DSM-5 eating disorder symptoms in adolescents with and without ADHD: A population-based study

Short title: Disordered eating in adolescents with ADHD

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Word count:

- Abstract: 199 words
- Manuscript: 2,000 words

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: [10.1002/eat.23080](https://doi.org/10.1002/eat.23080)

Acknowledgements: Mr Bisset's position is funded by a Deakin University Postgraduate Research Scholarship (2017-2018). A/Prof Sciberras' position is funded by an NHMRC Career Development Fellowship 1110688 (2016-2021) and a veski Inspiring Women's Fellowship. We thank all families participating in the LSAC study. This paper uses unit record data from Growing Up in Australia, the Longitudinal Study of Australian Children. The study is conducted in partnership between the Department of Social Services (DSS), the Australian Institute of Family Studies (AIFS) and the Australian Bureau of Statistics (ABS). The findings and views reported in this paper are those of the authors and should not be attributed to DSS, AIFS or the ABS.

Conflict of Interest: Prof Rinehart received funding from the Moose Foundation and the Australian Football League to conduct research in the field of neurodevelopmental disorders and inclusion. Prof Rinehart also received funding from the Ferrero Group Australia as part of its Kinder + Sport pillar of Corporate Social Responsibility initiatives to promote active lifestyles among young people. Prof Rinehart has previously received speaker honorarium from Novartis (2002), Pfizer (2006) and Nutricia (2007) and is a Director of the Amaze Board (Autism Victoria). None of the companies or organizational bodies listed above had a role in this research including the collection, analysis and interpretation of data; in writing of the manuscript; and/or in the decision to submit the manuscript for publication. Mr Bisset and A/Prof Sciberras have no conflicts of interest or financial relationships relevant to this article to disclose.

Data Availability Statement: The data that support the findings of this study are available from the Department of Social Services, Australian Institute of Family Studies and Australian Bureau of Statistics (2018). Restrictions apply to the availability of these data, which were used under license for this study.

Abstract

Objective: Attention-Deficit/Hyperactivity Disorder (ADHD) is associated with increased eating disorder symptoms, yet little research examining this association has taken a diagnostic approach using a population-based sample. This cross-sectional study examined differences in DSM-5 eating disorder symptoms and partial-syndrome diagnoses at age 14-15 years in adolescents with and without ADHD in a population-based sample. **Method:** This study uses waves 1, 5 and 6 from the Longitudinal Study of Australian Children (N=2,672). ADHD (6.9%) was defined at age 12-13 years by both parent- and teacher-reported SDQ Hyperactivity-Inattention scores $\geq 90^{\text{th}}$ percentile, parent-reported ADHD diagnosis and/or ADHD medication treatment. Adolescents reported eating disorder symptoms at age 14-15 years via the Branched Eating Disorders Test. **Results:** Boys with ADHD had greater odds of regular objective binge eating than boys without ADHD (OR: 9.4; 95% CI: 1.7-52.8; $p=0.01$). Groups did not differ in prevalence of any other eating disorder symptoms or partial-syndrome diagnoses. **Discussion:** Boys with ADHD appear to be at greater risk of

regular binge eating classified by DSM-5 criteria at age 14-15 years. Overall, risk for eating disorder symptoms and partial-syndrome diagnoses in adolescents with ADHD does not appear to be high at age 14-15 years when using DSM-5 criteria with population-based sampling.

Keywords: Attention Deficit Disorder with Hyperactivity; Feeding and Eating Disorders; Adolescent; Anorexia Nervosa; Bulimia Nervosa; Binge-Eating Disorder

Attention-deficit/hyperactivity disorder (ADHD) affects 5-7% of children worldwide (Polanczyk, Willcutt, Salum, Kieling, & Rohde, 2014). Characterized by enduring, developmentally-inappropriate patterns of inattention and/or hyperactivity and impulsivity, ADHD is highly comorbid with other psychiatric conditions. Whilst ADHD and eating disorders (EDs) have been linked with common factors (e.g., BMI status, internalizing and/or conduct problems), emerging research suggests that ADHD also increases risk of EDs or ED symptoms (Bleck, DeBate, Levin, & Baldwin, 2016; Curtin, Pagoto, & Mick, 2013; Güngör, Celiloğlu, Raif, Özcan, & Selimoğlu, 2016; Kaisari, Dourish, & Higgs, 2017; Levin & Rawana, 2016; Nazar et al., 2016; Yilmaz et al., 2017). Little research has examined this association in *adolescents* with ADHD.

Most research has utilized population/community samples (Erhart et al., 2012; Govey, Stromberg, Lim, & Janicke, 2017; Kim et al., 2014; Neumark-Sztainer, Story, Resnick, Garwick, & Blum, 1995; Råstam et al., 2013; Sonnevile et al., 2015; Viborg, Wångby-Lundh, & Lundh, 2014; Yoshimasu et al., 2012) but has rarely taken a *diagnostic* approach to ED assessment in youth with ADHD, instead using brief measures to examine ED *symptoms* (Erhart et al., 2012; Neumark-Sztainer et al., 1995; Råstam et al., 2013; Sonnevile et al., 2015; Viborg et al., 2014). Findings suggest that youth with ADHD are at greater risk of binge eating (Erhart et al., 2012; Govey et al., 2017; Kim et al., 2014; Neumark-Sztainer et al., 1995; Sonnevile et al., 2015), dietary restriction (Neumark-Sztainer et al., 1995; Råstam et al., 2013), engaging in other compensatory behaviors (e.g., self-induced vomiting; Neumark-Sztainer et al., 1995) and unspecified ED symptoms (Viborg et al., 2014). Similar findings are also reported in clinical samples (Cortese et al., 2007; Mikami et al., 2010; Mikami, Hinshaw, Lee, & Chang, 2008; Reinblatt et al., 2014).

