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Association Between Fat Mass in Early Life and Later Fat Mass Trajectories

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IMPORTANCE A rapid increase in weight in early life is associated with an increased risk for adiposity and cardiovascular diseases at age 21 years and beyond. However, data on associations of early change in measured fat mass percentage (FM%) with adiposity development are lacking.

OBJECTIVE To investigate whether a rapid increase in FM% in the first months of life is associated with higher trajectories of body fat mass during the first 2 years of life.

DESIGN, SETTING, AND PARTICIPANTS A birth cohort consisting of 401 healthy, term-born infants of the Sophia Pluto Cohort Study was analyzed. Participants were born between January 7, 2013, and October 13, 2017. Data were analyzed from February 1, 2020, to May 20, 2020.

INTERVENTIONS Longitudinal measurements of FM% by air-displacement plethysmography and dual-energy x-ray absorptiometry, and abdominal subcutaneous and visceral fat mass (FM) by ultrasonography in infants at ages 1, 3, 6, 9, 12, 18, and 24 months. A rapid increase in FM% was defined as a change in FM% of greater than 0.67 standard deviation scores (SDS).

MAIN OUTCOMES AND MEASURES Associations between change in FM% SDS in the first and second 6-month period of life with body composition at age 2 years and whether a rapid increase in FM% SDS during the first 6 months leads to higher body FM and abdominal FM trajectories during the first 2 years of life.

RESULTS Of the 401 participants, 228 infants (57%) were male. Change in FM% SDS from age 1 to 6 months was positively associated with FM% (β, 0.044; 95% CI, 0.017-0.068), FMI (β, 0.061; 95% CI, 0.032-0.091), and abdominal subcutaneous FM (β, 0.064; 95% CI, 0.036-0.092) at age 2 years, but not with visceral FM. In contrast, no associations were found within the 6- to 12-month period. Infants with a rapid increase in FM% of greater than 0.67 SDS in the first 6 months of life had higher trajectories of FM%, FM index, and subcutaneous FM during the first 2 years of life (all $P \leq .001$), but visceral FM index was not significantly different compared with infants without a rapid increase ($P = .12$).

CONCLUSIONS AND RELEVANCE In this study, only the change in FM% in the first 6 months of life was associated with more adiposity at age 2 years. Infants with a rapid increase in FM% had higher trajectories of FM% and FM index during the first 2 years of life. These findings appear to support a critical window for adiposity programming in early life.

Supplemental content

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The first 1000 days of life, from conception until age 2 years, are important for the development of body and brain.[1] A rapid increase in this period, in literature defined as a change in weight-for-age standard deviation score (SDS) greater than 0.67 between 2 times,[2,3] has been associated with an increased risk of overweight and adiposity,[2,4-7] unfavorable cardiovascular and metabolic health profiles in early adulthood,[8-11] and cardiovascular diseases in later life.[12,13]

We noted in the Programming Factors for Growth and Metabolism (PROGRAM) study that a rapid increase in weight-for-age greater than 0.67 SDS during the first year of life appeared to be positively associated with waist circumference, acute insulin response, total cholesterol to high-density lipoprotein cholesterol ratio, triglyceride levels, and a higher fat mass percentage (FM%), more central obesity, and reduced insulin sensitivity at age 21 years, and was inversely associated with insulin sensitivity and serum high-density lipoprotein levels.[8] First-year weight gain was postulated to be important for adiposity programming.[8,14]

Most studies, however, have used weight SDS, height SDS, body mass index (BMI) SDS, or skinfolds as a proxy of body composition.[3,15-17] Based on the results of the PROGRAM study, we conducted an observational cohort study to investigate longitudinally measured body composition in term-born infants.

