



Original Contribution

Weight Change and Depression Among US Young Women During the Transition to Adulthood

Michelle L. Frisco*, Jason N. Houle, and Adam M. Lippert

* Correspondence to Dr. Michelle L. Frisco, Department of Sociology and Population Research Institute, The Pennsylvania State University, 211 Oswald Tower, University Park, PA 16802 (e-mail: mlfrisco@gmail.com).

Initially submitted August 6, 2012; accepted for publication November 8, 2012.

By using data from wave 2 (in 1996) and wave 3 (in 2000–2001) of the US-based National Longitudinal Study of Adolescent Health, we investigated the association between young women's body weight and depression during the transition to adulthood. Respondents ($n = 5,243$) were 13–18 years of age during wave 2 and 19–25 years of age during wave 3. We used Center for Epidemiologic Studies Depression Scale scores to classify young women as never depressed, consistently depressed, experiencing depression onset, or experiencing depression recovery from wave 2 to wave 3. Results from adjusted multinomial logistic regression models indicated that respondents who experienced significant weight gain were at risk of depression onset. Normal weight (adjusted odds ratio = 2.10, 95% confidence interval: 1.14, 3.84) and overweight (adjusted odds ratio = 1.86, 95% confidence interval: 1.15, 2.99) adolescent girls who were obese by young adulthood, as well as young women who were consistently obese during adolescence and young adulthood (adjusted odds ratio = 1.97, 95% confidence interval: 1.19, 3.26), had roughly twice the odds of depression onset as did young women who were never overweight. We concluded that weight gain and obesity are risk factors for depression onset during the transition to adulthood. Policies prioritizing healthy weight maintenance may help improve young women's mental health as they begin their adult lives.

body weight changes; depression; mental health; obesity; weight gain

Abbreviations: BMI, body mass index; CES-D, Center for Epidemiologic Studies Depression Scale.

Most adult mental health disorders first manifest during adolescence and early adulthood, and nearly 75% of lifetime diagnosable problems are evident by 24 years of age (1). Depression, the most commonly reported adolescent mental health disorder (2), is more prevalent in female than male adolescents, and this gender difference persists into adulthood (3). Estimates of depression prevalence based on broad assessment criteria indicating debilitating sadness suggest that roughly one-third of all female US high school students are depressed compared with one-fifth of male students (4). Estimates based on the *Diagnostic and Statistical Manual of Mental Disorders-IV* are lower and suggest that 12% of female and 5% of male adolescents are depressed (5).

Previous research has examined whether body weight is a risk factor for depression among all adolescents and among

female adolescents in particular, because obesity is a stigmatized status that can lead to social isolation and discrimination (6, 7). These studies have produced mixed findings (8). Among clinical adolescent samples, obesity is a risk factor for depression (9–11). Among representative national and community samples of adolescents, obesity is generally not associated with depression (12, 13), especially in studies that adjust estimates for confounders (14, 15). Even longitudinal studies that examine how adolescent obesity at baseline predicts depression 1 year later produce modest (16) or null (12) findings.

Although representative studies have found little evidence that obesity is a risk factor among all adolescents, this relationship has been found among national samples of younger adolescents. Studies have found that, among students in 7th

and 8th grades, body mass index (BMI) (weight (kg)/height (m)²) was associated with depression (17), and that, among children aged 12–14 years, those who were classified as obese or overweight according to age- and sex-specific BMI percentiles were also at greater risk of depression (15). Weight gain during pubertal development has also been associated with depression among adolescent girls (18). Although these subgroups are slightly different, they are all samples of younger adolescents who are in the process of transitioning from childhood to adolescence.

In sum, prior research suggests that weight is not a risk factor for depression among all adolescents. Instead, it is a risk factor during the transition into adolescence. Previous studies have not examined whether weight is also associated with depression as young people transition out of adolescence, a life course stage commonly referred to as the “transition to adulthood” (19). During this time, young people undergo many life changes, including high school exit and entrance into the labor force or postsecondary educational institutions (18). Young women are also more likely than their male peers to exit parental residences, enter cohabiting and marital unions, and become parents (20). Weight gain and continued obesity in the midst of these transitions may be particularly stigmatizing and distressing because these life events place young women in new social settings and networks at a time when social relationships undergo extensive transformation (21). This leads us to hypothesize that obesity and weight gain may be associated with depression as young women transition to adulthood. To our knowledge, this is the first study to assess whether weight and weight change during the transition to adulthood influence the development of, recovery from, and “consistent” depression measured at 2 distinct time points.

