Author Query Form

Dear Author,

During the copyediting of your manuscript the following queries arose.

Please refer to the query reference callout numbers in the page proofs and respond.

Please remember illegible or unclear comments and corrections may delay publication.

Many thanks for your assistance.

AUTHOR: Please note that missing content in references have been updated where we have been able to match the missing elements without ambiguity against a standard citation database, to meet the reference style requirements of the journal. It is your responsibility to check and ensure that all listed references are complete and accurate.

Query reference	Query	Remarks
Q1	Please verify that the linked ORCID identifiers are correct for each author. The ORCID IDs for 'Jake Linardon', 'Jacqui Macdonald', and 'Daniel Le Grange' seem to be invalid. Please check and supply the correct ORCID IDs for these authors.	
Q2	Please confirm that given names (blue) and surnames/family names (vermilion) have been identified correctly.	
Q3	Please check that authors and their affiliations and correspondence details are correct.	
Q4	Please provide degree/educational qualification of all the authors.	
Q5	References "Vassallo & Sanson, 2013; Quay & Peterson, 1987; StataCorp, 2017; Lee & Carlin, 2010; Bernaards et al., 2007; Rubin, 1987" have not been included in the Reference List, please supply full publication details.	
Q6	Please check the layout of Tables 1 and 2. Kindly correct if necessary.	
Q7	Please check the edits made in the sentence starting with "Using data from..." Kindly correct if necessary.	
Q8	Please provide the "page range" for reference Stevens, 2014.	
Q9	Please provide the "volume number, page range" for reference Streatfeild et al., 2021.	
Q10	Please provide the "volume number" for reference Zhu & Chan, 2017.	
Q11	Please confirm whether the colour figures should be reproduced in colour or Black and white in the print version. If the colour figures must be reproduced in colour in print version, please fill the colour charge form immediately and return to the Production Editor. Or else, the colour figures for your article will appear in colour in the online version only.	

Funding Info Query Form

Please confirm that the funding sponsor list below was correctly extracted from your article: that it includes all funders and that the text has been matched to the correct FundRef Registry organization names. If no FundRef Registry organization name has been identified, it may be that the funder was not found in the FundRef registry, or there are multiple funders matched in the FundRef registry. If a name was not found in the FundRef registry, it may not be the canonical name form, it may be a program name rather than an organization name, or it may be an organization not yet included in FundRef Registry. If you know of another name form or a parent organization name for a "not found" item on this list below, please share that information.

Funding Agency	FundRef Organization Name
National Health and Medical Research Council	National Health and Medical Research Council

ORIGINAL ARTICLE

International Journal of **EATING DISORDERS** **WILEY**

Young adult mental health sequelae of eating and body image disturbances in adolescence

Jake Linardon[1] | Christopher J. Greenwood[1,2] | Matthew Fuller-Tyszkiewicz[1] |
Jacqui A. Macdonald[1,2,3] | Elizabeth Spry[1,2,3] | Delyse M. Hutchinson[1,2,3,4] |
George J. Youssef[1,2] | Ann Sanson[3] | Eleanor Wertheim[5] |
Jennifer E. McIntosh[1,2,3,5] | Daniel Le Grange[6] | Primrose Letcher[1,2,3] |
Craig A. Olsson[1,2,3]

[1]Center for Social and Early Emotional Development and School of Psychology, Deakin University, Geelong, Victoria, Australia

[2]Department of Pediatrics, Centre for Adolescent Health, Murdoch Children's Research Institute and University of Melbourne, Royal Children's Hospital, Parkville, Victoria, Australia

[3]Department of Pediatrics, The University of Melbourne, Royal Children's Hospital, Melbourne, Victoria, Australia

[4]The University of New South Wales, National Drug and Alcohol Research Centre, Randwick, New South Wales, Australia

[5]La Trobe University, School of Psychology and Public Health, Melbourne, Victoria, Australia

[6]Department of Psychiatry and Behavioral Sciences, University of California, San Francisco, Eating Disorders Program, San Francisco, California, USA

Correspondence
Jake Linardon, Centre for Social and Early Emotional Development, School of Psychology, Deakin University, 221 Burwood, Highway, Burwood, VIC 3125, Australia.
Email: jake.linardon@deakin.edu.au

Abstract

Objective: There has been interest in the antecedents and mental health impacts of eating and body image disturbances in adolescence. Less is known about longer-term mental health impacts into young adulthood, as longitudinal studies with data spanning this developmental period are rare. We capitalize on mental health data collected across adolescence and young adulthood from a population-based cohort study that has been following >2000 Australian children and their families from infancy to young adulthood.

Method: This sample comprised 1,568 participants who completed the *Eating Disorder Inventory* drive for thinness and bulimic behavior (the severity of binge-purge patterns) subscale, and a modified version of the body dissatisfaction subscale in mid-adolescence (15–16 years), or the depression, anxiety, stress scales in young adulthood (19–20, 23–24, and 27–28 years).

Results: After adjusting for baseline demographic and prior mental health factors (<13 years of age), all three indices of eating and body image disturbances in adolescence predicted each mental health outcome in young adulthood. Mental health risks associated with adolescent body dissatisfaction and bulimic behavior scores remained stable across young adulthood, with men having more pronounced problems associated with bulimic behavior scores than women. In contrast, mental health risks associated with adolescent drive for thinness scores diminished across this period similarly for men and women.

