Childhood Weight, Stature, and Body Mass Index Among Never Overweight, Early-Onset Overweight, and Late-Onset Overweight Groups

Wayne Wisemandle, MA; L. Michele Maynard, PhD; Shumei S. Guo, PhD; and Roger M. Siervogel, PhD

ABSTRACT. ***Objective.*** **To determine the effects of timing of onset of overweight (OW) on childhood anthropometric adiposity levels using long-term serial data from the Fels Longitudinal Study.**

Classification. **OW was defined as body mass index (BMI; kg/m²) >25, and the age at first measurement of BMI >25 was the age of onset of OW. Early onset of OW (early-OW) and late onset of OW (late-OW) were defined as having onset of OW before and after 25 years of age, respectively, whereas never OW (never-OW) was defined as never having a BMI >25.**

Subjects. **Subjects consisted of 67 males and 47 females in early-OW groups, 62 males and 48 females in late-OW groups, and 80 males and 114 females in never-OW groups.**

Results. **Levels of weight and BMI in early-OW males and females were significantly greater than those in never-OW and late-OW males and females beginning at the time of adiposity rebound, which generally occurs between 4 and 8 years of age. Median BMI and weight patterns between never-OW and late-OW males were similar throughout childhood. However, significant differences in median levels of BMI for never-OW and late-OW females began at 11 years of age, although onset of OW was not until >25 years of age in the latter group.**

Conclusions. **For both males and females, adiposity rebound is likely an effective time in a child's development to detect and initiate prevention for childhood and early adulthood onset of OW. Although later-onset OW needs additional study, puberty seems to be a critical phase in the development of later adult onset of OW in females.** ***Pediatrics*** **2000;106(1). URL: http://www.pediatrics.org/cgi/content/full/106/1/e14;** ***adiposity rebound, body mass index, overweight, obesity, children, serial data.***

ABBREVIATIONS. OW, overweight; BMI, body mass index; early-OW, early onset of overweight; late-OW, late onset of overweight; never-OW, never overweight; NHANES I, First National Health and Nutrition Examination Survey.

The increasing prevalence of overweight (OW) and obesity[1] over the last 30 years poses major public health concerns in the United States. The prevalence rates for OW of both adults and children have substantially increased, as have the levels of commonly used indices often applied in OW classification.[1–3] Furthermore, children that become OW are likely to remain OW as adults.[4–6] Childhood obesity increases morbidity and mortality,[7,8] and its effects on cardiovascular risk factors in adulthood are substantial.[9–11] With more members of the general population becoming obese in the United States, the consequent increases in obesity-related diseases, such as noninsulin-dependent diabetes mellitus and cardiovascular disease, are likely. Although obesity has been on the American Heart Association cardiovascular disease risk factor list for numerous years, being OW is now also considered an important cardiovascular disease risk factor, further substantiating the importance of addressing these increases in adiposity among adults and children alike.

The World Health Organization classifies adult individuals as OW if their body mass index (BMI) exceeds 25 kg/m² and obese if BMI exceeds 30 kg/m². With this classification, the number of OW individuals in industrialized countries has been reported to be ~40%, whereas some have reported even greater rates.[12] Similarly, the prevalence of obesity in the United States and Europe has been reported to be >20%. The staggering economic and personal burden that will accompany these increases in OW, obesity, and obesity-related diseases mandate targeted education, prevention, and early detection programs for those persons at greatest risk.[13,14]

Genetic predispositions, metabolic determinants, and lifestyle choices are major factors contributing to obesity.[15,16] Considering only the modifiable aspects of an individual's life, there are many lifestyle choices that greatly affect onset of obesity, including nutritional intake, physical activity levels, television viewing,[17] and other socioenvironmental factors.[18,19] The mechanisms responsible for the accumulation of adipose tissue leading to obesity are complex and may be a function of a combination of integrated factors within individuals.

