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Differential Risk Factors for Unhealthy Weight Control Behaviors by Sex and Weight Status Among U.S. Adolescents

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Abstract

Purpose—To determine if previously reported risk factors for the development of unhealthy weight control behaviors differ by sex and weight status using a nationally representative longitudinal sample of adolescents followed through young adulthood.

Methods—We used nationally representative longitudinal cohort data collected from baseline (11–18 years old, 1994–1995, Wave I) and seven-year follow-up (18–24 years old, 2001–2002, Wave III) of the National Longitudinal Study of Adolescent to Adult Health (Add Health). We examined adverse childhood events and adolescent family, school, body image, and mental health factors for development of unhealthy weight control behaviors including vomiting, fasting/skipping meals, or laxative/diuretic use to lose weight at seven-year follow-up in young adulthood.

Results—Of the 14,322 included subjects, 11% reported unhealthy weight control behavior at follow-up in young adulthood, with the highest proportion (23.7%) among overweight/obese females and the lowest proportion (3.7%) among underweight/normal weight males (12.9%). All adolescent family factors were significantly associated with unhealthy weight control behaviors in underweight/normal weight females whereas none were significantly associated in overweight/obese males. Similar trends were noted for adverse childhood events and adolescent school and

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community factors. Adolescent self-perception of being overweight was associated with young adult unhealthy weight control behaviors among all subgroups.

Conclusions—Risk factors for unhealthy weight control behaviors may differ based on sex and weight status. Screening, prevention, and treatment interventions for unhealthy weight control behaviors in adolescents and young adults may need to be tailored based on sex and weight status.

Keywords

Obesity; overweight; eating behavior; eating disorders; disordered eating behaviors; adolescents; young adults; family functioning; body image

Implications and Contribution

With a nationally representative sample, this study shows that family and school factors are associated with unhealthy weight control behaviors in under/normal weight females but not in overweight/obese adolescents or in males. Prevention, screening, and treatment interventions for unhealthy weight control behaviors may need to be tailored based on sex and weight status.

Introduction

Unhealthy weight control behaviors including vomiting, fasting/skipping meals, or laxative/diuretic use to lose weight are common among adolescents and young adults [1] and are associated with increased risk for eating disorders [2, 3], alcohol and tobacco use [4], mental health problems [5], and poor nutritional intake and quality [5]. Given these potentially serious medical and psychosocial consequences, unhealthy weight control behaviors represent significant public health challenges. Although traditionally thought to be limited to underweight females, unhealthy weight control behaviors are increasingly recognized among those who are overweight or obese [6] and among males [7, 8].

Previous studies have identified various socioenvironmental risk factors for the development of unhealthy weight control behaviors such as family dysfunction and disconnectedness [6, 9], school disconnectedness [8, 10], and adverse childhood events [11]. Prior regional samples have reported that higher family functioning and parent connection were associated with lower odds of engaging in unhealthy weight control behaviors [6, 9, 12]. Furthermore, childhood physical [11] and sexual abuse [13] has been shown to be associated with the development of unhealthy weight control behaviors. Although some of these studies did examine risk by sex, they did not also disaggregate by weight status. The presentations of unhealthy weight control behaviors may differ by both sex [7] and by weight status, particularly for those who are overweight or obese [14]; however, little is known about how risk for unhealthy weight control behaviors may differ when disaggregated by both sex and weight status.

Therefore, the objective of this study was to determine differences in risk during adolescence by sex and weight status for the development of unhealthy weight control behaviors in young adulthood using a nationally representative longitudinal sample (Figure 1).