Discussion: Findings suggest that adolescent eating and body image disturbances may have long-term mental health impacts that extend into young adulthood. This underscores the need for early preventative intervention, and longer-term monitoring and support for body image and eating disturbances.

KEYWORDS
body image, eating disorders, mental health, population-based cohort

Primrose Letcher and Craig A. Olsson are joint senior authors.

1 | INTRODUCTION

There has been widespread interest in the antecedents and mental health impacts of eating and body image disturbances in adolescence. Around 65% of young people are dissatisfied with their body (Dion et al., 2015), and between 10 and 30% of the general population engage in disordered eating behaviors, including binge eating, restrictive eating, and purging (Mitchison, Mond, Slewa-Younan, & Hay, 2013). Eating and body image disturbances often emerge during early adolescence and, if unaddressed, can persist well into later life and have the potential to progress to a clinically significant eating disorder (Brown, Forney, Klein, Grillot, & Keel, 2020; Neumark-Sztainer et al., 2006; Stice, Marti, & Rohde, 2013). The consequences of eating and body image disturbances can also be severe, and may include functional impairment, elevated mortality rates, and suicidality (Ágh et al., 2015; Arcelus, Mitchell, Wales, & Nielsen, 2011). In many countries, the burden of disease costs associated with eating disorders, including subthreshold variants, are substantial and resemble estimates reported for other common psychiatric conditions (Deloitte Access Economics, 2012; Streatfeild et al., 2021).

Eating and body image disturbances are often comorbid with other common mental health problems across all age groups. Comorbidity rates between eating, anxiety, and mood disorders can be as high as 60% in young and middle adults (Swinbourne et al., 2012), and adults with a clinically significant eating disorder report substantially higher levels of general psychological distress compared to healthy controls (Bardone-Cone et al., 2010; Marchesi, Ossola, Tonna, & De Panfilis, 2014). Moreover, a strong body of research has identified robust associations between dimensional measures of eating and body image disturbances and mental health problems in adult clinical (Linardon et al., 2018) and community samples (da Luz et al., 2018), as well as in adolescent student samples (Mitchison et al., 2017).

A meta-analysis of 22 studies that examined the *prospective* relationship between eating pathology and depressive symptoms observed a small but statistically significant pooled effect size ($r = .13$), suggesting that eating pathology may increase the risk for mood disturbances across adolescence (Puccio, Fuller-Tyszkiewicz, Ong, & Krug, 2016). Only one study has investigated these relationships from adolescence into young adulthood (Herpertz-Dahlmann et al., 2015). In this study, a subset of participants ($n = 772$, 54.5% girls) from a larger study assessing the health status of a cohort of German children and adolescents ($N = 2,863$) were analyzed. The authors found eating pathology at baseline ($M_{age} = 14.3$ years, $min = 11$ years, $max = 18$ years) to predict higher average depressive symptoms at six-year follow-up ($M_{age} = 21.0$ years, $min = 17.1$ years, $max = 27$ years), with a small to moderate effect size that was comparable for both sexes ($b = 0.45$; 95% CI: 0.19–0.70).

Although findings from this study provide important insights into the potential for longer-term mental health effects of eating pathology, assessments at only two time-points preclude a more nuanced understanding of the trajectory of long-term risk relationships; for example, whether risks remain stable, diminish, or worsen across the young adult years. Additionally, the mean age of participants at follow-up was 21.0 years ($SD = 2.2$), which leaves unanswered questions about longer-term impacts across the 20s. Attrition was also substantial (49%), introducing bias towards higher socioeconomic status and older age Finally, no assessments were made of the more common problem of body image disturbances, including drive for thinness and body dissatisfaction.

While other prospective studies have been conducted (Presnell, Stice, Seidel, & Madeley, 2009; Puccio et al., 2017; Stice, Hayward, Cameron, Killen, & Taylor, 2000; Vaughan & Halpern, 2010), finding consistent short-term (i.e., ranging from 1 to 6 year follow-up) prospective associations between eating pathology and subsequent mental health problems, most have focused exclusively on school-aged or adolescent girls, around the time of onset. Additionally, few studies have examined men, which is important as there is evidence to suggest that the timing and developmental sequelae of body image and eating problems may differ by sex (Slater & Tiggemann, 2011). Furthermore, most research has been based on samples of convenience (Stice & Bearman, 2001), which limits generalizability to broader community settings. Assessment of mental health difficulties has also been limited, typically with a focus on depressive symptoms, leaving a range of unanswered questions about the longer-term impacts on anxiety and other stress-related outcomes.

The purpose of the present study is to examine the extent to which mid-adolescent eating and body image disturbances (15–16 years) predict mental health difficulties across young adulthood (19–20, 23–24, and 27–28 years). Specifically, the aims are threefold: (a) to estimate the strength of association between adolescent eating and body image disturbances and young adult mental health outcomes, including symptoms of depression, anxiety and stress; (b) to examine the extent to which risk-relationships remain stable, diminish, or intensify across the young adulthood years; and (c) to determine whether the longer-term mental health risks into young adulthood differ by sex.