Methods for detection of children at high risk for childhood-onset OW have generally been based on levels of weight or weight adjusted for height in relation to national percentiles with or without inclusion of skinfold measurements.[20,21] The focus of these methods is to identify in early childhood those persons at risk for later childhood obesity, who, in turn, are likely to demonstrate adulthood obesity and its consequences.[4,15,22] The adiposity rebound, an early stage of normal childhood development occurring between 4 and 8 years of age in which levels of

From the Division of Human Biology, Department of Community Health, Wright State University School of Medicine, Dayton, Ohio.
Received for publication Jun 21, 1999; accepted Feb 18, 2000.
Reprint requests to (W.W.) Division of Human Biology, 3171 Research Blvd, Kettering, OH 45420-4014. E-mail: wayne.wisemandle@wright.edu

adiposity change from decreasing to increasing accumulation, has been proposed as an effective time in children's lives for prevention and intervention.[23–25] An earlier adiposity rebound has been associated with an increased risk of childhood and early adulthood OW and obesity. Because longitudinal data from childhood into adulthood, especially into middle age and beyond, are scarce, less attention has been given to childhood data in relation to later adult-onset of OW or obesity.

The primary aims of this study were to: 1) describe the distribution of the age of onset of adult classified OW, 2) describe childhood levels of weight, stature, and BMI in individuals defined by the time of onset of OW (that is, individuals becoming OW early in life, individuals becoming OW late in life, and individuals never becoming OW), and 3) determine if and when childhood levels of weight, stature, and BMI differed among those groups.

METHODS

Data Description

Lifetime serial data from a subset of participants in the Fels Longitudinal Study,[26] a cohort of generally healthy individuals, were used in these analyses. Participants in this study have been enrolled since 1929, typically near the time of their birth. Most are white, resided in southwestern Ohio at the time of their enrollment, and were selected without regard to the presence or absence of any specific disease or other physical characteristic. Child participants are generally scheduled for examinations biannually, whereas adult participants in the Fels Longitudinal Study are scheduled for examinations every 2 to 5 years, depending on their age and present location of residence. Participant examinations that occurred during pregnancy were excluded from these analyses. Informed consent was obtained from each participant, and when the participant was a minor, informed consent was also obtained from a parent or guardian. All procedures were approved by the Institutional Review Board of Wright State University, Dayton, Ohio.

The cohort composition of the Fels Longitudinal Study is mostly white individuals who reside, or did reside, in southwestern Ohio. Because it is known that there are racial differences in childhood growth values[27–29] and because the present analysis is comprised solely of white subjects, these results are limited in their generalizability to white individuals. However, simply and reliably obtainable anthropometric measures, weight and stature, were used in the present analysis. The mean childhood levels of these measures consistently reside between the 50th and 75th national percentiles,[30] with stature and weight on average 1.5 cm and 2.0 kg for males and 1.0 cm and 1.4 kg for females greater than the 50th percentile for 6 through 18 years of age. In addition, Fels data were used exclusively to construct the length and weight growth charts from birth to 36 month of age and have been popularly referenced by pediatricians and researchers to track and compare the growth of children nationally and internationally since 1979.[30] In adulthood, mean levels of weight for stature between 18 and 55 years of age were slightly less than mean US national levels by ~2 kg for statures ranging ± 5 cm of mean levels.[31]

OW Classification

For the present analysis, OW was defined using the recommendation of the World Health Organization Obesity Task Force, which states that a BMI >25 kg/m^2 is considered OW for both male and female adults. For OW classification, all available BMI data, from birth to the most recent examination, were considered and examined for BMI >25 kg/m^2. Age at onset of OW (onset-OW; years) was the age at first occurrence of a BMI >25 kg/m^2. Three OW status groups were defined in the analyses: early-onset OW (early-OW), late-onset OW (late-OW), and never-OW (never-OW). Individuals never having a measurement of BMI >25 kg/m^2 were considered never-OW, those having onset of OW before 25 years of age were considered early-OW, and those having onset of OW after 25 years of age were considered late-OW. For an individual to be categorized as either early-OW or late-OW, the individual must have maintained OW status for 80% of all subsequent examinations after onset of OW. The individuals whose BMI consistently fluctuated above and below 25 kg/m^2 were excluded from analyses (32 males and 34 females). For an individual to be classified into any of the 3 OW status groups, the individual must have had an examination before 18 years of age. Furthermore, the individual must have had an examination after 25 years of age to be classified into either the never-OW or late-OW group and after 18 years of age to be classified in the early-OW group.

Childhood Analyses

Weight (kg) and stature (cm) were measured for each participant using standardized techniques,[32] and BMI (kg/m^2) was calculated from weight and stature. For childhood analyses, birth weight and yearly examinations occurring within .25 years of 1 through 18 years of age were considered. That is, OW classification is based on all available data, and childhood analyses are based only on data occurring at or before 18 years of age.

