dietary pattern (*e.g.*, vegetarian, vegan, as well as chronic diseases influencing food choice patterns, such as diabetes mellitus, inflammatory bowel diseases, chronic kidney disease, or any other health condition reported by participants). For the control group, an additional exclusion criterion was any history of ADHD.

For the study group, 29 participants with a history of ADHD diagnosis were recruited. Each of these subjects was additionally diagnosed at the "MATAL diagnostic center" of the Hebrew University. MATAL is a system of standard tests and questionnaires developed for the purpose of diagnosing learning disabilities—dyslexia, dyscalculia, and dysgraphia—and to assess the likelihood of ADHD in adults. MATAL was developed at the Israeli National Center for Testing and Evaluation with the assistance of learning disability experts and is based on up-to-date theoretical knowledge. MATAL includes a background interview and a systematic information gathering, two questionnaires, and 20 tests that examine cognitive functions in the following areas: language (reading and writing), mathematical abilities, attention, memory, perception, and general processing speed. Based on the interview, the documentation, the questionnaires, and the tests, the existence of ADHD is determined by a trained diagnostician. The effectiveness of the tools in the diagnosis of learning disabilities was examined in a large-scale study of students with various learning disabilities, and national performance norms were collected for all tools (Ben-Simon and Inbar-Weiss, 2012). In addition, final diagnosis was confirmed by a neurologist or a psychiatrist.

With regard to the use of medication to treat ADHD, we received information from 27 of the 29 subjects with ADHD. Three subjects did

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not use medication at all, 10 subjects used medication occasionally, and 14 used it on a regular basis.

Non-ADHD control participants were recruited through the students' social media and advertisements posted in the student support center. This group included 31 participants with no history of ADHD diagnosis. In addition, they did not meet the screening criterion of the Adult ADHD Self-Report Scale.

Clinical Measures

The Hebrew version of the Adult ADHD Self-Report Scale (ASRS-V1.1; Kessler et al., 2005) was completed for continuous scaling of ADHD symptoms. It contains 18 items corresponding to the *Diagnostic and Statistical Manual of Mental Disorders* diagnostic criteria of ADHD, of which frequencies are rated from 1 (never) to 5 (very often). The questionnaire has high internal consistency (Cronbach's $\alpha = 0.88$) assessing ADHD in adults. Its sensitivity is 68.4% and specificity is 99.6% (Adler et al., 2006).

Eating Patterns

The "Food Frequency Questionnaire" (FFQ) is a semiquantitative scale with a standard portion size provided for each food item (119 items), presenting nine frequency options (Shai et al., 2004). The Hebrew version of the FFQ used in the National Health and Nutrition Survey was used for this study (FFQ of the Nutrition Department of Israeli Ministry of Health, which was developed for use in a national survey). Based on the World Health Organization Regional Office for Europe (2003) guidelines, the items were categorized to healthy items (*e.g.*, vegetables, fruits, whole grains, and minimally processed foods) and unhealthy items (cookies, processed meats, and other processed foods). The data from the FFQ were linked to a nutrient database to calculate daily nutrient intake.

BMI was calculated using self-reported weights and heights.

Statistical Analysis

Observations that were more than 2.76 standard deviations away from each of the diagnostic group means were defined as outliers, according to Grubbs G outlier test (Grubbs, 1969) for $\alpha = 0.05$. Outliers were replaced by the next higher or lower ranked value in the sample. The amount of servings, calories, and nutrients obtained from healthy and unhealthy types of foods were calculated and compared between ADHD and control groups. The healthy and unhealthy type of food scales were subjected to reliability analysis by calculating the Cronbach's alpha coefficient. All dependent variables were subjected to Kolmogorov-Smirnov normality testing. The majority of the variables were distributed normally across groups, and therefore, between-group comparisons were analyzed using analysis of variance (ANOVA) with repeated measures, with healthy and unhealthy types of food as a within-subject factor, and the diagnostic group as a between-subject factor. As some of the variables were not normally distributed, healthy/unhealthy ratio scores were calculated for the amount of servings, calories, fats, carbohydrates, and proteins. Both total and ratio scores were compared across ADHD and control groups using Mann-Whitney *U*-test.

RESULTS

Demographic and Clinical Characteristics

The groups were similar in terms of age, sex, and height, but not in BMI and ASRS scores (Table 1).