Based on prior research, we hypothesized that higher levels of eating and body image disturbances in adolescence would predict elevated symptoms of depression, anxiety and stress throughout young adulthood. In the absence by both data and theory on outcomes in young adulthood, we took an exploratory approach to investigating both the nature of risk-relationships over young adulthood as well as the nature of sex differences. To investigate these, we capitalize on rare prospective data from one of Australia's longest running, population-based cohort studies, that has been following a cohort of over 2,000 Australian children and their families from infancy to young adulthood since 1983.

2 | METHOD

2.1 | Participants and procedure

Participants were drawn from the Australian Temperament Project (ATP), a 15-wave longitudinal study tracking the psychosocial development of young people from infancy to adulthood. The baseline

sample consisted of 2,443 infants aged between 4–8 months, recruited in 1983 from urban and rural areas and representative of the state of Victoria, Australia. Since then, families have been invited to participate via mail surveys approximately every 2 years until 19–20 years and every 4 years thereafter (Vassallo & Sanson, 2013). The ATP has sustained approximately 1% attrition per annum, which is comparable to other major cohort studies of its kind worldwide. Data collection waves were approved by Human Research Ethics Committees at the University of Melbourne, the Australian Institute of Family Studies and/or the Royal Children's Hospital, Melbourne. Participants were included in the current study if they provided relevant data in adolescence or young adulthood. For the current study, data for the primary analytic variables are drawn from four waves spanning adolescence (eating and body image disturbances; 1 wave: age-15–16 years) and young adulthood (mental health problems; 3 waves: age 19–20, 23–24, and 27–28 years). Participants were included in the current study if they provided relevant data in adolescence or young adulthood. This resulted in a sample size of 1,568 (805 female) for the current study, for which 72% of participants provided data both in adolescence and young adulthood.

2.2 | Measures

2.2.1 | Eating and body image disturbances

Adolescents (15–16 years) completed the *drive for thinness* and *bulimic behavior* subscale from the Eating Disorder Inventory (EDI; Garner, Olmstead, & Polivy, 1983). The drive for thinness construct was assessed by 7-items ($\alpha = 0.87$) such as "*I am preoccupied with the desire to be thinner*", measuring behaviors such as restrictive dieting and fears of gaining weight. Bulimic behavior 6-items ($\alpha = 0.69$) assessed the presence and severity of binge-eating and purging behaviors (hereafter referred to as "bulimic behaviors") using items such as "*I eat moderately in front of others and stuff myself when they're gone.*"

A body dissatisfaction scale, assessing discontentment with overall shape and size of body regions, was specifically developed for the ATP study. It consisted of four items ($\alpha = 0.51$), including "*I think I am too fat*," "*I feel satisfied with the shape of my body*" (reversed), "*I think I am not muscular enough*," and "*I think I am too skinny*." The decision to use this subscale rather than the original EDI body dissatisfaction subscale was based on substantial numbers of missing items in the previous wave and negative feedback from participants, which resulted in a high level of missing data, yielding a variable unsuitable for analysis (Prior, Sanson, Smart, & Oberklaid, 2000).

Each item from the three scales was rated along a six-point scale (1 = Never, 6 = Always), as is recommended for normative samples where the prevalence of clinically significant disorders is low. For further details relating to the measurement characteristics of the items assessing eating and body image disturbances, see Le Grange et al. (2014).

2.2.2 | Mental health problems

Young adult (ages 19–20, 23–24, and 27–28 years) mental health was assessed using the 21-item self-report Depression, Anxiety, and Stress Scale (DASS; Lovibond & Lovibond, 1995). Seven items form the depression, anxiety, and stress subscales, with each item rated along a 4-point scale, ranging from 0 (*never*) to 3 (*almost always*). Item scores are summed to produce a subscale score, with higher scores reflecting more severe mental health problems. Internal reliability was acceptable for all subscales at each young adult age: depression: 19–20 ($\alpha = 0.89$), 23–24 ($\alpha = 0.90$), and 27–28 ($\alpha = 0.91$); anxiety: 19–20 ($\alpha = 0.77$), 23–24 ($\alpha = 0.78$), and 27–28 ($\alpha = 0.80$); stress: 19–20 ($\alpha = 0.83$), 23–24 ($\alpha = 0.83$), and 27–28 ($\alpha = 0.83$).

2.2.3 | Potential confounding factors

Potential confounders were assessed according to the modified disjunctive cause criteria, identified as pre-exposure variables that are associated with the exposure and/or outcomes, or a proxy for a potential unmeasured confounder, but unlikely to act as an instrument (associated with the outcome only via exposure; VanderWeele, 2019). These included parent family background characteristics of country of birth (either parent not born in Australia), low parental education (<year 12) and separation/divorce during the participant's childhood (ages 0–13 years). We also included participant sex, early puberty onset (menarche/voice break prior to 12 years old), and BMI at ages 12–13. Finally, to reduce the potential for reverse causality where possible (VanderWeele, 2019), elevated levels of depressive and anxiety symptoms at 13–14 years were adjusted for using the Short Mood and Feelings Questionnaire (Angold & Stephen, 1995) and the Revised Behavior Problem Checklist Short Form (RBPC; Quay & Peterson, 1987).

