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DO DISORDERED EATING BEHAVIORS HAVE LONG-TERM HEALTH-RELATED CONSEQUENCES?

Ulla Kärkkäinen, MSc¹, Linda Mustelin, MD, PhD, MPH^{1,2}, Anu Raevuori, MD, PhD^{1,3},
Jaakko Kaprio, MD, PhD^{1,2}, and Anna Keski-Rahkonen, MD, PhD, MPH¹

¹Department of Public Health, Clinicum, University of Helsinki, Finland ²Institute for Molecular Medicine FIMM, University of Helsinki, Helsinki, Finland ³Department of Adolescent Psychiatry, Helsinki University Central Hospital, Helsinki, Finland

Abstract

Objective—Long-term health-related consequences of disordered eating behaviors of young adults remain poorly understood. We examined whether disordered eating behaviors in mid-twenties are associated with physical and mental health ten years later.

Methods—Women (N=2,631) and men (N=2,394) from a population-based FinnTwin16 cohort were assessed using three subscales of the Eating Disorder Inventory-2 at age 24. Self-rated health, body mass index (BMI), waist circumference and psychological distress were assessed at age 24 and reassessed ten years later.

Results—In crude models, disordered eating behaviors at age 24 were associated cross-sectionally and prospectively with poor self-rated health, higher BMI, larger waist circumference and psychological distress in both sexes. In models adjusted for baseline BMI and potential confounders, disordered eating behaviors predicted increased psychological distress in both sexes, and poor self-rated health in men.

Conclusions—Among young adults, disordered eating behaviors are associated with long-term health-related consequences, particularly psychological distress.

Keywords

disordered eating behaviors; EDI; health; longitudinal; young adults

Introduction

Disordered eating is relatively common among adolescents and young adults (Herpertz-Dahlmann et al. 2008, Croll et al. 2002, Loth et al. 2015, Solmi et al. 2014, Neumark-Sztainer et al. 2011, Liechty, Lee 2013, Nurkkala et al. 2016, Reba-Harrelson et al. 2009,

Address correspondence to: Ulla Kärkkäinen, Dept of Public Health, PO Box 41, 00014 University of Helsinki, ulla.karkkainen@helsinki.fi.

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Wade, Wilksch & Lee 2012, McBride et al. 2013). In practice, the threshold between normal and disordered eating is difficult to define (Ackard, Fulkerson & Neumark-Sztainer 2007). For this reason, continuous measures such as Eating Disorder Inventory-2 are useful tools for measuring disordered eating behaviors in the population (Keel et al. 2007, Nurkkala et al. 2016).

Disordered eating symptoms tend to track from adolescence to adulthood (Steinhausen, Gavez & Winkler Metzke 2005, Neumark-Sztainer et al. 2011, Liechty, Lee 2013, Ackard, Fulkerson & Neumark-Sztainer 2011). Disordered eating in adolescence is associated with various adverse health outcomes. Among adolescents disordered eating is associated with higher BMI and increased weight gain (Neumark-Sztainer et al. 2012, Neumark-Sztainer et al. 2006, Rancourt, McCullough 2015), but also with several mental health problems (Herpertz-Dahlmann et al. 2008, Steinhausen, Gavez & Winkler Metzke 2005, Stein et al. 2013) and reduced quality of life (Herpertz-Dahlmann et al. 2008).

Much less is known about disordered eating behaviors among adults, but community survey indicates that the prevalence of such behaviors may be increasing (Hay et al. 2008). In a cross-sectional population study, disordered eating behaviors have shown to indicate increased risk for mental health comorbidities also among adults (McBride et al. 2013). Only few longitudinal studies have shown that disordered eating behavior is associated with increased body weight (Stein et al. 2013), and decreased physical and mental quality of life (Wade, Wilksch & Lee 2012, Fairweather-Schmidt, Lee & Wade 2015). However, these few longitudinal studies included only women, even though eating disorder behaviors are common also among men (Keel et al. 2007, Hay et al. 2008).

Existing studies have mainly focused on adolescents and women. Less is known about the long-term consequences of disordered eating in adulthood, particularly among men. The impact of disordered eating on general health also remains poorly understood. We explored whether disordered eating behaviors as measured by three subscales of the Eating Disorder Inventory 2 (EDI-2) are associated with long-term physical and mental health in young adult women and men. Specifically, we assessed how disordered eating behaviors in mid-twenties are associated with self-rated health, BMI, waist circumference and psychological distress cross-sectionally and prospectively after ten years of follow-up.

