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Discordance in the Assessment of Pre-Pregnancy Weight Status of Adolescents: A Comparison between the Center for Disease Control and Prevention Sex- and Age- Specific BMI Classification and the Institute of Medicine-Based Classification Used for Maternal Weight-Gain Guidelines

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Abstract

In 1990 the Institute of Medicine (IOM) issued maternal weight gain guidelines to prevent intrauterine growth retardation based on adult pre-pregnancy BMI. A recent IOM report, however, expressed concerns regarding the application of adult criteria (pre-pregnancy BMI and gestational weight gain recommendations) to categorize pregnant adolescents. To draw attention to the assessment of pre-pregnancy weight status among adolescents and to its potential clinical implications, we estimated the percent discordance between the Center for Disease Control (CDC) BMI-for-age categories currently used for the assessment of adolescent weight status (underweight, healthy weight, at risk of overweight, and overweight) and the IOM-based categories (low, average, high, obese) among 11,656 adolescents 12–20 years-old from a birth registry. Approximately a quarter of all adolescents in this sample and 40% of young adolescents (12–15 year-old) were 'misclassified'. Among healthy weight adolescents, 23.4% and 0.6% were 'misclassified' as low and high, respectively, by IOM categories. Among at risk of overweight adolescents, 13.5% and 26.9% were 'misclassified' as average and obese by IOM categories. Based on our findings, we suggest that adolescent pre-pregnancy weight categories be assessed using the CDC BMI charts and to examine gestational weight gain distributions exclusively among adolescents according to the CDC BMI categories.

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Keywords

adolescent pregnancy; anthropometric indicators of nutritional status; gestational weight gain; gestational weight gain recommendations

Introduction

The issue of appropriate weight gain during pregnancy lies at the intersection between the promotion of good birth outcomes and the prevention of postpartum obesity. Inadequate weight gain during pregnancy is associated with the delivery of low birthweight and small-for-gestational-age infants, and preterm delivery.(1–7) Excessive weight gain during pregnancy does not necessarily enhance fetal growth and has been consistently found to contribute to post-partum weight retention and later obesity.(8–10) In 1990, the Institute of Medicine(1) (IOM) issued recommendations for weight gain during pregnancy. The IOM recommendations consist of gestational weight gain ranges that differ by pre-pregnancy body mass index (BMI) category (Table 1) because pre-pregnancy weight status modifies the effect of gestational weight gain on fetal growth.(1,11–14) The IOM report suggested that the same BMI categories could be used for women of all ages.(1)

The IOM recommendations are used to monitor weight gain during adolescent pregnancy(15) and have been used in research involving various aspects of adolescent gestational weight gain.(5,16,17) Moreover, several studies combining adolescents and adults(18–20) have also used the IOM guidelines. The IOM gestational weight gain ranges, however, are based on adult pre-pregnancy BMI categories. A recent IOM workshop report expressed concerns regarding the application of adult criteria (pre-pregnancy BMI and gestational weight gain recommendations) to categorize adolescents in studies of weight-related pregnancy outcomes, both maternal and birth ones.(21) Adult BMI categories are not appropriate for adolescents since the percent body fat associated with particular BMI changes substantially with adolescents' age and stages of sexual maturity.(22) Therefore, using adult BMI values could potentially misclassify adolescents' pre-pregnancy weight status and lead to recommending inappropriate weight gain ranges during pregnancy. Since 2000, age- and sex-specific BMI growth curves that take into account the growth pattern of children and adolescents are available.(23–25) Age- and sex-specific BMI is highly correlated with adiposity among children and adolescents(24,26) and has been recommended to use in screening children and adolescents for overweight(27) and to characterize underweight.(28) Adolescents' pre-pregnancy weight status, therefore, can now be assessed more accurately. The objectives of the present paper are to classify pre-pregnancy weight status in a sample of adolescents from a population-based perinatal registry using the current age-and sex-specific BMI categories and the IOM-based categories and to estimate the percent discordance between the two classifications systems in the assessment of pre-pregnancy weight status among adolescents in our sample.