2.3 | Statistical analyses

All analyses were conducted in Stata 15 (StataCorp, 2017). Linear generalized estimating equations (GEEs) with an exchangeable working correlation were used to estimate associations between adolescent EDI subscales (15–16 years) and DASS subscales at young adult waves (19–20, 23–24, and 27–28 years). Models were fitted separately for each eating/body image disturbance and mental health variable relationship. For each model, analyses were estimated: (a) adjusting for outcome wave only, and (b) adjusting for all potential confounders. Fully adjusted models were then repeated by including: (c) an interaction between each eating/body image disturbance subscale and sex to examine whether associations varied between men and women, (d) an interaction between each eating/body image disturbance subscale and outcome measurement wave to examine whether associations varied across young adulthood, and (e) a 3-way interaction between eating/body image disturbance, sex, and outcome measurement wave to examine potential differential effects both across men and women, and across young adulthood.

Multiple imputation was used to handle missing data in the inferential analyses. Twenty complete datasets were imputed, based on a multivariate normal model (Lee & Carlin, 2010). Binary variables were imputed as continuous variables and then back transformed with adaptive rounding following imputation (Bernaards et al., 2007). Estimates were obtained by pooling results across the 20 imputed datasets using Rubin's rules (Rubin, 1987). Prior to inferential analyses, mental health symptoms and disordered eating subscales were standardized (z-scores), such that effect sizes are interpreted as _SD_ change in mental health outcomes for every _SD_ change in eating and body image disturbances.

3 | RESULTS

Table 1 presents the descriptive statistics for study variables. As seen, adolescent girls reported notably higher levels of drive for thinness, bulimic behavior, and body dissatisfaction than adolescent boys.

Levels of depression, anxiety, and stress across the young adulthood waves were similar for men and women.

Table 2 presents the results of the linear GEE models where DASS subscale scores were regressed onto each of the EDI subscales. After adjusting for time and potential confounders, higher drive for thinness, bulimic behavior, and body dissatisfaction scores each predicted more severe depressive (range $\beta = 0.07-0.14$), anxiety (range $\beta = 0.09-0.15$), and stress levels (range $\beta = 0.06-0.15$), independent of the young adulthood assessment timepoint.

For bulimic behavior only, effect sizes were larger in men than women for young adult depression (men $\beta = 0.25$, 95% CI $= 0.13-0.37$; women $\beta = 0.09$, 95% CI $= 0.03-0.15$), anxiety (men $\beta = 0.33$, 95% CI $= 0.22-0.44$; women $\beta = 0.07$, 95% CI $= -0.00-0.14$), and stress (men $\beta = 0.33$, 95% CI $= 0.23-0.42$; women $\beta = 0.07$, 95% CI $= 0.00-0.14$). No interaction by sex was observed for any other risk relationship.

The only evidence of interaction by wave of assessment in young adulthood was for the relationship between drive for thinness and

TABLE 1 Descriptive statistics for study variables

	Boys/men (n = 763)			Girls/women (n = 805)			Full sample (n = 1,568)		
Variable	M	95% CI	% missing	M	95% CI	% missing	M	95% CI	% missing
Eating and body image disturbances									
Drive for thinness (15–16 years)	0.78	(0.65, 0.92)	17%	3.65	(3.28, 4.02)	17%	2.25	(2.04, 2.47)	17%
Bulimia (15–16 years)	0.72	(0.60, 0.84)	17%	1.17	(1.00, 1.35)	17%	0.95	(0.84, 1.06)	17%
Body dissatisfaction (15–16 years)	1.13	(1.00, 1.26)	17%	2.36	(2.19, 2.54)	17%	1.76	(1.65, 1.88)	17%
Mental health problems									
Depression (19–20 years)	3.76	(3.41, 4.10)	34%	3.84	(3.52, 4.16)	20%	3.80	(3.57, 4.04)	27%
Depression (23–24 years)	3.23	(2.87, 3.59)	50%	3.37	(3.07, 3.67)	24%	3.32	(3.08, 3.55)	37%
Depression (27–28 years)	3.23	(2.86, 3.60)	45%	3.03	(2.75, 3.30)	25%	3.11	(2.89, 3.33)	35%
Anxiety (19–20 years)	2.54	(2.30, 2.78)	34%	2.81	(2.56, 3.07)	20%	2.69	(2.52, 2.87)	27%
Anxiety (23–24 years)	2.09	(1.83, 2.35)	50%	2.40	(2.17, 2.63)	24%	2.28	(2.11, 2.45)	37%
Anxiety (27–28 years)	1.96	(1.73, 2.19)	45%	2.07	(1.86, 2.28)	25%	2.03	(1.87, 2.18)	35%
Stress (19–20 years)	4.54	(4.23, 4.85)	34%	5.40	(5.09, 5.70)	20%	5.02	(4.80, 5.24)	27%
Stress (23–24 years)	4.57	(4.21, 4.93)	50%	5.25	(4.96, 5.54)	24%	4.98	(4.76, 5.21)	37%
Stress (27–28 years)	4.71	(4.38, 5.05)	45%	4.91	(4.64, 5.19)	25%	4.83	(4.62, 5.04)	35%
	N	%	95% CI	% missing	N	%	95% CI	% missing	N	%	95% CI	% missing
Parent												
Not born in Australia	209	29%	(26, 32%)	5%	213	27%	(24, 31%)	3%	422	28%	(26, 30%)	4%
<year 12 education	199	26%	(23, 29%)	0%	220	27%	(24, 31%)	0%	419	27%	(25, 29%)	0%
Separated/divorce	111	15%	(13, 18%)	2%	129	17%	(14, 19%)	4%	240	16%	(14, 18%)	3%
Participant												
Early onset puberty	11	2%	(1, 3%)	20%	123	18%	(16, 22%)	17%	134	10%	(9, 12%)	18%
Adolescent mental health	89	14%	(12, 17%)	17%	173	26%	(23, 30%)	18%	262	20%	(18, 23%)	18%
	M		95% CI	% missing	M		95% CI	% missing	M		95% CI	% missing
BMI (age 12–13 years)	19.25		(18.95, 19.55)	46%	19.89		(19.55, 20.23)	44%	19.58		(19.35, 19.81)	45%

Note: Adolescent mental health problems were defined as scoring either ≥11 on the SMFQ or a > 1 on the RBPC.