Materials and methods

Participants

The participants for this study were identified from FinnTwin16, a nationwide longitudinal study of Finnish twins born between October 1974 and December 1979 identified from the Central Population Registry of Finland (Kaprio, Pulkkinen & Rose 2002). The self-report questionnaires addressed various health behaviors (Kaprio 2013). Because the EDI subscales were first included at wave 4, analyses reported in this study are based on information collected at wave 4 (mean age 24.4, range: 22–27) and 10 years later at wave 5 (mean age 34.1, range: 31–37). The study was conducted according to the standards of the Declaration of Helsinki and was approved by the ethics committee of the Central Finland Hospital

district, Helsinki and Uusimaa Hospital Districts and IRB, Indiana University, Bloomington, IN.

Exclusions and attrition

At age 24, from the 2,835 female and 2,423 male responders we excluded participants whose information on weight or height was missing ($n=22$ women and 24 men) and participants with any eating disorder ($n=182$ women and 5 men). Analyses at age 24 were conducted using 2,631 women and 2,394 men (mean age 24.4, range: 22–27).

Ten years later, information on weight and height without any eating disorder was available from 2,035 women and 1,670 men (mean age 34.1, range: 31–37). The overall attrition rate between data collection at ages 24 and 34 was 26.8%; see below for an attrition analysis.

Measurements

Disordered eating behaviors—Disordered eating behaviors were assessed at age 24 using three subscales of the Eating Disorder Inventory-2 (EDI-2) questionnaire: Body Dissatisfaction, Drive for Thinness, and Bulimia. These three subscales were chosen because they measure behaviors and cognitions directly related to disordered eating, whereas the other EDI-2 subscales focus on other aspects of psychological and social functioning. Each individual item in the subscales was scored using 6-point Likert scoring (1-2-3-4-5-6) and the EDI-2 global score was calculated as the sum of all three subscales.

Body Mass Index (BMI) and Waist circumference—BMI was calculated from self-reported weight and height. For assessment of waist circumference, subjects were sent a tape measure along with illustrated instructions. BMI and waist circumference were measured at age 24 and ten years later. In a validation sample (Saarni et al. 2009), the agreement between actual measurements taken on average 2 years later and self-report from the questionnaire at age 24 was high. The interclass correlation for BMI was 0.89 (mean difference was 0.93 kg/m²) and 0.75 for waist circumference (mean difference was 2.48 cm). We used the standard World Health Organization definitions of ‘underweight’ (BMI <19.5 kg/m²), ‘normal weight’ (BMI 19.5–24.9 kg/m²), ‘overweight’ (BMI 25–29.9 kg/m²) and ‘obesity’ (BMI > 29.9 kg/m²).

Self-rated health and psychological distress—Self-rated health was assessed at age 24 and ten years later. Participants rated their current health as ‘excellent’, ‘rather good’, ‘fair’, ‘rather poor’, or ‘very poor’. Psychological distress was also assessed at age 24 and ten years later. It was measured with the 12-item General Health Questionnaire (GHQ-12) (Goldberg et al. 1997) using four-point Likert scoring (0-1-2-3), with the sum score ranging from 0 to 36.

Statistical analyses

We described our study sample characteristics using means and 95% confidence intervals (95% CI) for continuous variables and proportions for categorical measures. We used Pearson’s χ^2 test, Student’s t-test and one-way analysis of variance to test for sex differences. Testing the associations between disordered eating behaviors and health

outcomes included the following steps. First, we tested crude associations between disordered eating behaviors at age 24 and self-rated health, BMI, waist circumference and psychological distress a) cross-sectionally at age 24 and b) prospectively at age 34 with Spearman's correlation. Second, we used ordinary least-square linear regression to longitudinally examine whether disordered eating behaviors at age 24 predicted the aforementioned health outcomes at age 34 after controlling for factors at age 24. Therefore, in our 'baseline-controlled models', we controlled for the values of each outcome at age 24. For example, the association of disordered eating behaviors at age 24 with BMI at age 34 was controlled for BMI at age 24. Finally, in our 'fully controlled models' we took into account all potential confounders; self-rated health, BMI, waist circumference, psychological distress and education at age 24. We tested all models for multicollinearity by examining variance inflation factors. Continuous variables were standardized. Analyses were adjusted for correlated observations within twin pairs and no within-pair analyses were conducted. All analyses were conducted using the statistical software package Stata 14.0 (StataCorp LP, College Station, TX).

