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Gender Expression Associated With BMI in a Prospective Cohort Study of U.S. Adolescents

S. Bryn Austin[1,2,3], **Najat J. Ziyadeh**[1], **Jerel P. Calzo**[1], **Kendrin R. Sonneville**[4], **Grace A. Kennedy**[1], **Andrea L. Roberts**[3], **Jess Haines**[5], and **Emily A. Scherer**[6]

[1] Division of Adolescent and Young Adult Medicine, Boston Children's Hospital, Boston

[2] Channing Division of Network Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston

[3] Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston

[4] University of Michigan School of Public Health, Ann Arbor, MI

[5] University of Guelph, Guelph, Ontario, Canada

[6] Department of Biomedical Data Science, Geisel School of Medicine at Dartmouth, Hanover, NH

Abstract

Objective—To examine the relationship between gender expression (GE) and BMI in adolescence.

Methods—Repeated measures of weight-related behaviors and BMI were collected 1996-2011 via annual/biennial self-report surveys from youth ages 10 to 23 years (6,693 females, 2,978 males) in the longitudinal Growing Up Today Study. GE (very conforming [referent], mostly conforming, nonconforming) was assessed in 2010/11. Sex-stratified, multivariable linear models estimated GE group differences in BMI and the contribution of sexual orientation and weight-related exposures to group differences. Models for males included interaction terms for GE with age.

Results—In females, mostly conforming youth had 0.53 kg/m^2 and nonconforming had 1.23 kg/m^2 higher BMI; when adding adjustment for sexual orientation and weight-related exposures, GE-group estimates were attenuated up to 8% and remained statistically significant. In males, mostly conforming youth had −0.67 kg/m^2 and nonconforming had −1.99 kg/m^2 lower BMI (age [in years] interactions were between −0.09 to −0.14 kg/m^2; when adding adjustment for sexual orientation and weight-related exposures, GE-group estimates were attenuated up to 11% and remained statistically significant.

Corresponding Author: S. Bryn Austin, ScD, Division of Adolescent and Young Adult Medicine, Boston Children's Hospital, 333 Longwood Ave., Room #634, Boston, MA 02115, Ph (617)355-8194, Fax (617)730-0185, bryn.austin@childrens.harvard.edu.

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Conclusions—GE is a strong independent predictor of BMI in adolescence. Obesity prevention and treatment interventions with youth must address ways that gender norms may reinforce or undermine healthful behaviors.

INTRODUCTION

U.S. societal norms of masculinity and femininity pattern health behaviors of high public health importance, and dominant cultural standards for appearance strongly link femininity with thinness[1] and masculinity to physical stature and muscularity.[2] Findings from numerous studies suggest powerful effects of these gendered cultural standards on weight- and shape-related health indicators in adolescents and adults. A longitudinal study of adolescents found that weight concerns among girls increased from age 11 to 16 years, following the physical changes of puberty.[3] In another study, excess prevalence of depressive symptoms in adolescent girls compared to boys was found to be partially mediated by perceived overweight status, a gendered weight concern more common in girls than boys, regardless of actual overweight.[4] Previous research has identified clear gender differences in efforts at weight control and weight-related behaviors. For instance, adolescent girls have been found to be more likely than boys to restrict their diets (54% girls, 24% boys), use diet products (10% girls, 4% boys), purge (8% girls, 3% boys), and engage in weight-control-motivated exercising (67% girls, 47% boys).[5] In line with societal masculinity norms, men who endorse high levels of drive for muscularity also express high desire to gain weight in muscle,[6] and, unlike adolescent girls, boys report elevated body dissatisfaction at low BMIs.[7,8]

Previous research in other health domains has found differences by gender expression -- that is, the degree to which one presents oneself in a way consistent with culturally defined expressions of masculine or feminine -- in problem drinking[9] and violence perpetration.[10] Gender expression also patterns cancer risk behaviors,[11] including cigar smoking and U.V. tanning bed use, such that more masculine males are more likely than other males to smoke cigars and more feminine females are more likely than other females to engage in U.V. tanning.

No research to the authors' knowledge has directly explored the association of gender expression with body mass index (BMI, kg/m^2) within the sexes in adolescence, though previous studies have documented differences in weight-related health behaviors by gender expression within the sexes. For instance, in the Growing Up Today Study (GUTS), a national cohort of U.S. youth, researchers found that gender conforming girls were more likely to endorse trying to look like people in the media than gender nonconforming girls, and gender conforming boys were found to be more sports involved than gender nonconforming boys.[11,12] Because thinness is not consistent with dominant cultural standards of masculinity, youth who conform to masculinity norms may be more likely than other youth to engage in obesogenic behaviors, such as fast food consumption,[13] overeating,[14] and sedentary behaviors (e.g., TV viewing/sedentary screen time).[15]

While gender expression and sexual orientation are distinct constructs, it is important to note that the association between gender expression and sexual orientation is well documented,[16]

including in the GUTS cohort.[17] In GUTS, sexual minorities (e.g., lesbians, gay men, bisexuals) have been found to be more likely than their heterosexual peers to be gender nonconforming. In addition, sexual orientation disparities in BMI have been found in youth, where lesbian and bisexual females have higher BMI and gay males lower BMI than heterosexual peers.[18-20] Prospective research has found in adolescent males that heterosexuals experience greater BMI gains over time than gay males, leading to wider disparities in BMI by young adulthood than earlier in adolescence.[19] Whether gender expression may have an association with BMI independent of sexual orientation is not known.