Methods

Database

We obtained data from the Central New York and Finger Lakes Regions Perinatal Data System (PDS) of New York State (1996–2000). This secondary dataset is a population registry of prospectively collected data on all livebirths within the geographic areas covered by the registry.(29) PDS data were extracted from the perinatal medical records, personal interviews, and the birth certificate. As part of a larger study we have examined women less than 20 years of age at delivery who carried their pregnancies to term (between 38 to 42 weeks gestation), and delivered liveborn singletons with birthweight between 2,500–4,100 grams. Women with medical conditions prior to pregnancy (e.g., diabetes mellitus, renal disease) and those who develop conditions during pregnancy (e.g., gestational diabetes, preeclampsia, eclampsia) that may have influenced pre-pregnancy weight status and gestational weight gain were excluded. This study was exempted for human subjects review by the Research Subjects Review Board of the University of Rochester.

Variables

Pre-pregnancy BMI (pre-pregnancy weight in kilograms/height in meters^2) as an indicator of nutritional status was calculated using data on measured height and self-reported weight. Pre-pregnancy BMI was categorized using percentiles derived from the Center for Disease Control (CDC) and Prevention growth charts for BMI-for-age and sex (hereafter CDC categories).(30) The growth charts consist of a series of percentile curves that illustrate the distribution of BMI in U.S. children from 2 to 20 years of age. According to the CDC percentile cut points, adolescents' pre-pregnancy BMI-for-age was classified as underweight (< 5th percentile), healthy weight (≥5th–<85th percentile), at risk for overweight (≥85th–<95th percentile), and overweight (≥ 95th percentile). The BMI categories used by the IOM (hereafter, IOM categories) to assign maternal weight gain ranges are as follows: low (<19.8), average (19.8–26.0), high (>26.0–29.0), and obese (>29.0). For the purpose of this paper, we defined 'misclassification' as the discordance in the assessment of pre-pregnancy weight status between the CDC categories and the IOM categories among adolescents in our sample. An adolescent is correctly classified if her IOM category is in concordance with her CDC category. The concordance between the CDC and IOM categories is presented in table 2. An adolescent is 'misclassified' if her IOM category is in discordance with her CDC category. For example, an underweight adolescent according to the CDC is 'misclassified' if her BMI falls in the average IOM category.

Statistical analysis

We estimated the percent misclassification of pre-pregnancy weight status among adolescents in our sample by cross-tabulating the proportion of adolescents falling into each CDC category (underweight, healthy weight, at risk of overweight, and overweight) with the proportion of adolescents falling into each IOM category (low, average, high, and obese). In addition, we also estimated the percent misclassification in younger adolescents (12–15 years old) and older ones (16–20 years old) as two different subsets of the adolescent population. Since the average age at menarche is between 12 and 13 years of age in the U.S. population and young adolescents are those within 2 years after menarche[1], in our dataset, we defined younger adolescents as those 15 years of age or younger and older adolescents as those 16 years of age or older (12–15 years of age and 16–20 years of age, respectively). All analyses were done using SAS software Version 8.02 I for Windows. The calculation of BMI-for-age and sex percentiles was done using a CDC SAS program.(22)

Results

'Misclassification' of pre-pregnancy BMI categories (Table 3)

When comparing the current CDC categories with the IOM categories, we observed that, out of 11,656 adolescents, 23.5% of our sample was 'misclassified' using IOM categories. Most of the 'misclassification' occurred among the healthy weight and at risk of overweight CDC categories. Out of 8,039 adolescents with a healthy weight, 23.4 % were 'misclassified' as low and 0.6% were classified as high by IOM categories. Out of 1,971 at risk of overweight adolescents by CDC categories, 13.5 % were 'misclassified' as average and 26.9 % were 'misclassified' as obese by the IOM categories. Out of 1172 overweight adolescents, 1.2 % were 'misclassified' as high by IOM category. All 474 underweight and most of the 1,172 overweight (98.8%) adolescents were correctly classified by the correspondent IOM categories (low and obese, respectively).

Overall, 40% of younger (12–15 years-old) versus 22.8% of older (16–20 years-old) adolescents had their pre-pregnancy weight status ‘misclassified’ when the IOM classification was used. Among the younger group (n = 501), 33% of the healthy weight adolescents were ‘misclassified’ as low, 74.3% of the at risk of overweight adolescents were ‘misclassified’ as average, and 23% of the overweight ones were ‘misclassified’ as high by the IOM categories. Among 11,155 older adolescents, 23% of the healthy weight adolescents were ‘misclassified’ as low, 10.1% of the at risk of overweight were ‘misclassified’ as average, and 28.5% of the at risk of overweight were ‘misclassified’ as obese by the IOM categories. Finally, less than 1% of the overweight adolescents were ‘misclassified’ as high by the IOM categories. According to the CDC categories, 98.8% of the overweight older adolescents and 76.9% of the overweight younger adolescents were correctly classified by the IOM classification (obese).

