

Binge Eating, Mood, and Quality of Life in Youth With Type 2 Diabetes

Baseline data from the TODAY study

THE TODAY STUDY GROUP*

OBJECTIVE—The current study examines the prevalence of binge eating and its association with adiposity and psychosocial functioning in a large, diverse sample of youth with type 2 diabetes.

RESEARCH DESIGN AND METHODS—In the TODAY study, 678 (mean age 14.0 years; 64.9% girls) of the 704 youth randomized to the study completed a self-report measure of eating disorder symptoms and were categorized as nonovereaters, overeaters, subclinical binge eaters, or clinical binge eaters.

RESULTS—Youth with clinical (6%) and subclinical (20%) levels of binge eating had significantly higher levels and rates of extreme obesity, global eating disorder and depressive symptoms, and impaired quality of life.

CONCLUSIONS—These findings highlight the importance of evaluating youth with type 2 diabetes for the presence of binge eating. Future research is needed to determine the cumulative effects of disordered eating, obesity, and psychosocial distress on adherence to lifestyle change recommendations and longitudinal response to treatment.

Diabetes Care 34:858–860, 2011

Binge eating and other eating disturbances occur more commonly in girls with type 1 diabetes than girls without diabetes (1–3). However, disturbed eating behaviors, such as binge eating, have not been well studied in youth with type 2 diabetes, despite risk due to age and weight status (4,5). This report summarizes binge eating and related psychosocial disturbances in a large sample of youth with type 2 diabetes in TODAY (Treatment Options for type 2 Diabetes in Adolescents and Youth).

RESEARCH DESIGN AND METHODS

TODAY is a multicenter randomized clinical trial funded by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) of the National Institutes of Health (NIH). The collaborative study includes 15 clinical

centers and a data coordinating center (see Supplementary Data). The study design and objectives have been described elsewhere (6). The protocol was approved by an External Evaluation Committee convened by the NIDDK and by Institutional Review Boards at each participating institution. All participants provided informed consent, and minor children confirmed assent according to local guidelines. Enrollment began May 2004 and ended February 2009 with a total of 704 participants. Eligibility requirements included 10–17 years of age, type 2 diabetes <2 years' duration, BMI \geq 85th percentile at diagnosis, and an adult caregiver willing to support study participation. All participants completed a run-in period to discontinue nonstudy diabetes treatments, achieve hemoglobin A_{1c} (HbA_{1c}) <8% on metformin only, and demonstrate adherence to the study protocol.

Demographic variables included age, sex, self-report race/ethnicity, and highest household educational level as a proxy for socioeconomic status. Baseline body composition measures included height, weight, waist circumference, and abdominal height. BMI percentile, BMI z score, and percent overweight were calculated. Other physical health measures included HbA_{1c}, blood lipids, and blood pressure.

Of 704 randomized youth, 678 completed the baseline Youth Eating Disorder Examination Questionnaire (YEDEQ), a self-report measure of eating disorder symptoms (7). Responses to “How many times [over the past 28 days] have you eaten what other people would think was a really big amount of food, given the situation?” (objective overeating episodes) and “On how many of these times did you feel like you had lost control while eating?” were used to derive eating categories. Positive responses to both questions were used to establish binge eating, i.e., reporting episodes of objective overeating with an associated loss of control. Nonovereaters reported zero for objective overeating episodes and loss of control questions; overeaters, \geq 1 objective overeating episodes, but zero loss of control episodes; subclinical binge eaters, \geq 1–<4 binge eating episodes; and clinical binge eaters, \geq 4 binge eating episodes. Responses to each of the four YEDEQ subscales (restraint, eating, weight, and shape concerns) were totaled and averaged to provide a global subscale score, a measure of overall distress related to eating, weight, and shape concerns.

Mood was evaluated by self-report questionnaires, the Beck Depression Inventory (BDI) (8), or the Child Depression Inventory (CDI) (9), depending upon participant age. The presence of clinically significant mood impairment was indicated by a BDI score \geq 14 and CDI \geq 13. Quality of life (QOL) was measured by total score on the Pediatric Quality of Life Inventory (PedsQL) (10). Clinically significant impairment in QOL was defined as a total score at least 1 SD below the mean score for the sample.

Corresponding author: Denise E. Wilfley, wilfleyd@psychiatry.wustl.edu.

Received 2 September 2010 and accepted 15 January 2011.

DOI: 10.2337/dc10-1704

This article contains Supplementary Data online at <http://care.diabetesjournals.org/lookup/suppl/doi:10.2337/dc10-1704/-/DC1>.

*Members of the writing group are listed in the ACKNOWLEDGMENTS. Individuals and institutions that constitute the TODAY Study Group are listed in Supplementary Data online.