Other exposures known to be associated with higher risk of overweight remain underexplored as to how they may be associated with gender expression. These include exposures such as mother's BMI in childhood, family household annual income, infrequent family dinners, skipping breakfast, fast food consumption, overeating or binge eating, excessive or insufficient sleep at night, sugar-sweetened beverage consumption, and TV viewing.[21]

Given the evidence that societal norms of masculinity and femininity may pattern weight-related behaviors in adolescents, gender expression also may be associated with BMI and BMI gain throughout adolescence. Understanding the potential relationship between gender expression and BMI is critical, as obesity in adolescence confers a strong likelihood of persisting into adulthood and is associated with a myriad of negative health outcomes.[22] In the current study, we assessed the relationship between gender expression and BMI across adolescence and into early adulthood in the GUTS cohort. We hypothesized that in adolescence, higher gender nonconformity in girls (i.e., more masculine) and higher gender conformity in boys (also more masculine) would be associated with a higher BMI and greater BMI gains over time compared to same-sex peers.

METHODS

Sample

Data were collected from 1996 to 2011 via annual and biennial self-report surveys from adolescents participating in the longitudinal GUTS cohort, which is composed of a GUTS1 cohort (n=16,882) begun in 1996 and a GUTS2 cohort (n=10,442) begun in 2004. At baseline for each cohort, participants were between the ages of 9-15 years and were invited to participate if their mother was enrolled in the Nurses' Health Study 2 cohort (http://www.channing.harvard.edu/nhs/?page_id=70). Once parental consent was obtained, participants who returned a completed questionnaire at baseline were considered enrolled. The cohort is 94% of white race/ethnicity. This study has been approved by the Brigham and Women's Hospital Institutional Review Board.

Measures

Socially assigned gender expression was the primary predictor and was assessed in 2010-11 with a brief, validated, two-item self-report measure of how others perceive one's gendered appearance and mannerisms.[23,24] The construct "socially assigned" refers to how one

believes one is perceived by others. The measure was based on one previously developed by the Centers for Disease Control and Prevention to assess socially assigned race.[25] Participants were asked to rate how they believe others would describe their "appearance, style, or dress" and "mannerisms" each on a 7-point Likert-scale (1=very feminine; 7=very masculine). In previous research with the GUTS cohort, the scale items were highly correlated (Pearson $r = 0.68$; $p < 0.0001$).[26] A gender conformity score was created by taking the mean response of the two items and reverse coding for males so that a higher score indicated more gender nonconformity. A mean score of less than 1.5 was categorized as very gender conforming, a score from 1.5 to 3 inclusive as mostly gender conforming, and a score higher than 3 as gender nonconforming. A participant's socially assigned gender expression was considered to be constant over all observations (time-invariant), and the very gender conforming group served as the referent.

BMI was the outcome and was calculated from repeated measures of height and weight, assessed via annual or biennial self-reports from 1996 to 2011 and treated as a continuous measure in kg/m^2 units. Self-reported heights and weights have been found to generate valid estimates of BMI cross-sectionally[27] and of BMI change longitudinally[28] in youth.

Sexual orientation was assessed in multiple waves and included in analyses as a predictor of BMI using sexual orientation reported in the same year as the wave in which BMI was assessed when available. When sexual orientation was not collected in a year BMI was reported, it was back assigned from the next available wave. It was assessed using a single item,[29] which asked participants to select "which of the follow best describes your feelings? (1) completely heterosexual (attracted to persons of the same sex), (2) mostly heterosexual, (3) bisexual (equally attracted to men and women), (4) mostly homosexual, (5) completely homosexual (gay/lesbian, attracted to persons of the same sex), (6) not sure." Because of small subsample sizes, responses of "mostly homosexual" and "completely homosexual" were combined to create a "lesbian/gay" category. Responses of "not sure" were treated as missing for the wave in which "not sure" was reported.

Weight-related behaviors were assessed with validated measures. Self-report measures assessed behavior over the past year and included physical activity (hours/week in moderate/vigorous activity; ordinal, seven levels ranging from 0 to 11 or more hours), TV viewing (hours/week viewing TV; ordinal, eight levels ranging from 0 to 18 or more hours), hours of sleep per night (hours sleep/night; ordinal, eight levels ranging from less than 5 to 11 or more hours), sugar-sweetened beverage consumption (servings/day; ordinal, seven levels ranging from never/less than once per month to 3 or more servings per day), fast food consumption (days/week; ordinal, four levels ranging from never to daily), eating breakfast (days per week; ordinal, four levels ranging from never to 5 or more times per week), eating dinner with family (days/week; ordinal, four levels ranging from never to 5 or more times per week), dieting (ordinal, five levels ranging from never to always), binge eating (binary, any binge eating in the past year), and fasting to control weight (ordinal, five levels ranging from never to 2-6 times per week/daily). Weight-related behavioral variables were included in analyses as lagged predictors of BMI using values reported one year prior to the wave when BMI was reported when available. When a weight-related behavior was not collected

in the year prior to when BMI was reported, it was carried forward or backward from the closest available wave.

