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Diet pill and laxative use for weight control predicts first-time receipt of an eating disorder diagnosis within the next five years among female adolescents and young adults

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Abstract

Objective: To replicate findings from a prior study which identified prospective associations between use of products for weight control and subsequent receipt of a first-time eating disorder (ED) diagnosis among female adolescents and young adults.

Method: Data from a prospective cohort study, Project EAT (Eating and Activity in Teens and Young Adults), were used to examine prospective associations between self-reported past-year diet pill and laxative use for weight control and self-reported receipt of an ED diagnosis among females without prior receipt of an ED diagnosis (N=1,015). Participants were followed from early/middle adolescence (EAT-I; M_{age}=14.9 years) into late adolescence/emerging adulthood (EAT-II; M_{age}=19.5 years) and young adulthood (EAT-III; M_{age}=24.8 years).

Results: First-time receipt of an ED diagnosis was reported by 2.4% of participants at EAT-II and 4.0% at EAT-III. After adjusting for demographics and weight status, participants using diet pills (risk ratio [RR]=3.58, 95% confidence interval [CI]: 1.96–6.54) and laxatives (RR=2.77, 95% CI: 1.01–7.64) had greater risk of receiving a first-time ED diagnosis within 5 years than those not using these products.

Discussion: The present study replicated prior findings, providing further evidence for a prospective link between use of products for weight control and subsequent receipt of an ED diagnosis.

Conflict of interest:
The authors declare that they have no conflict of interest.

Data Availability Statement:
Investigators interested in utilizing the dataset used in the current study should contact the corresponding author.

Keywords

Eating Disorders; Diet pills; Laxatives; Weight Loss; Adolescent; Young Adult

Introduction

Eating disorders (EDs; e.g., anorexia nervosa, bulimia nervosa, binge-eating disorder) are estimated to negatively impact nearly 9% of individuals in the United States at some point in their lives (Deloitte Access Economics, 2020). EDs represent a significant public health concern given their prevalence and burden of disease, which includes substantial psychosocial impairment, psychiatric comorbidity, physical consequences such as gastrointestinal and cardiovascular complications, elevated mortality rate, and economic costs (Crow et al., 2009; Hudson, Hiripi, Pope, & Kessler, 2007; Mitchell & Crow, 2006; Streatfeild et al., 2021; Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011). Much more work is needed to help reduce the burden of EDs, as over half of patients do not respond to even the most empirically-supported ED treatments (Linardon, 2018; Linardon & Wade, 2018; Watson & Bulik, 2013). In addition to working to improve treatment effectiveness and access, we must also work to identify early markers of EDs and intervene to prevent the development of full-threshold EDs among those at risk.

Use of products such as diet pills and laxatives to control weight (hereafter referred to as weight-control product use) may represent an important early ED marker. Weight-control product use can lead to a myriad of severe physical health consequences including kidney disease and electrolyte disturbance-induced cardiac arrhythmias (Roerig, Steffen, Mitchell, & Zunker, 2010; Zheng & Navarro, 2015), yet minors can purchase these products over the counter and abuse them in attempts to control their weight. Cross-sectional evidence suggests that use of these products for weight control is common among individuals with EDs (Roerig et al., 2010; Steffen et al., 2010). Moreover, in a community-based sample of female adolescents and young adults, Levinson and colleagues found that diet pill and laxative use for weight control prospectively predicted receiving a first-time ED diagnosis from a healthcare provider 1–3 years later (Levinson et al., 2020). To our knowledge, the study by Levinson and colleagues is the first and only study to date that has examined the prospective association between weight-control product use and subsequent first-time receipt of an ED diagnosis, and replication is needed. Although EDs are quite prevalent in the United States (Deloitte Access Economics, 2020; Streatfeild et al., 2021), few individuals with symptoms of an ED actually receive a diagnosis from a healthcare provider (Sonneville & Lipson, 2018). Thus, low statistical power is inherently a challenge of research in this area because weight-control product use and *diagnosed* EDs are both relatively uncommon in the general population (Hudson et al., 2007; Neumark-Sztainer, Story, Hannan, Perry, & Irving, 2002; Swanson et al., 2011). Replication is therefore particularly pertinent for research in this area (Lindsay, 2015). Accordingly, the present study aimed to replicate the prospective findings of Levinson and colleagues in a separate community-based sample of female adolescents and young adults.