To our knowledge, this is the first study to evaluate the associations of change in measured FM% SDS, instead of weight-for-age SDS, in early life with longitudinal body composition by detailed fat mass (FM) measurements in healthy infants during the first 2 years of life. As increased abdominal visceral FM has been specifically associated with an unfavorable metabolic health profile during childhood and later on,[18,19] we also measured abdominal subcutaneous and visceral FM thickness by noninvasive ultrasonography.[20-22]

In this study, we investigated the time within postnatal months when a change in FM% is associated with FM% at age 2 years. Subsequently, we assessed whether a rapid increase in FM% during that period would associate with higher trajectories of body FM and abdominal FM during the first 2 years of life. We hypothesized that infants with a rapid increase in FM% SDS would have more body FM and visceral FM at age 2 years.

Key Points

Question Is a rapid increase in fat mass percentage in early life associated with higher trajectories of body fat mass during the first 2 years of life?

Findings In a cohort study of 401 infants, only the change in fat mass percentage during the first 6 months of life was associated with fat mass percentage and abdominal subcutaneous fat mass at age 2 years. A rapid increase in fat mass percentage during that period was associated with higher trajectories of body fat mass during the first 2 years of life.

Meaning The data from this study suggest that the first 6 months of life are a critical window for adiposity programming, which may have major implications for primary health care.

Methods

Participants

The study population consisted of healthy, term-born infants participating in the Sophia Pluto Study, a birth cohort study in the Rotterdam, the Netherlands, area. Ninety-eight percent of the births were singleton. Between January 7, 2013, and October 13, 2017, infants were recruited from obstetric departments of regional hospitals and primary health care centers to obtain detailed data on body composition and growth during early life. The Sophia Pluto Study obtained approval from the medical ethics committee of Erasmus University Medical Center, and parents gave written informed consent. Participants did not receive financial compensation. Data were analyzed from February 1, 2020, to May 20, 2020. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline for cohort studies.

All participants fulfilled the following inclusion criteria: term born (≥37 weeks' gestation), age less than 28 days, and uncomplicated neonatal period without signs of severe asphyxia (defined as an Apgar score <3 after 5 minutes), sepsis, or long-term complications of respiratory ventilation. Infants were excluded if they had known congenital or postnatal diseases, confirmed intrauterine infection, maternal use of corticosteroids during pregnancy, or a significant maternal medical condition that could interfere with the study results.

Data Collection and Measures

Outpatient clinic visits were scheduled at ages 1, 3, 6, 9, 12, 18, and 24 months (**Table 1**). Data on pregnancy and birth were obtained from records and measurements were performed by trained staff.

Weight was measured with an electronic infant scale to the nearest 5 g (Seca 717, Seca). Length was measured twice by 2-person technique with an infantometer to the nearest 0.1 cm (Seca 416) and head circumference was measured twice as the widest frontal-occipital circumference with a measuring tape to the nearest 0.1 cm (Seca 201). Weight-for-length, weight-for-age, and height-for-age SDS were calculated by Growth Analyser.[23]

Until age 6 months, body composition was assessed by air-displacement plethysmography (ADP) (Pea Pod, COSMED) as described in detail elsewhere.[20] The ADP system was calibrated daily, according to standard protocol.[24]

From 6 months onward, a dual-energy x-ray absorptiometry (DEXA) scan was performed in all infants at every visit. All DEXA scans were performed with the same device (Lunar Prodigy, GE Healthcare) and software (enCORE software, version 14.1, enCORE).

At 6 months, median FM% was 24.1 as measured by ADP and 25.0 by DEXA, with a median difference of 0.9% between both measurements. Bland-Altman analysis showed no proportional bias (P = .32).[25] Fat mass index (FMI) was determined by dividing fat mass (kilograms) by height squared (meters squared) and fat-free mass index (FFMI) by dividing fat-free mass (kilograms) by height squared.