For comparison of childhood data in each of the 3 OW status groups, medians and interquartile ranges of weight, stature, and BMI were calculated for each childhood age from birth through 18 years of age. The interquartile range is the difference between the 75th and 25th percentiles and is representative of variability in the sample. To test statistical differences between 2 groups, Student's *t* tests or nonparametric tests, where appropriate, were used. For the comparison of >2 groups, nonparametric multiple comparison tests based on the Kruskal-Wallis rank sum test were used.[33] This test jointly ranks the age- and sex-specific variables of interest, and multiple comparisons among groups are based on the group ranks. Nonparametric statistics are presented and nonparametric tests conducted to minimize the effect of severely obese children on the interpretation of statistical significance. All tests were conducted at the $P < .05$ level of significance.

TABLE 1. Number or Mean and Standard Deviation for Number of Examinations for OW Classification, Number of Annual Childhood (Birth to 18 Years of Age) Examinations, Birth Weight, Age at Last Examination, and Age at Onset of OW by Sex and OW Classification

	Male			Female		
	Early-OW	Late-OW	Never-OW	Early-OW	Late-OW	Never-OW
n	67	62	80	47	48	114
Number of examinations for OW classification	2537	2416	2902	1501	1888	4254
Number of examinations for child analysis	1098	1013	1281	720	789	1806
Birth y (y)	1954 (16)	1950 (11)	1954 (11)	1959 (14)	1951 (11)	1951 (12)
Birth weight (kg)	3.42 (.75)	3.36 (.61)	3.51 (.47)	3.37 (.61)	3.14 (.45)	3.19 (.46)
Last examination (y)	38.3 (15.4)	44.0 (10.6)	36.7 (9.3)	30.0 (13.2)	44.4 (11.6)	41.8 (11.8)
Onset-OW (y)	18.6 (4.2)	38.4 (8.1)	—	17.7 (4.6)	38.6 (9.9)	—

Entries: either number or mean (standard deviation).

RESULTS

Group characteristics are shown in Table 1. For OW classification, a total of 15 498 examinations, ~37 examinations per individual, were used to classify the 209 males and 209 females into OW groups. For the childhood analyses, a total of 6707 examinations were used to calculate the medians within each OW category for each of the 19 yearly childhood age groups, birth through 18 years of age. Within each OW status group, the number of examinations used for the childhood analyses averaged >15 per individual. Thus, these data represent a fairly complete serial childhood record for these individuals.

The mean age of most recent examination for males was >36 years of age for all groups. The never-OW and late-OW females had a mean age at most recent examination of >40 years of age, whereas the early-OW females were significantly younger with a mean of 30 years of age. The mean age of onset of OW was not significantly different between the sexes within respective OW status groups. Considering the mean age at last examination and age of onset of OW, the male and female early-OW groups maintained OW for an average of 20 and 12 years, respectively. For late-OW groups, this average length of maintenance of OW was ~6 years for both males and females. Gender-specific mean levels of birth weight for the OW status groups were not significantly different from each other. Also, the mean birth year for never-OW and early-OW males was 1954, whereas late-OW males had a mean birth year of 1950. Mean birth year was 1959 for early-OW females and 1951 for both never-OW and late-OW females.

Figure 1 shows the distribution of age of onset of OW for males and females that became and maintained OW. The *y*-axis represents the percentage of the 129 OW males or the percentage of the 95 OW females having onset of OW within the specified 5-year age group. More males became OW at 20 to 25 years of age than during the other 5-year age groupings, with >20% becoming OW within this age interval. From 25 to 40 years of age, ~9% of OW males had onset of OW within each 5-year age group, with that number increasing to 15% for the 40- to 45-year age group. For females, 40% of the OW females had onset of OW between 10 and 15 years of age or between 20 and 25 years of age, equally distributed within each age group. Approximately 10% of OW females had onset of OW within each group of 15 to 20 years, 25 to 30 years, 30 to 35 years, and 35 to 40 years of age, and nearly 20% had onset of OW after 40 years of age.

Figure 2 presents median levels of weight and BMI for OW status groups from birth through 18 years of age for males, with the significant differences between OW status groups indicated. The lower graphs present a more detailed depiction of weight and BMI at or below 8 years of age. Also, Table 2 presents the medians and interquartile ranges for weight and BMI for selected ages for males and the significant differences between OW status groups are indicated. The median weight and BMI patterns for late-OW and never-OW males are extremely similar, with the late-OW group having consistently higher values, although these values are not statistically significant in any instance. However, median weight and BMI for early-OW males were significantly greater than for never-OW males beginning at 3 years of age, and greater than late-OW males beginning at 8 years of age for weight and 5 years of age for BMI and continuing throughout childhood.

