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The buddy system: A randomized controlled experiment of the benefits and costs of dieting in pairs

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Abstract

A total of 67 pairs of female roommates were randomized into a diet condition: (1) both ate normally; (2) one dieted, the other ate normally; and (3) both dieted. Adherence, weight loss, anxiety, depression, disordered eating symptoms, and stress were measured. Dieters lost more weight than non-dieters, but average loss was <1 pound. Pairs where both dieted reported higher anxiety, depression, and disordered eating than one-dieter pairs. Structural equation models revealed an interrelated network of stress, anxiety, depression, and disordered eating. This was weakest when one roommate dieted. The "buddy system" may not promote weight loss, but living with a non-dieting partner may buffer consequences.

Keywords

anxiety, depression, dieting, disordered eating, dyads, stress, weight loss

Introduction

Dieting has become a 60-billion-dollar industry with over 100 million adult dieters in the United States (Marketdata Enterprises Inc., 2013), and low-calorie dieting is one of the most common recommendations for weight loss and obesity prevention in general practice (Jensen et al., 2014). However, dieting may not be effective for weight loss, as the average dieter typically maintains only about 2 pounds of lost weight (Tomiyama et al., 2013). Because successful dieting is elusive, some research has investigated whether having a diet "buddy" might increase diet success. Findings from intensive long-term obesity interventions suggest that individuals lose weight when their partner also loses weight (Gorin et al., 2005). Furthermore, having at-home support partners during long-term behavioral weight-loss interventions affects weight-loss trajectories, even when at-home partners are not attempting weight loss themselves (Cornelius et al., 2016). In fact, even the popular website WebMD recommends having a diet buddy (Bouchez, 2011), and it appears that many are amenable to this idea. For example, one study found that after completing a low-calorie diet, 75 percent of dieters thought that having a buddy would help them maintain their behavior and weight loss (DePue et al., 1995).

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There is a gap in the literature, however, when it comes to empirical research investigating the buddy system in the naturalistic dieting that most individuals attempt, often after receiving a healthcare provider's recommendation.

The importance of filling this gap is compounded by the possibility that the diet buddy system may have unexpected costs in terms of psychological and psychopathological outcomes. A well-established literature has evidenced the negative consequences of dieting for individual dieters, namely, dieting increases psychological stress (Tomiyama et al., 2010), is associated with anxiety (Isomaa et al., 2010), increases depressive symptomatology (Cachelin and Regan, 2006), and perpetuates disordered eating symptomatology and is itself a risk factor for eating disorders (Fairburn and Harrison, 2003; Polivy and Herman, 2002). Perhaps, then, the social support of having a buddy might help to buffer these consequences. However, given that individuals are susceptible to the stress and strain of those around them (Westman, 2001), dieting with a buddy might intensify the stress of dieting through dyadic transmission.

This study therefore tested two types of buddy systems. We randomly assigned pairs of non-romantic cohabiting dyads (i.e. roommates) to diet together or for one roommate to diet and the other to eat normally but complete all other study activities (i.e. serve as a support partner without also endeavoring to diet). We also included a control condition where neither roommate dieted. First, this study aimed to understand whether dieting with a buddy versus dieting alone but having a non-dieting partner improved diet success in terms of low-calorie diet adherence and weight-loss outcomes. Second, it aimed to investigate whether, in either case, the buddy system might buffer or exacerbate negative psychological consequences of dieting already established in the literature—perceived stress, anxiety, depression, and disordered eating. Finally, to achieve a more integrated understanding of the potential risks associated with dieting in pairs, we built and tested a model based on the abovementioned literature demonstrating relationships among stress, anxiety, depression, and disordered eating symptomatology (see Figure 1). In particular, we tested whether perceived stress might be linked to disordered eating symptoms via depression and anxiety, both of which are often implicated in eating disorders (e.g. Casper, 1998).

Methods

Participants

Pairs of female undergraduate students were recruited from a large public university. Sample size was based on a prior dieting study (Tomiyama et al., 2010) to provide adequate power (.95). In total, 164 participants were enrolled. Of these, 30 participants (15 pairs) dropped out before completion of the study (wherein either one or both roommates decided to terminate their participation), leaving a total of 134 participants (67 pairs) with complete data (see Figure 2). Because dieting is inherently stressful (Tomiyama et al., 2010), we anticipated some dropouts, and our attrition rate is acceptable according to current guidelines (Jensen and Ryan, 2014). Additionally, dropouts did not differ at baseline on any measures (all $ps > .05$). The final sample had a mean age of 19.04 years (standard deviation [*SD*] = 1.12) and reported ethnicity as White (30.6%), Black (6.0%), Asian (32.8%), Latina (26.9%), and other (3.7%).