Covariates included youth age (range 10-23 years), race/ethnicity, gender (female/male), and membership in the GUTS 1 or GUTS 2 cohort, in addition to mother's annual household income in 2001 (ordinal, four levels ranging from less than $75,000 to $150,000 and above) and mother's BMI at age 18 years (continuous), both reported by the participant's mother.

Statistical Analysis: All-Available-Observations Analysis Using Single Imputation of Predictors and Covariates

To estimate the association between gender expression and BMI across all waves, the dataset was first converted from a person-level data file to a longitudinal data file whereby each participant contributed an observation each time they completed each questionnaire. All observations with available BMI and predictors were included in the analysis. Missing values of the predictors and covariates were singly imputed to reduce potential bias introduced by non-response. We used single imputation for missing covariate data based on last observation carried forward or subsequent value carried back. Among females, for those who were pregnant at the time BMI was reported or within the past year (n observations=971), their BMI value was set to missing for that wave only, and they were retained in analyses for all other waves in which they provided data. Implausible values on weight, height, or BMI were also set to missing (n observations=60).

Multivariable linear generalized estimating equations (GEE) were used to examine differences in BMI across gender expression groups, adjusting for effects of covariates, sexual orientation, and weight-related behaviors. The GEE models account for repeated measures within individuals. Because GUTS participants are all children of women in the Nurses' Health Study 2 cohort, the GEE models also account for intracluster correlation resulting from sibling groups in the cohort using the mother's ID.[30] An exchangeable residual covariance structure was used for all models. Separate models were examined for females and males. Both age-by-gender expression and age-by-sexual orientation interactions were tested and retained if significant. Among females, age interactions were not significant so were not retained. For males, interactions of age with gender expression and sexual orientation were significant so were retained.

For both females and males, a base model (adjusting for youth age, race/ethnicity, and GUTS cohort and mother's annual household income and mother's BMI at age 18 years), a model additionally adjusting for sexual orientation, and a model additionally adjusting for weight-related behaviors were fit. Weight-related behavioral predictors were retained in models only if they achieved statistical significance at $P<0.05$; therefore, weight-related behavioral predictors retained in the model for females varied from those retained in the model for males. The final all-available-observations analysis sample included 6,693 females and 2,978 males ages 10 to 23 years, providing 29,406 and 12,516 observations, respectively. All analyses were conducted using SAS 9.3 (Cary, NC).

Missing Data Analysis and Multiple Imputation

To identify differences in participants included in the analyses described above compared to those excluded, we compared the two groups (those with no observations for BMI and predictors vs. those with BMI and predictors for at least some observations) in terms of gender, age, race/ethnicity, cohort, sexual orientation, and socially assigned gender expression. There were no differences between those included in analyses and those excluded in race/ethnicity ($p=0.99$), and within the GUTS1 cohort, no differences in sexual orientation ($p=0.40$) were observed; though in the GUTS2 cohort, mostly heterosexual and lesbian/gay participants were more likely to be included in analyses than other orientation groups ($p<0.0001$). In addition, greater likelihood of being included in analyses was associated with: female vs. male gender ($p<0.0001$), GUTS1 vs. GUTS2 cohort membership ($p<0.0001$), older compared to younger age at baseline ($p<0.0001$), and being mostly gender conforming compared to the other two gender expression groups ($P<0.01$).

To explore potential bias due to missing values that could result from all-available-observations analysis, we carried out secondary analyses using multiple imputation (MI).[31] The MI models for females and males included all predictor variables of the final multivariable models described above with the exception of socially assigned gender expression (the primary predictor). The regression equations were applied iteratively to produce multiple, newly created, complete datasets with all of the missing values filled in. The next phase of MI involved analyzing these multiple, newly generated datasets, and the last phase combined the model estimates created from each dataset into one set of estimates. There were few differences in findings comparing MI models to all-available-observations analysis models and no important differences in direction or significance of associations; therefore, tables and figures present results based on all-available-observations analyses.

RESULTS

Table 1 presents sample characteristics at age 17 years, which falls midway in the age range included in analyses (10 years to 23 years); 4,913 females and 1,736 males provided data at age 17 years presented in the table. Among 17-year-old females and males, respectively, 28% (n=1363) and 41% (n=712) were very gender conforming, 65% (n=3200) and 55% (n=958) were mostly gender conforming, and 7% (n=350) and 4% (n=66) were gender nonconforming. For females, mean BMI at age 17 years was 22.0 kg/m^2 (std. dev. 3.3), and for males, mean BMI at age 17 years was 23.2 kg/m^2 (std. dev. 3.9).

Table 2 displays maternal and youth factors and youth BMI at age 17 years by gender expression among females. Differences at age 17 years across gender expression groups were found for maternal BMI at age 18 years and youth factors, including sexual orientation, binge eating, and dieting ($Ps<0.05$). Also among females, at age 17 years, gender conformity was associated with lower BMI: Very gender conforming BMI 21.3 kg/m^2 (std. dev. 2.9); mostly gender conforming BMI 22.2 kg/m^2 (std. dev. 3.4); gender nonconforming BMI 23.3 kg/m^2 (std. dev. 3.7)($P<0.0001$).