Discussion

Almost a quarter of the adolescents in this sample of healthy term singleton pregnancies would have had their pre-pregnancy weight status ‘misclassified’ had the IOM BMI classification been applied in order to assign gestational weight gain ranges. Healthy weight and at risk of overweight adolescents are the most frequently misclassified by the use of IOM categories in both age-groups (‘misclassified’ as IOM low and IOM average, respectively). Overall, the ‘misclassification’ is larger among the younger adolescents (12–15 years old) than among the older ones (16–20 years old). The difference between younger and older adolescents, however, is not surprising since BMI can be used to track body size throughout the life span.(30) Older adolescents, who are more likely to be sexually mature than their younger counterparts, have a body size closer to adults’ body size than the body size of younger adolescents. Hence, the BMI values for older adolescents are closer to the adult BMI values than those for younger adolescents. All underweight BMI-for-age adolescents, young and old, however, were correctly classified by the correspondent IOM classification low. This is because the 5^{th} percentile of the BMI distribution for adolescents is consistently below the IOM cut point for the low category (BMI 19.8) along the age continuum. Consequently, the low IOM category will correctly capture all adolescents identified as underweight by the CDC criterion. Along the same lines, few of the overweight BMI-for-age adolescents in the sample (only 14 overweight adolescents, 12 younger and 2 older adolescents) were misclassified as high. This is because the 95^{th} percentile of the BMI distribution for adolescents 12–16 years old is above the IOM cut point for the high category (BMI 29). Therefore, the high category will incorrectly capture only adolescents under 16 who constitute a small proportion of the total sample.

It has been established that pre-pregnancy weight status modifies the effect of gestational weight gain on birth outcomes.(12,13,15,31,32) Thus, having an accurate assessment of the pre-pregnancy weight status is essential to assist in assigning BMI-specific target weight gains. This study illustrates that the IOM gestational weight gain recommendations are not consistent with the current CDC accepted assessment of adolescents’ weight status.(30)

Implication for clinical practice

Practitioners use the IOM guidelines to recommend and monitor the weight gain of their pregnant adolescent patients.(15) Classifying adolescents into incorrect BMI categories will potentially lead to the assignment of inappropriate IOM gestational weight gain ranges. For example, 24 % of the adolescents in the healthy weight and 13.5% of adolescents in the at risk of overweight CDC groups in our sample would be recommended to gain too much weight because they would be assigned the gestational weight gain range correspondent to, respectively, the low and average IOM categories. As a result, these adolescents may be at higher risk of retaining weight postpartum.(8, 9, 10) Furthermore, adolescents in the healthy weight and at risk of overweight categories are the most frequently ‘misclassified’. Since most adolescents in the population fall under the latter categories, the incorrect measurement of weight status would affect the gestational weight gain recommendations of the vast majority of the pregnant adolescents in clinical practice (approximately 83% of our sample).

Another practical implication of this study’s findings is the effect of the misclassification of pre-pregnancy weight status in the assignment of the appropriate weight gain range among younger adolescents since weight gain during pregnancy seems to have a greater effect on fetal growth in these adolescents.(33) In this study, misclassification of the pre-pregnancy weight status is almost twice as large among 12–15 year-old adolescents as it is among 16–20 year olds across all but the underweight BMI category.

Limitations

Young adolescents comprise only 4.3% of the total sample, thus, the proportions could be somewhat unstable. Additionally, pre-pregnancy weight was self-reported. Several authors have found, however, that self-reported weight is on average accurate among adolescents and adults(34–39) but differences between self-reported and measured weight differ by nutritional status.(17,36,37) The limitations of self-reported weight are not unique to our data but reflect the reality of clinical practice. Routinely collected obstetric data usually rely on self-reported pre-pregnancy weight and are used to make decisions regarding maternal weight gain advice and the risk assessment of deleterious birth and maternal outcomes. Moreover, the IOM guidelines were based on self-reported pre-pregnant weight.(1)

Conclusion

The data presented in this paper cannot be used to make any inference on the appropriate gestational weight gain ranges for adolescents. It is important to note that the IOM[1] recommendations were based on observations of the distribution of maternal weight gain in a sample combining adolescents and adults with optimal birth outcomes (birthweight 3000–4000 grams). The recent IOM workshop report on the influence of pregnancy weight on maternal and child health(21) states that the current recommendations need to be updated, specifically for obese women and adolescents since the 1990 recommendations did not consider the effect of weight gain on the maternal outcomes of pregnancy. To our knowledge, it is not known whether the distribution of maternal weight gain differs when observed separately in adolescent and adult women and, consequently, whether the target weight gain should also differ. Although adolescents vary in their degree of physiologic maturity, a sample of the population distribution of maternal weight gain among adolescents would reflect this variability.