Figure 3 presents median levels of weight and BMI for OW status groups from birth through 18 years of age for females, and Table 3 presents the corresponding medians and interquartile ranges for weight and BMI for selected ages with significant differences between OW status groups indicated. Median levels of weight and BMI were significantly greater for early-OW females compared with never-OW and late-OW females at 4 years of age and continuing throughout childhood. Also, early-OW females had significantly greater median weights at 2 and 3 years of age and significantly greater BMI at 3 years of age compared with never-OW females. In addition, late-OW females had significantly greater median

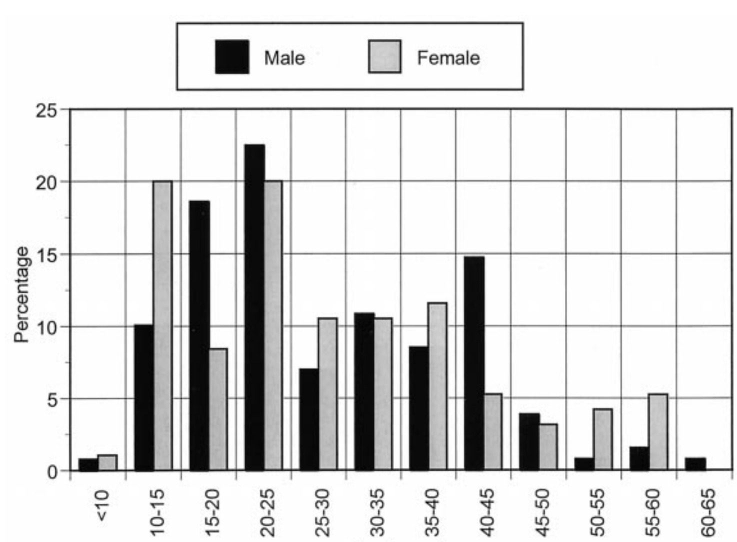

Fig 1. Distribution of age of onset of OW for males and females.