Table 1. Clinical Characteristics

Characteristic	Age, pooled means (SD), mo						
	Age, mo						
	1	3	6	9	12	18	24
Sex, No. (%)	401	401	401	401	401	401	401
Male	228 (56.9)	228 (56.9)	228 (56.9)	228 (56.9)	228 (56.9)	228 (56.9)	228 (56.9)
Female	173 (43.1)	173 (43.1)	173 (43.1)	173 (43.1)	173 (43.1)	173 (43.1)	173 (43.1)
Weight, kg							
Male	4.37 (0.53)	6.20 (0.67)	7.92 (0.85)	9.14 (0.99)	10.01 (1.12)	11.46 (1.26)	12.76 (1.45)
Female	4.10 (0.60)	5.69 (0.70)	7.35 (0.79)	8.49 (0.87)	9.37 (0.95)	10.86 (1.04)	12.17 (1.17)
Length, cm							
Male	55.0 (2.20)	62.0 (2.07)	68.7 (2.18)	73.3 (2.36)	77.0 (2.62)	83.6 (2.96)	89.3 (3.30)
Female	53.9 (2.32)	60.3 (2.20)	66.8 (2.08)	71.1 (2.24)	75.0 (2.39)	81.8 (2.62)	87.9 (2.93)
FM%							
Male	16.1 (4.34)	22.1 (4.80)	23.0 (5.15)	20.9 (5.35)	19.7 (5.00)	17.6 (4.81)	17.4 (4.74)
Female	16.6 (4.57)	23.0 (5.08)	25.2 (5.35)	23.7 (4.90)	21.5 (4.88)	18.4 (5.33)	17.5 (4.97)
FFM, kg							
Male	3.66 (0.41)	4.82 (0.48)	6.07 (0.56)	7.20 (0.69)	8.02 (0.83)	9.41 (0.89)	10.50 (1.07)
Female	3.41 (0.42)	4.37 (0.44)	5.49 (0.51)	6.47 (0.64)	7.33 (0.69)	8.83 (0.80)	10.01 (0.89)
Abdominal subcutaneous FM, cm							
Male	NA	0.41 (0.11)	0.41 (0.11)	0.37 (0.10)	0.34 (0.10)	0.32 (0.10)	0.32 (0.10)
Female	NA	0.40 (0.12)	0.41 (0.12)	0.38 (0.10)	0.34 (0.09)	0.31 (0.09)	0.32 (0.09)
Visceral FM, cm							
Male	NA	2.46 (0.63)	2.33 (0.64)	2.46 (0.67)	2.46 (0.67)	2.32 (0.65)	2.15 (0.58)
Female	NA	2.34 (0.59)	2.28 (0.58)	2.46 (0.70)	2.44 (0.64)	2.29 (0.61)	2.15 (0.57)

Abbreviations: FFM, fat-free mass; FM, fat mass; FM%, fat mass percentage; NA, not applicable.

Abdominal subcutaneous and visceral fat thickness were measured by ultrasonography at every visit starting from age 3 months, because earlier measurements are unreliable.[20,21] Unsuccessful ultrasonographic measurements of visceral FM, without visualization of the lumbar vertebra, were excluded from analyses.

Infant feeding was classified as exclusively breastfed if an infant received breastfeeding for at least 3 months and non-exclusively breastfed if an infant received either formula feeding or a mixture of breastfeeding and formula feeding. Information on the timing of solid food introduction was obtained from questionnaires.

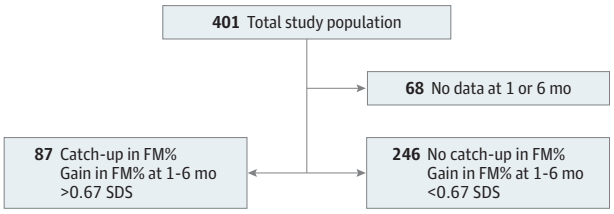
Statistical Analysis

The total population consisted of 401 infants with 5 or more measurements of body composition during the first 2 years of life. Clinical characteristics were expressed as pooled means and SDs. Differences in clinical characteristics were determined by independent *t* test or Mann-Whitney test for non-parametric parameters.