Attrition analysis

Before conducting the analyses, we examined attrition. Our study spanned a period of ten years: 26.8% of our respondents (23.3% of women and 30.9% of men) were lost to follow-up. In attrition analyses, participants responding at follow-up did not differ from non-responders with respect to disordered eating behaviors, self-rated health, BMI, waist circumference or psychological distress. Women with children were more likely to be lost to follow-up. In both sexes, respondents at age 34 were significantly more educated, were more likely to live in an urban area and less likely to smoke (full attrition analysis available from the author upon request). In conclusion, we did not find significant differences in key variables between participants and non-participants in this study.

Results

Characteristics at age 24

The characteristics of our participants in their mid-twenties are presented in Table 1. As previously reported, women on average weighted 61 kg and men 77 kg, and their mean BMIs were 22.2 and 23.9, respectively (Table 1) (Kärkkäinen et al. 2016). Waist circumference was on average 75 cm among women and 85 cm among men. At age 24, 11% of women and 25% of men were overweight, and 4% of women and 4% of men met criteria of obesity.

The distributions of EDI-2 scores among women and men are shown in Figure 1 and mean values and their confidence intervals in Table 1. The majority of the participants reported their self-rated health to be rather good or excellent at age 24; only 17% of women and 14% of men reported their self-rated health to be fair, rather poor, or very poor. The mean GHQ-12 score, measuring psychological distress, was 11.2 (SD 5.4, range 0–36) for women and 9.8 (SD 4.7, range 0–36) for men at age 24.

Health-related outcomes at follow-up

Over the follow-up period, women gained on average 5 kg and men 6 kg, resulting in a mean BMI gain of 1.8 (SD 1.7–1.9) and 1.9 (SD 1.8–2.1), respectively. Waist circumference increased by 6.5 cm (SD 6.0–6.9) in women and 7.1 cm (SD 6.6–7.5) in men. At age 34, the majority was at good health, but 20% of women and 19% of men rated their self-rated health as fair, rather poor, or very poor. At follow-up, the mean GHQ scores did not differ from mean GHQ scores at age 24 for either sex.

Associations of disordered eating behaviors with weight and well-being

In unadjusted, cross-sectional analyses, disordered eating behaviors at age 24 were strongly associated with poor self-rated health, BMI, waist circumference and psychological distress in both sexes (Figure 2). Moreover, disordered eating behaviors at age 24 were associated with these health-related outcomes ten years later (Figure 2).

Prediction of future health-related outcomes

Women—In ‘baseline-controlled models’, disordered eating behaviors at age 24 were significant predictors of all health-related outcomes ten years later (Table 2, Baseline-controlled models). In these models, we controlled for the values of each outcome at age 24. For example, the association of disordered eating behaviors at age 24 with BMI at age 34 was controlled for BMI at age 24.

However, when we controlled for additional characteristics at age 24 (self-rated health, BMI, waist circumference, psychological distress and education), disordered eating behaviors predicted only increased psychological distress at age 34 in women (Table 2, Fully controlled models).

Men—In men, too, disordered eating behaviors at age 24 were significant predictors of all health-related outcomes at age 34 in ‘baseline-controlled models’ (Table 3, Baseline-controlled models). In the ‘fully controlled models’, disordered eating behaviors at age 24 were associated with both increased psychological distress and poor self-rated health ten years later (Table 3, Fully controlled models).

Discussion

According to this longitudinal community-based study, disordered eating behaviors have long-term health-related consequences among young adults. We found that disordered eating behaviors in young adults were associated with worse physical and psychological well-being cross-sectionally and prospectively. After controlling for BMI and other potential confounders, disordered eating in young adulthood predicted increased psychological distress in both sexes and poor self-rated health among men ten years later.

Our results confirm and extend findings from previous studies. Disordered eating behaviors have been shown to be associated with several mental health problems both among adolescent girls and boys (Herpertz-Dahlmann et al. 2008, Steinhausen, Gavez & Winkler Metzke 2005) and cross-sectionally among women and men (McBride et al. 2013). A cross-

sectional association between disordered eating and poor self-rated health has been observed earlier among young Finnish men (Nurkkala et al. 2016). Yet, we are aware of only two longitudinal studies investigating the psychological and physical well-being of adult women with disordered eating behaviors. Both studies found a longstanding association between disordered eating and decreased mental and physical quality of life among young and middle-aged women (Wade, Wilksch & Lee 2012, Fairweather-Schmidt, Lee & Wade 2015). Our study is in line with these findings. To our knowledge, this is also the first study to show that disordered eating behaviors prospectively predict psychological distress and poor self-rated health also among young men.