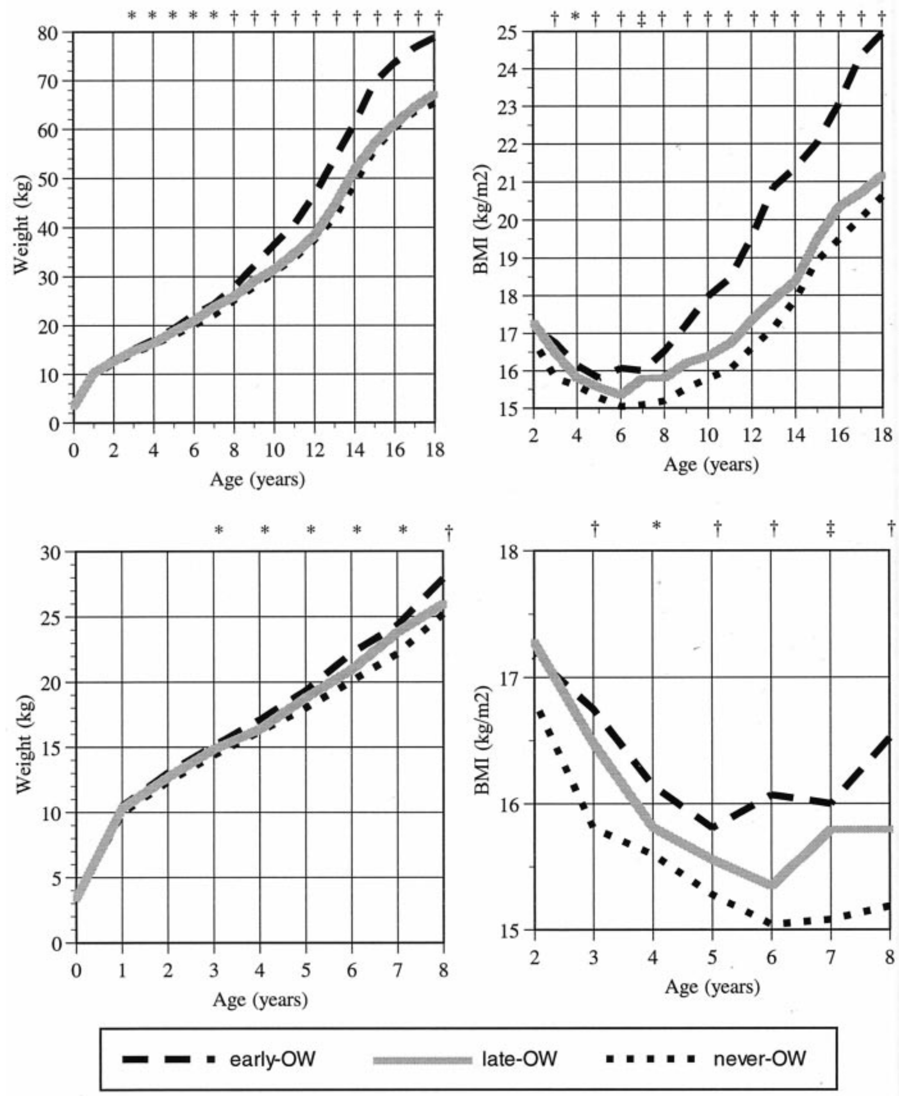

Fig 2. Childhood weight (left) and BMI (right) medians for males throughout childhood and through 8 years of age with significant differences between early-OW and never-OW (*); between early-OW and never-OW and between early-OW and late-OW (†); and between all OW status groups (‡) indicated.

TABLE 2. Medians and Interquartile Ranges of Weight and BMI for Males Within OW Status Groups for Selected Ages

Male Age (Years)	Weight (kg)			BMI (kg/m²)		
	Early-OW	Late-OW	Never-OW	Early-OW	Late-OW	Never-OW
3	15.1* (2.1)	14.9 (1.8)	14.4 (1.7)	16.7* (1.1)	16.5 (1.4)	15.8 (1.2)
6	22.2* (3.2)	20.9 (3.6)	20.1 (2.5)	16.1† (1.4)	15.3 (1.4)	15.0 (1.3)
8	27.9† (6.0)	26.0 (4.2)	25.2 (3.6)	16.5† (2.3)	15.8 (1.4)	15.2 (1.7)
11	40.6† (10.8)	34.7 (5.1)	33.8 (5.8)	18.5† (4.2)	16.7 (1.7)	16.0 (2.0)
13	53.9† (16.4)	44.4 (6.4)	42.1 (10.2)	20.8† (4.0)	17.9 (1.9)	17.1 (2.6)
15	69.5† (15.6)	57.0 (10.2)	55.7 (10.0)	22.0† (4.0)	19.5 (2.5)	18.9 (2.2)
18	78.8† (16.3)	67.1 (9.9)	65.3 (9.5)	24.9† (4.0)	21.2 (3.0)	20.6 (2.9)

Entries: median (interquartile range).
* Significant difference between early-OW and never-OW; $P < .05$.
† Significant difference between early-OW and never-OW and between early-OW and late-OW; $P < .05$.
‡ Significant difference among all OW status groups; $P < .05$.

BMI compared with never-OW females beginning at 11 years of age and continuing through 18 years of age. These data were not smoothed, so there are some minor year-to-year fluctuations within the median levels, most notably in early-OW female BMI levels before 8 years of age. However, overall the median levels are consistent from year to year for both weight and BMI.

The plots for the median levels of stature are not shown but generally follow the same pattern of change as evidenced in the childhood growth charts.[30] For males, the only significant differences in median statures were at 12 and 13 years of age with early-OW males having greater statures compared with never-OW males. For females, significant differences were found at 10 through 13 years of age, where early-OW females were taller than never-OW females.