Reliability of the Healthy and Unhealthy Scales

The unhealthy servings scale consisted of 46 items, and its reliability was found to be in the acceptable range (Cronbach's $\alpha = 0.745$). The healthy servings scale, initially composed of 50 items, showed acceptable internal consistency (Cronbach's $\alpha = 0.787$). However, further analysis revealed that omitting three items (skimmed milk, avocado, and olive oil) resulted in reliability in the good range (Cronbach's $\alpha = 0.837$).

Parametric Tests

Multivariate ANOVA revealed no group effects on total number of servings, calories, and nutrients, including healthy, neutral, and unhealthy foods ($F[1,58] = 0.441, 0.086, 0.005, 0.108, 0.259$, for servings, calories, fats, carbohydrates, and proteins, respectively). In further analyses, only healthy and unhealthy types of foods were included.

ANOVA with repeated measures on the number of servings revealed a significant main effect of type of food, namely, that both groups consumed more healthy than unhealthy number of servings ($F[1,58] = 59.34$, $p < 0.001$). Group by type of food interaction was found ($F[1,58] = 8.68$, $p = 0.005$), with healthy/unhealthy number of servings ratio higher for the control than for the ADHD group (Fig. 1). Repeating the analyses with height as a covariate did not change the results.

ANOVA with repeated measures on the calorie intake did not reveal a significant main effect of type of food ($F[1,58] = 2.59$, $p = 0.113$). Repeating this analysis with height as a covariate revealed that both groups consumed more healthy than unhealthy calories ($F[1,58] = 4.21$, $p = 0.045$). Group by type of food interaction was found ($F[1, 58] = 9.44$, $p = 0.003$), with healthy/unhealthy calorie intake ratio higher for the control than for the ADHD group (Fig. 2). Repeating this analysis with height as a covariate did not change the results.

ANOVA with repeated measures on the carbohydrate and protein intake revealed a significant main effect of type of food, namely, that both groups consumed more healthy than unhealthy carbohydrates and proteins ($F[1,58] = 6.30$, $p = 0.015$; $F[1,58] = 22.77$, $p < 0.001$, for carbohydrates and proteins, respectively). Group by type of food interaction was found ($F[1,58] = 9.44$, $p = 0.003$; $F[1,58] = 9.70$, $p = 0.003$, for carbohydrates and proteins, respectively), with healthy/unhealthy carbohydrate and protein ratio higher for the control than for the ADHD group (Table 2). Repeating the analyses with height as a covariate did not change the results.

ANOVA with repeated measures on fat intake did not reveal a significant main effect of type of food, namely, that both groups consumed similar amounts of healthy and unhealthy fats ($F[1,58] = 0.53$, $p = 0.469$). Group by type of food interaction was found ($F[1,58] = 4.29$, $p = 0.043$), with healthy/unhealthy intake of fat ratio higher

TABLE 1. Demographic and Clinical Characteristics by Diagnostic Group

	Controls ($n = 31$)	ADHD ($n = 29$)	Group Comparison
Age, mean (SD)	24.90 (1.78)	25.39 (1.71)	$t(55) = 1.07$ ($p = 0.288$)
Sex	55% male	49% male	$\chi^2(1) = 0.712$ ($p = 0.399$)
Height, mean (SD)	1.70 (0.11)	1.73 (0.06)	$t(52) = 1.53$ ($p = 0.132$)
BMI, mean (SD)	21.17 (2.38)	24.02 (3.02)	$t(51) = 3.81$ ($p < 0.001$)
ASRS, mean (SD)	42.21 (10.18)	59.56 (12.58)	$t(58) = 5.89$ ($p < 0.001$)

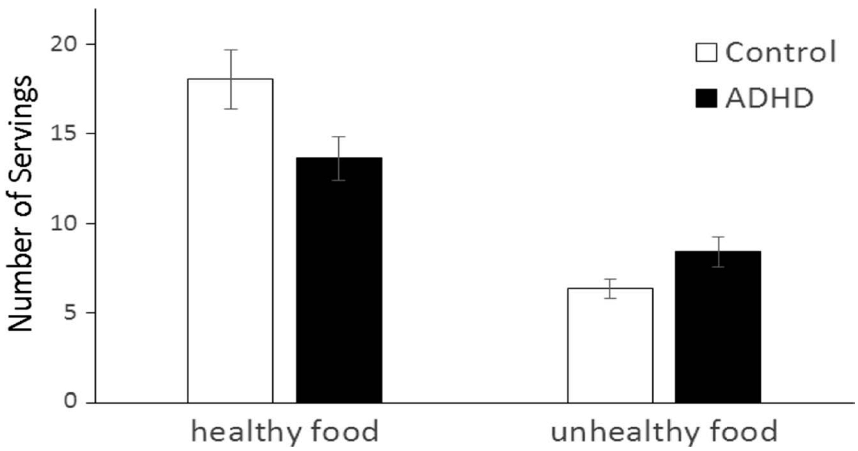

FIGURE 1. Number of serving from healthy and unhealthy food categories by participants with and without ADHD.

for the control than for the ADHD group (Table 2). Repeating the analyses with height as a covariate did not change the results.