Two studies examined ED *diagnoses* in youth with ADHD (Biederman et al., 2007; Yoshimasu et al., 2012). Assessment of DSM-IV diagnoses in a clinical sample of 10-25 year-old females (N=235) suggested that ADHD increases risk of anorexia nervosa (AN) and/or bulimia nervosa (BN), with an earlier mean onset age of 12.3 years for females with ADHD (compared to 14 years for controls; Biederman et al., 2007). In a retrospective population-based study of males and females (N=1,055), ADHD increased risk for ED diagnoses (pre-DSM-5) by age 19 years, after adjusting for sex, maternal age and maternal education (Yoshimasu et al., 2012). Whilst suggesting that associations between ADHD and ED diagnoses are not specific to clinical samples, the study's criteria for diagnosing EDs was unclear.

Limitations of previous research include wide age-ranges, preventing examination of ED prevalence at specific ages for adolescents with ADHD (Cortese et al., 2007; Erhart et al., 2012; Gowey et al., 2017; Kim et al., 2014; Mikami et al., 2010, 2008; Neumark-Sztainer et al., 1995; Reinblatt et al., 2014; Yoshimasu et al., 2012). No research has explored associations between ADHD and EDs according to DSM-5 criteria (American Psychiatric Association, 2013), which revised AN (e.g., now includes persistent behavior interfering with weight gain) and BN criteria (e.g., frequency of binge-eating and compensatory behaviors reduced to weekly) and recognizes Binge-Eating Disorder (BED). The present study aimed to comprehensively examine differences by sex and ADHD status in the prevalence of 1) ED symptoms, and 2) partial-syndrome ED diagnoses, in a population-based sample of 14-15 year-old boys and girls with/without ADHD. It was hypothesized that a greater prevalence of ED symptoms (aim 1) and partial-syndrome ED diagnoses (aim 2) would be found in boys and girls with ADHD compared to adolescents without ADHD.

METHOD

Study Design

Data from the nationally-representative Longitudinal Study of Australian Children (Gray & Sanson, 2005) were used at ages 4-5 (wave 1 – sample characteristics only, $n=4,983$), 12-13 (wave 5, $n=3,956$; 79% retention from wave 1) and 14-15 years (wave 6, $n=3,537$; 71% retention). The Australian Institute of Family Studies ethics committee approved this study. Participants provided informed consent before inclusion.

Participants

Adolescents were included with complete data available for: 1) ADHD measures at age 12-13 years, and; 2) at least one ED symptom at age 14-15 years. Overall, 2,672 adolescents were included (54% of wave 1 sample, 76% of wave 6 sample), comprising 186 adolescents with ADHD (148 boys, 38 girls) and 2,486 adolescents without ADHD (1,186 boys, 1,300 girls). Socio-demographics and factors commonly associated with ADHD were examined between included/excluded adolescents, revealing no differences in age, sex, parent/adolescent BMI, ADHD diagnosis, ADHD medication treatment, or clinical internalizing or conduct problems ($p>0.05$). Included parents were more likely to be English speakers, single parents and to have completed high school ($p<0.001$; see *Measures* for ages when *sample characteristics* were reported).

Measures

ADHD was assessed at age 12-13 years. The ADHD sample included adolescents with: 1) parent- and teacher-reported inattention/hyperactivity symptoms $\geq 90^{\text{th}}$ percentile (≥ 6) on the *Strengths and Difficulties Questionnaire* (SDQ; Goodman, 2001), reflecting previous studies validating this approach (Sciberras et al., 2013; Sciberras, Ukoumunne, & Efron, 2011); or 2) a parent-reported ADHD diagnosis assessed as “yes” to the question “Does your child have Attention Deficit Disorder or Attention-Deficit/Hyperactivity Disorder?”; or 3) parent-reported ADHD medication use via the question: “Is your child currently taking medication for ADD/ADHD?”

ED symptoms and partial-syndrome diagnoses were assessed at age 14-15 years via the self-completed *Branched Eating Disorders Test* (BET), which has previously shown high agreement with the Eating Disorders Examination (sensitivity: 1.0; specificity: 0.99; positive predictive value: 0.7) in an Australian community sample of adolescent girls (mean age 14.8 years; Selzer, Hamill, Bowes, & Patton, 1996). Adolescents initially self-completed questions on engagement in particular behaviors/attitudes over the past 4 weeks (e.g., “In the last 4 weeks have you gone all day without eating to control your weight or shape?”, yes/no). If adolescents responded “yes”, they then self-completed follow-up questions to determine a) frequency of engagement in each behavior/attitude (<1 day/week, 1 day/week, 2-3 days/week, 4-5 days/week, 6-7 days/week) and b) duration of engagement in each behavior/attitude (<4 weeks, 4 weeks-3 months, 3-6 months, 6 months-1 year, >1 year). Whilst the BET has assessed DSM-IV diagnoses of partial-syndrome AN and BN (Patton, Coffey, Carlin, Sanci, & Sawyer, 2008; Patton, Selzer, Coffey, Carlin, & Wolfe, 1999), the present study used existing items to derive ED symptoms and partial-syndrome AN, BN and BED diagnoses according to DSM-5 (American Psychiatric Association, 2013; see Table 1).