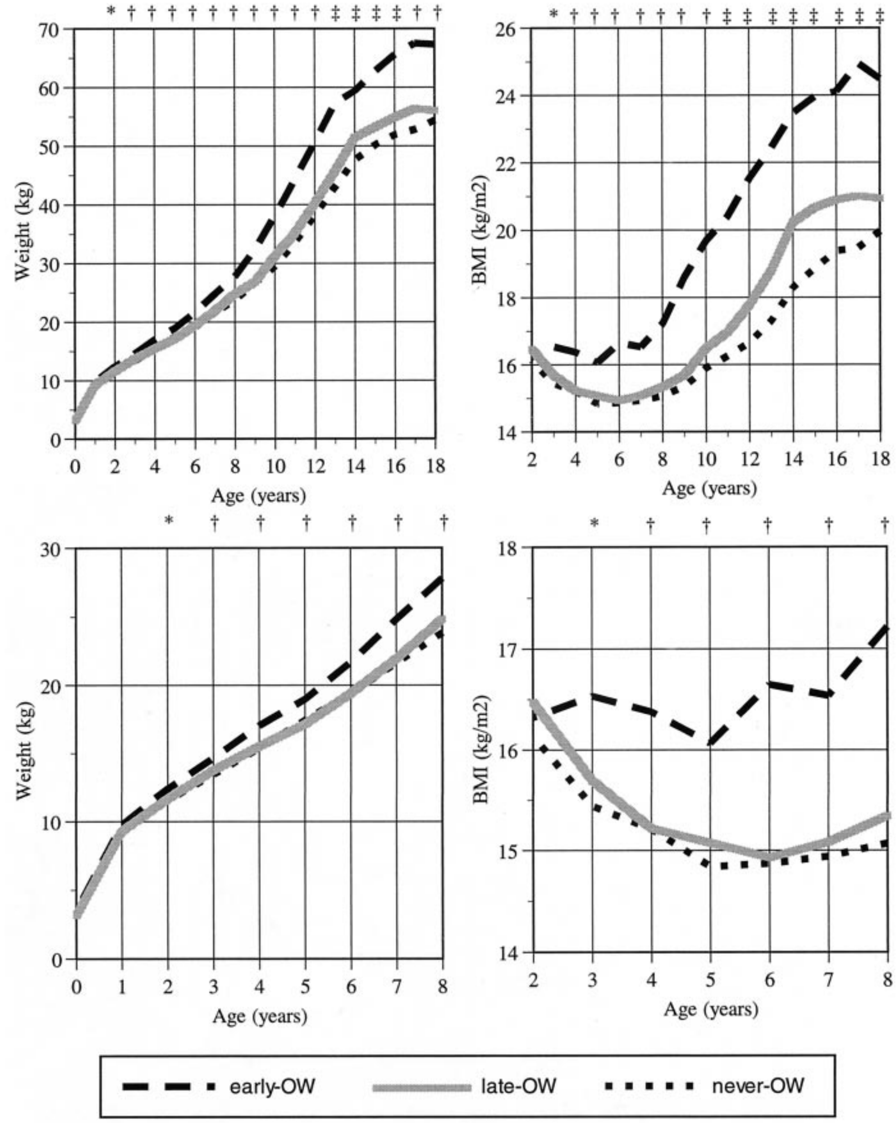

Fig 3. Childhood weight (left) and BMI (right) medians for females throughout childhood and through 8 years of age with significant differences between early-OW and never-OW (*); between early-OW and never-OW and between early-OW and late-OW (†); and between all OW status groups (‡) indicated.

TABLE 3. Medians and Interquartile Ranges of Weight and BMI for Females Within OW Status Groups for Selected Ages

Female Age (Years)	Weight (kg)			BMI (kg/m²)		
	Early-OW	Late-OW	Never-OW	Early-OW	Late-OW	Never-OW
3	14.7† (1.7)	13.8 (2.8)	13.5 (1.7)	16.5* (1.0)	15.7 (1.7)	15.4 (1.3)
6	21.7† (3.4)	19.4 (3.7)	19.4 (3.0)	16.6† (1.2)	14.9 (1.7)	14.9 (1.5)
8	27.8† (7.5)	24.8 (5.7)	23.9 (3.9)	17.2† (2.8)	15.3 (2.1)	15.1 (1.8)
11	44.3† (9.6)	35.2 (10.1)	33.6 (7.2)	20.4‡ (4.4)	17.0 (3.3)	16.3 (2.2)
13	57.2‡ (12.8)	45.7 (6.9)	43.0 (8.4)	22.4‡ (3.9)	18.8 (2.4)	17.3 (2.9)
15	62.7‡ (12.7)	53.2 (5.7)	50.2 (7.8)	24.0‡ (5.1)	20.7 (2.2)	18.9 (2.3)
18	67.4† (14.9)	56.0 (8.9)	54.4 (7.4)	24.5‡ (5.1)	20.9 (2.2)	20.0 (2.4)

Entries: median (interquartile range).
* Significant difference between early-OW and never-OW; $P < .05$.
† Significant difference between early-OW and never-OW and between early-OW and late-OW; $P < .05$.
‡ Significant difference among all OW status groups; $P < .05$.