Table 3 displays maternal and youth factors and youth BMI at age 17 years by gender expression among males. Differences at age 17 years across gender expression groups were

found for several youth factors, including sexual orientation, binge eating, fasting, family dinner, sugar-sweetened beverages, physical activity, television viewing, and sleep (Ps<0.05). However, among males, gender conformity was not associated with BMI at age 17 years: Very gender conforming BMI 23.7 kg/m^2 (std. dev. 4.1); mostly gender conforming BMI 23.0 kg/m^2 (std. dev. 3.7); gender nonconforming BMI 22.8 kg/m^2 (std. dev. 4.1) (P=0.10).

Tables 4 and 5 present the multivariable GEE model results for 6,693 females (n observations=29,406) and 2,978 males (n observations=12,516), respectively, from ages 10-23 years. For females, compared to the very gender conforming group, mostly gender conforming expression was associated with 0.53 kg/m^2 higher BMI and gender nonconforming expression was associated with 1.23 kg/m^2 higher BMI (base model, Table 4). Accounting for sexual orientation and weight-related behaviors resulted in virtually no change in the estimate for the mostly gender conforming group and only 8% attenuation in the estimate for the gender nonconforming group, and group differences remained statistically significant (Table 4).

As shown in Table 5, for males, compared to the very gender conforming group, mostly gender conforming expression was associated with −0.67 kg/m^2 lower BMI with an additional −0.09 kg/m^2 reduction in relative BMI with each year of age (base model, Table 5); gender nonconforming expression was associated with −1.99 kg/m^2 lower BMI with an additional −0.14 kg/m^2 reduction in relative BMI with each year of age (base model, Table 5). Accounting for sexual orientation and weight-related behaviors resulted in just 6% attenuation in the estimate for the mostly gender conforming group and very small attenuation in the gender expression-by-age interaction term, which remained significant. For the gender nonconforming group, accounting for sexual orientation and weight-related behaviors resulted in almost 11% attenuation of the estimate and the gender expression-by-age interaction was reduced substantially and became nonsignificant (Table 5).

DISCUSSION

Obesity is a well-established public health priority.[21] Furthermore, recent evidence implicates societal pressures on young people to conform to socially accepted expressions of masculinity and femininity in a range of health damaging behaviors,[9-11] including weight-related behaviors.[11,12,32] Nevertheless, to our knowledge, this is the first prospective cohort study examining the relationship between gender expression and BMI in adolescence. Our findings indicate that socially assigned gender expression is a powerful predictor of BMI. In females, nonconformity -- or greater masculinity -- was linked with higher BMI, though not with greater gains in BMI throughout adolescence. In males, conformity -- that is, greater masculinity -- was similarly linked with higher BMI as well as with greater BMI gains throughout adolescence. We accounted for a comprehensive set of weight-related behaviors occurring throughout adolescence, in addition to sexual orientation, finding that these exposures explained only approximately 10% of gender expression group differences. Thus, gender expression plays a substantial role in BMI in adolescence, but the underlying pathways are only partially illuminated here.

Among children with overweight or obesity at ages 8-15 years, boys are less likely than girls of similar weight status to perceive themselves as overweight or obese.[33] Furthermore, among adolescent boys ages 16-22 years, one study found that one in three boys with BMI in the healthy range and one in six boys with BMI in the overweight or obese range reported trying to gain weight.[8] Patterns observed in these studies may result in part from variation in gender norms and gender expression both within each sex and between boys and girls. While gender norms and gender expression have not typically been targeted in behavioral interventions for obesity prevention, public health professionals working in other health domains have gained important insights into the modifiability of gender norms and the impact these types of interventions can have on targeted health outcomes. For instance, a recent study reviewed 22 evaluations of sexuality and HIV education curricula, of which 10 specifically targeted gender norms.[34] This review found that 80% of the studies designed to change gender norms to be more equitable resulted in reduction in unintended pregnancy or sexually transmitted infections; whereas, only 17% of the studies not targeting gender norms had these beneficial health effects. Similarly, preventive interventions targeting gender norms to reduce intimate-partner and dating violence have been successful in reducing violence perpetration by boys and men.[35-37] Given the substantial elevation of BMI associated with masculine gender expression in both females and males in the present study, our findings suggest that, as has been done in some other fields of public health, the field of overweight prevention may need to target gender norms relating to weight-related behaviors and perceptions in designing health promoting interventions.

Perhaps most importantly, health professionals, policymakers, and advocates are increasingly targeting structural forces that create and perpetuate harmful gender norms. Globally, a myriad of systems-level initiatives are being tested to reduce discrimination, violence, and economic inequalities linked to gender, gender expression and identity, and sexual orientation.[38-40] These types of upstream strategies are likely to hold the most promise to effect lasting change in gender-expression-related health inequities.

Our study has several limitations. We used a single measure to assess socially assigned gender expression. In addition, in most cases, gender expression was assessed after weight-related behaviors and BMI were assessed. It is possible that for some participants their weight status influenced the way they chose to describe their gender expression. The GUTS cohort is not racially/ethnically or economically diverse nor representative of the U.S. population, which limits generalizability. Importantly, participants were not recruited into the sample based on their gender expression. While validated measures were used to assess weight-related behavioral predictors, surveys were administered only annually or biennially, so important variation occurring between survey years affecting BMI might be missed.