Sample characteristics: Parents reported socio-demographics at ages 4-5 (single-parent family, maternal education level) and 12-13 years (language spoken). Adolescent BMI was obtained at 14-15 years via trained researchers directly measuring height and weight (without shoes) using glass bathroom scales and a portable rigid stadiometer. BMI was calculated as weight (kilograms) divided by height-squared (meters) and z-scores were derived (De Onis et al., 2007). Weight categories were specified using International Obesity Taskforce age- and sex-specific BMI cut-points for overweight/obesity (BMI +2 and +3 SD units above expected BMI; Cole, Bellizzi, Flegal, & Dietz, 2000) and thinness (BMI -1, -2 and -3 SD units below expected BMI; Cole, Flegal, Nicholls, & Jackson, 2007). Parent BMI was derived at 14-15 years via self-reported height and weight. Clinical internalizing and conduct problems ($\geq 90^{\text{th}}$ percentile [≥ 7]) were measured at 14-15 years via parent-reported Emotional Problems ($\alpha=0.74$) and Conduct Problems ($\alpha=0.66$) SDQ scores.

Statistical analyses

Analyses were performed using Stata v14.2 (StataCorp, 2015) and weighted via survey methods to account for the unequal probability of participant selection, non-response and sample attrition, and the multi-stage, clustered sampling design (Soloff, Lawrence, & Johnstone, 2005). T-tests (continuous variables) and logistic regression (categorical variables) compared sample characteristics between groups. Logistic regression compared prevalence of ED symptoms (aim 1) and partial-syndrome ED diagnoses (aim 2) between groups.

RESULTS

Sample characteristics

At age 14-15 years, the ADHD group (n=186) had more boys (79.6% vs. 47.7%; OR: 4.3; 95% CI: 2.9-6.1) than adolescents without ADHD (n=2,486), more adolescents with clinical internalizing (33.3% vs. 16.0%; OR: 2.6; 95% CI: 1.9-3.7) and conduct problems (41.9% vs. 9.9%; OR: 6.7; 95% CI: 4.9-9.2), single-parent families (17.7% vs. 11.4%; OR: 1.7; 95% CI: 1.1-2.5), and fewer mothers who had completed high school (54.3% vs. 65.1%; OR: 0.6; 95% CI: 0.5-0.9) or spoke a language other than English (4.4% vs. 12.5%; OR: 0.3; 95% CI: 0.2-0.7). Mean age (14.9 years; SD=0.3) and BMI z-scores (mean difference: 0.06, p=0.47) did not differ between groups. Adolescents with ADHD were less likely to have a BMI categorized as “normal” weight (67.7% vs. 74.6%; OR: 0.7; 95% CI: 0.5-0.9), and more likely to meet criteria for “obesity” (20.9% vs. 14.3%; OR: 1.6; 95% CI: 1.1-2.3; Cole et al., 2000) and to have a BMI 3 SD units below that expected for their age (2.2% vs. 0.3%; OR: 6.7; 95% CI: 2.0-22.6; Cole et al., 2007). Data for ED symptom variables were available for 2,345-2,546 (87.8-95.3%) adolescents at age 14-15 years. Missing data was primarily due to participants not having other data available (e.g., height/weight/BMI measures) from which to derive certain ED symptom variables.

Eating disorder symptoms

Few differences in ED symptom prevalence were found between groups (Table 2). AN symptom prevalence did not differ between groups.

Adolescents with ADHD tended to have greater odds of objective binge eating weekly for ≥ 3 months compared to adolescents without ADHD, but this was not statistically

significant (OR: 2.9; 95% CI: 0.9-8.6). However, boys with ADHD had significantly greater odds of regular objective binge eating than boys without ADHD (OR: 9.4; 95% CI: 1.7-52.8).

Boys with ADHD also tended to have greater odds than boys without ADHD of weekly medication use to control weight for ≥ 3 months (OR: 7.2; 95% CI: 0.9-53.9), but this was not statistically significant. Groups did not differ in prevalence of regularly engaging in other compensatory behaviors to control weight.

ED symptom prevalence did not differ between adolescents with a parent-reported ADHD diagnosis or SDQ-identified clinical ADHD symptoms.

Partial-syndrome diagnoses

There were no statistically significant differences in the prevalence of partial-syndrome ED diagnoses between adolescents with/without ADHD (Table 2). Partial-syndrome ED diagnoses did not differ between adolescents with a parent-reported ADHD diagnosis and adolescents with SDQ-identified clinical ADHD symptoms.

DISCUSSION

This study found evidence of greater risk of regular objective binge eating for 14-15 year-old adolescents with ADHD, particularly for boys. There was also evidence of greater risk of regular medication use to control weight for boys with ADHD. However, groups did not differ in the prevalence of partial-syndrome ED diagnoses in this study, suggesting that ED risk is not high for 14-15 year-old adolescents with ADHD when using DSM-5 criteria, compared to previous studies using pre-DSM-5 criteria (Biederman et al., 2007; Mikami et al., 2008; Neumark-Sztainer et al., 1995; Råstam et al., 2013; Viborg et al., 2014).

The hypothesis that ED behaviors would be more prevalent in adolescents with ADHD (aim 1) was only partially supported. Whilst previous population-based research reported greater risk of binge eating in youth with ADHD (Erhart et al., 2012; Gowey et al., 2017; Kim et al., 2014; Sonnevile et al., 2015), the present study used a comprehensive measure to show that 14-15 year-old *boys* with ADHD are at greater risk of binge eating weekly for at least 3 months (aligning with DSM-5 criteria). However, incidence of binge eating (and most ED symptoms) was low in this sample. Whilst risk was not evident for *girls* with ADHD, only a small sample of girls with ADHD were examined so the present study may have lacked the power to identify a significant effect for girls. Findings should be interpreted with caution, particularly in relation to girls with ADHD.