TABLE 2 Associations between eating and body image disturbances in adolescence (15–16 years) and changes in mental health symptoms across three waves (19–20, 23–24, 27–28 years) in young adulthood (n = 1,568)

| Predictor | Unadjusted | | | Adjusted | | | Interactions | | |
	β	95% CI	p	β	95% CI	p	Predictor × gender p	Predictor × wave p	Predictor × gender × wave p
Depressive symptoms									
Drive for thinness	0.10	(0.05, 0.15)	<.001	0.07	(0.02, 0.13)	.011	.409	.028	.885
Bulimic behavior	0.17	(0.11, 0.23)	<.001	0.14	(0.08, 0.20)	<.001	.024	.944	.097
Body dissatisfaction	0.16	(0.11, 0.21)	<.001	0.14	(0.09, 0.19)	<.001	.194	.549	.740
Anxiety symptoms									
Drive for thinness	0.11	(0.06, 0.16)	<.001	0.09	(0.03, 0.15)	.003	.645	.319	.434
Bulimic behavior	0.18	(0.12, 0.24)	<.001	0.15	(0.09, 0.21)	<.001	<.001	.406	.018
Body dissatisfaction	0.13	(0.08, 0.18)	<.001	0.11	(0.05, 0.16)	<.001	.563	.424	.248
Stress symptoms									
Drive for thinness	0.11	(0.05, 0.16)	<.001	0.06	(0.01, 0.12)	.028	.556	.064	.153
Bulimic behavior	0.18	(0.12, 0.23)	<.001	0.15	(0.09, 0.20)	<.001	<.001	.436	.009
Body dissatisfaction	0.13	(0.08, 0.18)	<.001	0.10	(0.05, 0.15)	<.001	.099	.167	.031

Note: Covariates in adjusted analyses included country of birth, low parental education (<year 12) and separation/divorce during the participant's childhood (ages 0–13 years), sex, early puberty onset (menarche/voice break prior to 12 years old), BMI at ages 12–13 years, and elevated levels of mental health problems at 13–14 years.

depression. This relationship reduced in magnitude across each time point in young adulthood, from 19–20 years ($\beta = 0.13$, 95% CI = 0.06–0.19), and 23–24 years ($\beta = 0.06$, 95% CI = −0.01–0.13), to 27–28 years ($\beta = 0.03$, 95% CI = −0.04–0.10).

For completeness, we examined whether there were three-way interactions between EDI subscale scores, participant sex, and outcome assessment wave (visualized in Figure S1). Three-way interactions emerged for bulimic behavior and body dissatisfaction on depressive symptoms, indicating that the strength of these associations at each wave was stronger in men than women (see Figure S1).

4 | DISCUSSION

Using data from one of Australia's longest running studies of social and emotional development, we found that each index of eating and body image disturbances were associated with long-term mental health sequelae in young adulthood. Young adult mental health risks associated with adolescent bulimic-behavior and body dissatisfaction remained stable across the 20s, with the longer-term mental health effects of adolescent bulimic-behavior being more pronounced in men than women. Effects of drive for thinness on mental health sequelae were also present but diminished (for depressive symptoms specifically) over time. Together, findings raise the possibility that adolescent eating and body disturbances may be an important developmental marker for long-term mental health difficulties, one that could potentially guide more targeted approaches to population mental health promotion in the teens as well as clinical practice through improved screening (particularly for men) that could likewise enhance targeting of treatment.

Findings from this study extend earlier prospective studies (Puccio et al., 2016; Puccio et al., 2017; Vannucci & Ohannessian, 2018; Vaughan & Halpern, 2010) in three important ways. First, we show that adolescent eating and body image disturbances predict mental health problems much later in young adult development than has previously been reported (Herpertz-Dahlmann et al., 2015). Second, we show that several of these relationships are no less pronounced for men than women, indicating that lower levels of eating disturbances in men do not necessarily confer lower risk of later mental health problems. This highlights the importance of intervening with and supporting both boys and girls affected by eating and body image disturbances during adolescence. Third, we show that these risk-relationships, particularly for bulimic behavior and body dissatisfaction, remain largely stable across the young adulthood years (ages 21–28 years). Taken together, we show that eating and body image disturbances in adolescence may exacerbate psychological vulnerabilities that persist well into young adult life.