MATERIALS AND METHODS

Data for the study were drawn from the restricted-use version of the National Longitudinal Study of Adolescent Health (hereafter referred to as “Add Health”), a longitudinal, nationally representative survey of students in the 7th–12th grades from 134 schools (22). Respondents were selected from a stratified random sample of students. Four waves of in-home survey data were collected in 1995 (wave 1), 1996 (wave 2), 2000–2001 (wave 3), and 2008 (wave 4). The response rate to the wave-1 survey was 79% ($n = 20,745$). During wave 2, the 12th-grade students from wave 1 were not followed up, and the response rate among followed-up respondents was quite high (88.6%, $n = 16,706$). It remained high in wave 3 (77.4%, $n = 15,197$) and wave 4 (80.3%, $n = 15,701$) (23). We analyzed data from survey participants in waves 2 and 3 who were adolescents (aged 13–18 years) in wave 2 and young adults (aged 19–25 years) in wave 3. We used wave 2 rather than wave 1 to capture adolescence because wave 2 included interviewer-measured assessments of respondents’ height and weight; wave 1 did not (data are self-reported).

Of the 15,197 wave-3 respondents, 8,030 were young women. We retained female respondents in the analysis if they were ≤ 18 years of age in wave 2 ($n = 7,061$) and > 18 years of age in wave 3 ($n = 5,695$). This ensured that we were

estimating associations between weight (and weight change) and depression between adolescence and early adulthood. This sample selection strategy has been used in a study that uses Add Health data to estimate weight gain and stability during the transition to adulthood (24). We excluded women who were pregnant during either the wave-2 interview or the wave-3 interview ($n = 447$) because their estimated weight classifications while pregnant would be biased by pregnancy weight gain, leading to potential misclassification of body weight change during the transition to adulthood. The final sample included 5,243 young women aged 13–18 years in 1996 and 19–25 years in 2000–2001.

Measures

Depression change. Waves 2 and 3 of the Add Health included modified versions of the Center for Epidemiologic Studies Depression Scale (CES-D) (25). Wave 2 included a 19-item version of the instrument and wave 3 included a 9-item version. Modified, shortened forms of the CES-D are commonly used by researchers (26–28), and versions that use as few as 4 items are reliable (27). Because we were interested in changes in symptomatology, we created comparable indicators of depressive symptoms in waves 2 and 3 by summing responses (ranging from 0 to 3) from the 9 CES-D items found in both the wave-2 and wave-3 surveys. Items asked respondents how often in the last week they were bothered by things not normally bothersome, could not shake the blues, felt like they were not as good as others, had trouble focusing, were depressed, were too tired to do things they enjoyed, and were sad. Higher scores (range, 0–27) indicated more depressive symptoms (in wave 2, $\alpha = 0.78$; in wave 3, $\alpha = 0.80$). Young women with scores of 11 or higher were classified as depressed. Previous research that used the 9-item scale has indicated that scores of this magnitude predict a diagnostic definition of depression for female respondents (29, 30). Other studies have used lower scores on the 9-item scale to signify depression—either 10 or a score that was 1 standard deviation above the mean (15, 31, 32). We tested the sensitivity of study results to these cutoffs, and results were consistent across all of them.

Wave-2 and wave-3 depression indicators were used to create a 4-category variable signifying depression during adolescence and early adulthood. Respondents were classified as never depressed (not depressed in either wave 2 or 3), consistently depressed (depressed in both waves 2 and 3), recovered from depression (depressed in wave 2 but not in wave 3), or as experiencing depression onset (depressed in wave 3 but not in wave 2). Category names are used for brevity only; they are not clinical assessments, and these classifications capture depression at 2 time points only, not possible bouts of depression or recovery between the survey waves.

Body weight change. Early adult BMI scores are based on interviewer-measured height and weight data collected in wave 3. We used calculated BMI scores to classify young women as not overweight (BMI < 25), overweight (BMI ≥ 25 to < 30), or obese (BMI ≥ 30).

For adolescent subjects, we used wave-2 height and weight data to calculate age- and sex-specific BMI percentiles according to guidelines of the US Centers for Disease Control

and Prevention (Atlanta, Georgia). We then classified young women as not overweight, overweight, or obese by using guidelines of the International Obesity Taskforce (London, United Kingdom) for matching adolescent BMI percentiles to adult BMI scores. After this conversion, we classified adolescents as not overweight, overweight, or obese by using the guidelines for adults (33). This approach accounted for the discrepancy in assessments of overweight and obesity for adolescents and adults and has been used in prior studies that examined weight gain during the transition to adulthood (24). Results from supplementary analyses that did not transform adolescent BMI percentiles to adult BMI scores before classifying respondents into weight categories are consistent with the results presented here.

We used adolescent and early adult weight categories to classify young women as never overweight (referent), consistently overweight, consistently obese, or as weight losers or weight gainers. Weight gainers were further decomposed into categories indicating a transition from normal weight to overweight, from normal weight to obese, or from overweight to obese. Weight losers were not decomposed because few sample members (3.7%) lost weight.