Unlike previous research, the present study did not find adolescents with ADHD to be at greater risk of engaging in dietary restriction (Neumark-Sztainer et al., 1995; Råstam et al., 2013) or other compensatory behaviors (e.g., self-induced vomiting; Cortese et al., 2007; Mikami et al., 2008; Neumark-Sztainer et al., 1995) than adolescents without ADHD. However, evidence of this risk has previously been identified in clinical samples (Cortese et al., 2007; Mikami et al., 2008) or via brief measures (Neumark-Sztainer et al., 1995; Råstam et al., 2013), rather than examining symptoms aligning with clinical criteria in a general population.

No differences were found between groups in the prevalence of partial-syndrome ED diagnoses, unlike previous research (Biederman et al., 2007; Yoshimasu et al., 2012). Thus, the hypothesis that more adolescents with ADHD would report partial-syndrome ED diagnoses was not supported (aim 2). Whilst the ADHD sample in the present study was larger than in some previous studies (Biederman et al., 2007; Erhart et al., 2012; Gowey et

al., 2017; Mikami et al., 2008; Reinblatt et al., 2014), few adolescents in the present study reported ED symptoms. Our findings may suggest that increased risk of most ED symptoms for adolescents with ADHD is: a) only evident in clinical samples; b) not evident when using DSM-5 criteria (American Psychiatric Association, 2013); or c) not yet evident at age 14-15 years, as most previous studies included older participants (Cortese et al., 2007; Mikami et al., 2008; Neumark-Sztainer et al., 1995; Yilmaz et al., 2017; Yoshimasu et al., 2012).

Study strengths include population-based sampling to capture a broad range of boys and girls with ADHD, including those not accessing clinical services. Parents and teachers assessed ADHD symptoms and adolescents reported outcomes. ED symptoms were comprehensively assessed, unlike previous population-based research (Erhart et al., 2012; Neumark-Sztainer et al., 1995; Råstam et al., 2013; Sonnevile et al., 2015; Viborg et al., 2014). Further, symptoms and partial-syndrome diagnoses were aligned with DSM-5 criteria.

Findings should be interpreted with caution due to study limitations. Few adolescents reported ED symptoms, so analyses could not control for potential covariates differing between groups, as other studies have done (e.g., BMI status, clinical internalizing/conduct problems). Further, only a small sample of girls with ADHD was examined. Future studies should incorporate a larger sample of girls with ADHD to examine sex differences. Although parent- and teacher-reported symptoms were assessed, the SDQ does not replace clinical ADHD assessment. Whilst the BET has been validated against the EDE (Selzer et al., 1996), it has not been validated for measuring partial-syndrome EDs using DSM-5 criteria. Future research could compare the BET and EDE using DSM-5 criteria. Despite adolescent self-report being a reliable assessment of some ED symptoms in adolescents (Field, Taylor, Celio, & Colditz, 2004), there are associated challenges. Future research could incorporate

supplemental information from parents and/or clinical observation. Finally, objective measures (e.g., review of medical records) were not used to confirm parent-reported ADHD diagnoses or medication use.

CONCLUSIONS

Boys with ADHD aged 14-15 years appear to be at greater risk of regular binge eating classified by DSM-5. Overall, risk for ED symptoms and partial-syndrome diagnoses does not appear to be high for 14-15 year-old adolescents with ADHD when using DSM-5 criteria with population-based sampling. Future population-based research incorporating boys and girls with ADHD should comprehensively assess DSM-5 ED symptoms to examine whether risk differs at later ages.

References

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5)*. Arlington: American Psychiatric Publishing.
- Biederman, J., Ball, S. W., Monuteaux, M. C., Surman, C. B., Johnson, J. L., & Zeitlin, S. (2007). Are girls with ADHD at risk for eating disorders? Results from a controlled, five-year prospective study. *Journal of Developmental and Behavioral Pediatrics*, 28(4), 302–307. <http://doi.org/10.1097/DBP.0b013e3180327917>
- Bleck, J., DeBate, R., Levin, B. L., & Baldwin, J. (2016). Underlying mechanisms and trajectory of comorbid ADHD and eating disorders: Proposing an innovative systems framework for informing research. *International Journal of Mental Health and Addiction*, 14(4), 449–458. <http://doi.org/10.1007/s11469-015-9593-7>
- Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: International survey. *British Medical Journal*, 320(7244), 1240–1240. <http://doi.org/10.1136/bmj.320.7244.1240>
- Cole, T. J., Flegal, K. M., Nicholls, D., & Jackson, A. A. (2007). Body mass index cut offs to define thinness in children and adolescents: International survey. *British Medical Journal*, 335(7612), 194–197. <http://doi.org/10.1136/bmj.39238.399444.55>
- Cortese, S., Isnard, P., Frelut, M. L., Michel, G., Quantin, L., Guedeney, A., ... Mouren, M. C. (2007). Association between symptoms of attention-deficit/hyperactivity disorder and bulimic behaviors in a clinical sample of severely obese adolescents. *International Journal of Obesity*, 31(2), 340–346. <http://doi.org/10.1038/sj.ijo.0803400>
- Curtin, C., Pagoto, S. L., & Mick, E. (2013). The association between ADHD and eating disorders/pathology in adolescents: A systematic review. *Open Journal of*

Epidemiology, 3(4), 193–202. <http://doi.org/10.4236/ojepi.2013.34028>

De Onis, M., Onyango, A. ., Borghi, E., Siyam, A., Nishida, C., & Sickmann, J. (2007).

Development of a WHO growth reference for school-aged children and adolescents.

Bulletin of the World Health Organization, 85, 660–667.

<http://doi.org/10.2471/BLT.07.043497>

Department of Social Services; Australian Institute of Family Studies; Australian Bureau of

Statistics (2018). "Growing Up in Australia: Longitudinal Study of Australian Children

(LSAC) Release 6 (Waves 1-6)", ADA Dataverse, V1.