Methods

Study Design and Population

Project EAT (Eating and Activity in Teens and Young Adults) is a population-based, longitudinal investigation of weight and weight-related behaviors among young people. At the first wave of data collection (EAT-I), 4,746 middle- and high-school students in the Minneapolis-St. Paul metropolitan area completed surveys in 1998–1999 (ages 11–18 years; Neumark-Sztainer, Croll, Story, Hannan, et al., 2002; Neumark-Sztainer, Story, Hannan, & Croll, 2002). EAT-I was originally designed as a cross-sectional study; however, given growing research interest in the eating and weight-related health of young people, a decision was later made to follow-up at five-year intervals with participants from the original sample who provided sufficient contact information at EAT-I (n=3,672). Follow-up assessments were conducted in 2003–2004 (EAT-II; ages 17–23 years) and 2008–2009 (EAT-III; ages 21–27 years; Larson et al., 2011; Neumark-Sztainer et al., 2006; Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011). From the original sample, 2,516 responded at EAT-II (68.4% of those with sufficient contact information) and 2,287 responded at EAT-III (66.4% of those with sufficient contact information). Of the 1,902 participants who responded across all three waves, the analytic sample for the present study was comprised of 1,015 females who reported no prior ED diagnosis at EAT-I and provided complete data on all variables of interest (see Figure S1, available online, for more detail). Those who reported an ED diagnosis at EAT-II (n=30) were additionally excluded from analyses examining first-time ED diagnosis at EAT-III. The University of Minnesota's Institutional Review Board Human Subjects Committee approved all protocols.

Because attrition from the original EAT-I sample did not occur at random, analyses were weighted using the response propensity method (Little, 1986). Response propensities (i.e., the probability of responding to the Project EAT-III survey) were estimated using a logistic regression of response at both EAT-II and EAT-III on several predictor variables from the Project EAT-I survey. The weighting method resulted in estimates representative of the demographic make-up of the original school-based sample. Participants in the weighted analytic sample were 48.6% non-Hispanic white, 19.7% non-Hispanic black or African American, 4.7% Hispanic/Latinx, 18.5% Asian, 0.5% Native Hawaiian or Other Pacific Islander, 3.1% Native American, and 4.8% mixed or other ethnic/racial identity. The weighted distribution of the analytic sample across categories of parental socioeconomic status based primarily on educational attainment was: 18.4% low, 18.2% low-middle, 26.4% middle, 22.3% upper-middle, and 14.7% high. Participants in the analytic sample had a mean age of 14.9±1.6 years at EAT-I, 19.5±1.6 years at EAT-II, and 24.8±1.7 years at EAT-III.

Measures

The Project EAT survey assessed a broad range of weight-related attitudes, behaviors, and outcomes at each wave. Test-retest reliability of survey items was examined in a separate sample of 161 adolescents at EAT-I and a separate sample of 66 young adults at EAT-III. We report the test-retest reliability of survey items at EAT-III or at EAT-I if the item was only assessed at earlier waves. Measures used in the present study are described in Table 1.

Statistical Analysis

To estimate prospective associations between past-year weight-control product use and subsequent first-time ED diagnosis reported at the next wave of data collection, modified Poisson (Zou, 2004) generalized estimating equations (GEEs) with independence correlation structure were used to account for repeated measures within individuals. Unadjusted and adjusted models were conducted. Adjusted models controlled for the following potential confounding variables that were selected *a priori*, each of which are theoretically believed to be and have been demonstrated empirically to be associated with both weight-control product use (Calzo, Sonneville, Scherer, Jackson, & Austin, 2016; Neumark-Sztainer, Story, Hannan, Perry, et al., 2002; Story, French, Resnick, & Blum, 1995) and ED diagnosis (Sonneville & Lipson, 2018) in prior studies: age (continuous, time-varying), ethnicity/race (collapsed into non-Hispanic white or ethnic/racial minority and modeled as a dichotomous), SES (modeled as continuous), and weight status at the time ED diagnosis was assessed (three-level categorical, time-varying). In primary analyses, separate models were tested to estimate the associations for diet pill and laxative use. As a sensitivity analysis, diet pill and laxative use were examined simultaneously in a mutually adjusted model that controlled for potential confounding variables. Results were considered statistically significant at $p<.05$. All analyses incorporated response propensity weights and were conducted with Stata 16.1.

Results

Prevalence of Weight-Control Product Use and ED Diagnoses

At EAT-I, 5.5% of females ($n=53$) reported using diet pills for weight control and 1.5% ($n=13$) reported using laxatives for weight control. At EAT-II among participants with no prior receipt of an ED diagnosis, 15.9% of females ($n=157$) reported using diet pills for weight control and 2.4% ($n=23$) reported using laxatives for weight control. First-time receipt of an ED diagnosis was reported by 2.4% of participants ($n=30$) at EAT-II and 4.0% ($n=41$) at EAT-III.