Even though the association between disordered eating and weight gain appears to be strong in adolescence (Neumark-Sztainer et al. 2012, Neumark-Sztainer et al. 2006, Rancourt, McCullough 2015, Sonnevile et al. 2013), we did not find disordered eating behaviors to predict weight gain in young adults. Factors other than disordered eating seem to explain weight gain during young adulthood. However, given that disordered eating behaviors and BMI were strongly associated cross-sectionally at age 24, it is likely that weight development before this age is connected to these behaviors. Future studies should investigate the causal relationships and timing between disordered eating behaviors and weight gain during the transition from adolescence to adulthood.

Our study shows that disordered eating behaviors among young adults are not without consequences. Disordered eating behaviors predict increased psychological distress and poor self-rated health in the future. In addition to being a source of suffering on its own, psychological distress predicts physical morbidity (Winning et al. 2015, Puustinen et al. 2011, Chida et al. 2008). According to a large meta-analysis, even low levels of psychological distress are associated with increased mortality from several major causes (Russ et al. 2012). Similarly, self-rated health is a powerful predictor of morbidity, mortality, and clinical outcome in a wide range of conditions (Idler & Benyamini 1997, Fayers & Sprangers 2002). Self-rated health also predicts future health expenditures (DeSalvo et al. 2009). Against this background, individuals with subclinical disordered eating behaviors might benefit from early identification along with targeted interventions to prevent the development of mental and physical health problems.

A possible factor influencing the relationship between disordered eating and health is physical activity. Physical activity is important for general health and well-being (Kuykendall, Tay & Ng 2015, Warburton, Nicol & Bredin 2006), but disordered eating behaviors may contribute to unhealthy physical activity behaviors (Lichtenstein et al. 2017, Nurkkala et al. 2016) that may have negative health consequences. Future studies should explore the long-term relationship between physical activity and disordered eating behaviors to understand their joint effects on health and well-being.

Limitations and strengths—Our study was limited in several ways. First, loss to follow-up could have caused bias; attrition was 23% among women and 31% among men. Yet, we did not find evidence of selective attrition in respect to our main outcomes. Second, all variables were self-reported, which may cause reporting bias. However, self-reported BMI has previously been shown to correlate closely with measured BMI in a subsample of this

cohort (Mustelin et al. 2009). Third, our outcome measures did not include physical morbidity and the follow-up was too short to assess impact on mortality. Instead, we focused on intermediate health-related outcomes such as BMI, self-rated health and psychological distress. Yet, BMI predicts of healthy and disease-free life expectancy among adults (Stenholm et al. 2017) and self-rated health and psychological distress predict future health status (Winning et al. 2015, Puustinen et al. 2011, Chida et al. 2008, Russ et al. 2012, Idler, Benyamini 1997, Fayers, Sprangers 2002, DeSalvo et al. 2009).

The weaknesses outlined above were counterbalanced by several strengths. Our study was nationwide, population-based, and included both women and men with excellent participation rates. Our follow-up time was ten years, adequate to address meaningful associations of disordered eating behaviors with health-related consequences over young adulthood. In addition, the last wave of data collection took place recently: thus, our findings are topical and relevant. Although few previous authors have addressed the long-term health-related consequences of disordered eating behaviors among women (Stein et al. 2013, Wade, Wilksch & Lee 2012, Fairweather-Schmidt, Lee & Wade 2015), we are not aware of other nationwide longitudinal studies that are informative about health-related consequences of disordered eating behaviors in both sexes.

Conclusions

Disordered eating behaviors appear to have longstanding adverse consequences for mental health and well-being among young women and men. Future studies should evaluate strategies for prevention of health problems among these individuals.

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Figure 1.
Eating Disorder Inventory Scores in women and men at age 24.

Figure 2.

Crude associations of disordered eating behaviors at age 24 with self-rated health, BMI, waist circumference and psychological distress at age 24 and ten years later (r =Spearman's coefficient). All correlations highly statistically significant ($p<0.0001$).

Table 1

Sample Characteristics at age 24.