© 2011 by the American Diabetes Association. Readers may use this article as long as the work is properly cited, the use is educational and not for profit, and the work is not altered. See <http://creativecommons.org/licenses/by-nc-nd/3.0/> for details.

Table 1—Comparisons by eater category

	Nonovereater	Overeater	BE		P value
			Subclinical BE	Clinical BE*	
N	337	164	135	42	
Mean (SD)					
BMI percentile	97.5 (3.2)	97.5 (4.2)	97.9 (2.9)	98.6 (2.1)	0.1583
BMI z score	2.17 (0.46) ^a	2.24 (0.50) ^b	2.26 (0.45)	2.40 (0.42) ^{a,b}	0.0077
% Overweight†	73.4 (35.8) ^{a,b}	80.6 (37.9) ^c	82.4 (37.9) ^a	94.2 (36.4) ^{b,c}	0.0012
Waist circumference (cm)	106.0 (16.5) ^{a,b,c}	109.9 (18.0) ^a	109.9 (19.2) ^b	112.8 (22.4) ^c	0.0171
Abdominal height (cm)††	23.9 (3.7) ^a	24.4 (4.0)	24.5 (3.7)	25.5 (3.4) ^a	0.0403
Global YEDEQ	1.1 (0.9) ^{a,b}	1.2 (0.9) ^{c,d}	1.8 (1.0) ^{a,c,e}	2.3 (1.0) ^{b,d,e}	<0.0001
BDI‡	5.1 (7.4) ^{a,b}	5.8 (6.0) ^c	8.4 (7.5) ^{a,d}	14.5 (12.9) ^{b,c,d}	0.0031
CDI‡	5.6 (5.2) ^{a,b,c}	7.5 (6.0) ^{a,d}	8.4 (7.1) ^{b,e}	11.1 (8.7) ^{c,d,e}	<0.0001
PEDSQL	82.5 (11.7) ^{a,b,c}	79.4 (11.3) ^{a,d}	78.2 (11.5) ^{b,e}	70.5 (12.9) ^{c,d,e}	0.0033
Percent					
Sex (% girls)	65.3	62.2	67.4	69.0	0.7488
BMI percentile ≥99	37.7 ^{a,b,c}	51.2 ^a	48.1 ^{b,d}	66.7 ^{c,d}	0.0004
Global YEDEQ ≥4.0	0.6 ^{a,b}	0.6 ^c	3.7 ^a	9.5 ^{b,c}	<0.0001
BDI ≥14 or CDI ≥13	10.1 ^{a,b}	16.3 ^c	20.3 ^a	30.0 ^{b,c}	<0.0001
PEDSQL <68.2§	11.6 ^{a,b}	17.2 ^c	19.1 ^{a,d}	41.5 ^{b,c,d}	<0.0001

Comparisons across eater categories were made by ANOVA for continuous variables and χ^2 test for categorical variables, followed by unadjusted pairwise comparisons to explore overall significance. BE, binge eater. *Although the definition of clinical binge eater used in this article is consistent with proposed definitions of binge eating disorder in the *Diagnostic and Statistical Manual of Mental Disorders, fifth edition* (DSM-V), published by the American Psychiatric Association, the current study focuses on a shorter time period for diagnosis than DSM-V (1 vs. 3 months). †Percentage above age- and sex-specific median BMI. ††Also referred to as sagittal abdominal diameter (SAD); measured laterally using a Holtain Kahn Abdominal Caliper with the patient supine. ‡BDI administered to youth age 16 years or older ($N = 84$ for nonovereaters; $N = 44$ for overeaters; $N = 31$ for subclinical binge eaters; $N = 8$ for clinical binge eaters); CDI to youth younger than 16 years ($N = 244$ for normal eaters; $N = 117$ for overeaters; $N = 102$ for subclinical binge eaters; $N = 32$ for clinical binge eaters). §Cutoff used is 1 SD below the sample mean. ^{a,b,c,d,e}Pairs of values in a row with the same letters are significantly different from each other ($P < 0.05$).

RESULTS—The mean age of the sample was 14.0 years (41.7% Hispanic, 32.0% black non-Hispanic, 20.1% white non-Hispanic, 6.2% American Indian), and 64.9% were girls. Of the households, 16.9% had a primary caregiver with a bachelor's degree or higher educational level, whereas more than half reported completing high school or less. The mean HbA_{1c} for the sample at baseline was 6.0 (SD = 0.7).