Methods

Study design and sample

The National Longitudinal Study of Adolescent to Adult Health (Add Health) has followed a nationally representative cohort of youth in the US from adolescence through adulthood [15]. The baseline sample used systematic sampling methods and implicit stratification to ensure that the high schools (n=80) and middle schools (n=52) selected were representative of US schools with respect to region of country, urbanicity, size, type, and ethnicity. For this particular study, we used the restricted-use baseline sample (Wave I), which was collected from 1994–1995 when subjects were 11–18 years old and seven-year follow-up data (Wave III), which was collected in 2001–2002 when subjects were 18–24 years old. We included subjects in the nationally representative weighted sample who had data at both baseline and seven-year follow-up (N=14,322). Further details about the Add Health study design, coordinated by the Carolina Population Center, can be found elsewhere [15]. The University of North Carolina Institutional Review Board approved all Add Health study procedures, and the University of California, San Francisco Institutional Review Board deemed this specific project exempt.

Procedures

At baseline and seven-year follow-up, an interviewer traveled to the home or another suitable location for the potential participant. Written consent was obtained from the parent if the participant was under age 18, or from the participant if 18 or older. Interviews lasted approximately 90 minutes and were conducted in as private an area as possible. Audio computer-assisted self-interview (baseline) and computer-assisted self-interview (follow-up) were used by participants to answer potentially sensitive questions.

Measures

Baseline measures—Demographic characteristics; socioenvironmental variables including family, school, and community factors; adverse childhood events; body image and weight factors; and mental health questions were collected during an in-home interview. Family factors included questions about family functioning and family connectedness. School and community factors included questions about how much adolescents felt cared for by friends, teachers, and other adults. Adverse childhood events included reports of childhood physical or sexual abuse or neglect. Body image and weight factors included weight perception (“how do you think of yourself in terms of weight?”) and if adolescents were currently trying to lose weight. Depression score was a modified version of the Center for Disease Epidemiology Depression Scale (CESD-20) [16]. A full list of measures is listed in online Appendix A.

Self-reported weight (pounds) and height (inches) were converted to kilograms and meters to calculate body mass index (BMI) using the standard formula weight (kilograms) divided by height (meters) squared ($BMI = \text{weight}/\text{height}^2$). BMI was then converted into sex- and age-specific percentiles and then classified as underweight (BMI <5th percentile), normal weight (5th percentile to less than the 85th percentile), overweight (85th to less than the 95th

percentile), or obese (95th percentile or greater) in accordance with guidelines from the US Centers for Disease Control and Prevention (CDC) [17].

Seven-year follow-up measures—Unhealthy weight control behaviors including vomiting, fasting/skipping meals, or laxative/diuretic use to lose weight in the past seven days were self-reported at seven-year follow-up during an in-home interview as the primary outcome variable [18].

Statistical analysis

Data analysis was performed in 2017 using STATA 15.0. We used Add Health's pre-constructed sample weights to provide a nationally representative sample [19, 20]. We tested unadjusted differences between adolescent risk factors and unhealthy weight control behaviors in young adulthood using Chi-square tests, disaggregated by sex and weight status. We used multiple logistic regression to identify associations between unhealthy weight control behaviors and family, school, community, adverse childhood events, and body image factors, adjusting for age, race/ethnicity, and household income [6, 9, 21]. These analyses are disaggregated by sex and weight status to identify potential differences in associations based on sex or weight category. Alpha was set at 95% confidence, and $p < 0.05$ is considered significant.

Results

Of the 18,924 adolescents in the nationally representative weighted baseline sample, 14,322 (75.7%) had seven-year follow-up data. Baseline demographic and anthropometric characteristics of the sample are reported in Table 1, disaggregated by sex and weight status. Overall, 11% reported unhealthy weight control behavior at seven-year follow-up, with the highest proportion (23.7%) among overweight or obese females and the lowest proportion (3.7%) among underweight or normal weight males (12.9%).

In unadjusted comparisons, underweight or normal weight females who reported unhealthy weight control behaviors reported lower satisfaction with family factors compared to those who did not report unhealthy weight control behaviors (Table 2). For instance, underweight or normal weight females with versus without unhealthy weight control behaviors reported lower satisfaction with their relationship with their mother (81.7% vs 86.2%, $p = 0.013$) and father (72.1% vs 81.0%, $p = 0.001$), respectively. All family factors were significantly associated with unhealthy weight control behaviors in underweight or normal weight females whereas none were significantly associated in males across all weight strata. Similar trends were noted for school and community factors (Table 2). Body image and weight concerns were associated with unhealthy weight control behaviors among all subgroups. Depressive symptoms were associated with increased odds of unhealthy weight control behaviors in females but not males.