Missing data, mainly for infants who had not yet reached age 2 years or showed resistance at measurements, were imputed using a multiple imputation approach in SPSS, version 25 (SPSS Inc) to generate 20 imputed data sets. We performed multiple linear regression analyses to investigate the associations of change in FM% standard deviation scores (SDS) during the first year of life with body composition at age 2 years, with adjustments for sex, gestational age, age, and gain in length in the same period. Although small differences in some effect estimates were observed between analyses with imputed missing data and complete cases only, the main conclusions of the results were similar. For determining rapid increase in FM% SDS of greater than 0.67, we could only include infants with measured FM% at 1 and 6 months. As previously reported, an increase greater than 0.67 SDS represents the width of a percentile band on standard growth charts and is used to define a rapid increase in weight.[8] We used the same definition for a rapid increase in FM% SDS. As there are no published references for FM% from birth until age 2 years using ADP and DEXA, we calculated SDS for FM% in our large cohort.[25] The study group was divided in 2 subgroups: one with a rapid increase in FM% SDS from age 1 to 6 months and one without (**Figure 1**). Longitudinal growth and body composition development in infants with and without a rapid increase in FM% SDS were analyzed using linear mixed model analysis, with adjustment for sex. Time was modeled by entering hospital visits at ages 1, 3, 6, 9, 12, 18, and 24 months into the linear mixed models. For comparison with our PROGRAM study and literature data, we also analyzed data on changes in weight, length, and weight-for-length SDS.

For the analyses of abdominal FM, we used ultrasonographic measurements of abdominal FM at 4 or more times during the first 2 years of life. A χ^2 test was performed to determine whether the percentage of breastfeeding differed between infants with and without a rapid increase in FM% SDS. SPSS

Figure 1. Study Flowchart



FM% indicates fat mass percentage; SDS, standard deviation score.

statistical package version was used for analysis. *P* values <.05 were considered statistically significant.

Results

Clinical characteristics are presented in Table 1. Of the total group (n = 401), 228 infants (56.9%) were male and 173 infants (43.1%) were female. Median (interquartile range [IQR]) birth weight was 3.38 (IQR, 3.05-3.74) kg at a gestational age of 39.9 (IQR, 39.0-40.7) weeks in the total group, 3.44 (IQR, 3.12-3.77) kg at a gestational age of 39.8 (IQR, 38.9-40.6) weeks in boys, and 3.33 (IQR, 2.98-3.71) kg at a gestational age of 40.0 (IQR, 39.0-40.9) weeks in girls.

In the total group of 401 infants, we divided the first year of life into 6-month periods. **Table 2** presents associations between change in FM% SDS and outcomes at age 2 years. Change in FM% SDS during the first 6 months of life was positively associated with FM% (β, 0.044; 95% CI, 0.017-0.068), FMI (β, 0.061; 95% CI, 0.032-0.091), and abdominal subcutaneous FM (β, 0.064; 95% CI, 0.036-0.092) at age 2 years, but not with visceral FM. No associations were found for the following 6- to 12-month period (ie, after the first 6 months of life).

When subdivided in 3-month periods, change in FM% SDS in the 3- to 6-month period was positively associated with FM% (β, 0.065; 95% CI, 0.029-0.101), FMI (β, 0.084; 95% CI, 0.041-0.127), and abdominal subcutaneous FM (β, 0.090; 95% CI, 0.046-0.133) at age 2 years, but not with visceral FM. Change in FM% SDS from 1 to 3 months was associated only with subcutaneous FM (β, 0.043; 95% CI, 0.008-0.078). We found no associations for the other 3-month periods.

For comparison with literature data, we also analyzed the associations between change in weight-for-length SDS, which is often used as a proxy for body composition, with body composition at age 2 years. Similar to the change in FM%, changes in weight-for-length SDS from 1 to 6 months were associated with FM% (β, 0.057; 95% CI, 0.026-0.087), FMI (β, 0.092; 95% CI, 0.056-0.128), and abdominal subcutaneous FM (β, 0.091; 95% CI, 0.058-0.124), but not with visceral FM (eTable in the Supplement).