Conclusions

In U.S. society, youth are inundated with messages from media, peers, and family about cultural expectations of gender expression for girls and women, boys and men. Evidence is accumulating that these messages carry with them health risks in myriad domains.[9-12,32] With the present study, it is clear that conformity to masculinity ideals confers risk of elevated BMI in both sexes and, for males in particular, more rapid BMI gains in

adolescence. While our study examined a wide range of known predictors of BMI in youth, our results indicated that these exposures accounted for a relatively small proportion of the pronounced gender-expression group differences in BMI. Much work remains to identify the specific leptogenic and obesogenic behaviors and exposures that produce substantial gender-expression group differences in BMI. In addition, greater health research attention to societal gender norms will be crucial to understanding and mitigating the ways that societal messages idealizing particular expressions of masculinity and femininity are undermining the health and well-being of both girls and boys.

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What is already known about this subject?

- Societal norms of masculinity and femininity influence health behaviors of high public health importance, such as problem drinking, violence perpetration, and cancer risk behaviors.
- In the United States, dominant cultural standards for appearance strongly link femininity with thinness and masculinity to physical stature and muscularity.
- Prior research has documented differences in weight-related health behaviors by gender expression within the sexes.

What does this study add?

- This is the first prospective cohort study to examine the association between gender expression and BMI, finding gender expression is a powerful predictor of BMI.
- In females, nonconformity -- or greater masculinity -- is linked with higher BMI.
- In males, conformity -- that is, greater masculinity -- is similarly linked with higher BMI as well as with greater BMI gains throughout adolescence.

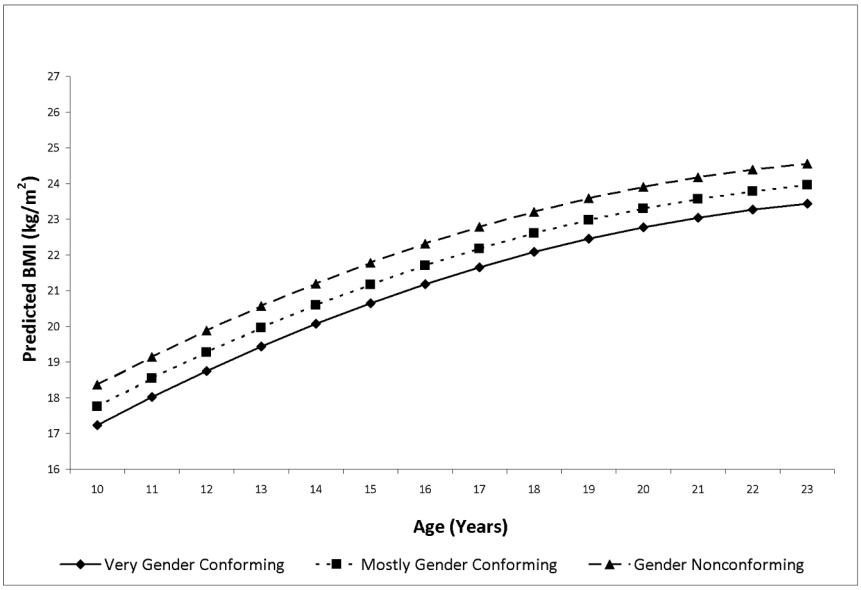

Figure 1.

Predicted mean BMI (kg/m^2) by age and gender expression group as estimated from model in Table 4 adjusting for sexual orientation and weight-related behaviors, females

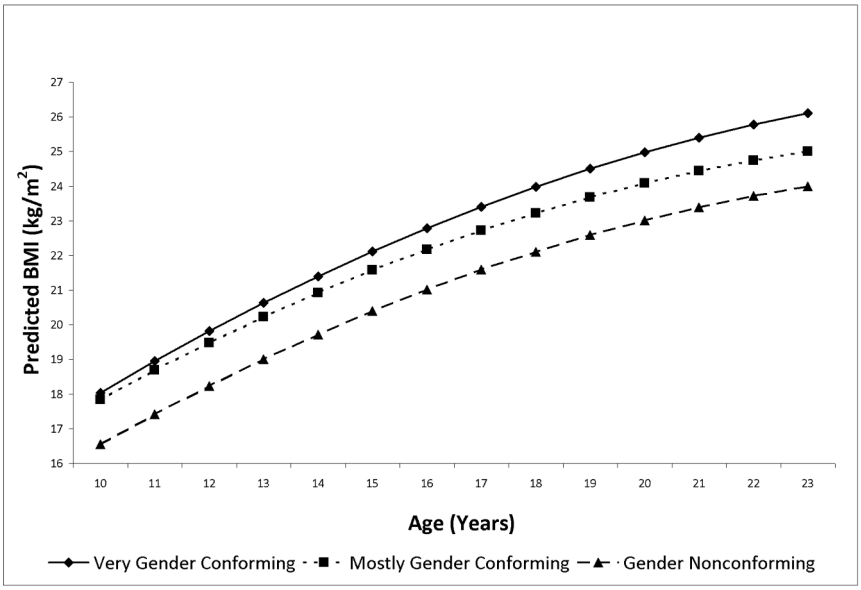

Figure 2.