Further research is now needed to clarify whether long term developmental associations reported here are causal, and if so, identify mechanisms through which risk is transmitted. A range of causal mechanisms might be at play. From a biological perspective, disordered eating in adolescence may disrupt normative developmental process across puberty, a critical period that can have a long-standing influence on later mental health (Patton & Viner, 2007). Restrictive eating has been linked with growth retardation and pubertal delay, possibly via endocrine abnormalities in key growth axes (Gianotti et al., 2002; Misra & Klibanski, 2016; Travaglini et al., 1976) and neurotransmission pathways (e.g., 5HTT) (Bailer et al., 2004; Kaye, 2008). Disrupted growth patterns, and pubertal delay, may be among a number of biological mediated pathways that increase risk for on-going mental health problems (De Onis & Branca, 2016; Tanner, 1952; Zhu & Chan, 2017). Greater understanding of such biological pathways would assist with targeting of preventive and health promotion interventions in adolescence as well as potential pharmacotherapy interventions if severity of clinical presentation warranted an extended response.

From a psychological perspective, eating and body image disturbances have long been thought to reflect attempts by young people to regulate and cope with negative emotional experiences (Haedt-Matt & Keel, 2011). When sustained, these problematic coping styles play a key role in later mental health problems (Pineles et al., 2011; Stevens, 2014) and also represent modifiable targets for both prevention and clinical intervention. From a social transition role perspective, engaging in unhealthy weight control behaviors in adolescence may also disrupt social maturation; for example, avoidance of or withdrawal from social situations that elicit concerns with eating, shape, and weight (Arcelus, Yates, & Whiteley, 2012) may hamper transitions to emerging adulthood roles and responsibilities such as finding a partner, developing new friendship networks, and taking on the role as a parent. These developmental achievements are key to later mental health and wellbeing (Schulenberg, Sameroff, & Cicchetti, 2004). Further research on mechanisms of risk transmission through this phase of the life cycle may advance targeting of population and clinical interventions in adolescence and young adulthood.

4.1 | Limitations

Despite several key strengths of this study, there are also limitations that need to be considered. Assessments of eating and body image disturbances were not conducted during middle childhood and pre-adolescence, a period within which these problems typically first emerge. This means that EDI scores in mid-adolescence likely represent a range of earlier etiological pathways, which if modelled separately may have revealed different risk relationships with later mental health difficulties. Concurrent 15–16 year old mental health problems were also not assessed. However, mental health problems at ages 13–14 were adjusted for using the developmentally appropriate SMFQ and RBCQ, ensuring that the observed mental health risks associated with adolescent EDI scores were not explained by pre-exposure mental health problems (depression/anxiety). Additionally, all variables were based on self-report. Although efficient, evidence suggests that individuals may overestimate the nature and severity of symptoms through self-report assessment (Berg, Peterson, Frazier, & Crow, 2011). Future research should investigate prospective relationships with interviewer-based assessments. Finally, while we adjusted

for a range of baseline demographic and individual factors, as with all observational studies, the potential for confounding remains. This includes confounding related to prior help-seeking, treatment history, or the presence of a clinically significant eating disorder. Extension of investigations to other cohort studies with clinical diagnostic and treatment data would be valuable, as would randomized controlled trials of clinical treatments of adolescent eating disorder that maintain long term follow-up into young adulthood.

4.2 | Implications and conclusion

Taken together, findings suggest that eating and body image disturbances in adolescence may be important factors influencing the mental health in younger adulthood, potentially highlighting the importance of investing in prevention and early intervention programs across the teenage years. Replication in other longitudinal studies is now needed; however, if similar patterns are observed, one translational outcome of this work could be to promote greater awareness of the potential long-term effects of adolescent eating and body image disturbances in healthcare and education settings. A second translational outcome might be to ensure that adolescent population monitoring systems, commonly implemented in secondary schools, include dedicated indicators of disordered eating attitudes and behaviors which could be used by policy makers, healthcare and education professionals to target potentially at-risk young people for preventive and early intervention. A third implication of this work could be to inform the development of new approaches to intervening on disordered eating attitudes and behaviors in adolescence, including the development of school based curricula (Kwag et al., 2021; Yager, Diedrichs, Ricciardelli, & Halliwell, 2013), which could be trialed in stronger study designed, and include follow-up of participants into the young adult years. A final clinical translation point could be to include systematic screening for prior adolescent eating problems when treating mental health problems in young adulthood, for example within university mental health services (Harrer et al., 2020).

ORCID

Jake Linardon https://orcid.org/0000-0003-4475-7139
Jacqui A. Macdonald https://orcid.org/0000-0001-9451-2709
Daniel Le Grange https://orcid.org/0000-0001-7293-9496

REFERENCES

Ágh, T., Kovács, G., Pawaskar, M., Supina, D., Inotai, A., & Vokó, Z. (2015). Epidemiology, health-related quality of life and economic burden of binge eating disorder: A systematic literature review. *Eating and Weight Disorders*, 20, 1–12.

Angold, A., & Stephen, C. (1995). Development of a short questionnaire for use in epidemiological studies of depression in children and adolescents. *International Journal of Methods in Psychiatric Research*, 6, 237–249.

Arcelus, J., Mitchell, A. J., Wales, J., & Nielsen, S. (2011). Mortality rates in patients with anorexia nervosa and other eating disorders: A meta-analysis of 36 studies. *Archives of General Psychiatry*, 68, 724–731.

Arcelus, J., Yates, A., & Whiteley, R. (2012). Romantic relationships, clinical and sub-clinical eating disorders: A review of the literature. *Sexual and Relationship Therapy*, 27, 147–161.