<http://dx.doi.org/10.26193/jozw2u>

Erhart, M., Herpertz-Dahlmann, B., Wille, N., Sawitzky-Rose, B., Hölling, H., & Ravens-

Sieberer, U. (2012). Examining the relationship between attention-deficit/hyperactivity

disorder and overweight in children and adolescents. *European Child & Adolescent*

Psychiatry, 21(1), 39–49. <http://doi.org/10.1007/s00787-011-0230-0>

Field, A. E., Taylor, C. B., Celio, A., & Colditz, G. A. (2004). Comparison of self-report to

interview assessment of bulimic behaviors among preadolescent and adolescent girls and

boys. *International Journal of Eating Disorders*, 35(1), 86–92.

<http://doi.org/10.1002/eat.10220>

Goodman, R. (2001). Psychometric properties of the Strengths and Difficulties

Questionnaire. *Journal of the American Academy of Child & Adolescent Psychiatry*,

40(11), 1337–1345. <http://doi.org/10.1097/00004583-200111000-00015>

Gowey, M. A., Stromberg, S., Lim, C. S., & Janicke, D. M. (2017). The moderating role of

body dissatisfaction in the relationship between ADHD symptoms and disordered eating

in pediatric overweight and obesity. *Children's Health Care*, 46(1), 15-33.

<http://doi.org/10.1080/02739615.2015.1065745>

Gray, M., & Sanson, A. (2005). Growing up in Australia: The Longitudinal Study of Australian Children. *Family Matters*, 72, 4–9.

Güngör, S., Celiloğlu, Ö. S., Raif, S. G., Özcan, Ö. Ö., & Selimoğlu, M. A. (2016). Malnutrition and obesity in children With ADHD. *Journal of Attention Disorders*, 20(8), 647–652. <http://doi.org/10.1177/1087054713478465>

Kaisari, P., Dourish, C. T., & Higgs, S. (2017). Attention deficit hyperactivity disorder (ADHD) and disordered eating behaviour: A systematic review and a framework for future research. *Clinical Psychology Review*, 53, 109–121. <http://doi.org/10.1016/j.cpr.2017.03.002>

Kim, E. J., Kwon, H. J., Ha, M., Lim, M. H., Oh, S. Y., Kim, J. H., ... Paik, K. C. (2014). Relationship among attention-deficit hyperactivity disorder, dietary behaviours and obesity. *Child: Care, Health and Development*, 40(5), 698–705. <http://doi.org/10.1111/cch.12129>

Levin, R. L., & Rawana, J. S. (2016). Attention-deficit/hyperactivity disorder and eating disorders across the lifespan: A systematic review of the literature. *Clinical Psychology Review*, 50, 22–36. <http://doi.org/10.1016/j.cpr.2016.09.010>

Mikami, A. Y., Hinshaw, S. P., Arnold, L. E., Hoza, B., Hechtman, L., Newcorn, J. H., & Abikoff, H. B. (2010). Bulimia nervosa symptoms in the multimodal treatment study of children with ADHD. *International Journal of Eating Disorders*, 43(3), 248–259. <http://doi.org/10.1002/eat.20692>

Mikami, A. Y., Hinshaw, S. P., Lee, K. A., & Chang, J. (2008). Eating pathology among adolescent girls with attention-deficit/hyperactivity disorder. *Journal of Abnormal*

Psychology, 117(1), 225–235. <http://doi.org/10.1037/0021-843X.117.1.225>

Nazar, B. P., Bernardes, C., Peachey, G., Sergeant, J., Mattos, P., & Treasure, J. (2016). The risk of eating disorders comorbid with attention-deficit / hyperactivity disorder : A systematic review and meta-analysis. *International Journal of Eating Disorders*, 49(November), 1045–1057. <http://doi.org/10.1002/eat.22643>

Neumark-Sztainer, D., Story, M., Resnick, M. D., Garwick, A., & Blum, R. W. (1995). Body dissatisfaction and unhealthy weight-control practices among adolescents with and without chronic illness: A population-based study. *Archives of Pediatrics & Adolescent Medicine*, 149(12), 1330–1335. <http://doi.org/10.1001/archpedi.1995.02170250036005>

Patton, G. C., Coffey, C., Carlin, J. B., Sanci, L., & Sawyer, S. (2008). Prognosis of adolescent partial syndromes of eating disorder. *British Journal of Psychiatry*, 192(4), 294–299. <http://doi.org/10.1192/bjp.bp.106.031112>

Patton, G. C., Selzer, R., Coffey, C., Carlin, J. B., & Wolfe, R. (1999). Onset of adolescent eating disorders: Population based cohort study over 3 years. *BMJ*, 318(7186), 765–768. <http://doi.org/10.1136/bmj.318.7186.765>

Polanczyk, G. V., Willcutt, E. G., Salum, G. A., Kieling, C., & Rohde, L. A. (2014). ADHD prevalence estimates across three decades: An updated systematic review and meta-regression analysis. *International Journal of Epidemiology*, 43(2), 434–442. <http://doi.org/10.1093/ije/dyt261>

Råstam, M., Täljemark, J., Tajnia, A., Lundström, S., Gustafsson, P., Lichtenstein, P., ... Kerekes, N. (2013). Eating problems and overlap with ADHD and autism spectrum disorders in a nationwide twin study of 9- and 12-year-old children. *The Scientific World Journal*, 2013, 315429. <http://doi.org/10.1155/2013/315429>