Of the total group, 87 infants (26.1%) had a rapid increase in measured FM% (>0.67 SDS) during the first 6 months of life (Figure 1). Birth weight SDS, corrected for gestational age and sex, was significantly lower in infants with a rapid increase in FM% SDS compared with those without a rapid increase (−0.47 vs −0.10 SDS, *P* = .004), albeit 95.4% had a birth weight well within the reference range. Gestational age did not differ significantly (39.6 vs 39.8 weeks, *P* = .09).

The FM% and FMI trajectories during the first 2 years of life were higher in infants with a rapid increase in FM% SDS compared with those without a rapid increase (*P* ≤ .001), resulting in a higher FM% and FMI at age 2 years (both *P* ≤ .001) (**Figure 2**). The FFM trajectories during the first 2 years of life were not significantly different between both groups (*P* = .16), but when corrected for length, FFMI trajectories were higher in infants with a rapid increase in FM% SDS (*P* = .007). Length-for-age SDS trajectories during the first 2 years of life were significantly lower in infants with a rapid increase in FM% SDS (*P* = .006).

Abdominal subcutaneous FM trajectories were higher in infants with a rapid increase in FM% SDS compared with those without a rapid increase (*P* < .001), but visceral FM trajectories were not significantly different from age 3 months until 2 years (*P* = .12) (**Figure 3**). At age 2 years, abdominal subcutaneous FM was higher in infants with a rapid increase in FM% SDS compared with infants without a rapid increase (*P* < .001), but visceral FM was similar (*P* = .85).

In addition, we analyzed the anthropometric data, which are often used as a proxy for body composition. At age 2 years, weight-for-length SDS and weight-for-age SDS were higher in infants with a rapid increase in FM% SDS (weight-for-length: 0.16 vs −0.69, *P* < .001 and weight-for-age: 0.05 vs −0.39, *P* = .017). Length-for-age SDS was not different (0.33 vs 0.36, *P* = .21).

Prepregnancy BMI of the mothers and mother's weight gain during pregnancy were not significantly different between infants with and without a rapid increase in FM% SDS (BMI: 23.8 vs 23.4, *P* = .12 and weight gain: 13.0 vs 14.0 kg, *P* = .62). When stratified by infant's sex, however, prepregnancy BMI of the mothers was significantly higher in girls with vs without catch-up in FM% SDS (25.8 vs 23.8, *P* = .04).

The percentage of infants with exclusive breastfeeding vs nonexclusive breastfeeding was not different between groups (*P* = .81), and the duration of breastfeeding was similar in breastfed infants with and without a rapid increase in FM% SDS (5.91; 95% CI, 3.94-10.18 vs 7.49; 95% CI, 4.96-11.19 months; *P* = .12). Timing of introduction of solid foods was not significantly different (4.04; 95% CI, 4.01-5.03 vs 4.04; 95% CI, 3.98-4.96 months; *P* = .26).

Discussion

To our knowledge, this is the first study to note that not only the change in weight-for-age or weight-for-length SDS, but specifically, the change in FM% SDS in the first 6 months of life vs the subsequent months is associated with FM% and FMI at age 2 years in healthy infants. In addition, a rapid increase in the FM% SDS resulted in higher trajectories of longitudinal FM% and FMI during the first 2 years of life. Our findings, therefore, appear to support a critical window for adiposity programming.