Fifty percent of the participants were classified as nonovereaters, 24% as overeaters, 20% as subclinical binge eaters, and 6% as clinical binge eaters. There were no significant differences among eater categories on sex, age, race/ethnicity, household education, or on physical health indexes such as HbA_{1c}, blood lipids, or blood pressure. However, participants classified as clinical binge eaters differed significantly from nonovereaters and overeaters in terms of levels and rates of obesity, as measured by BMI z scores and percent overweight, and from nonovereaters on waist circumference and abdominal height. Participants categorized as clinical binge eaters had significantly greater global eating and weight and shape concerns than nonovereaters or overeaters. Clinical binge eaters had more depressive

symptoms than participants in any of the other eater categories. Subclinical and clinical binge eaters had lower QOL than nonovereaters (see Table 1).

CONCLUSIONS—The current study found that 26% of the youth with type 2 diabetes in this large, diverse sample reported binge eating, with significant relationships between binge eating patterns, higher levels of obesity, psychosocial distress, and poorer QOL. The presence of binge eating in youth with type 2 diabetes is particularly troubling given the association of binge eating with accelerated weight gain in those who are already overweight (11). The significant differences in waist circumference and abdominal height between youth with clinical levels of binge eating compared with those without binge-eating patterns are cause for further concern. Waist circumference has been shown to be an independent risk factor for cardiovascular problems such as high blood pressure, and visceral fat deposits have been linked to heightened insulin resistance (12).

Because binge eating has been identified as a moderator and predictor of reduced treatment outcome in weight loss studies (13), the results of this article

have implications for youth with type 2 diabetes whose treatment prescription includes disease management through changes in eating habits and physical activity. Furthermore, evidence from the type 1 diabetes literature suggests that the effects of disordered eating on clinical outcomes are cumulative (14). The results reported here highlight the importance of early assessment for disturbed eating, weight and shape concerns, and mood problems, so that appropriate referral and/or specialized treatment can be initiated (15). Future research is required to assess the impact of binge eating and its associated features upon response to treatment and weight reduction for youth with type 2 diabetes.

Acknowledgments—This work was completed with funding from NIDDK/NIH grant numbers U01-DK-61212, U01-DK-61230, U01-DK-61239, U01-DK-61242, and U01-DK-61254; from National Institute of Mental Health Grant 1K24-MH-070446-01 (to D.W.); from the National Center for Research Resources General Clinical Research Centers Program Grants M01-RR-00036 (Washington University School of Medicine), M01-RR-00043-45 (Children's Hospital Los Angeles), M01-RR-00069 (University of Colorado Denver), M01-RR-00084

(Children's Hospital of Pittsburgh), M01-RR-01066 (Massachusetts General Hospital), M01-RR-00125 (Yale University), and M01-RR-14467 (University of Oklahoma Health Sciences Center); and from the National Center for Research Resources Clinical and Translational Science Awards Grants U11-RR-024134 (Children's Hospital of Philadelphia), U11-RR-024139 (Yale University), U11-RR-024153 (Children's Hospital of Pittsburgh), U11-RR-024989 (Case Western Reserve University), U11-RR-024992 (Washington University), U11-RR-025758 (Massachusetts General Hospital), and U11-RR-025780 (University of Colorado Denver).

The TODAY Study Group thanks the American Diabetes Association and the following companies for donations in support of the study's efforts: Becton, Dickinson and Company; Bristol-Myers Squibb; Eli Lilly and Company; GlaxoSmithKline; LifeScan, Inc.; Pfizer; and sanofi-aventis. No other potential conflicts of interest relevant to this article were reported.

The members of the writing group are as follows: Denise Wilfley, PhD (chair), Professor of Psychiatry, Medicine, Pediatrics, and Psychology, Washington University School of Medicine, St. Louis, Missouri; R. Berkowitz, MD, Associate Professor of Psychiatry and Pediatrics, University of Pennsylvania, Philadelphia, Pennsylvania; A. Goebel-Fabbri, PhD, Assistant Professor of Psychiatry, Harvard Medical School, Boston, Massachusetts; K. Hirst, PhD, Associate Research Professor, George Washington University Biostatistics Center, Rockville, Maryland; C. Ievers-Landis, PhD, Division of Behavioral Pediatrics and Psychology, Rainbow Babies & Children's Hospital and Case Western Reserve University School of Medicine; T.H. Lipman, PhD, Professor of Nutrition and Nursing of Children, University of Pennsylvania School of Nursing; M. Marcus, PhD, Professor of Psychiatry and Psychology, Western Psychiatric Institute and Clinic, Pittsburgh, Pennsylvania; D. Ng, MPH, MA, Naomi Berry Diabetes Center, Columbia University, New York, New York; T. Pham, MPH, George Washington University Biostatistics Center, Rockville, Maryland; R. Saletsky, PhD, Associate Professor, Psychiatry and Behavioral Sciences, SUNY Upstate Medical University, Syracuse, New York; J. Schanuel, MEd, Department of Pediatrics, University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma; D. Van Buren, PhD, Assistant

Research Professor, Department of Psychiatry, Washington University School of Medicine, St. Louis, Missouri.