Covariates. Several variables were treated as confounders because of their relationships with body weight and depression. These included race/ethnicity (non-Hispanic black, Hispanic, and “other” vs. the referent, non-Hispanic white); nativity; age; total family income; parents’ highest level of education measured as a continuous variable ranging from 1 (no formal schooling) to 8 (graduate/professional school); family structure (living in single-parent, step-parent, or other type of household vs. living in a household with 2 biological/adoptive parents); fair/poor self-reported health; physical activity (i.e., frequency of activities such as jogging, walking, and dancing in the past week); and whether women were ever pregnant prior to wave 2 or between waves 2 and 3. All covariates were constructed by using wave-2 data except for family income, which was assessed at wave 1 only, and pregnancy data, which were retrospectively reported by women.

Data analysis

All variables had missing data for 5% or fewer cases, with the exception of family income (22% of cases). When omitting cases with missing data on any variable, we lost roughly 30% of the sample, and the retained sample was not representative of the Add Health’s wave-3 female respondents on key variables, including depression and weight gain.

The use of multiple imputation to handle missing data is more efficient and less biased than the use of listwise deletion (34). Given the sample selection bias that listwise deletion produced, we multiply imputed missing data by using the imputation for changed equations (ICE) procedure for Stata, version 12.0, software (StataCorp LP, College Station, Texas). The procedure iteratively replaces missing values on all variables with predictions based on random draws from the posterior distributions of parameters observed in the sample, creating multiple complete data sets (35). We averaged empirical results across 5 imputation samples and accounted for random variation across samples to calculate standard errors (36). In supplementary analysis, we estimated statisti-

cal models on the sample observed after listwise deletion of missing data. Results were similar to those shown here, but estimates here are slightly more conservative. These results also better represent the national sample of female Add Health participants.

All statistical analyses were conducted by using Stata, version 12.0, software (StataCorp LP). Survey commands were used to weight estimates and to account for the Add Health survey design. We first calculated weighted means and proportions for study variables to show characteristics of the total sample and of young women in different weight categories (Table 1). We then used multinomial logistic-regression models to estimate unadjusted odds ratios, adjusted odds ratios, and 95% confidence intervals that show how weight change is related to changes in depression between adolescence and early adulthood (Table 2).

RESULTS

Table 1 describes the study sample’s characteristics. Most young women were never depressed during the transition to adulthood (77.6%). Among young women with some depression incidence, 4.2% were depressed during adolescence and early adulthood, 11.1% recovered from depression by early adulthood, and 7.0% experienced depression onset by early adulthood. With respect to weight change, 51.4% of the sample was never overweight. Another 20% was not overweight during adolescence, but three-quarters of these young women were overweight by early adulthood and the other 25% were obese. Consistently overweight young women represented 6.2% of the sample, and 8.9% of young women transitioned from overweight to obese. Nearly 10% of young women were obese during adolescence and early adulthood. The smallest proportion of young women included those who lost enough weight to be classified into a lower BMI category (3.7%). Sociodemographic characteristics of the sample show that 68.5% of the included subjects were non-Hispanic white, 94.3% were US natives, 57.3% lived with both parents during adolescence, the average level of parental education was slightly more than high school, and families’ average yearly income in 1994–1995 was \$46,600. Only 7% of young women reported fair/poor health. On average, young women reported participating in physical activities infrequently (1.7 times per week), and 30% reported at least 1 pregnancy between waves 2 and 3 or prior to wave 2.

Young women’s characteristics varied across weight categories. With respect to depression, a greater proportion of young women who were never overweight (80.0%), consistently overweight (80.6%), and classified as weight losers (81%) were never depressed compared with peers who were obese during adolescence and early adulthood (70.0%) and those who became obese by early adulthood (72.2% of those who were not overweight during adolescence and 70.6% of those who were overweight). Consistent depression during the transition to adulthood was most common among consistently obese young women (7.1%) and least common among those who were never overweight (3.5%). Consistently obese young women (10.2%) and those who became obese (11.5%

Table 1. Characteristics^a of the Total Sample and of Young Women^b With Different Weight Change Experiences During the Transition to Adulthood in the National Longitudinal Study of Adolescent Health, Wave 2 (in 1996) and Wave 3 (in 2001–2002)