Procedure

The university Institutional Review Board approved all procedures. This parallel design protocol is registered on clinicaltrials.gov (NCT02898844; see Figure 2 for study flow diagram). Data were collected from September 2013 to December 2015. Participants were recruited from the Psychology subject pool and via flyers posted on campus. Inclusion criteria were living in a two-person dorm room with an eligible roommate, having a campus meal plan (to ensure equal access to food and the ability to eat together), and having indicated interest or

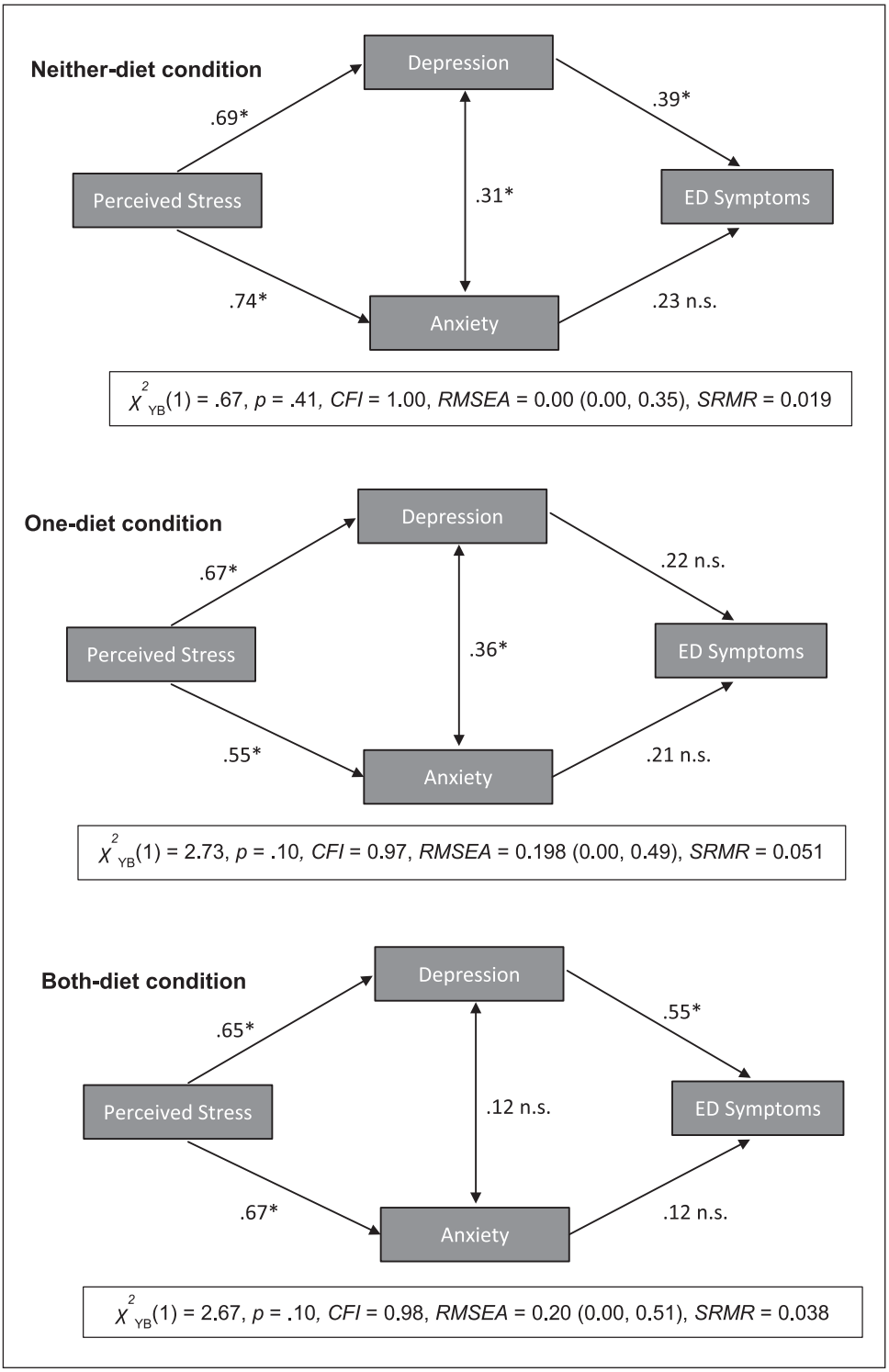

Figure 1. Structural equation models.