Bailer, U. F., Price, J. C., Meltzer, C. C., Mathis, C. A., Frank, G. K., Weissfeld, L., ... Barbarich, N. C. (2004). Altered 5-HT 2A receptor binding after recovery from bulimia-type anorexia nervosa: Relationships to harm avoidance and drive for thinness. *Neuropsychopharmacology*, 29, 1143–1155.

Bardone-Cone, A. M., Harney, M. B., Maldonado, C. R., Lawson, M. A., Robinson, D. P., Smith, R., & Tosh, A. (2010). Defining recovery from an eating disorder: Conceptualization, validation, and examination of psychosocial functioning and psychiatric comorbidity. *Behaviour Research and Therapy*, 48, 194–202. https://doi.org/10.1016/j.brat.2009.11.001

Berg, K. C., Peterson, C. B., Frazier, P., & Crow, S. J. (2011). Convergence of scores on the interview and questionnaire versions of the eating disorder examination: A meta-analytic review. *Psychological Assessment*, 23, 714–724. https://doi.org/10.1037/a0023246

Brown, T. A., Forney, K. J., Klein, K. M., Grillot, C., & Keel, P. K. (2020). A 30-year longitudinal study of body weight, dieting, and eating pathology across women and men from late adolescence to later midlife. *Journal of Abnormal Psychology*, 129, 376–386. https://doi.org/10.1037/abn0000519

da Luz, F. Q., Sainsbury, A., Mannan, H., Touyz, S., Mitchison, D., Girosi, F., & Hay, P. (2018). An investigation of relationships between disordered eating behaviors, weight/shape overvaluation and mood in the general population. *Appetite*, 129, 19–24.

De Onis, M., & Branca, F. (2016). Childhood stunting: A global perspective. *Maternal & Child Nutrition*, 12, 12–26.

Deloitte Access Economics. (2012). *Paying the price: The economic and social impact of eating disorders in Australia.* New South Wales:

The Butterfly Foundation. http://thebutterflyfoundation.org.au/wp-content/up

Dion, J., Blackburn, M.-E., Auclair, J., Laberge, L., Veillette, S., Gaudreault, M., … Touchette, É. (2015). Development and aetiology of body dissatisfaction in adolescent boys and girls. *International Journal of Adolescence and Youth*, 20, 151–166.

Garner, D. M., Olmstead, M. P., & Polivy, J. (1983). Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. *International Journal of Eating Disorders*, 2, 15–34.

Gianotti, L., Lanfranco, F., Ramunni, J., Destefanis, S., Ghigo, E., & Arvat, E. (2002). GH/IGF-I axis in anorexia nervosa. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 7, 94–105.

Haedt-Matt, A. A., & Keel, P. K. (2011). Revisiting the affect regulation model of binge eating: A meta-analysis of studies using ecological momentary assessment. *Psychological Bulletin*, 137, 660.

Harrer, M., Adam, S. H., Messner, E. M., Baumeister, H., Cuijpers, P., Bruffaerts, R., … Taylor, C. B. (2020). Prevention of eating disorders at universities: A systematic review and meta-analysis. *International Journal of Eating Disorders*, 53, 813–833.

Herpertz-Dahlmann, B., Dempfle, A., Konrad, K., Klasen, F., Ravens-Sieberer, U., & Group, B. S. (2015). Eating disorder symptoms do not just disappear: The implications of adolescent eating-disordered behaviour for body weight and mental health in young adulthood. *European Child & Adolescent Psychiatry*, 24, 675–684.

Kaye, W. (2008). Neurobiology of anorexia and bulimia nervosa. *Physiology & Behavior*, 94, 121–135.

Kwag, K. H., Han, S. W., Cho, J. Y., Ko, M., Park, E. J., & Kim, Y. R. (2021). A school-based eating disorder prevention program (Me, You & Us) for young adolescents in Korea: A 3-year follow-up study. *International Journal of Eating Disorders*, 54, 168–173. https://doi.org/10.1002/eat.23447

Le Grange, D., O'Connor, M., Hughes, E. K., Macdonald, J., Little, K., & Olsson, C. A. (2014). Developmental antecedents of abnormal eating attitudes and behaviors in adolescence. *International Journal of Eating Disorders*, 47, 813–824.

Linardon, J., Phillipou, A., Castle, D., Newton, R., Harrison, P., Cistullo, L. L., … Brennan, L. (2018). The relative associations of shape and weight over-evaluation, preoccupation, dissatisfaction, and fear of weight gain with measures of psychopathology: An extension study in individuals with anorexia nervosa. *Eating Behaviors*, 29, 54–58. https://doi.org/10.1016/j.eatbeh.2018.03.002

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, 33, 335–343.

Marchesi, C., Ossola, P., Tonna, M., & De Panfilis, C. (2014). The TAS-20 more likely measures negative affects rather than alexithymia itself in patients with major depression, panic disorder, eating disorders and substance use disorders. *Comprehensive Psychiatry*, 55, 972–978.

Misra, M., & Klibanski, A. (2016). Anorexia nervosa and its associated endocrinopathy in young people. *Hormone Research in Paediatrics*, 85, 147–157.