	Women(N=2,631)	Men (N=2,394)	p-value for sex difference
Sociodemographic variables			
High school education, n (%)	1,257 (55.8)	998 (45.3)	p<0.0001 [‡]
Married or cohabiting, n (%)	1,367 (51.8)	1,023 (42.5)	p<0.0001 [‡]
Has children, n (%)	274 (16.7)	167 (11.0)	p<0.0001 [‡]
Urban living (vs. rural living), n (%)	2,243 (85.4)	1,949 (81.0)	p<0.0001 [‡]
Weight-related variables			
Height (cm), mean (95% CI)	165.7 (165.4–166.1)	179.3 (179.0–179.7)	p<0.0001 [‡]
Weight (kg), mean (95% CI)	61.1 (60.6–61.7)	77.0 (76.4–77.5)	p<0.0001 [‡]
BMI (kg/m ²), mean (95% CI)	22.2 (22.1–22.4)	23.9 (23.7–24.1)	p<0.0001 [‡]
BMI categories ^a			
Underweight, n (%)	471 (17.9)	105 (4.4)	
Normal weight, n (%)	1,768 (67.2)	1,578 (65.9)	
Overweight, n (%)	289 (11.0)	608 (25.4)	
Obesity, n (%)	103 (3.9)	103 (4.3)	p<0.0001 [•]
Waist circumference (cm), mean (95% CI)	75.0 (74.6–75.5)	85.4 (85.0–85.9)	p<0.0001 [‡]
Psychological and behavioral variables			
Self-rated health			
Excellent, n (%)	753 (28.7)	852 (35.7)	
Rather good, n (%)	1,428 (54.4)	1,199 (50.3)	
Fair, n (%)	392 (15.0)	295 (12.4)	
Rather poor, n (%)	51 (1.9)	34 (1.4)	
Very poor, n (%)	1 (0.0)	4 (0.2)	p<0.0001 [•]
Disordered eating behaviors ^b , mean (95% CI)	55.6 (54.9–56.3)	37.3 (36.5–38.0)	p<0.0001 [‡]
Body Dissatisfaction, mean (95% CI)	26.0 (25.6–26.4)	15.5 (15.0–15.9)	p<0.0001 [‡]
Drive for Thinness, mean (95% CI)	18.5 (18.2–18.7)	12.0 (11.7–12.3)	p<0.0001 [‡]
Bulimia, mean (95% CI)	11.3 (11.1–11.4)	9.8 (9.7–10.0)	p<0.0001 [‡]
Psychological distress ^c , mean (95% CI)	11.2 (11.0–11.4)	9.8 (9.5–10.0)	p<0.0001 [‡]

^aBMI categories: underweight <19.5 kg/m²; normal weight 19.5–24.9 kg/m²; overweight 25–29.9 kg/m²; obesity > 29.9 kg/m².

^bFrom Eating Disorder Inventory-2 (EDI, including subscales: Body Dissatisfaction, Drive for Thinness, Bulimia).

^cFrom General Health Questionnaire (GHQ-20).

[‡]From Pearson's χ^2 test.

[‡]From Student's t-test.

[•]From one-way analysis of variance.

All analyses corrected for clustered sampling.

Disordered eating behaviors ^a at age 24 **in women** (N=2,631) to predict self-rated health, BMI, waist circumference and psychological distress at age 34 from controlled with baseline values of each outcome and fully controlled linear regression models.

Table 2

Outcome	Baseline-controlled models			Fully controlled models ^c		
	Beta	95% CI	p-value	Beta	95% CI	p-value
Poor self-rated health	0.09	0.06–0.13	0.0001	0.03	–0.00–0.07	0.088
BMI (kg/m ²)	0.04	0.00–0.08	0.047	0.03	–0.01–0.07	0.121
Waist circumference	0.10	0.06–0.14	0.0001	–0.00	–0.04–0.04	0.910
Psychological distress ^b	0.12	0.07–0.17	0.0001	0.12	0.06–0.18	0.0001

^{*} Linear regression, cluster corrected, all participants with any eating disorder diagnoses excluded.

^a From Eating Disorder Inventory-2 (EDI, including subscales: Body Dissatisfaction, Drive for Thinness, Bulimia).

^b From General Health Questionnaire (GHQ-20).

^c Controlled with baseline self-rated health, BMI, waist circumference, psychological distress and education.

Disordered eating behaviors ^a at age 24 **in men** (N=2,394) to predict self-rated health, BMI, waist circumference and psychological distress at age 34 from controlled with baseline values of each outcome and fully controlled linear regression models.

Table 3

Outcome	Baseline-controlled models			Fully controlled models ^c		
	Beta	95% CI	p-value	Beta	95% CI	p-value
Poor self-rated health	0.14	0.09–0.19	0.0001	0.09	0.02–0.15	0.007
BMI (kg/m ²)	0.08	0.01–0.16	0.021	0.04	–0.02–0.10	0.198
Waist circumference	0.09	0.03–0.16	0.007	0.02	–0.04–0.09	0.455
Psychological distress ^b	0.14	0.07–0.22	0.0001	0.17	0.08–0.26	0.0001

^{*} Linear regression, cluster corrected, all participants with any eating disorder diagnoses excluded.

^a From Eating Disorder Inventory-2 (EDI, including subscales: Body Dissatisfaction, Drive for Thinness, Bulimia).

^b From General Health Questionnaire (GHQ-20).

^c Controlled with baseline self-rated health, BMI, waist circumference, psychological distress and education.