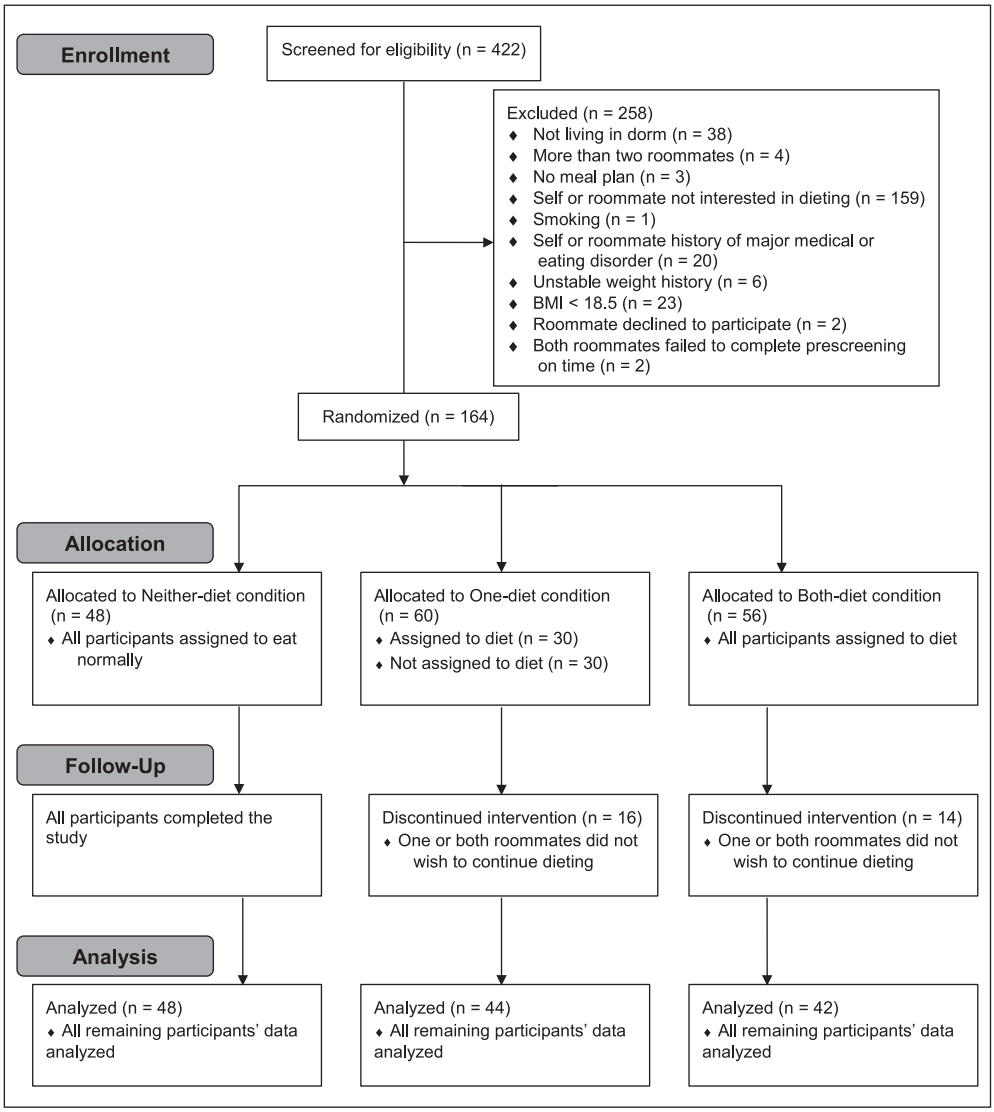

Figure 2. Participant flow diagram.

intention to diet in the coming year. Exclusion criteria were smoking, pregnancy, history of any major medical or eating disorder, unstable weight history of more than 5 kg of weight change over the previous 3 months, and a body mass index (BMI) < 18.5. After screening, eligible participants completed three laboratory visits and a three-week manipulation. Participants received US$40 or 4 credit hours prorated throughout the study to encourage adherence.