Our findings are in line with the PROGRAM study data, in which participants with a rapid increase in weight in early life had a significantly higher FM% and unfavorable metabolic and

Table 2. Regression Coefficients for Change in FM% SDS During the First Year of Life and Body Composition at Age 2 Years[a]

Outcome at age 2 y	Change in FM% SDS											
	1-6 mo		6-12 mo		1-3 mo		3-6 mo		6-9 mo		9-12 mo	
	β (95% CI)	*P* value	β (95% CI)	*P* value	β (95% CI)	*P* value	β (95% CI)	*P* value	β (95% CI)	*P* value	β (95% CI)	*P* value
Fat mass (%)	0.044 (0.017 to 0.068)	.001	0.05 (−0.027 to 0.036)	.78	0.019 (−0.014 to 0.052)	.26	0.065 (0.029 to 0.101)	<.001	0.011 (−0.019 to 0.041)	.49	−0.004 (−0.038 to 0.031)	.84
Fat mass index, kg/m^2	0.061 (0.032 to 0.091)	<.001	0.007 (−0.029 to 0.044)	.70	0.033 (−0.006 to 0.071)	.10	0.084 (0.041 to 0.127)	<.001	0.016 (−0.020 to 0.051)	.38	−0.005 (−0.045 to 0.035)	.82
Abdominal subcutaneous fat mass, cm	0.063 (0.036 to 0.091)	<.001	−0.024 (−0.056 to 0.008)	.15	0.045 (0.012 to 0.079)	.008	0.084 (0.041 to 0.126)	<.001	−0.029 (−0.061 to 0.003)	.07	0.003 (−0.032 to 0.038)	.86
Abdominal visceral fat mass, cm	0.016 (−0.011 to 0.043)	.25	0.018 (−0.015 to 0.051)	.29	0.003 (−0.030 to 0.037)	.85	0.021 (−0.018 to 0.060)	.28	−0.006 (−0.038 to 0.026)	.71	0.028 (−0.007 to 0.063)	.12

Abbreviations: FM%, fat mass percentage; SDS, standard deviation score.

[a] All associations were based on log-transformed outcomes, adjusted for sex, gestational age, age, and gain in length in the same period. A positive β score means that when 1 SD in FM% SDS is gained from 1 to 6 months, for example, FM% increases with 4.4% at 2 years.

cardiovascular profiles at age 21 years.[8,26,27] Also, other studies suggested that first-year rapid increase in weight of greater than 0.67 SDS resulted in a higher BMI SDS at age 2 years,[28] while a rapid increase in weight during the first 2 years of life resulted in a higher BMI SDS and FM% at ages 6 and 7 years.[15,29] In these studies, however, FM% was calculated by equations from skinfolds, because detailed body composition was not measured.

Our findings are in line with those of 2 studies suggesting that FM accretion until 6 months measured by ADP correlated with higher FMI at 4 years[30] and FM accretion until 8 months measured by bioelectrical conductivity with overweight/obesity at 6 to 11 years.[31] We can now present apparent trajectories of measured body composition based on longitudinal data in infants with and without a rapid increase in FM% SDS.

We found higher trajectories of abdominal subcutaneous FM in infants with a rapid increase in FM% SDS compared with those without. Other studies noted that children with a rapid increase in weight during the first 2 years of life had more FM and more central fat distribution based on skinfolds and waist circumference at age 5 years,[3,7] but abdominal subcutaneous and visceral FM were not measured in early life.