Characteristic	Full Sample (n = 5,243)		Never Overweight ^c (n = 2,694)		Consistently Overweight ^d (n = 325)		Consistently Obese ^e (n = 514)		Not Overweight to Overweight ^f (n = 792)		Not Overweight to Obese ^g (n = 257)		Overweight to Obese ^h (n = 467)		Lost Weight ⁱ (n = 194)		
	No. in Each Category	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)		
Depression																	
Never depressed	4,069	77.6		80.0		80.6		70.0		78.4		72.2		70.6		81.0	
Consistently depressed	225	4.3		3.5		4.5		7.1		4.2		4.4		4.8		5.0	
Depression onset	367	7.0		5.6		6.0		10.2		7.0		11.5		9.8		7.7	
Depression recovery	582	11.1		10.9		9.0		12.8		10.4		11.9		14.8		6.3	
Sociodemographic characteristics																	
Age in wave 2, years			15.7 (1.4)		15.7 (1.8)		15.3 (1.9)		15.9 (1.9)		15.8 (1.9)		16.1 (1.8)		15.7 (2.0)		15.2 (2.1)
Race/ethnicity																	
Black	828	15.8		10.7		24.8		24.9		17.8		19.6		23.7		15.3	
Hispanic	619	11.8		10.1		17.8		14.7		10.7		14.5		13.5		14.1	
White	3,592	68.5		74.0		55.7		59.4		68.2		62.5		59.4		69.2	
Other	204	3.9		5.2		1.7		1.1		3.3		3.4		3.5		1.8	
US born	4,944	94.3		93.0		95.2		97.3		95.1		95.2		97.0		90.5	
Parental income in wave 1 ^j , US dollars (in 1,000s)			46.6 (45.7)		51.3 (71.1)		40.6 (55.5)		38.8 (59.3)		44.6 (54.4)		39.6 (41.8)		42.7 (86.8)		40.4 (57.2)
Parental education in wave 2 ^k			5.3 (1.6)		5.6 (2.25)		5.2 (2.2)		5.0 (2.3)		5.3 (2.2)		5.0 (2.2)		5.0 (2.2)		5.1 (2.3)
Family structure in wave 2																	
Single-parent household	1,159	22.1		19.6		26.1		27.7		21.3		24.9		27.4		22.3	
Step-parent household	849	16.2		17.0		14.7		10.5		17.9		17.3		16.8		12.7	
Two-parent household	3,004	57.3		59.8		55.6		56.5		54.3		52.3		52.5		58.2	
Other	231	4.4		3.6		3.6		5.3		6.5		5.5		3.3		6.8	
Health and health-related behavior																	
Fair/poor self-rated health in wave 2	367	7.0		5.2		5.5		17.4		5.3		8.2		7.5		9.2	
Weekly exercise in wave 2, days/week			1.7 (0.9)		1.7 (1.3)		1.8 (1.3)		1.6 (1.3)		1.7 (1.3)		1.7 (1.3)		1.7 (1.3)		1.7 (1.2)
Ever pregnant (1 = yes)	1,573	30.0		25.7		27.8		35.5		34.1		47.9		34.6		26.3	

Abbreviation: SD, standard deviation.

^a Analyses are weighted to account for survey design.^b Participants were aged 13–18 years in wave 2 and 19–25 years in wave 3.^c Participants who were not overweight or obese in waves 2 and 3.^d Participants who were overweight in both waves 2 and 3.^e Participants who were obese in both waves 2 and 3.^f Participants who were not overweight in wave 2 and were overweight in wave 3.^g Participants who were not overweight in wave 2 and were obese in wave 3.^h Participants who were overweight in wave 2 and obese in wave 3.ⁱ Participants who lost weight between wave 2 and wave 3.^j Wave 1 was conducted in 1995.^k An ordinal indicator of the highest educational level of parents ranging from a low of 1 (no formal schooling) to a high of 8 (graduate/professional school).

Table 2. Multinomial Logistic Regression Models^a of the Association Between Weight Change and Depression Change Among Young Women^b During the Transition to Adulthood, National Longitudinal Study of Adolescent Health, Wave 2 (in 1996) to Wave 3 (in 2000–2001)