Table 3 reports odds (adjusted odds ratios) of unhealthy weight control behaviors based on family, school and community, adverse childhood, body image, and mental health factors, while adjusting for age, race/ethnicity, and household income. Multiple logistic regression models are disaggregated by sex and weight status. Similar to unadjusted models, family,

school, and community factors are most consistently associated with unhealthy weight control behaviors in the underweight or normal weight female subgroup, but not other subgroups. For instance, female underweight or normal weight subjects reporting that their mother cared very much compared to not caring very much have 36% lower odds of development of unhealthy weight control behaviors at follow-up. Perception of being slightly or very overweight is associated with higher odds of unhealthy weight control behavior at follow-up in all subgroups ($p < 0.05$).

Discussion

In this large, nationally representative longitudinal sample, we find that family, school, and community factors are associated with unhealthy weight control behaviors only in underweight or normal weight females. These same factors are not consistently associated with unhealthy weight control behaviors among males or overweight/obese adolescents. This finding is important since prevention, screening, and treatment interventions for unhealthy weight control behaviors may need to be tailored based on sex and weight status.

Previous studies have similarly found that a positive family environment is associated with lower odds of engaging in unhealthy weight control behaviors, but these studies did not disaggregate results by baseline weight status and sex [6, 9, 12]. Two of these studies did, however, find shared risk and protective factors (including body dissatisfaction and weight concerns) for unhealthy weight control behaviors and overweight/obesity as separate outcomes.[6, 9] This research contributes to the literature by disaggregating the odds by baseline sex and weight status, finding that these associations were only present in underweight or normal weight females.

Our findings that adverse childhood events are associated with increased odds of unhealthy weight control behaviors is consistent with previous literature [11, 13], and disaggregation by sex and weight status provides additional insights. Childhood physical abuse has previously been shown to be associated with unhealthy weight control behaviors in women [11]. When disaggregating by weight and sex we find that childhood physical abuse is associated with unhealthy weight control behaviors in underweight or normal weight females and overweight or obese males in adjusted models. Prior studies that did not disaggregate by sex and weight status did not find a significant association between childhood neglect and unhealthy weight control behaviors [11]; however, when we disaggregated these groups we found that childhood neglect was associated with increased odds of unhealthy weight control behaviors in females but not in males across both weight categories.

Our study adds to this previous literature by showing that previously reported family-related associations with unhealthy weight control behaviors may be most applicable to the subset of underweight or normal weight females. In our sample and in others, overweight or obese adolescents reported higher levels of unhealthy weight control behaviors than underweight or normal weight adolescents [6, 14]. It is possible that the risk factors and etiology for unhealthy weight control behaviors among overweight or obese adolescents and in males may be different than for underweight or normal weight females.

Unhealthy weight control behaviors and eating disorders in males are typically under-recognized and therefore represent an important area of research [7, 8]. Crucially, the present results underscore the notion that results documenting the risk and maintenance of disordered eating practices in largely female populations cannot be seamlessly extrapolated to male populations, since males with unhealthy weight control behaviors may present fundamentally differently than female counterparts [7, 8, 22–25]. In this study, depressive symptoms and childhood neglect were associated with unhealthy weight control behaviors in females but not males. The only family factor protective of unhealthy weight control behavior in underweight or normal weight males was the perception that one's father cared very much. Given that most family and school factors were not significantly associated with unhealthy weight control behaviors in males across weight categories, there may be different risk factors for unhealthy weight control behaviors in this subgroup. However, it is important to note that the questions designed to assess disordered eating practices (i.e., laxative use, purging) may have been more salient for females, given that males may engage in unhealthy weight control behaviors connected to muscularity-oriented concerns, rather than thinness oriented concerns [7, 22]. Males with eating disorders may present with a greater array of psychiatric comorbidities such as substance use and psychotic symptoms than females [7, 26]. Body image concerns, including weight perception, were significantly associated with an increased odds ratio for unhealthy weight control behaviors in males. Future research may examine other specific risk factors for unhealthy weight control behaviors in underweight or normal weight males, such as certain sports with weight cutoffs (like wrestling or rowing) [22, 27, 28], sexual orientation [29, 30], substance use, and other psychiatric comorbidity [7, 26].