Predicted mean BMI (kg/m^2) by age and gender expression group as estimated from model in Table 5 adjusting for sexual orientation and weight-related behaviors, males

Table 1

Sample Characteristics at Age 17 Years Among Female and Male Youth in the Growing Up Today Study (N=6649)

	Females		Males	
	(n=4913)		(n= 1736)	
Characteristics				
YOUTH FACTORS				
Youth Socially Assigned Gender Expression (n, %)				
Very gender conforming	1363	27.7	712	41.0
Mostly gender conforming	3200	65.1	958	55.2
Gender nonconforming	350	7.1	66	3.8
Youth Sexual Orientation (n, %)				
Completely heterosexual	4046	82.4	1503	86.6
Mostly heterosexual	695	14.2	140	8.1
Bisexual	102	2.1	17	1.0
Lesbian/Gay	70	1.4	76	4.4
Youth BMI (kg/m^2) (m, std. dev.)	22.0	3.3	23.2	3.9
Youth Weight-Related Behaviors[a]				
Binge Eating (n, %)				
Yes	305	6.2	26	1.5
No	4600	93.6	1708	98.4
Missing	8	0.2	2	0.1
Dieting (m, std. dev.)	2.1	1.2	1.5	1.0
Fasting (m, std. dev.)	1.3	0.8	1.1	0.5
Breakfast (m, std. dev.)	3.5	0.9	3.5	0.9
Family Dinner (m, std. dev.)	3.0	0.9	3.1	0.9
Fast Food (m, std. dev.)	1.5	0.6	1.8	0.7
Sugar-Sweetened Beverages (m, std. dev.)	2.6	1.5	3.5	1.6
Physical Activity (m, std. dev.)	9.2	7.5	10.2	7.7
TV Viewing (m, std. dev.)	6.4	6.0	7.9	7.0
Sleep (m, std. dev.)	4.1	1.1	4.2	1.0
MATERNAL FACTORS				
Maternal BMI (kg/m^2) at Age 18 Years (m, std. dev.)	21.0	2.8	21.0	3.0
Maternal Annual Household Income (n, %)				
Less than $74,999	1507	30.7	535	30.8
$75,000-$99,999	915	18.6	335	19.3
$100,000-$149,000	1041	21.2	377	21.7
$150,000 and above	641	13.1	230	13.3
Missing income	809	16.5	259	14.9

[a]Youth Weight-Related Behaviors: *Binge eating* (binary, any binge eating in the past year); *Dieting* (ordinal, five levels ranging from never to always); *Fasting* (ordinal, five levels ranging from never to 2-6 times per week/daily); *Breakfast* (days per week; ordinal, four levels ranging from never to 5 or more times per week); *Family dinner* (days/week; ordinal, four levels ranging from never to 5 or more times per week); *Fast food* (days/week; ordinal, four levels ranging from never to daily); *Sugar-sweetened beverages* (servings/day; ordinal, seven levels ranging from never/less than once per month to 3 or more servings per day); *Physical activity* (hours/week in moderate/vigorous activity; ordinal, seven levels ranging from 0 to 11 or more hours); *TV viewing* (hours/week viewing TV; ordinal, eight levels ranging from 0 to 18 or more hours); *Sleep* (hours sleep/night; ordinal, eight levels ranging from less than 5 to 11 or more hours).

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Table 2

Sample Characteristics at Age 17 Years Among Female Youth, by Socially Assigned Gender Expression, in the Growing Up Today Study (N =4913)

	Very Gender Conforming (n = 1363)		Mostly Gender Conforming (n = 3200)		Gender Nonconforming (n = 350)		P-value
Characteristics							
YOUTH FACTORS							
Sexual Orientation (n, %)							
Completely heterosexual	1258	92.3	2578	80.6	210	60.0	
Mostly heterosexual	87	6.4	517	16.2	91	26.0	**<0.0001**
Bisexual	13	1.0	68	2.1	21	6.0	
Lesbian	5	0.4	37	1.2	28	8.0	
BMI (kg/m^2) at Age 17 Years (m, std. dev.)	21.3	2.9	22.2	3.4	23.3	3.7	**<0.0001**
Youth Weight-Related Behaviors[b]							
Binge Eating (n, %)							
Yes	73	5.4	202	6.3	30	8.6	
No	1289	94.6	2991	93.5	320	91.4	**0.0485**
Missing	1	0.1	7	0.2	0	0.0	
Dieting (m, std. dev.)	2.2	1.2	2.0	1.2	2.2	1.3	**0.0369**
Fasting (m, std. dev.)	1.3	0.8	1.3	0.7	1.4	0.9	0.6940
Breakfast (m, std. dev.)	3.5	0.9	3.5	0.9	3.3	1.0	0.1269
Family Dinner (m, std. dev.)	3.0	0.9	3.0	0.9	2.8	1.0	0.0960
Fast Food (m, std. dev.)	1.5	0.6	1.5	0.6	1.5	0.7	0.3053
Sugar-Sweetened Beverages (m, std. dev.)	2.5	1.4	2.6	1.5	2.7	1.6	0.0667
Physical Activity (m, std. dev.)	9.4	7.5	9.0	7.4	9.7	8.4	0.9752
TV Viewing (m, std. dev.)	6.2	5.9	6.4	6.0	6.9	6.1	0.2960
Sleep (m, std. dev.)	4.1	1.1	4.1	1.1	3.9	1.3	0.4761
MATERNAL FACTORS							
BMI (kg/m^2) at Age 18 Years (m, std. dev.)	20.8	2.7	21.0	2.8	21.6	3.1	**0.0020**
Annual Household Income (n, %)							

Characteristics	Very Gender Conforming (n = 1363)		Mostly Gender Conforming (n = 3200)		Gender Nonconforming (n = 350)		P-value
Less than $74,999	428	31.4	961	30.0	118	33.7	
$75,000-$99,999	234	17.2	617	19.3	64	18.3	
$100,000-$149,000	292	21.4	665	20.8	84	24.0	0.4041
$150,000 and above	194	14.2	411	12.8	36	10.3	
Missing income	215	15.8	546	17.1	48	13.7	

[a] Bold indicates statistical significance at P<0.05.