In Visit 1, informed consent was obtained from all individual participants included in the study. Participants were then weighed and completed questionnaires. In Visit 2, pairs were randomized into one of the following conditions using a pre-determined computer-generated simple randomization sequence: (1) both participants ate normally (neither-diet condition); (2) determined by coin flip, one roommate was randomly assigned to a 1200-kcal/day diet and

to monitor all calorie intake using the electronic food diary, MyFitnessPal, while the other roommate was instructed to eat normally (one-diet condition); and (3) both roommates were assigned the above diet (both-diet condition). This diet was based on one used in previous research and designed by a registered dietician (Tomiyama et al., 2010). Participants assigned to diet were trained on the MyFitnessPal platform. They were also trained to estimate serving sizes and to use the university website to obtain precise calorie counts for all food consumed in dining halls. All participants were encouraged to eat at least one meal together per day, thus ensuring salience of the dieting behavior in the latter two conditions. Because diet adherence is highest in the short term, a 3-week manipulation was chosen (Jeffery et al., 2000). Over the diet period, study personnel monitored MyFitnessPal accounts to ensure adherence. The nature of this manipulation and training made it impossible to blind participants and researchers to condition. After the diet period ended, participants returned for Visit 3, where they completed post-study measures and were debriefed. No adverse events were reported.

Measures

Anxiety. Anxiety was assessed with the state subscale of the State Trait Anxiety Inventory (Spielberger et al., 1970). Participants responded to 20 items (e.g. "I feel strained") using a four-point scale ranging from "not at all" to "very much so" ($\alpha = .85$).

Depression. Depressive symptomatology was measured by the Center for Epidemiologic Studies Depression Scale (Radloff, 1977). Participants responded to 20 items (e.g. "I felt depressed") using a four-point scale indicating the frequency of each item's occurrence ranging from "rarely" to "most or all of the time" ($\alpha = .91$). At baseline and at follow-up, participants reported on the previous week.

Disordered eating symptoms. The Eating Disorder Examination Questionnaire (Fairburn and Beglin, 1994) measured disordered eating symptoms. Participants rated the frequency of 29 thoughts and behaviors (e.g. "Have you felt fat?") on either a six-point scale ranging from "0 days" to "every day," or by responding "yes" or "no." At baseline, participants reflected on their feelings over the previous month, whereas at follow-up, they reflected on the 3-week manipulation. Because calorie restriction was inherent to the diet manipulation, in calculating the global eating disorder symptomatology score, the five dietary restraint items were excluded ($\alpha = .93$).

Perceived stress. Perceived stress was assessed using the Perceived Stress Scale (Cohen et al., 1983). Participants rated the frequency of 10 statements (e.g. "felt nervous and stressed") using a five-point Likert scale ranging from "Never" to "Very Often." Again, at baseline, participants reflected on their feelings over the previous month, whereas at follow-up, they reflected on the 3-week manipulation ($\alpha = .86$).

Weight, height, and BMI. Trained research staff measured body weight in pounds using a platform-based bioelectric impedance monitor (Tanita SC-331S, Arlington Heights, IL). Height was measured in inches using a wall-mounted stadiometer. BMI was then calculated via the standard formula: weight (lbs)/height $(\text{in})^2 * 703$. At baseline, the average BMI was 24.77 ($SD = 4.44$), and at follow-up, the average BMI was 24.78 ($SD = 4.34$).

Calorie intake. Because monitoring calorie intake can be psychologically stressful (Tomiyama et al., 2010), only participants assigned to diet tracked calories. Participants entered all liquids and foods consumed each day of the 3-week diet using the MyFitnessPal application or website.

Results

There were no baseline differences on any variables among the conditions (all $ps > .14$). See Table 1 for correlations among psychological outcomes both pre- and post-manipulation.

Table 1. Correlations among psychological outcomes.

Variable	Correlations			
	1	2	3	4
Pre-manipulation	–			
1. Perceived stress				
2. Anxiety	.49	–		
3. Depression	.64	.61	–	
4. Disordered eating symptoms (global)	.46	.49	.58	–
Post-manipulation				
1. Perceived stress	–			
2. Anxiety	.65	–		
3. Depression	.66	.61	–	
4. Disordered eating symptoms (global)	.37	.46	.54	–

All correlations are significant at the level of $p < .001$.

Aim 1: Diet adherence and weight-loss outcomes

An independent samples *t*-test revealed that dieters did lose more weight ($M = -0.52$, $SD = 4.21$) than non-dieters, who gained some weight ($M = 0.89$, $SD = 2.85$), $t(132) = 2.26$, $p = .026$. However, follow-up analyses revealed that average weight change did not differ by condition or between dieters in the one-diet condition versus the both-diet condition (see Table 2).