Limitations of this study include the use of self-reported data at baseline (including height and weight) and follow-up, a method that may be subject to reporting bias. However, self-reported height and weight have been shown to be highly correlated with objectively measured height and weight ($r=0.99$; $p<0.001$) in community samples [31]. In addition, a seven-day timeframe was used for the recall of unhealthy weight control behaviors in Add Health, which is shorter than other measures of unhealthy weight control behaviors such as the Eating Disorder Examination Questionnaire which uses a timeframe of the past 28 days [32]. This may have underestimated the rate of unhealthy weight control behaviors compared to other measures. Strengths include the use of nationally-representative longitudinal data with seven-year follow-up in a large community sample size of adolescents followed into young adulthood.

Conclusion

Risk factors for unhealthy weight control behaviors differ based on sex and weight status, with family, school, and community factors most consistently associated with unhealthy weight control behaviors in underweight or normal weight females. Although some adverse childhood events and body image concerns were associated with unhealthy weight control behaviors in underweight or normal weight males and overweight or obese females, future research may better delineate risk factors for unhealthy weight control behaviors in overweight or obese adolescents and in males. Screening, prevention, and treatment interventions for unhealthy weight control behaviors in adolescents and young adults may

need to be tailored based on sex and weight status to address these major public health challenges.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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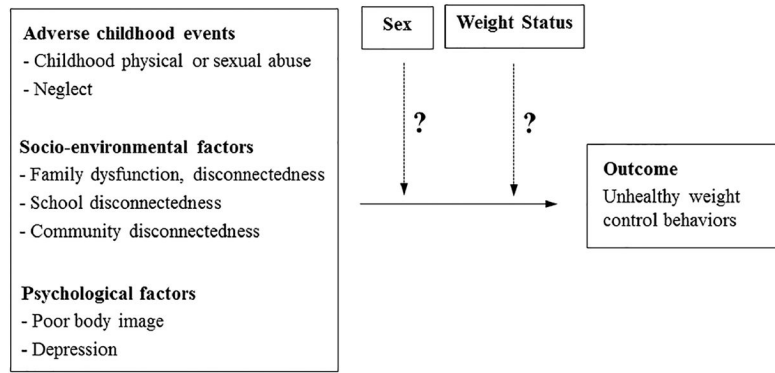


Figure 1. Conceptual framework for how adverse childhood events and adolescent socio-environmental and psychological factors may predict young adult unhealthy weight control behaviors differently by sex and weight status.

Table 1

Baseline demographic and anthropometric characteristics and outcome at seven-year follow up, by sex and baseline weight status

	n ^d	Total	Underweight or normal weight		Overweight or obese	
			Female	Male	Female	Male
N	14,322	14,322	5,598	4,798	1,965	1,961
Total		Mean ± SE / % ^b	Mean ± SE / % ^b	Mean ± SE / % ^b	Mean ± SE / % ^b	Mean ± SE / % ^b
Demographic characteristics						
Age	14,314	15.94 ± 0.12	15.89 ± 0.12	16.08 ± 0.12	15.80 ± 0.14	15.88 ± 0.14
Race/ethnicity	14,312					
White (non-Hispanic)		67.9%	72.2%	68.6%	58.0%	64.6%
Black/African American (non-Hispanic)		15.5%	12.8%	14.8%	24.6%	16.0%
Hispanic/Latino		11.8%	10.3%	11.5%	14.9%	13.9%
Asian/Pacific Islander (non-Hispanic)		3.4%	3.8%	4.0%	1.4%	3.1%
American Indian/Native American		0.5%	0.4%	0.3%	0.8%	1.5%
Other		0.8%	0.7%	0.9%	0.3%	1.0%
Household income, (thousands of dollars, parent report)	10,830	45.74 ± 1.68	49.23 ± 2.18	47.50 ± 2.05	39.03 ± 1.85	38.92 ± 1.23
Baseline anthropometric characteristics						
Body mass index (BMI), kg/m ²	13,942	22.47 ± 0.11	20.35 ± 0.06	20.53 ± 0.09	28.58 ± 0.15	28.21 ± 0.19
Outcome variable						
Unhealthy weight control behavior	14,322	11.0%	12.9%	3.7%	23.7%	12.6%