- Reinblatt, S. P., Leoutsakos, J. M. S., Mahone, E. M., Forrester, S., Wilcox, H. C., & Riddle, M. A. (2014). Association between binge eating and attention-deficit/hyperactivity disorder in two pediatric community mental health clinics. *International Journal of Eating Disorders*, 48(5), 505–511. <http://doi.org/10.1002/eat.22342>
- Sciberras, E., Lucas, N., Efron, D., Gold, L., Hiscock, H., & Nicholson, J. M. (2013). Health care costs associated with parent-reported ADHD: A longitudinal Australian population-based study. *Journal of Attention Disorders*, 21(13), 1063–1072.
- Sciberras, E., Ukoumunne, O. C., & Efron, D. (2011). Predictors of parent-reported Attention-Deficit/Hyperactivity Disorder in children aged 6–7 years: A national longitudinal study. *Journal of Abnormal Child Psychology*, 39(7), 1025–1034.
- Selzer, R., Hamill, C., Bowes, G., & Patton, G. (1996). The branched eating disorders test: Validity in a nonclinical population. *International Journal of Eating Disorders*, 20(1), 57–64. [http://doi.org/10.1002/\(SICI\)1098-108X\(199607\)20:1<57::AID-EAT7>3.0.CO;2-3](http://doi.org/10.1002/(SICI)1098-108X(199607)20:1<57::AID-EAT7>3.0.CO;2-3)
- Soloff, C., Lawrence, D., & Johnstone, R. (2005). LSAC technical paper no. 1: Sample design. *Melbourne, Australia: Australian Institute of Family Studies*.
- Sonneville, K. R., Calzo, J. P., Horton, N. J., Field, A. E., Crosby, R. D., Solmi, F., & Micali, N. (2015). Childhood hyperactivity/inattention and eating disturbances predict binge eating in adolescence. *Psychological Medicine*, 45(12), 2511–2520. <http://doi.org/10.1017/S0033291715000148>
- StataCorp. (2015). *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP.
- Viborg, N., Wångby-Lundh, M., & Lundh, L. G. (2014). Reciprocal prospective associations between disordered eating and other psychological problems in a community sample of

Swedish adolescent girls. *Eating Behaviors*, 15(1), 159–163.

<http://doi.org/10.1016/j.eatbeh.2013.11.002>

Yilmaz, Z., Javaras, K. N., Baker, J. H., Thornton, L. M., Lichtenstein, P., Bulik, C. M., &

Larsson, H. (2017). Association between childhood to adolescent attention

deficit/hyperactivity disorder symptom trajectories and late adolescent disordered eating.

Journal of Adolescent Health, 61(2), 140–146.

<http://doi.org/10.1016/j.jadohealth.2017.04.001>

Yoshimasu, K., Barbaresi, W. J., Colligan, R. C., Voigt, R. G., Killian, J. M., Weaver, A. L.,

& Katusic, S. K. (2012). Childhood ADHD is strongly associated with a broad range of

psychiatric disorders during adolescence: A population-based birth cohort study. *Journal*

of Child Psychology and Psychiatry, 53(10), 1036–1043. [http://doi.org/10.1111/j.1469-](http://doi.org/10.1111/j.1469-7610.2012.02567.x)

[7610.2012.02567.x](http://doi.org/10.1111/j.1469-7610.2012.02567.x)

Table 1. Criteria for identification of DSM-5 eating disorder symptom and partial-syndrome diagnosis using the Branched Eating Disorders Test (BET)

Symptom	Criteria
Partial-Syndrome Anorexia Nervosa (at least 2 symptoms present)	
A. Body weight that is significantly lower than minimally expected	Being assessed as having a very low body weight, sourced from their Body Mass Index (BMI).
B. Fear of gaining weight, or behaviours that interfere with weight gain, despite low body weight	Assessed as being underweight, sourced from their BMI. AND At least ONE of the following: Reported fearing weight gain for at least 2 days per week AND reported being “very” or “extremely” concerned about gaining weight. OR Reported at least ONE of the following behaviours, lasting at least 3 months: Self-induced vomiting to control weight at least weekly; taking medication to control weight at least weekly; fasting to control weight at least 4 days per week; excessive exercise (2+ hours) to control weight at least 6 days per week.
C. Disturbance in experience of body weight, or overvaluation of weight	If underweight: Rated themselves as being “about the right weight”, “somewhat overweight” or “very overweight”; If normal weight: Rated themselves as being “somewhat overweight” or “very overweight”; If overweight: Rated themselves as being “very overweight” (note: could not be rated if obese). OR Reported weight as being “very important” to how they feel about themselves.

Symptom	Criteria
Partial-Syndrome Bulimia Nervosa† (at least 2 symptoms present)	
A. Regular objective binge-eating	Reported experiencing a loss of control over eating at least weekly for at least 3 months. AND Reported that it is “very difficult” or “impossible” to stop eating after starting to eat in this way. AND The amount of food eaten in a 2-hour period is equivalent to “8 pieces of bread and half a litre of ice-cream and 5 biscuits” OR “12 pieces of bread and 1 litre of ice-cream and 10 biscuits” OR “1 loaf of bread and 2 litres of ice-cream and 1 packet of biscuits”.
B. Overvaluation of weight	Rated their weight as “very important” to how they feel about themselves.
C. Regular engagement in compensatory behaviours	Reported at least ONE of the following behaviours, lasting at least 3 months: Self-induced vomiting to control weight at least weekly; taking medication to control weight at least weekly; fasting to control weight at least 4 days per week; excessive exercise (2+ hours) to control weight at least 6 days per week.
Partial-Syndrome Binge-Eating Disorder‡ (the following symptom is present)	