[b] Youth Weight-Related Behaviors: *Binge eating* (binary, any binge eating in the past year); *Dieting* (ordinal, five levels ranging from never to always); *Fasting* (ordinal, five levels ranging from never to 2-6 times per week/daily); *Breakfast* (days per week; ordinal, four levels ranging from never to 5 or more times per week); *Family dinner* (days/week; ordinal, four levels ranging from never to 5 or more times per week); *Fast food* (days/week; ordinal, four levels ranging from never to daily); *Sugar-sweetened beverages* (servings/day; ordinal, seven levels ranging from never/less than once per month to 3 or more servings per day); *Physical activity* (hours/week in moderate/vigorous activity; ordinal, seven levels ranging from 0 to 11 or more hours); *TV viewing* (hours/week viewing TV; ordinal, eight levels ranging from 0 to 18 or more hours); *Sleep* (hours sleep/night; ordinal, eight levels ranging from less than 5 to 11 or more hours).

Table 3

Sample Characteristics at Age 17 Years Among Male Youth, by Socially Assigned Gender Expression, in the Growing Up Today Study (N =1736)

	Very Gender Conforming (n = 712)		Mostly Gender Conforming (n = 958)		Gender Nonconforming (n = 66)		P-value
Characteristics							
YOUTH FACTORS							
Sexual Orientation (n, %)							
Completely heterosexual	681	95.7	787	82.2	35	53.0	
Mostly heterosexual Bisexual	26 0	3.7 0.0	105 15	11.0 1.6	9 2	13.6 3.0	**<0.0001**
Gay	5	0.7	51	5.3	20	30.3	
BMI (kg/m^2) at Age 17 Years (m, std. dev.)	23.7	4.1	23.0	3.7	22.8	4.1	0.1012
Youth Weight-Related Behaviors[b]							
Binge Eating (n, %)							
Yes	5	0.7	15	1.6	6	9.1	
No	707	99.3	942	98.3	59	89.4	**0.0024**
Missing	0	0.0	1	0.1	1	1.5	
Dieting (m, std. dev.)	1.5	1.0	1.5	1.0	1.7	1.2	0.9803
Fasting (m, std. dev.)	1.1	0.4	1.1	0.6	1.4	0.9	**0.0144**
Breakfast (m, std. dev.)	3.5	0.9	3.5	0.9	3.1	1.0	0.0962
Family Dinner (m, std. dev.)	3.1	0.8	3.0	0.9	2.9	1.0	**0.0178**
Fast Food (m, std. dev.)	1.8	0.8	1.8	0.7	1.6	0.6	0.1618
Sugar-Sweetened Beverages (m, std. dev.)	3.7	1.5	3.5	1.6	3.3	1.8	**0.0002**
Physical Activity (m, std. dev.)	11.5	7.8	9.4	7.6	7.4	6.9	**<0.0001**
TV Viewing (m, std. dev.)	8.2	7.1	7.7	6.9	6.8	6.8	**0.0435**
Sleep (m, std. dev.)	4.3	1.0	4.1	1.1	4.0	1.3	**0.0010**
MATERNAL FACTORS							
BMI (kg/m^2) at Age 18 Years (m, std. dev.)	20.9	2.8	21.1	3.0	21.8	4.5	0.1395
Annual Household Income (n, %)							
Less than $74,999	235	33.0	280	29.2	20	30.3	

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Characteristics	Very Gender Conforming (n = 712)		Mostly Gender Conforming (n = 958)		Gender Nonconforming (n = 66)		P-value
$75,000-$99,999	151	21.2	173	18.1	11	16.7	
$100,000-$149,000	141	19.8	219	22.9	17	25.8	0.0891
$150,000 and above	80	11.2	145	15.1	5	7.6	
Missing income	105	14.8	141	14.7	13	19.7	

[a] Bold indicates statistical significance at P<0.05.

[b] Youth Weight-Related Behaviors: *Binge eating* (binary, any binge eating in the past year); *Dieting* (ordinal, five levels ranging from never to always); *Fasting* (ordinal, five levels ranging from never to 2-6 times per week/daily); *Breakfast* (days per week; ordinal, four levels ranging from never to 5 or more times per week); *Family dinner* (days/week; ordinal, four levels ranging from never to 5 or more times per week); *Fast food* (days/week; ordinal, four levels ranging from never to daily); *Sugar-sweetened beverages* (servings/day; ordinal, seven levels ranging from never/less than once per month to 3 or more servings per day); *Physical activity* (hours/week in moderate/vigorous activity; ordinal, seven levels ranging from 0 to 11 or more hours); *TV viewing* (hours/week viewing TV; ordinal, eight levels ranging from 0 to 18 or more hours); *Sleep* (hours sleep/night; ordinal, eight levels ranging from less than 5 to 11 or more hours).