^a Group n may not sum to total N because of missing data

^b All means and percentages are calculated with weighted data to reflect the representative proportion in the target U.S. population

Table 2

Unadjusted adolescent risk factors for unhealthy weight control behaviors (UWCB) in young adulthood, by sex and weight status

	Unhealthy weight control behaviors											
	Underweight or normal weight at baseline					Overweight or obese at baseline						
	Female		Male			Female		Male				
	No UWCB	UWCB	p ^d	No UWCB	UWCB	p ^d	No UWCB	UWCB	p ^d	No UWCB	UWCB	p ^d
Family factors												
Mother cares (very much)	89.5 %	86.0 %	0.029	91.2 %	91.5 %	0.945	87.0 %	84.0 %	0.222	89.7 %	89.1 %	0.853
Mother communication (satisfied)	76.5 %	69.7 %	0.005	83.1 %	83.5 %	0.925	77.2 %	73.7 %	0.264	86.4 %	87.0 %	0.877
Satisfied with relationship with mother (satisfied)	86.2 %	81.7 %	0.013	91.7 %	90.9 %	0.917	84.4 %	82.4 %	0.450	93.4 %	92.6 %	0.749
Father cares (very much)	83.7 %	78.2 %	0.020	83.3 %	77.7 %	0.198	80.9 %	83.4 %	0.413	81.6 %	85.5 %	0.456
Father communication (satisfied)	73.8 %	67.0 %	0.022	79.5 %	76.5 %	0.550	72.3 %	66.8 %	0.183	80.8 %	78.2 %	0.573
Satisfied with relationship with father (satisfied)	81.0 %	72.1 %	0.001	86.1 %	81.1 %	0.240	77.3 %	72.1 %	0.111	86.8 %	84.2 %	0.511
Parents care (very much)	86.9 %	80.6 %	<0.001	84.6 %	85.2 %	0.886	83.0 %	81.8 %	0.654	86.4 %	84.5 %	0.508
Family understands (quite a bit / very much)	55.0 %	45.5 %	<0.001	56.9 %	56.5 %	0.915	49.8 %	48.5 %	0.710	61.6 %	59.0 %	0.608
Family pays attention (quite a bit / very much)	71.9 %	57.5 %	<0.001	72.9 %	68.9 %	0.380	66.2 %	59.2 %	0.023	73.3 %	66.9 %	0.142
Family has fun (quite a bit / very much)	62.7 %	51.6 %	<0.001	61.5 %	63.3 %	0.689	61.4 %	57.5 %	0.246	67.0 %	66.2 %	0.854
Want to leave home (very much)	5.7 %	9.3 %	0.003	6.0 %	8.2 %	0.344	9.1 %	9.7 %	0.794	4.5 %	5.6 %	0.592
School and community factors												
Adults care (very much)	61.5 %	53.4 %	0.002	51.0 %	44.9 %	0.236	58.4 %	55.1 %	0.353	52.3 %	59.7 %	0.146
Teachers care (very much)	19.4 %	13.4 %	0.004	17.1 %	16.8 %	0.928	19.2 %	16.7 %	0.368	17.9 %	19.5 %	0.689
Friends care (very much)	54.8 %	48.8 %	0.049	36.8 %	28.5 %	0.052	49.2 %	45.3 %	0.240	34.0 %	35.4 %	0.730
Happy at school (agree / strongly agree)	66.9 %	59.4 %	0.003	67.4 %	64.2 %	0.513	63.0 %	60.8 %	0.532	69.2 %	68.7 %	0.896
Adverse childhood events												
Any physical abuse	24.4 %	36.3 %	<0.001	29.0 %	41.4 %	0.017	29.0 %	32.6 %	0.279	29.8 %	37.3 %	0.133
Any sexual abuse	4.4 %	4.7 %	0.799	3.9 %	6.5 %	0.201	4.4 %	6.9 %	0.110	5.7 %	5.2 %	0.842
Any neglect	35.8 %	45.2 %	<0.001	43.8 %	51.0 %	0.213	37.7 %	48.1 %	0.006	41.3 %	41.5 %	0.967
Basic needs (food, clothing, keeping clean) not met	7.9 %	9.4 %	0.341	13.7 %	18.5 %	0.149	9.2 %	15.0 %	0.004	15.6 %	19.7 %	0.265
Body image and weight concerns												