Symptom	Criteria
A. Regular objective binge-eating	<p>Reported experiencing a loss of control over eating at least weekly for at least 3 months. AND Reported that it is “very difficult” or “impossible” to stop eating after starting to eat in this way. AND The amount of food eaten in a 2-hour period is equivalent to “8 pieces of bread and half a litre of ice-cream and 5 biscuits” OR “12 pieces of bread and 1 litre of ice-cream and 10 biscuits” OR “1 loaf of bread and 2 litres of ice-cream and 1 packet of biscuits”.</p>
<p>Note: †Must not also meet criteria for Partial-Syndrome Anorexia Nervosa; ‡Must not also meet criteria for Partial-Syndrome Anorexia Nervosa or Bulimia Nervosa</p>	

Table 2. Odds of DSM-5 eating disorder symptoms and partial-syndrome diagnoses between ADHD and control groups

	Boys (n=1,334)			Girls (n=1,338)		
ED symptoms at age 14-15 years	ADHD (n=148) %	Control (n=1,186) %	OR (95% CI)	ADHD (n=38) %	Control (n=1,300) %	OR (95% CI)
<i>Anorexia Nervosa</i>						
A. Very low body weight	7.0	5.5	1.3 (0.5-3.1)	2.1	5.4	0.4 (0.1-2.9)
B. Fear of weight gain, or persistent behavior that interferes with weight gain, despite low body weight	0	0.05	-	0	0.4	-
C. Disturbance in the way weight/shape is experienced, or overvaluation of weight/shape	18.7	16.5	1.2 (0.7-1.9)	46.1	44.2	1.1 (0.5-2.3)
<i>Bulimia Nervosa</i>						
A. Regular objective binge-eating weekly for 3+ months	2.9	0.3	9.4 (1.7-52.8)*	6.5	2.2	3.1 (0.7-14.0)
B. Regular engagement in compensatory behaviours to control weight weekly for 3+ months	6.1	4.6	1.3 (0.5-3.6)	0	3.7	-
1. Restricted food intake	0.6	0	-	0	0.7	-
2. Induced vomiting	0	0.2	-	0	0.9	-
3. Excessive	3.3	4.1	0.8 (0.2-2.9)	0	2.3	-

		Boys (n=1,334)			Girls (n=1,338)		
ED symptoms at age 14-15 years		ADHD (n=148) %	Control (n=1,186) %	OR (95% CI)	ADHD (n=38) %	Control (n=1,300) %	OR (95% CI)
exercise							
4. Medication (any)		2.2	0.3	7.2 (0.9-53.9)	0	0.5	-
i. Laxatives		0	0	-	0	0.1	-
ii. Diuretics		0	0	-	0	0	-
iii. Appetite suppressants		1.6	0	-	0	0.3	-
iv. Other med		0.6	0.3	1.9 (0.2-20.5)	0	0.1	-
C. Overvaluation of weight/shape		9.6	11.7	0.8 (0.4-1.6)	33.7	24.8	1.5 (0.7-3.5)
<i>Partial-syndrome ED</i>		6.9	3.3	2.2 (0.8-5.7)	8.7	7.6	1.2 (0.3-4.0)
Partial-syndrome AN		3.9	1.6	2.6 (0.8-8.8)	2.1	3.4	0.6 (0.1-4.9)
Partial-syndrome BN		1.6	1.5	1.0 (0.1-8.0)	6.5	3.6	1.9 (0.4-8.2)
Partial-syndrome BED		1.3	0.2	6.2 (0.6-61.1)	0	0.6	-

Note: OR = odds ratio; CI = confidence interval; ED = eating disorder; AN = anorexia nervosa; BN = bulimia nervosa; BED = binge-eating disorder; *p<0.05. Analyses were weighted via survey methods to account for the unequal probability of participant selection, non-response and sample attrition, and the multi-stage, clustered sampling design. ^aData was available for 2,345-2,546 (87.8-95.3%) adolescents.

Table 1. Criteria for identification of DSM-5 eating disorder symptom and partial-syndrome diagnosis using the Branched Eating Disorders Test (BET)

Symptom	Criteria
Partial-Syndrome Anorexia Nervosa (at least 2 symptoms present)	
A. Body weight that is significantly lower than minimally expected	Being assessed as having a very low body weight, sourced from their Body Mass Index (BMI).
B. Fear of gaining weight, or behaviours that interfere with weight gain, despite low body weight	Assessed as being underweight, sourced from their BMI. AND At least ONE of the following: Reported fearing weight gain for at least 2 days per week AND reported being “very” or “extremely” concerned about gaining weight. OR Reported at least ONE of the following behaviours, lasting at least 3 months: Self-induced vomiting to control weight at least weekly; taking medication to control weight at least weekly; fasting to control weight at least 4 days per week; excessive exercise (2+ hours) to control weight at least 6 days per week.
C. Disturbance in experience of body weight, or overvaluation of weight	If underweight: Rated themselves as being “about the right weight”, “somewhat overweight” or “very overweight”; If normal weight: Rated themselves as being “somewhat overweight” or “very overweight”; If overweight: Rated themselves as being “very overweight” (note: could not be rated if obese). OR Reported weight as being “very important” to how they feel about themselves.

Symptom	Criteria
Partial-Syndrome Bulimia Nervosa[†] (at least 2 symptoms present)	
A. Regular objective binge-eating	Reported experiencing a loss of control over eating at least weekly for at least 3 months. AND Reported that it is “very difficult” or “impossible” to stop eating after starting to eat in this way. AND The amount of food eaten in a 2-hour period is equivalent to “8 pieces of bread and half a litre of ice-cream and 5 biscuits” OR “12 pieces of bread and 1 litre of ice-cream and 10 biscuits” OR “1 loaf of bread and 2 litres of ice-cream and 1 packet of biscuits”.
B. Overvaluation of weight	Rated their weight as “very important” to how they feel about themselves.
C. Regular engagement in compensatory behaviours	Reported at least ONE of the following behaviours, lasting at least 3 months: Self-induced vomiting to control weight at least weekly; taking medication to control weight at least weekly; fasting to control weight at least 4 days per week; excessive exercise (2+ hours) to control weight at least 6 days per week.
Partial-Syndrome Binge-Eating Disorder[‡] (the following symptom is present)	
A. Regular objective binge-eating	Reported experiencing a loss of control over eating at least weekly for at least 3 months. AND Reported that it is “very difficult” or “impossible” to stop eating after starting to eat in this way. AND The amount of food eaten in a 2-hour period is equivalent to “8 pieces of bread and half a litre of ice-cream and 5 biscuits” OR “12 pieces of bread and 1 litre of ice-cream and 10 biscuits” OR “1 loaf of bread and 2 litres of ice-cream and 1 packet of biscuits”.