D.W. chaired the writing group, researched data, contributed to discussion, and reviewed and edited the manuscript. R.B. and A.G.-F. contributed to discussion and reviewed and edited the manuscript. K.H. researched data, contributed to discussion, wrote the manuscript, and reviewed and edited the manuscript. C.I.-L. and T.H.L. contributed to discussion and reviewed and edited the manuscript. M.M. researched data, contributed to discussion, and reviewed and edited the manuscript. D.N. reviewed and edited the manuscript. T.P. researched data. R.S. researched data, contributed to discussion, and reviewed and edited the manuscript. J.S. contributed to discussion. D.V.B. contributed to discussion, wrote the manuscript, and reviewed and edited the manuscript.

Parts of this study were presented as a poster titled, "Binge eating, mood, and quality of life in youth with type 2 diabetes," at the 70th Scientific Sessions of the American Diabetes Association, Orlando, Florida, 25–29 June 2010.

References

1. Colton PA, Olmsted MP, Daneman D, Rydall AC, Rodin GM. Disturbed eating behavior and eating disorders in preteen and early teenage girls with type 1 diabetes: a case-controlled study. *Diabetes Care* 2004;27:1654–1659
2. Olmsted MP, Colton PA, Daneman D, Rydall AC, Rodin GM. Prediction of the onset of disturbed eating behavior in adolescent girls with type 1 diabetes. *Diabetes Care* 2008;31:1978–1982
3. Howe CJ, Jawad AF, Kelly SD, Lipman TH. Weight-related concerns and behaviors in children and adolescents with type 1 diabetes. *J Am Psychiatr Nurses Assoc* 2008;13:376–385
4. Pinhas-Hamiel O, Standiford D, Hamiel D, Dolan LM, Cohen R, Zeitler PS. The type 2 family: a setting for development and treatment of adolescent type 2 diabetes mellitus. *Arch Pediatr Adolesc Med* 1999; 153:1063–1067
5. Goldschmidt AB, Aspen VP, Sinton MM, Tanofsky-Kraff M, Wilfley DE. Disordered eating attitudes and behaviors in

overweight youth. *Obesity* (Silver Spring) 2008;16:257–264

6. Zeitler P, Epstein L, Grey M, et al.; TODAY Study Group. Treatment options for type 2 diabetes in adolescents and youth: a study of the comparative efficacy of metformin alone or in combination with rosiglitazone or lifestyle intervention in adolescents with type 2 diabetes. *Pediatr Diabetes* 2007;8:74–87
7. Goldschmidt AB, Doyle AC, Wilfley DE. Assessment of binge eating in overweight youth using a questionnaire version of the Child Eating Disorder Examination with Instructions. *Int J Eat Disord* 2007;40: 460–467
8. Beck AT, Steer RA. *Beck Depression Inventory II*. San Antonio, TX, Psychological Corp, 1996
9. Kovacs M. *Children's Depression Inventory Manual*. North Tonawanda, NY, Multi-Health Systems, 1992
10. Varni JW, Burwinkle TM, Jacobs JR, Gottschalk M, Kaufman F, Jones KL. The PedsQL in type 1 and type 2 diabetes: reliability and validity of the Pediatric Quality of Life inventory generic core scales and type 1 diabetes module. *Diabetes Care* 2003;26:631–637
11. Tanofsky-Kraff M, Wilfley DE, Young JF, et al. Preventing excessive weight gain in adolescents: interpersonal psychotherapy for binge eating. *Obesity* (Silver Spring) 2007;15:1345–1355
12. Goran MI, Ball GDC, Cruz ML. Obesity and risk of type 2 diabetes and cardiovascular disease in children and adolescents. *J Clin Endocrinol Metab* 2003;88: 1417–1427
13. Wildes JE, Marcus MD, Kalarchian MA, Levine MD, Houck PR, Cheng Y. Self-reported binge eating in severe pediatric obesity: impact on weight change in a randomized controlled trial of family-based treatment. *Int J Obes (Lond)* 2010; 34:1143–1148
14. Peveler RC, Bryden KS, Neil HAW, et al. The relationship of disordered eating habits and attitudes to clinical outcomes in young adult females with type 1 diabetes. *Diabetes Care* 2005;28:84–88
15. American Diabetes Association. Standards of medical care in diabetes—2010. *Diabetes Care* 2010;33(Suppl. 1):S11–S61