	Depression Recovery ^{c,d} (n = 582)				Depression Onset ^{c,e} (n = 367)				Consistent Depression ^{c,f} (n = 225)			
	Model 1 ^g		Model 2 ^h		Model 1 ^g		Model 2 ^h		Model 1 ^g		Model 2 ^h	
	OR	95% CI	Adjusted OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Weight change between waves 2 and 3												
Never overweight	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
Consistently overweight	0.82	0.49, 1.36	0.78	0.47, 1.30	1.06	0.60, 1.87	0.97	0.54, 1.74	1.27	0.55, 2.96	1.16	0.48, 2.05
Consistently obese	1.34	0.92, 1.95	0.98	0.66, 1.45	2.06**	1.28, 3.31	1.97**	1.19, 3.26	2.31**	1.32, 4.05	1.61	0.86, 3.02
Weight gain												
Not overweight to overweight	0.97	0.69, 1.36	0.87	0.61, 1.23	1.27	0.83, 1.96	1.22	0.79, 1.89	1.22	0.71, 2.13	1.04	0.59, 1.82
Not overweight to obese	1.21	0.76, 1.93	0.89	0.55, 1.46	2.26**	1.24, 4.09	2.10*	1.14, 3.84	1.40	0.67, 2.94	0.95	0.44, 2.05
Overweight to obese	1.54*	1.05, 2.25	1.34	0.90, 2.00	1.97**	1.24, 3.14	1.86*	1.15, 2.99	1.54	0.80, 2.96	1.23	0.63, 2.39
Weight loss												
	0.57	0.27, 1.19	0.52	0.24, 1.11	1.36	0.68, 2.70	1.22	0.61, 2.46	1.38	0.56, 3.39	1.27	0.52, 3.13
Sociodemographic characteristics												
Age in wave 2, years			1.10*	1.02, 1.19			0.91	0.83, 1.01			1.07	0.94, 1.21
Race/ethnicity												
White	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent	1.00	Referent
Black			1.03	0.76, 1.40			1.08	0.75, 1.56			0.89	0.53, 1.49
Hispanic			1.28	0.87, 1.88			0.94	0.60, 1.48			1.94*	1.13, 3.33
Other			1.41	0.86, 2.32			1.09	0.51, 2.35			2.60*	1.23, 5.52
US born			0.85	0.52, 1.40			0.59	0.31, 1.13			2.78*	1.01, 7.67
Parental income in wave 1 ⁱ , US dollars (in 1,000s)			1.00	0.99, 1.00			1.00	0.99, 1.00			1.00	0.99, 1.01
Parental education ^j in wave 2			0.95	0.88, 1.02			0.96	0.88, 1.06			0.90	0.79, 1.03
Family structure in wave 2												
Two-parent household			1.00	Referent			1.00	Referent			1.00	Referent
Single-parent household			2.12**	1.58, 2.84			1.43	0.97, 2.11			1.91**	1.17, 3.12
Step-parent household			1.64**	1.19, 2.25			1.62*	1.10, 2.38			1.58	0.97, 2.58
Other household			1.47	0.85, 2.53			1.77	0.99, 3.14			1.28	0.54, 2.99
Health and health-related behavior												
Fair/poor self-rated health in wave 2			3.85**	2.69, 4.50			1.40	0.75, 2.62			3.89**	2.23, 6.79

Table continues

Table 2. Continued

	Depression Recovery ^{a,d} (n = 582)			Depression Onset ^{e,g} (n = 367)			Consistent Depression ^{c,f} (n = 225)			
	Model 1 ^g		Model 2 ^h	Model 1 ^g		Model 2 ^h	Model 1 ^g		Model 2 ^h	
	OR	95% CI	Adjusted OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Weekly exercise ^k in wave 2			0.93	0.83, 1.05					0.92	0.77, 1.11
Ever pregnant (1 = yes)			1.75**	1.37, 2.34			1.07	0.93, 1.24	2.35**	1.55, 3.57

Abbreviations: CI, confidence interval; OR, odds ratio.

* $P < 0.05$; ** $P < 0.01$ (2-sided).

^a Analyses are weighted to account for survey design.

^b Sample size was 5,243 women aged 13–18 years in wave 2 and 19–25 years in wave 3.

^c The referent group was “never depressed” (i.e., not depressed in waves 2 and 3).

^d Participants who were depressed in wave 2 and not depressed in wave 3.

^e Participants who were not depressed in wave 2 and depressed in wave 3.

^f Participants who were depressed in both waves 2 and 3.

^g Model 1 includes weight change only.

^h Model 2 adjusts estimates for confounders.

ⁱ Wave 1 was conducted in 1995.

^j An ordinal indicator of the highest educational level of parents ranging from a low of 1 (no formal schooling) to a high of 8 (graduate/professional school).

^k Average days per week the respondent participated in physical activity.

of those who were not overweight during adolescence and 9.8% of those who were overweight) had the highest prevalence of depression onset by early adulthood. Surprisingly, depression recovery was most common among young women who were overweight as adolescents and obese as young adults (14.8%). Young women in different weight categories also had disparate background characteristics. For example, black and Hispanic young women were disproportionately underrepresented among the subsample that was never overweight. Young women reporting fair/poor health were disproportionately overrepresented among consistently obese sample members.

Table 2 shows results that were obtained from multinomial logistic regression models that estimated depression change during the transition to adulthood. “Never depressed” was the reference category. The first set of models shows how weight change was associated with depression recovery. The second set shows how weight change was associated with depression onset. The final set shows how weight change was related to consistent depression. “Never overweight” was the reference category for weight change.

Results from models estimating depression recovery indicated that girls who transitioned from overweight to obese were more likely than peers who were never overweight to recover from depression by early adulthood. When odds ratios were adjusted for young women’s sociodemographic backgrounds, this estimated association was no longer statistically significant (adjusted odds ratio = 1.34, 95% confidence interval: 0.90, 2.00).