This study only aims to draw attention to the discordances in the assessment of adolescent pre-pregnancy weight status that are arrived by using the two classification systems, the currently accepted percentiles from the CDC BMI growth curves and the IOM-based classification. Using IOM cut-off values among adolescents in our sample resulted in substantial misclassification of their pre-pregnancy weight status as defined by this paper. Based on our findings, we suggest that pre-pregnancy weight categories be assessed in clinical practice using the CDC BMI charts since these are the current recommended tools. Lastly, we recommend that the distribution of gestational weight gain in adolescents be re-examined using the current accepted age- and sex-specific BMI growth charts.

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TABLE 1

Institute of Medicine Gestational Weight Gain Recommendations

	IOM[a] Recommendations
Pre-Pregnancy BMI[b]	**Gestational weight gain ranges (kg)**
Low (<19.80)	12.50 –18.00
Average (19.80–26.00)	11.50 –16.00
High (>26.00–29.00)	7.00 – 11.50
Obese (>29.00)	7.00 – 11.00

[a]Institute of Medicine;

[b]Body Mass Index

TABLE 2

Parallels between the CDC[a] BMI[b] classification and the IOM[c] BMI classification

CDC BMI Classification	IOM BMI Classification
Underweight (5th Pc[d])	**Low** (<19.80)
Healthy Weight (≥ 5th – < 85th Pc)	**Average** (19.80–26.00)
At Risk of Overweight (≥ 85th – < 95th Pc)	**High** (>26.00–29.00)
Overweight (≥ 95th Pc)	**Obese** (>29.00)

[a]Center for Disease Control and Prevention;

[b]Body Mass Index;

[c]Institute of Medicine;

[d]Percentile

Table 3

Cross-tabulation of the CDC Classification with the IOM Classification. Adolescents in the Perinatal Data System of Central and the Finger Lakes Regions of New York (1996 – 2000)

CDC categories[a]	IOM Categories[b]	AGE		
		All n (row %)	12–15 years old n (row %)	16–20 years old n (row %)
Underweight (n=474)	Low (correctly classified)	474 (100.0)	9 (100.0)	465 (100.0)
	Average (misclassified)	0 (100.0)	0 (100.0)	0 (100.0)
	High (misclassified)	0 (100.0)	0 (100.0)	0 (100.0)
	Obese (misclassified)	0 (100.0)	0 (100.0)	0 (100.0)
Healthy weight (n=8,039)	Low (misclassified)	1,881 (23.4)	111(33.1)	1,770 (23.0)
	Average (correctly classified)	6,107 (75.9)	224 (66.9)	5,883 (76.4)
	High (misclassified)	51 (0.6)	0 (0.0)	51 (0.7)
	Obese (misclassified)	0 (0.0)	0 (0.0)	0 (0.0)
At Risk of Overweight (n=1,971)	Low (misclassified)	0 (0.0)	0 (0.0)	0 (0.0)
	Average (misclassified)	266 (13.5)	78 (74.3)	188 (10.1)
	High (correctly classified)	1,174 (59.6)	27 (25.7)	1,147 (61.5)
	Obese (misclassified)	531 (26.9)	0 (0.0)	531 (28.5)
Overweight (n=1,172)	Low (misclassified)	0 (0.00)	0 (0.00)	0 (0.00)
	Average (misclassified)	0 (0.00)	0 (0.00)	0 (0.00)
	High (misclassified)	14 (1.28)	12 (23.10)	2 (0.02)
	Obese (correctly classified)	1,158 (98.8)	40 (76.9)	1,118 (99.80)

[a]Center for Disease Control and Prevention categories: Underweight <5th percentile (P_C); Healthy Weight ≥5th P_C – <85th; At Risk of Overweight ≥ 85th P_C – <95th P_C; Overweight ≥95th P_C.

[b]Institute of Medicine BMI Categories: Low (<19.8), Average (19.8–26.0), High (>26.0–29.0), and Obese (>29.0)