Nonparametric Tests

Both total and healthy/unhealthy ratio scores of the amount of servings, calories, fats, carbohydrates, and proteins were compared across ADHD and control groups using Mann-Whitney *U*-tests. No significant differences were found between groups on total intake amounts ($U = 393, 397, 414, 392, 405, p > 0.05$, for servings, calories, fats, carbohydrates, and proteins, respectively). Healthy/unhealthy ratio scores were higher in the control group compared with those in the ADHD group in all measures, with all but fats reaching significance level ($U = 274, 257, 322, 263$, and 209, $p = 0.009, 0.004, 0.059, 0.006$, and <0.001, for servings, calories, fats, carbohydrates, and proteins, respectively).

In addition, we compared those subjects with ADHD who used medications to treat ADHD on a regular basis to those who used it occasionally on all indices using Mann-Whitney *U*-tests. None of the comparisons were statistically significant.

DISCUSSION

Considering the previously described occurrence of overweight in adult individuals with ADHD (Cortese et al., 2016), the aim of the current study was to examine whether ADHD in students was associated with unhealthy food choices, relatively to age- and sex-matched controls. We report that students with ADHD have a higher BMI than students without ADHD. Although participants in both groups consumed similar amounts of servings, calories, and nutrients, students with ADHD reported eating lower amounts of healthy food and higher amounts of unhealthy food. The results suggest that ADHD is not associated with general overeating, but with a biased proportion of unhealthy versus healthy food consumption.

In the past decade, an important claim has been made asserting an association between ADHD and obesity (Nigg et al., 2016). A significant association was also found between ADHD and overweight, suggesting that future research in the field should examine less severe grades of weight excess in addition to obesity (Cortese et al., 2016). Longitudinal studies suggested that ADHD predicted subsequent obesity, rather than the opposite (Cortese et al., 2016). Effects of obesity and ADHD may be most apparent in adulthood (Fliers et al., 2013), as the pooled prevalence of obesity was increased by about 70% in adults with ADHD compared with those without ADHD. Other demographic and clinical variables seem not to explain this link, as a significant association emerged also when pooling odds ratios adjusted for possible confounders, including socioeconomic status and comorbid psychiatric conditions (Cortese et al., 2016). The current study further confirmed the association between adult ADHD and higher BMI (although both groups demonstrated BMI in the normal range of 18.5–25 kg/m^2), controlling for sex and age. Importantly, all subjects were university students, which add further control over lifestyle.

The underlying mechanism of association between ADHD and obesity is still unclear (Cortese et al., 2016). Several mechanisms have been suggested, including low participation in physical activity, attention and executive dysfunction, impulsivity, anxiety, depression, sleep disorders,

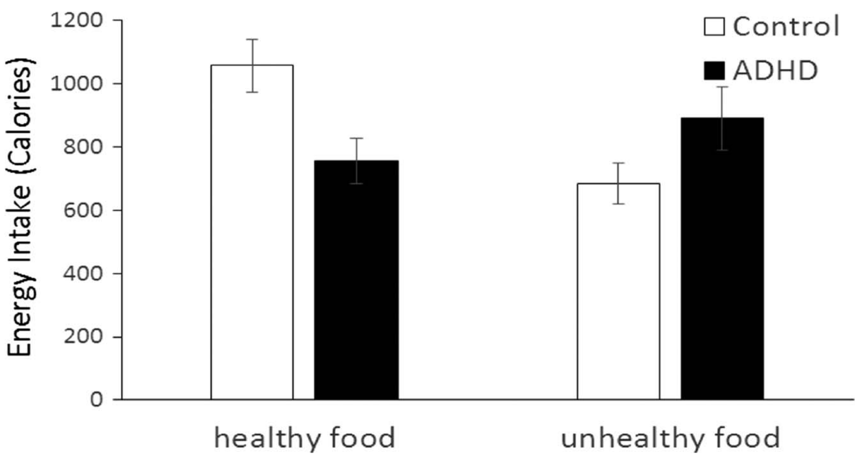

FIGURE 2. Number of calories from healthy and unhealthy food categories by participants with and without ADHD.