Odds ratios and adjusted odds ratios from models estimating depression onset indicated that consistently obese young women and those who became obese during the transition to adulthood had higher odds of depression onset than did their peers who were never overweight. Consistently obese young women (adjusted odds ratio = 1.97, 95% confidence interval: 1.19, 3.26) and both normal weight (adjusted odds ratio = 2.10, 95% confidence interval: 1.14, 3.84) and overweight (adjusted odds ratio = 1.86, 95% confidence interval: 1.15, 2.99) adolescent girls who became obese all had roughly twice the odds of depression onset.

The final set of models showed that consistent obesity more than doubled the odds of consistent depression when results were unadjusted (odds ratio = 2.31, 95% confidence interval: 1.32, 4.05). After adjustment for young women’s background characteristics, the association was reduced and was not statistically significant. Supplementary analyses indicated that self-rated health explains the estimated association between consistent obesity and consistent depression, suggesting that the poor physical health of consistently obese young women explained their elevated risk of depression during the transition to adulthood.

We conducted supplementary analyses to further assess the meaning and robustness of these findings. These analyses showed that the relationships between weight change and depression change described above are unique to young women. Multinomial logistic regression models showed no significant relationship between weight change and depression change among young men. Supplementary analyses also suggested that study results were unique to the transition to adulthood. We replicated the analyses presented here by using

data from waves 3 and 4 of the Add Health when sample members were adults aged 19–25 years and 25–31 years, respectively. Neither weight gain nor obesity predicted depression consistency, recovery, or onset between survey waves. We also tested whether results were robust to the inclusion of stress-related confounders in statistical models. Addition of either a binary measure of experiencing a stressful life event or a count of such events to the models did not statistically or substantively change the estimated associations shown in model 2 (Table 2). Finally, to test whether results were driven by reverse causation (with depression causing weight gain), we conducted supplementary analyses testing whether wave-2 depression predicted weight change. It did not, regardless of whether we operationalized weight change by using the categories we used here or a difference score between BMI in waves 2 and 3.

DISCUSSION

Our findings showed that weight change was related to depression during the transition to adulthood. Young women who became obese and those who were consistently obese had roughly double the odds of depression onset during early adulthood as did their peers who were never overweight. Although this is the first study to focus on weight change and depression during the transition to adulthood, the findings are in line with those of previous studies of weight and depression among young people. Analyses of nationally representative and community data have consistently found no association between obesity and depression during the adolescent years as a whole (12–16). Instead, obesity and weight gain are related to depression as children transition into adolescence regardless of whether this transition is defined by pubertal development (18) or entry into the teen years (ages 12–14 years) (15, 17). Together, these findings suggest that weight gain is especially salient for depression during major life-course transitions.

Supplementary analyses showing that weight gain and consistent obesity are not associated with depression onset during adulthood offer further evidence that obesity is not uniformly consequential for depression across the life course. These findings highlight the need to heed recent calls for health researchers to use a life-course framework (37). Failing to do so may lead researchers and practitioners to overlook key moments in time when intervention strategies are needed most.

Our findings also showed that consistent obesity was associated with consistent depression, but this association was explained by fair/poor self-assessed health during adolescence. These findings dovetail with previous research showing that obese adolescents have lower health-related quality of life (38) and poorer self-assessed health (15) than do their normal-weight counterparts.

Our findings also reveal that weight gain is a significant public health concern in the transition to adulthood. We found that 9.8% of young women were consistently obese during adolescence and early adulthood, and 13.8% of young women became obese by early adulthood. This is consistent with previous research examining weight change during the transition to adulthood (24). Our study's major contribution is

documenting that this physical health risk also jeopardizes mental well-being during a life-course stage when depression onset is common (1).

To our knowledge, this is the first study to examine the relationship between weight change and depression during the transition to adulthood. It has several strengths. Data for the study were drawn from a nationally representative, longitudinal US sample of young people followed from adolescence through early adulthood. Studies of physical and mental health during the transition to adulthood are also important because this life-course stage marks a time when young people experience transitions that can reshape their physical health, mental health, and, as our study shows, the relationship between the 2. Finally, the BMI categories we used were based on interviewer-assessed height and weight data. These data are often self-reported in large population-representative samples.

The study also has limitations. We operationalized depression by using the CES-D. This instrument is often used in epidemiologic studies (39–41), but it is not a diagnostic tool. Accordingly, results reflect depression as indicated by self-reported symptomology rather than by clinical diagnosis. In addition, weight and depression were measured at only 2 time points. Given that depression is largely episodic, our indicator of depression change was somewhat limited. BMI scores and categories also have strengths (e.g., the indicators of height and weight that are used to create them are low cost and easily measured in large, population-representative studies) but also limitations for capturing body fatness (42). In addition, we could not measure all possible confounders of the relationships this study identifies, as is often the case when analyzing secondary data. Stress is an obvious example. Although we included a measure of stressful life events in supplementary models, it was a fairly limited measure that could not fully capture the stress universe.