Table 4

Adjusted GEE Linear Models[a] Estimating Socially Assigned Gender Expression Group Differences in BMI (kg/m2) Using Lagged Predictors and Repeated Measures from 1996 to 2011 Among Female Adolescents and Young Adults in the Growing Up Today Study1&2

	Females # observations=29,406		
	Base Model	**Model Adjusted for Sexual Orientation**	**Model Adjusted for Weight-Related Behaviors**
	B (95% CI)	**B (95% CI)**	**B (95% CI)**
PREDICTORS			
Socially Assigned Gender Expression			
Very gender conforming	Reference	Reference	Reference
Mostly gender conforming	**0.53 (0.28, 0.78)**	**0.51 (0.25, 0.76)**	**0.52 (0.27, 0.77)**
Gender nonconforming	**1.23 (0.74, 1.73)**	**1.17 (0.65, 1.68)**	**1.13 (0.64, 1.62)**
Age			
Age	**0.47 (0.46, 0.48)**	**0.47 (0.46, 0.48)**	**0.47 (0.46, 0.48)**
Age squared	**−0.03 (−0.03, −0.02)**	**−0.03 (−0.03, −0.02)**	**−0.03 (−0.03, −0.02)**
Sexual Orientation			
Completely heterosexual		Reference	Reference
Mostly heterosexual		0.14 (−0.17, 0.45)	0.11 (−0.19, 0.41)
Bisexual		0.50 (−0.43, 1.44)	0.52 (−0.36, 1.40)
Lesbian		0.67 (−0.13, 1.47)	0.65 (−0.15, 1.44)
Weight-Related Behaviors			
Dieting			**0.24 (0.20, 0.28)**
Fasting			**−0.09 (−0.16, −0.02)**
Breakfast			**−0.16 (−0.23, −0.09)**
Fast food			**0.07 (0.01, 0.14)**
Physical activity			**−0.01 (−0.02, −0.01)**
TV viewing			**0.02 (0.01, 0.02)**

[a] All models control for GUTS cohort, race/ethnicity, mother's income, and mother's BMI at 18 years of age. Bolding indicates statistical significance at P<0.05.

Table 5

Adjusted GEE Linear Models[a] Estimating Socially Assigned Gender Expression Group Differences in BMI (kg/m2) Using Lagged Predictors and Repeated Measures from 1996 to 2011 Among Male Adolescents and Young Adults in the Growing Up Today Study1&2

	Males # observations=12,516		
	Base Model	**Model Adjusted for Sexual Orientation**	**Model Adjusted for Weight-Related Behaviors**
	B (95% CI)	**B (95% CI)**	**B (95% CI)**
PREDICTORS			
Socially Assigned Gender Expression			
Very gender conforming	Reference	Reference	Reference
Mostly gender conforming	**−0.67 (−1.09, −0.25)**	**−0.64 (−1.06, −0.22)**	**−0.63 (−1.03, −0.22)**
Gender nonconforming	**−1.99 (−2.76, −1.21)**	**−1.88 (−2.75, −1.01)**	**−1.78 (−2.63, −0.93)**
Age			
Age	**0.64 (0.61, 0.67)**	**0.65 (0.62, 0.68)**	**0.65 (0.62, 0.68)**
Age squared	**−0.02 (−0.03, −0.02)**	**−0.02 (−0.03, −0.02)**	**−0.02 (−0.03, −0.02)**
Interactions: Gender Expression-by-age			
Very gender conforming-by-age	Reference	Reference	Reference
Mostly gender conforming-by-age	**−0.09 (−0.12, −0.05)**	**−0.07 (−0.11, −0.03)**	**−0.07 (−0.11, −0.03)**
Gender nonconforming-by-age	**−0.14 (−0.24, −0.05)**	−0.05 (−0.16, 0.06)	−0.05 (−0.15, 0.06)
Sexual Orientation			
Completely heterosexual		Reference	Reference
Mostly heterosexual		−0.43 (−1.10, 0.24)	−0.41 (−1.04, 0.23)
Bisexual		0.95 (−1.43, 3.32)	0.90 (−1.41, 3.20)
Gay		−0.29 (−1.73, 1.16)	−0.44 (−1.82, 0.94)
Interactions: Orientation-by-Age			
Mostly Heterosexual-by-age		−0.04 (−0.11, 0.02)	−0.04 (−0.11, 0.03)
Bisexual-by-age		−0.04 (−0.21, 0.12)	−0.03 (−0.19, 0.12)
Gay-by-age		**−0.25 (−0.36, −0.14)**	**−0.24 (−0.34, −0.13)**
Weight-Related Behaviors			
Dieting			0.38 (0.29, 0.47)
Fast food			0.11 (0.02, 0.20)
Physical activity			−0.02 (−0.03, −0.01)
TV viewing			0.01 (0.00, 0.02)

[a] All models control for GUTS cohort, race/ethnicity, mother's income, and mother's BMI at 18 years of age. Bolding indicates statistical significance at P<0.05.