Aim 2: Psychological consequences of dieting

Analyses of covariance (ANCOVAs) examined differences in post-study anxiety, depression, eating disorder pathology, and perceived stress (controlling for pre-study levels) by condition as well as between only the dieters in one-diet condition versus those in the both-diet condition.[1] False discovery rate analyses (Benjamini and Hochberg, 1995) were also conducted to correct for multiple tests (see Table 3). This approach is recommended particularly for health-related research (Glickman et al., 2014). Overall, participants in the one-diet condition reported significantly lower levels of these four psychological constructs than those in the both-diet condition (see Table 2 for group means and full results).

Aim 3: Interrelatedness of psychological constructs

To investigate potential relationships among psychological constructs, structural equation models were estimated using EQS 6.2. To account for small sample sizes, models were evaluated with robust fit indices, and in the case of χ^2, the Yuan–Bentler residual based χ^2 was used as it performs well without losing any of its large sample properties (Yuan and Bentler, 1998). Model fit was determined according to conventional fit criteria and evaluated in terms of the coherence of the combined set of fit indices. For graphical displays and fit indices, see Figure 1. The model fit well in the neither-diet such that perceived stress significantly predicted both depression and anxiety, which were significantly correlated. Depression, in turn, significantly predicted disordered eating symptoms, whereas anxiety did not. The model did not fit as well in in the one-diet condition. Here, although perceived stress significantly predicted depression and anxiety, which remained significantly correlated, neither of the latter significantly predicted disordered eating symptoms. Finally, in the both-diet condition, the model fit slightly better than in the one-diet condition. Perceived stress significantly predicted depression and anxiety, but these were not correlated with each other. Depression alone predicted disordered eating symptoms.

Discussion

In a novel paradigm, this study investigated the potential costs and benefits of the "buddy system," or dieting in pairs. Although dieters in this study did lose more weight than non-dieters, participants' actual weight change was negligible (<1 pound). All dieters regardless of condition showed equal diet adherence. Additionally, results suggest that the condition

Table 2. Results of between-group comparisons.

Measure	Condition				*df*	*t* or *F*	*p*	*d* or η_p^2	95% CI	Post hoc
	Neither-diet (*n* = 48)	One-diet (*n* = 44)	One-diet: Dieters only (*n* = 22)	Both-diet (*n* = 42)						
Average daily calories			1142.68 (106.75)	1125.52 (119.54)	62	0.57	.574	*d* = .15	−43.53, 77.86	
Weight change (lbs)	0.88 (4.24)	0.43 (3.96)		−0.76 (2.32)	2.131	2.38	.096	$\eta_p^2 = .04$	−0.44, 0.81	
			−0.06 (3.68)	−0.76 (2.32)	62	0.93	.356	*d* = .23	−0.80, 2.20	
Anxiety	41.75 (8.65)	39.55 (8.02)		41.83 (9.41)	2.130	2.16	.119	$\eta_p^2 = .03$	39.80, 42.37	2 < 3*
			40.09 (7.84)	41.83 (9.41)	1.61	1.67	.201	*d* = .20	39.01, 42.71	
Depression	15.94 (10.52)	13.80 (8.72)		17.88 (10.93)	2.130	3.67	.028	$\eta_p^2 = .05$	14.57, 17.19	2 < 3*
			13.50 (8.80)	17.88 (10.93)	1.61	6.12	.016	*d* = .44	13.60, 17.60	
Disordered eating symptoms (global)	42.48 (24.92)	35.20 (20.12)		43.36 (22.40)	2.130	4.04	.020	$\eta_p^2 = .06$	38.04, 42.74	1 > 2$^+$ 2 < 3**
			38.73 (22.87)	43.36 (22.40)	1.61	0.67	.417	*d* = .20	37.89, 44. 77	
Perceived stress	26.54 (7.17)	25.89 (6.93)		26.02 (6.59)	2.130	0.23	.793	$\eta_p^2 = .004$	25.14, 27.17	
			26.82 (7.38)	26.02 (6.59)	1.61	0.10	.758	*d* = .11	24.81, 27.65	

Numbers in parentheses are standard deviations. Values reported are post-manipulation. Statistical tests control for baseline values.
*$p < .05$; **$p < .01$; $^+p = .052$.

Table 3. False discovery rate analyses.