Future research should examine what roles stress and social support have in relationships between weight change and depression change. Both may be important mechanisms. Prior research has shown that social support helps overweight and obese women cope with the stress of weight stigma (43). As young women take on new social roles and are thrust into new social settings and networks during the transition to adulthood (19–21), they may face increased weight stigma, increased stress, and reduced social support, thus increasing their odds of becoming depressed. Nearly 1 in 4 US adolescent girls becomes or remains obese by early adulthood, making it critical to understand how stress, social support, and other possible mechanisms explain why these young women are at risk of depression onset during the transition to adulthood.

ACKNOWLEDGMENTS

Author affiliations: Department of Sociology and Population Research Institute, The Pennsylvania State University, University Park, Pennsylvania (Michelle L. Frisco, Adam M. Lippert); and Dartmouth College, Hanover, New Hampshire (Jason N. Houle).

The Robert Wood Johnson Foundation Health and Society Scholars program provided financial support for this study. This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development with cooperative funding from 23 other federal agencies and foundations. No direct support was received from grant P01-HD31921 for this analysis.

Add Health investigators ask that special acknowledgment be given to Ronald R. Rindfuss and Barbara Entwisle for assistance on the original design of the Add Health data set. The authors of this manuscript are also grateful for helpful comments from Drs. Richard Carpiano, Patrick Kreuger, and Margaret Weden.

The opinions expressed reflect those of the authors and not necessarily those of the granting agency. Information on how to obtain the Add Health data files is available on the Add Health website (<http://cpc.unc.edu/addhealth>).

Conflict of interest: none declared.

REFERENCES

- Kessler RC, Berglund P, Demler O, et al. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry*. 2005;62(6):593–602.
- Knopf D, Park MJ, Mulye T. *The Mental Health of Adolescents: A National Profile, 2008*. San Francisco, CA: National Adolescent Health Information Center; 2008.
- Kessler RC, Walters EE. Epidemiology of DSM-III-R major depression and minor depression among adolescents and young adults in the National Comorbidity Survey. *Depress Anxiety*. 1998;7(1):3–14.
- Centers for Disease Control and Prevention. Youth Online: high school Youth Risk Behavior Surveillance System. Atlanta, GA: Centers for Disease Control and Prevention; 2009. (<http://apps.nccd.cdc.gov/YouthOnline/App/>). (Accessed December 14, 2012).
- Federal Interagency Forum on Child and Family Statistics. *America's Children: Key National Indicators of Well-Being, 2011*. Washington, DC: US Government Printing Office; 2011.
- Puhl R, Brownell KD. Bias, discrimination, and obesity. *Obes Res*. 2001;9(12):788–805.
- Strauss RS, Pollack HA. Social marginalization of overweight children. *Arch Pediatr Adolesc Med*. 2003;157(8):746–752.
- Wardle J, Cooke L. The impact of obesity on psychological well-being. *Best Pract Res Clin Endocrinol Metab*. 2005; 19(3):421–440.
- Britz B, Siegfried W, Ziegler A, et al. Rates of psychiatric disorders in a clinical study group of adolescents with extreme obesity and in obese adolescents ascertained via a population based study. *Int J Obes Relat Metab Disord*. 2000;24(12): 1707–1714.
- Eremis S, Cetin N, Tamar M, et al. Is obesity a risk factor for psychopathology among adolescents? *Pediatr Int*. 2004; 46(3):296–301.
- Hillman JB, Dorn LD, Huang B. Association of anxiety and depressive symptoms and adiposity among adolescent females, using dual energy x-ray absorptiometry. *Clin Pediatr (Phila)*. 2010;49(7):671–677.
- Goodman E, Whitaker RC. A prospective study of the role of depression in the development and persistence of adolescent obesity. *Pediatrics*. 2002;110(3):497–504.
- Mustillo S, Worthman C, Erkanli A, et al. Obesity and psychiatric disorder: developmental trajectories. *Pediatrics*. 2003;111(4):851–859.
- Eisenberg ME, Neumark-Sztainer D, Story M. Associations of weight-based teasing and emotional well-being among adolescents. *Arch Pediatr Adolesc Med*. 2003;157(8):733–738.
- Swallen KC, Reither EN, Haas SA, et al. Overweight, obesity, and health-related quality of life among adolescents: the National Longitudinal Study of Adolescent Health. *Pediatrics*. 2005;115(2):340–347.
- Boutelle KN, Hannan P, Fulkerson JA, et al. Obesity as a prospective predictor of depression in adolescent females. *Health Psychol*. 2010;29(3):293–298.
- Needham BL, Crosnoe R. Overweight status and depressive symptoms during adolescence. *J Adolesc Health*. 2005; 36(1):48–55.
- Ge XJ, Elder GH, Regnerus M, et al. Pubertal transitions, perceptions of being overweight, and adolescents' psychological maladjustment: gender and ethnic differences. *Soc Psychol Q*. 2001;64(4):363–375.
- Shanahan MJ. Pathways to adulthood in changing societies: variability and mechanisms in life course perspective. *Annu Rev Sociol*. 2000;26:667–692.
- Jekielek S, Brown B. *The Transition to Adulthood: Characteristics of Young Adults Ages 18 to 24 in America*. Washington, DC: The Annie E. Casey Foundation, Population Reference Bureau, and Child Trends; 2005.
- Collins WA, Raby KL, Causadus JM. Transformations in close relationship networks: parent–child relationships and their social extensions. In: Laursen B, Collins WA, eds. *Relationship Pathways from Adolescence to Young Adulthood*. Thousand Oaks, CA: Sage Publications; 2012:3–22.
- Bearman PS, Jones J, Udry JR. *Connections Count: Adolescent Health and the Design of the National Longitudinal Study of Adolescent Health*. Chapel Hill, NC: University of North Carolina-Chapel Hill; 1997.
- Mullan Harris K, Halpern CT, Whitsel EA, et al. The National Longitudinal Study of Adolescent Health: research design. Chapel Hill, NC: University of North Carolina-Chapel Hill; 2009. (<http://www.cpc.unc.edu/projects/addhealth/design>). (Accessed June 2, 2012).
- Gordon-Larsen P, Adair LS, Nelson MC, et al. Five-year obesity incidence in the transition period between adolescence and adulthood: the National Longitudinal Study of Adolescent Health. *Am J Clin Nutr*. 2004;80(3):569–575.
- Radloff LS. The CES-D Scale: a self-report depression scale for research in the general population. *Appl Psychol Meas*. 1977;1(3):385–401.
- Crockett LJ, Randall BA, Shen YL, et al. Measurement equivalence of the Center for Epidemiological Studies Depression Scale for Latino and Anglo adolescents: a national study. *J Consult Clin Psychol*. 2005;73(1):47–58.
- Grzywacz JG, Hovey JD, Seligman LD, et al. Evaluating short-form versions of the CES-D for measuring depressive symptoms among immigrants from Mexico. *Hisp J Behav Sci*. 2006;28(3):404–424.
- Roberts RE, Lewinsohn PM, Seeley JR. Screening for adolescent depression—a comparison of depression scales. *J Am Acad Child Adolesc Psychiatry*. 1991;30(1): 58–66.