Table 3
Adjusted adolescent risk factors for unhealthy weight control behaviors in young adulthood, by sex and weight status

	Unhealthy weight control behaviors		p	Male		p	Overweight or obese at baseline		p	Male	
	Underweight or normal weight at baseline	Female		OR	OR		Female	OR		OR	OR
Family factors											
Mother cares	0.74		0.050	1.01	0.989		0.70	0.104		1.12	0.816
Satisfied with mother's communication	0.65		0.001	0.96	0.897		0.79	0.242		1.14	0.716
Satisfied with relationship with mother	0.69		0.018	1.09	0.839		0.79	0.293		1.10	0.839
Father cares	0.64		0.007	0.54	0.035		1.05	0.854		1.57	0.343
Satisfied with father's communication	0.74		0.002	0.67	0.246		0.67	0.072		0.93	0.813
Satisfied with relationship with father	0.64		0.009	0.58	0.569		0.59	0.010		0.80	0.511
Parents care	0.63		0.001	0.76	0.397		0.73	0.131		0.74	0.239
Family understands	0.65		<0.001	0.99	0.944		0.90	0.543		0.86	0.528
Family pays attention	0.50		<0.001	0.79	0.373		0.64	0.008		0.75	0.230
Family has fun	0.69		0.001	0.92	0.698		0.73	0.048		0.84	0.449
Want to leave home	1.92		0.002	1.60	0.261		1.26	0.436		1.29	0.582
School and community factors											
Adults care	0.73		0.012	0.68	0.115		0.88	0.445		1.27	0.308
Teachers care	0.66		0.016	0.64	0.202		0.82	0.380		1.11	0.676
Friends care	0.83		0.178	0.68	0.103		0.77	0.111		0.99	0.977
Happy at school	0.76		0.025	0.86	0.554		0.85	0.335		0.83	0.408
Adverse childhood events											
Any physical abuse	1.76		<0.001	1.45	0.150		1.22	0.265		1.63	0.037
Any sexual abuse	1.27		0.361	1.18	0.769		1.85	0.108		0.73	0.573
Neglect	1.54		0.002	0.98	0.928		1.65	0.004		1.08	0.710
Basic needs not met	1.37		0.165	1.09	0.796		1.73	0.014		1.41	0.245
Body image and weight concerns											
Weight perception	1.88		<0.001	3.25	<0.001		1.96	0.009		1.58	0.034

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	Unhealthy weight control behaviors		Overweight or obese at baseline	
	Female	Male	Female	Male
	OR	OR	OR	OR
	p	p	p	p
Trying to lose weight	2.47	<0.001	1.62	1.35
Mental health				
Depressive symptoms	1.65	<0.001	1.58	1.23
		0.232	0.006	0.482

Bold indicates p-value <0.05

^aOR = odds ratio, adjusted for age, race/ethnicity, and household income