Weight-Control Product Use and Subsequent First-Time ED Diagnosis Within 5 Years

Diet pill use was significantly associated with subsequent receipt of a first-time ED diagnosis in both unadjusted and adjusted models, while the association for laxative use was only significant in the adjusted model (Table 2). In unadjusted models, participants using diet pills had 4.00 times greater risk of reporting a first-time ED diagnosis 5 years later than those not using diet pills (95% confidence interval [CI]: 2.24–7.15), and, while not statistically significant ($p=.07$), participants using laxatives had 2.49 times greater risk of reporting a first-time ED diagnosis 5 years later than those not using laxatives (95% CI: 0.92–6.72). After adjusting for demographics and weight status, participants using diet pills had 3.58 times greater risk of reporting a first-time ED diagnosis 5 years later than those not using diet pills (95% CI: 1.96–6.54), and participants using laxatives had 2.77 times greater risk of reporting a first-time ED diagnosis 5 years later than those not using laxatives (95% CI: 1.01–7.64). Full results from these multivariable models are reported in Tables S1–S2 (available online). When product types were examined simultaneously in a mutually adjusted model as a sensitivity analysis, diet pill use remained a significant predictor of

subsequent ED diagnosis (risk ratio [RR]=3.44, 95% CI: 1.80–6.60), while laxative use did not (RR=1.39, 95% CI: 0.46–4.17).

Discussion

This study is among the first to prospectively investigate weight-control product use in relation to subsequent first-time receipt of an ED diagnosis. In this community-based sample of females, weight-control product use predicted first-time ED diagnosis within the next 5 years, with associations observed for both diet pill and laxative use, though the association for laxative use was only statistically significant when adjusting for covariates. Findings replicate those from a previous community-based study conducted by Levinson and colleagues, which was the first study, to our knowledge, to identify prospective associations between weight-control product use and first-time ED diagnosis (Levinson et al., 2020). The previous study found that diet pill use and laxative use for weight control each preceded new ED diagnoses 1–3 years later among female adolescents and young adults in the Growing Up Today Study (GUTS) cohort (Levinson et al., 2020). The present study replicates these findings in the EAT cohort with a longer interval between the assessment of weight-control product use and first-time ED diagnosis (5 years in the present study as compared to 1–3 years in the GUTS cohort), demonstrating predictive value of weight-control product use across a longer time period. Therefore, although the body of existing evidence is still small, the consistency in findings across studies bolsters the notion that use of products for weight control may precede the development and/or diagnosis of EDs.

Study strengths include the population-based sample and longitudinal design. However, study limitations must also be considered when interpreting our results. The self-report nature of weight-control product use and receipt of an ED diagnosis are limitations, as is the self-report nature of height and weight used to compute weight status, though self-reported and measured BMI were found to be highly correlated in validation subsamples (Himes et al., 2005; Quick et al., 2013). Additionally, the item used to assess receipt of an ED diagnosis in EAT-III differed from the item used in EAT-I and EAT-II, such that the item at EAT-III (a) asked separately about anorexia nervosa, bulimia nervosa, and binge-eating disorder diagnoses but did not ask about diagnoses for other EDs and (b) did not specifically ask if the diagnosis had been made by a doctor. Gender identity and sexual orientation were not assessed, representing additional limitations. Finally, and importantly, we were underpowered to examine associations among males due to few receiving first-time ED diagnoses. Future research is thus needed among males.

The present study adds further evidence for a link between use of products such as diet pills and laxatives for weight control and subsequent first-time ED diagnosis. If weight-control product use is in fact an early marker of elevated ED risk, then parents, guardians, and adults working with adolescents and young adults (e.g., healthcare providers, coaches, teachers, school-based social workers/counselors) should consider use of these products to be a warning sign and act accordingly (e.g., seek evaluation or provide a referral). Use of products such as diet pills and laxatives should be screened for in primary care, particularly among patients of higher weight who may be more likely to use these products (Neumark-Sztainer, Story, Hannan, Perry, et al., 2002). Screening should be conducted carefully so as

to not introduce new ideas to patients, as well as in a manner that maximizes patient comfort in reporting use of these products (e.g., as part of an online or paper questionnaire rather than in person). When patients report use of non-prescribed diet pills or laxatives, primary care providers should initiate a conversation with them about the potential consequences of using these products, thoroughly evaluate their physical health, and refer them to a mental health professional and other specialists as necessary (e.g., dietitian, gastroenterologist). Additionally, considering well documented evidence that these products can lead to a myriad of severe physical health consequences (Roerig et al., 2010; Zheng & Navarro, 2015), policies are needed to reduce access to and use of these products. Such policies could include taxing these products (Austin, Liu, & Tefft, 2018), increasing warning labels on these products, and banning sales of these products to minors (Pomeranz, Taylor, & Bryn Austin, 2013).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Descriptions of measures used in the present study