Mitchison, D., Hay, P., Griffiths, S., Murray, S. B., Bentley, C., Gratwick-Sarll, K., … Mond, J. (2017). Disentangling body image: The relative associations of overvaluation, dissatisfaction, and preoccupation with psychological distress and eating disorder behaviors in male and female adolescents. *International Journal of Eating Disorders*, 50, 118–126. https://doi.org/10.1002/eat.22592

Mitchison, D., Mond, J., Slewa-Younan, S., & Hay, P. (2013). Sex differences in health-related quality of life impairment associated with eating disorder features: A general population study. *International Journal of Eating Disorders*, 46, 375–380.

Neumark-Sztainer, D., Wall, M., Guo, J., Story, M., Haines, J., & Eisenberg, M. (2006). Obesity, disordered eating, and eating disorders

in a longitudinal study of adolescents: How do dieters fare 5 years later? *Journal of the American Dietetic Association*, 106, 559–568.

Patton, G. C., & Viner, R. (2007). Pubertal transitions in health. *The Lancet*, 369, 1130–1139.

Pineles, S. L., Mostoufi, S. M., Ready, C. B., Street, A. E., Griffin, M. G., & Resick, P. A. (2011). Trauma reactivity, avoidant coping, and PTSD symptoms: A moderating relationship? *Journal of Abnormal Psychology*, 120, 240.

Presnell, K., Stice, E., Seidel, A., & Madeley, M. C. (2009). Depression and eating pathology: Prospective reciprocal relations in adolescents. *Clinical Psychology & Psychotherapy*, 16, 357–365.

Prior, M., Sanson, A., Smart, D., & Oberklaid, F. (2000). *Pathways from infancy to adolescence: Australian Temperament Project 1983–2000*. Melbourne, Australia: Australian Institute of Family Studies.

Puccio, F., Fuller-Tyszkiewicz, M., Ong, D., & Krug, I. (2016). A systematic review and meta-analysis on the longitudinal relationship between eating pathology and depression. *International Journal of Eating Disorders*, 49, 439–454. https://doi.org/10.1002/eat.22506

Puccio, F., Fuller-Tyszkiewicz, M., Youssef, G., Mitchell, S., Byrne, M., Allen, N., & Krug, I. (2017). Longitudinal bi-directional effects of disordered eating, depression and anxiety. *European Eating Disorders Review*, 25, 351–358.

Schulenberg, J. E., Sameroff, A. J., & Cicchetti, D. (2004). The transition to adulthood as a critical juncture in the course of psychopathology and mental health. *Development and Psychopathology*, 16, 799–806.

Slater, A., & Tiggemann, M. (2011). Gender differences in adolescent sport participation, teasing, self-objectification and body image concerns. *Journal of Adolescence*, 34, 455–463.

Stevens, F. L. (2014). Affect regulation styles in avoidant and anxious attachment. *Individual Differences Research*, 12.

Stice, E., & Bearman, S. K. (2001). Body-image and eating disturbances prospectively predict increases in depressive symptoms in adolescent girls: A growth curve analysis. *Developmental Psychology*, 37, 597–607.

Stice, E., Hayward, C., Cameron, R. P., Killen, J. D., & Taylor, C. B. (2000). Body-image and eating disturbances predict onset of depression among female adolescents: A longitudinal study. *Journal of Abnormal Psychology*, 109, 438.

Stice, E., Marti, C. N., & Rohde, P. (2013). Prevalence, incidence, impairment, and course of the proposed DSM-5 eating disorder diagnoses in an 8-year prospective community study of young women. *Journal of Abnormal Psychology*, 122, 445.

Streatfeild, J., Hickson, J., Austin, S. B., Hutcheson, R., Kandel, J. S., Lampert, J. G., … Velasquez, K. (2021). Social and economic cost of eating disorders in the United States: Evidence to inform policy action. *International Journal of Eating Disorders*.

Swinbourne, J., Hunt, C., Abbott, M., Russell, J., St Clare, T., & Touyz, S. (2012). The comorbidity between eating disorders and anxiety disorders: Prevalence in an eating disorder sample and anxiety disorder sample. *Australian and New Zealand Journal of Psychiatry*, 46, 118–131. https://doi.org/10.1177/0004867411432071

Tanner, J. (1952). The assessment of growth and development in children. *Archives of Aisease in Childhood*, 27, 10.

Travaglini, P., Beck-Peccoz, P., Ferrari, C., Ambrosi, B., Paracchi, A., Severgnini, A., … Faglia, G. (1976). Some aspects of hypothalamic-pituitary function in patients with anorexia nervosa. *European Journal of Endocrinology*, 81, 252–262.

VanderWeele, T. J. (2019). Principles of confounder selection. *European Journal of Epidemiology*, 34, 211–219.

Vannucci, A., & Ohannessian, C. M. (2018). Body image dissatisfaction and anxiety trajectories during adolescence. *Journal of Clinical Child & Adolescent Psychology*, 47, 785–795.

Vaughan, C. A., & Halpern, C. T. (2010). Gender differences in depressive symptoms during adolescence: The contributions of weight-related concerns and behaviors. *Journal of Research on Adolescence*, 20, 389–419.

Yager, Z., Diedrichs, P. C., Ricciardelli, L. A., & Halliwell, E. (2013). What works in secondary schools? A systematic review of classroom-based body image programs. *Body Image*, *10*, 271–281.

Zhu, J., & Chan, Y.-M. (2017). Adult consequences of self-limited delayed puberty. *Pediatrics*, 139.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.