Rank of *p*-value	Variable	Original *p*-value	Corrected threshold
All three conditions			
1	Disordered eating symptoms (global)	.020	.013
2	Depression	.028	.025
3	Anxiety	.119	.038
4	Perceived stress	.793	.050
Dieters in the one-diet versus both-diet conditions			
1	Depression	.016	.013
2	Anxiety	.201	.025
3	Disordered eating symptoms (global)	.417	.038
4	Perceived stress	.758	.050

For this false discovery rate analysis, variables are listed in rank-order of their *p*-values. Each rank is multiplied by 0.05 and divided by the number of variables in the analyses to produce a corrected threshold for determining significance (Benjamini and Hochberg, 1995).

where one roommate dieted and the other did not was associated with fewer symptoms of anxiety, depression, and disordered eating than the condition where both roommates dieted. Perhaps, the non-dieting roommate served as a support partner for the dieting roommate, while in the condition where both roommate dieted, there may have been some dyadic stress transmission (Westman, 2001), partially interrupting this buffering effect. Finally, the structural equation models found stress, anxiety, depression, and disordered eating symptoms to be interrelated. However, these relationships were weakest within the one-diet condition, further indicating that dieting in the company of a non-dieting close other may perhaps be protective.

In terms of limitations, as with all self-report behavioral data, it is possible that the participants were not truthful in their calorie tracking. Although this is the largest study using this design (i.e. non-romantic cohabiting dyads randomly assigned to diet), the sample size is somewhat modest. Additionally, this sample consists of predominantly individuals with normal-weight BMIs. It is possible that a pair-dieting paradigm may be more effective among individuals with overweight and obese BMIs (i.e. with more weight to lose). Along with that, to minimize participant burden and reactance, we did not measure physical activity, which could affect weight loss and even psychological variables. However, we employed random assignment to lessen concerns about confounds such as this, and, as mentioned above, average weight loss was quite small. Nonetheless, this study has notable strengths. We employed a novel pair-dieting paradigm and used a randomized controlled experimental design to examine real-world dieting behavior. The college dorm setting's meal-plan requirement allowed us greater consistency across conditions in terms of access to food, and we asked participants to eat at least one meal together per day to increase dieting salience. Finally, this study used mobile health technology for diet-tracking, which improves upon typical paper food diaries (Handel, 2011).

Our findings also offer novel insight into previously untested interrelationships among stress, depression, anxiety, and disordered eating symptoms. Our structural equation models are the first evidence linking these constructs in one integrated model, both in non-dieting and dieting individuals. Given the novelty of this evidence, these models could inform future research on consequences associated with the health behavior of dieting as well as eating disorder etiology and prevention. This is particularly important considering that while dieting and eating disorders are related (Fairburn and Harrison, 2003; Polivy and Herman, 2002), our findings highlight a propensity for stress to lead to disordered eating even outside the context of dieting behavior, at least in this age-group of college females. Additionally, dieting behavior may not necessarily exacerbate disordered eating, provided that it occurs in the proper social support context. Further research can use these models in other demographic groups to better understand processes underlying disordered eating symptoms and to inform preventative efforts.

In sum, although the buddy system may not improve weight-loss outcomes for dieters, it could buffer potential negative psychological

consequences of dieting, particularly if the buddy is not also dieting, but perhaps providing social support throughout the process. One potential explanation for our results may be that dieting with a buddy who is also dieting could exacerbate co-rumination, a phenomenon that has been shown to have implications for stress generation and internalizing symptoms (specifically depression), in particular among adolescent girls (Hankin et al., 2010; Rose et al., 2016). These results have important implications for the fields of health psychology and behavioral medicine, especially considering that clinicians very commonly recommend low-calorie dieting to their patients (Jensen et al., 2014). They likewise contribute meaningfully to our broader understanding of how the health behavior of dieting relates to disordered eating. Therefore, examining the influence of social relationship contexts in weight-management health behaviors and eating disorder symptomatology is critical. Future research should continue to empirically test dieting outcomes resulting from pair-dieting, including over a longer diet duration and in different types of relationships. This will allow us to identify the most maximally effective and psychologically beneficial type of buddy system to improve diet and weight-loss outcomes without undermining psychological well-being.

Author contribution

A.C.I.R developed the study concept; A.C.I.R and A.J.T. designed the protocol with D.S.; A.C.I.R. and L.C.C. oversaw data collection; A.C.I.R. and A.R. conducted data analysis under the supervision of A.J.T; A.C.I.R., L.C.C. and A.R. drafted the paper; and A.J.T. and D.S. provided critical revisions. All authors approved the final version for submission.

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Note

1. Because Aim 2 focused on understanding and identifying group differences on each of the four distinct psychological outcomes individually, we selected this approach rather than using a multivariate analysis of covariance (MANCOVA) framework.

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