Note: [†]Must not also meet criteria for Partial-Syndrome Anorexia Nervosa; [‡]Must not also meet criteria for Partial-Syndrome Anorexia Nervosa or Bulimia Nervosa

Table 2. Odds of DSM-5 eating disorder symptoms and partial-syndrome diagnoses between ADHD and control groups

	Boys (n=1,334)			Girls (n=1,338)			All Children ^a		
ED symptoms at age 14-15 years	ADHD (n=148) %	Control (n=1,186) %	OR (95% CI)	ADHD (n=38) %	Control (n=1,300) %	OR (95% CI)	ADHD (n=186) %	Control (n=2,486) %	OR (95% CI)
<i>Anorexia Nervosa</i>									
A. Very low body weight	7.0	5.5	1.3 (0.5-3.1)	2.1	5.4	0.4 (0.1-2.9)	6.0	5.5	1.1 (0.5-2.5)
B. Fear of weight gain, or persistent behavior that interferes with weight gain, despite low body weight	0	0.05	-	0	0.4	-	0.0	0.2	-
C. Disturbance in the way weight/shape is experienced, or overvaluation of weight/shape	18.7	16.5	1.2 (0.7-1.9)	46.1	44.2	1.1 (0.5-2.3)	24.3	30.9	0.7 (0.5-1.1)
<i>Bulimia Nervosa</i>									
A. Regular objective binge-eating weekly for 3+ months	2.9	0.3	9.4 (1.7-52.8)*	6.5	2.2	3.1 (0.7-14.0)	3.7	1.3	2.9 (0.9-8.6)
B. Regular engagement in compensatory behaviours to control weight weekly for 3+ months	6.1	4.6	1.3 (0.5-3.6)	0	3.7	-	4.8	4.1	1.2 (0.4-3.1)

	Boys (n=1,334)			Girls (n=1,338)			All Children ^a		
ED symptoms at age 14-15 years	ADHD (n=148) %	Control (n=1,186) %	OR (95% CI)	ADHD (n=38) %	Control (n=1,300) %	OR (95% CI)	ADHD (n=186) %	Control (n=2,486) %	OR (95% CI)
1. Restricted food intake	0.6	0	-	0	0.7	-	0.5	0.3	1.4 (0.2-12.3)
2. Induced vomiting	0	0.2	-	0	0.9	-	0.0	0.5	-
3. Excessive exercise	3.3	4.1	0.8 (0.2-2.9)	0	2.3	-	2.6	3.2	0.8 (0.2-3.0)
4. Medication (any)	2.2	0.3	7.2 (0.9-53.9)	0	0.5	-	1.7	0.4	4.2 (0.8-23.9)
i. Laxatives	0	0	-	0	0.1	-	0.0	0.1	-
ii. Diuretics	0	0	-	0	0	-	0.0	0.0	-
iii. Appetite suppressants	1.6	0	-	0	0.3	-	1.3	0.2	7.1 (0.7-73.9)
iv. Other med	0.6	0.3	1.9 (0.2-20.5)	0	0.1	-	0.5	0.2	2.7 (0.3-26.5)
C. Overvaluation of weight/shape	9.6	11.7	0.8 (0.4-1.6)	33.7	24.8	1.5 (0.7-3.5)	14.5	18.5	0.7 (0.4-1.3)
<i>Partial-syndrome ED</i>	6.9	3.3	2.2 (0.8-5.7)	8.7	7.6	1.2 (0.3-4.0)	7.3	5.5	1.3 (0.6-2.8)
Partial-syndrome AN	3.9	1.6	2.6 (0.8-8.8)	2.1	3.4	0.6 (0.1-4.9)	3.6	2.5	1.4 (0.5-4.1)
Partial-syndrome BN	1.6	1.5	1.0 (0.1-8.0)	6.5	3.6	1.9 (0.4-8.2)	2.6	2.6	0.9 (0.3-3.4)
Partial-syndrome BED	1.3	0.2	6.2 (0.6-61.1)	0	0.6	-	1.1	0.4	2.5 (0.3-19.3)

Note: OR = odds ratio; CI = confidence interval; ED = eating disorder; AN = anorexia nervosa; BN = bulimia nervosa; BED = binge-eating disorder;

*p<0.05. Analyses were weighted via survey methods to account for the unequal probability of participant selection, non-response and sample attrition, and the multi-stage, clustered sampling design. ^aData was available for 2,345-2,546 (87.8-95.3%) adolescents.

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Title:

DSM-5 eating disorder symptoms in adolescents with and without attention-deficit/hyperactivity disorder: A population-based study

Date:

2019-07-01

Citation:

Bisset, M., Rinehart, N. & Sciberras, E. (2019). DSM-5 eating disorder symptoms in adolescents with and without attention-deficit/hyperactivity disorder: A population-based study. INTERNATIONAL JOURNAL OF EATING DISORDERS, 52 (7), pp.855-862. <https://doi.org/10.1002/eat.23080>.

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