29. Primack BA, Swanier B, Georgiopoulos AM, et al. Association between media use in adolescence and depression in young adulthood: a longitudinal study. *Arch Gen Psychiatry*. 2009;66(2):181–188.
30. Shrier LA, Harris SK, Sternberg M, et al. Associations of depression, self-esteem, and substance use with sexual risk among adolescents. *Prev Med*. 2001;33(3):179–189.
31. Frisco ML, Houle JN, Martin MA. The image in the mirror and the number on the scale: weight, weight perceptions, and adolescent depressive symptoms. *J Health Soc Behav*. 2010; 51(2):215–228.
32. Gotlib IH, Lewinsohn PM, Seeley JR. Symptoms versus a diagnosis of depression: differences in psychosocial functioning. *J Consult Clin Psychol*. 1995;63(1):90–100.
33. Cole TJ, Bellizzi MC, Flegal KM, et al. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320(7244): 1240–1243.
34. Lee K, Carin J. Multiple imputation for missing data: fully conditional specification versus multivariate normal imputation. *Am J Epidemiol*. 2010;171(5):624–632.
35. Allison PD. *Missing Data*. Thousand Oaks, CA: Sage Publications; 2001.
36. Royston P. Multiple imputation of missing values: update of ice. *Stata J*. 2005;5(4):527–536.
37. Daaleman TP, Elder GH Jr. Family medicine and the life course paradigm. *J Am Board Fam Med*. 2007;20(1): 85–92.
38. Schwimmer JB, Burwinkle TM, Varni JW. Health-related quality of life of severely obese children and adolescents. *JAMA*. 2003;289(14):1813–1819.
39. Duncan B, Rees DI. Effect of smoking on depressive symptomatology: a reexamination of data from the National Longitudinal Study of Adolescent Health. *Am J Epidemiol*. 2005;162(5):461–470.
40. Godin O, Elbejjani M, Kaufman JS. Body mass index, blood pressure, and risk of depression in the elderly: a marginal structural model. *Am J Epidemiol*. 2012;176(3):204–213.
41. Kubzansky LD, Subramanian SV, Kawachi I, et al. Neighborhood contextual influences on depressive symptoms in the elderly. *Am J Epidemiol*. 2005;162(3):253–260.
42. Daniels SR. The use of BMI in the clinical setting. *Pediatrics*. 2009;124(1 suppl):35S–41S.
43. Puhl RM, Brownell KD. Confronting and coping with weight stigma: an investigation of overweight and obese adults. *Obesity*. 2006;14(10):1802–1815.