Because percentile data for BMI are not readily available on the growth charts in current use, the present data are compared with the national BMI percentile data to give relative perspective on median levels. Comparisons of median levels of BMI with national levels are based on First National Health and Nutrition Examination Survey (NHANES I) data of white children conducted between 1971 and 1974.[34] The use of NHANES I percentile data for comparison purposes should yield the most meaningful results of the 3 US national surveys because year of birth in the present study ranges from 1929 to 1979, with a mean birth year of 1953. The median levels of BMI for early-OW groups are between the 50th and 75th percentiles between 2 and 12 years of age inclusive for males and between

2 and 7 years of age inclusive for females. For males at 13 years of age and females at 8 years of age, the early-OW groups surpass the 75th NHANES I percentiles for BMI and continue to exceed this percentile for the remainder of childhood. The never-OW and late-OW males have median levels of BMI at approximately the 50th national percentile throughout childhood. The median BMI levels of late-OW males exceeded the 50th percentile at 3 years of age and 7 to 9 years of age inclusive. The never-OW females had levels of BMI between the 25th and 50th national percentiles throughout childhood, with the levels generally nearer to the 25th percentile. The late-OW females had median levels of BMI between the 25th and 50th national percentiles between 3 and 13 years of age inclusive, with levels generally nearer to the 50th percentiles. At 14 years of age and throughout the remainder of childhood, median levels of BMI for late-OW females resided between the 50th and 75th national percentiles.

DISCUSSION

This study used lifetime serial data from participants enrolled in the Fels Longitudinal Study to describe childhood weight, stature, and BMI in early-OW, late-OW, and never-OW groups and to determine the timing of possible differences in these variables among groups. The median BMI and weight for early-OW males and females differed significantly from the late-OW and never-OW males and females beginning at 4 years of age and continuing throughout childhood. Median BMIs for late-OW and never-OW females were significantly different beginning at 11 years of age, whereas median BMI for late-OW and never-OW males were generally similar throughout childhood. For both males and females, median statures for all of the early-OW groups were greater than never-OW groups at 12 and 13 years of age and at 11 and 12 years of age as well for females. Median weight for never-OW and late-OW groups were similar throughout childhood.

Data Strengths and Limitations

Data from the Fels Longitudinal Study provide the unique opportunity to address issues of childhood levels of the component measures of BMI with groups based on data collected well into adulthood. In fact, the mean age at last examination for all groups in the present study is 30 years of age or older, with half of the groups having a mean age at last examination of >41 years of age. These extensive data allow for the classification of groups of individuals that have never been OW or have become OW either early or late in their life, while still considering prospectively collected childhood data. Furthermore, considering the accuracy with which stature and weight data are obtained and the relative wealth of lifetime serial data for each individual used to classify OW status, misclassification within these groups is kept to a minimum.

It is important to clarify that the classification of OW was made at an adult level of OW at all ages, rather than a childhood level for those who have onset of OW before 18 years of age. Generally, in children, OW is defined as age- and sex-specific weight or BMI above the 85th percentile.[20] The onset of adult classified OW (BMI >25) was used in this study because the primary aim was to investigate attainment and maintenance of this adult OW status in relation to childhood levels of the component measures of BMI.

With prevalence of OW and obesity increasing substantially over the last 30 years,[1] a secular trend within the OW group representation is unavoidable and expected. Considering the birth year of the groups, a secular trend is most evident in the early-OW females, where the mean birth year was 1959 with 59% born after 1960. Also, late-OW males tended to be born slightly earlier than other males, but generally there were no other substantial secular differences between the remaining groups.

The use of 25 years as the defining age between early-OW and late-OW was made while considering a number of factors that primarily relate to the relationship of BMI with fat-free mass during childhood and the general timing of peak fat-free mass acquisition. During childhood, BMI is confounded with fat, fat-free mass, and stature[35] and can be a measure of leanness as well as fatness in children.[36] Also, peak fat-free mass is attained by 25 years of age for most individuals,[37] and afterward increases in weight are likely representative of increases in adiposity.

Weight and BMI are expected to be substantially greater in OW children compared with those not OW during childhood. However, in the present classification, 40% of early-OW females (19 of 47) and 43% of early-OW males (29 of 67) did not exhibit adult-classified OW until between 20 and 25 years of age. Because these individuals had an examination at 18 years of age and did not exhibit a BMI resulting in an adult OW classification, the data are consistent with previous reports[4,6] that onset of OW within young adulthood has its basis within early childhood.