TABLE 2. Consumption of Fats, Carbohydrates, and Proteins From Healthy and Unhealthy Types of Food Across Diagnostic Groups

Diagnostic Group	Control (*n* = 31)		ADHD (*n* = 29)	
Type of food	Healthy	Unhealthy	Healthy	Unhealthy
Fats, mean (SD)	30.62 (11.51)	27.59 (14.54)	25.26 (11.62)	31.59 (17.37)
Carbohydrates, mean (SD)	132.34 (72.43)	70.25 (46.03)	93.47 (48.08)	99.75 (69.78)
Proteins, mean (SD)	18.04 (9.09)	6.35 (3.01)	13.64 (6.56)	8.42 (4.55)

and addictions (Barbudo et al., 2015; Cortese et al., 2008a), as well as shared genetic transmission, altered metabolism, and dysfunctions in brain reward pathways or dopaminergic dysregulation (Cortese et al., 2008b, 2012). For instance, it has been found that both ADHD and obesity are significantly associated with excessive daytime sleepiness, independently of other sleep disorders (Cortese et al., 2008b). One more possibility is poor eating habits directly leading to excess weight gain (Cortese and Vincenzi, 2012; Nigg, 2013). The current study focused on this last suggestion.

Previous studies provided evidence for a positive association between ADHD and disordered eating, and with overeating behavior in particular (*e.g.*, Davis et al., 2006). These studies were mainly conducted in the form of questionnaires that generally examine eating habits (eating disorders such as anorexia, bulimia, and binge eating, as well as emotional or external eating). In the present study, however, we used the FFQ questionnaire, which accurately measures what the subjects eat each day (in terms of calories and number of servings).

Other studies focused on diet patterns, rather than general overeating, suggesting that ADHD is associated with unhealthy food choices (Woo et al., 2014a). The present study was designed to concurrently measure total and healthy versus unhealthy food choices. The findings clearly suggest that diet pattern, rather than general food consumption, is linked to the presence of ADHD in adults.

In the majority of previous studies, the population examined was children/adolescents, whereas the current study examined eating patterns among adults, who are responsible for their own diets (unlike children, where their parents are responsible for the nutrition at home). Other studies have examined healthy adults or adults with eating disorders, whereas in the present study, the population examined was students with and without ADHD, whose lifestyle generally does not allow regular and continuous eating throughout the day, economically and academically (Kaisari et al., 2017).

In conclusion, considering the high prevalence and chronicity of ADHD, if replicated in future research, this study may have considerable clinical and health outcomes, namely, the metabolic syndrome, which is the primary cause of morbidity and mortality of adults in Western countries, as well as significant economic and social costs (Drichoutis et al., 2008; Wansink et al., 2005; Winterman et al., 2014). As dietary patterns continue to evolve and obesity rises both among children and adults in Western countries, future studies will determine whether and why people with ADHD are among those vulnerable to poor health outcomes. Our research provides evidence that can be used to tailor interventions for healthy eating among people with overweight and obesity in this population. As emphasized by Cortese and Castellanos (2014), ADHD may be a barrier to effective weight loss treatment in individuals with obesity (Pagoto et al., 2010). Therefore, identifying and treating ADHD in those people with comorbid obesity may improve the effectiveness of weight management strategies, as was suggested (Levy et al., 2009).

This study contains several limitations: the sample size was relatively small, and therefore, the study might not have had sufficient power to detect small differences in overall food consumption. The role of ADHD subtype and use of medication used to treat ADHD were not tested. The vast majority of the subjects from the study group used medications to treat ADHD, and therefore, the role of medication in healthy food choices could not be controlled. Of note, there were no significant differences in food choices between those who used medication to treat ADHD on a regular basis and those who used it only occasionally. As noted, samples were recruited from one university faculty, which enhances control over many demographic variables, but at the same time weakens the ability to generalize the conclusions to other populations. Another limitation is the use of new scales that were derived from the original FFQ.

CONCLUSIONS

The current study reported higher BMI in students with ADHD. They also reported eating lower amounts of healthy food and higher amounts of unhealthy food (compared with students without ADHD). This finding suggests that ADHD is not associated with general overeating, but with a biased proportion of unhealthy versus healthy food consumption.

DISCLOSURE

Dr Anna Aronis was a scientific advisor for Prana Essentials Company for dietary supplements, Israel (2011–2015). The other authors declare no conflict of interest.

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