Measure	Description
Weight-control product use	The use of diet pills and laxatives was measured across all waves of data collection with the question: "Have you done any of the following things in order to lose weight or keep from gaining weight during the past year?" (Goldschmidt et al., 2018; Neumark-Sztainer, Croll, et al., 2002). Participants responded *yes* or *no* to a list of potential weight control behaviors, including "took diet pills" and "used laxatives" (test-retest percent agreement = 98% for each behavior; kappa = 0.79 for each behavior).
Receipt of eating disorder diagnosis	Receipt of an ED diagnosis was measured at EAT-I and EAT-II with the following question: "Has a doctor ever told you that you have an eating disorder such as anorexia nervosa, bulimia nervosa, or binge eating disorder?" (*yes*/*no*; Neumark-Sztainer, Croll, Story, Hannan, et al., 2002; Neumark-Sztainer, Story, Hannan, Perry, & Irving, 2002; Neumark-Sztainer et al., 2006). At EAT-III, participants responded to the item: "For each condition, indicate whether you have been diagnosed in your lifetime" (Karr, Bauer, Graham, Larson, & Neumark-Sztainer, 2014). Participants who responded *yes* for the conditions "Anorexia Nervosa", "Binge Eating Disorder," and/or "Bulimia Nervosa" were categorized as having received an ED diagnosis by EAT-III (test-retest percent agreement for any ED diagnosis = 97%; kappa = 0.78).
Demographic characteristics	Sex, structurally racialized categories labelled as ethnicity/race, and household socioeconomic status (SES) were based on self-report at EAT-I. Age was self-reported at each study wave. Household SES was coded in 5 groupings: low, low-middle, middle, upper-middle, and high. SES groupings were based primarily on parental educational level, defined by the higher level of either parent. Other variables used to assess SES included family receipt of public assistance, eligibility for free or reduced-cost school meals, and parental employment. An algorithm was developed using Classification and Regression Trees to avoid classifying participants as high SES based on parental education levels if they were receiving public assistance, were eligible for free or reduced-cost school meals, or had 2 unemployed parents (or 1 unemployed parent if from a single-parent household). These variables were also used to categorize SES in cases of missing parental education data (Neumark-Sztainer, Story, Hannan, & Croll, 2002; Sherwood, Wall, Neumark-Sztainer, & Story, 2009).
Weight status	Height and weight were self-reported at each study wave. Body mass index (BMI, kg/m^2) was calculated using self-reported height and weight. Height and weight were also measured by trained research staff in the full sample at EAT-I and in a subsample of 62 females at EAT-III (Himes et al., 2005; Quick et al., 2013). Self-reported BMI and measured BMI were highly correlated at EAT-I (females $r = 0.85$) and EAT-III (females $r = 0.98$; Himes et al., 2005; Quick et al., 2013). Using sex- and age-specific BMI percentile cut-offs identified by Must and colleagues for children and adults (Must, Dallal, & Dietz, 1991; Aviva Must, Dallal, & Dietz, 1991), weight status at EAT-I and EAT-II was classified as: underweight (BMI < 15th percentile), "healthy" weight (15th percentile < BMI < 85th percentile), or higher weight (BMI > 85th percentile). Using current BMI guidelines for adults (Jensen et al., 2014), weight status at EAT-III was classified as: underweight (BMI < 18.5 kg/m^2), "healthy" weight (18.5 $kg/m^2 \leq$ BMI < 25 kg/m^2), or higher weight (BMI ≥ 25 kg/m^2).

Table 2.

Use of products for weight control predicting first-time receipt of an eating disorder diagnosis within the next 5 years among female adolescents and young adults

Use of Products for Weight Control	Observations	Observations Reporting First-Time ED Diagnosis	Unadjusted RR (95% CI)	Adjusted† RR (95% CI)
Diet pills				
No	1,706	47	Ref	Ref
Yes	188	19	4.00 (2.24, 7.15)***	3.58 (1.96, 6.54)***
Laxatives				
No	1,862	62	Ref	Ref
Yes	33	4	2.49 (0.92, 6.72)	2.77 (1.01, 7.64)*

Note.

ED = eating disorder; RR = risk ratio; CI = confidence interval. Observations represent $N = 1{,}015$ participants.

†Adjusted for age, ethnicity/race, socioeconomic status, and weight status.

*$p < .05$,

**$p < .01$,

***$p < .001$.