Childhood Inferences

For each sex, the significant differences in median BMI between early-OW groups and both never-OW and late-OW groups begin to emerge at 4 years of age, at the initiation of adiposity rebound. The adiposity rebound is characterized by the change from a decreasing degree of adiposity to an increasing degree of adiposity between 4 and 8 years of age. This occurs as 1 of the 3 normal phases of early childhood development that include increases in adiposity to 1 year of age, followed by decreases in adiposity until 4 to 8 years of age, and finally increases in adiposity again that continue throughout childhood.[38,39] Early adiposity rebound has been reported to be indicative of future OW and obesity in later childhood and in early adulthood.[22–25] The early-OW groups in this present analysis exhibit an earlier adiposity rebound than do other OW status groups, and, in addition, the significant differences in BMI among the groups begin to emerge at this important phase of growth. Also, the early-OW female median BMI crosses the 75th national percentile level in the latter stages of the adiposity rebound age range.

Whitaker et al[24] abstracted height and weight data from medical records to determine the risk of adulthood obesity, defined between 21 and 29 years of age, in relation to adiposity rebound. They found that early adiposity rebound, as determined by the method of Siervogel et al,[23] was associated with increased risk of adulthood obesity. Although the methods and classification of OW differed slightly, the results of the present study support the claim that an early adiposity rebound is indicative of early-OW. The present study has a considerably longer follow-up than does the study by Whitaker et al[24] that allowed for classification of a late-OW group, and it is prospective rather than retrospective.

For females, the BMI patterns early in life are similar between the late-OW and never-OW groups but begin to diverge at ~8 years of age and become significantly different by 11 years of age. At 14 years of age, the late-OW females cross the 50th percentile for national BMI levels, while the never-OW females remain between the 25th and 50th national percentiles. Considering that onset of OW for these females is not, on average, for another 27 years, the differentiation in levels of BMI between never-OW and late-OW groups by 11 years of age suggest that later adult onset of OW has its roots at, or even before, puberty. There is evidence that obese girls mature more rapidly than do their lean counterparts.[40,41] The significant differences in early adolescence in the present study may also indicate pubertal timing differences or possible metabolic or endocrinologic differences between life-long lean individuals and adult-onset OW individuals.

For males, the patterns of change in BMI in the late-OW and never-OW groups follow similar courses throughout childhood, including the adiposity rebound phase of development. Furthermore, these patterns closely match those of the 50th national percentile levels. The general lack of distinction between never-OW and late-OW males suggests that childhood levels of BMI and weight for those non-OW children may not be the differentiating factors of those at greater risk of OW later in life. The risk of males becoming OW or obese adults is likely to be a function of lifestyle choices made after childhood. Although the foundation for those adulthood lifestyle choices, such as physical activity level and nutritional intake, are certainly established during childhood, those lifestyle choices are not manifested in greater or lesser adiposity (as measured by BMI) until later in life.

Conclusions and Future Directions

Additional studies need to be directed at determining not only the causality of the onset of OW but also the effects of early- and late-OW on the accumulation of adipose tissue and the levels of cardiovascular disease risk factors in adulthood. Special attention should be given to possible differences between the earlier and later onset of OW and the effects of timing and duration of OW on these adulthood cardiovascular disease risk factors.

The present study found that weight and BMI in males and females with early-OW are significantly greater than in those who never become OW or those with late-OW, beginning at the time of adiposity rebound. This early-onset group had adiposity rebound at younger ages than did the other groups, and continued growth was such that weight and BMI began to cross national percentile levels. Also, never-OW and late-OW males had significant differences in median levels of BMI only at 7 years of age and never for weight. The mean growth patterns between these 2 groups were similar and representative of the 50th national percentile levels for weight and BMI. However, significant differences in median levels of BMI for late-OW and never-OW females began at the initiation of puberty, although not for mean levels of weight. These childhood differences between late-OW and never-OW existed, although the onset of OW for these females was not for another 2½ decades. For both males and females, the adiposity rebound is likely an effective time in a child's development to initiate detection and prevention for early onset of OW and obesity. Puberty for females may be an important time for careful consideration of the development of later-onset OW, although more studies need to be conducted to examine the nature of these changes that occur at puberty. Furthermore, the lack of differentiation with childhood levels of weight and BMI between males with late onset of OW and those never OW pose difficult questions concerning the natural progression of later onset of OW in males.

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