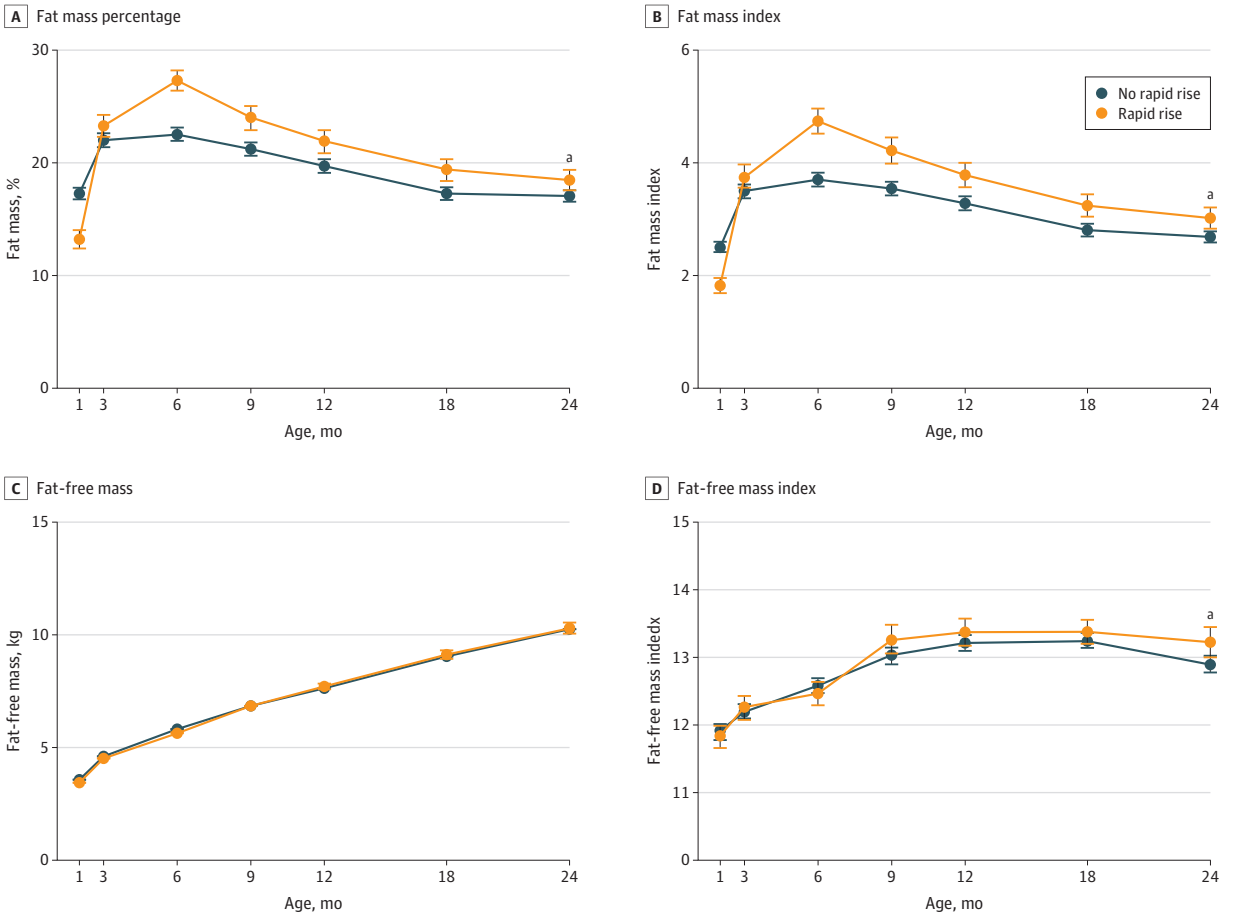
In contrast to our hypothesis, we found no difference in visceral FM until age 2 years between infants with and without a rapid increase in FM% SDS. This finding is in line with literature data describing that total FM in young children is associated with abdominal subcutaneous FM rather than visceral FM.[32,33]

Mice studies reported that most adipocytes arise from proliferating progenitors, which are committed in the prenatal or early postnatal period.[34] After birth, adipose tissue grows mainly by an increase in the number of small adipocytes, which is set during childhood and adolescence.[35] When a certain number of adipocytes is reached, the number cannot be decreased by a reduction in body weight.[35]

We showed that a rapid increase in FM% SDS results in more adiposity at age 2 years. This increase might stimulate the proliferation of the progenitor cells in early life and thus increase the number of adipocytes in infants with a rapid increase in FM% SDS. Because we measured visceral FM thickness, we could not distinguish between the number or size of adipocytes. An alternative explanation could be that visceral adipocytes have a different time and rate of development than subcutaneous adipocytes. This difference could explain why the variability in the first 2 years of life is found in subcutaneous FM rather than in visceral FM. Further studies are required to investigate whether visceral fat cells increase in size at a later age and whether children with a rapid increase in FM% SDS in early life develop more visceral fat at an older age than those without the rapid increase.

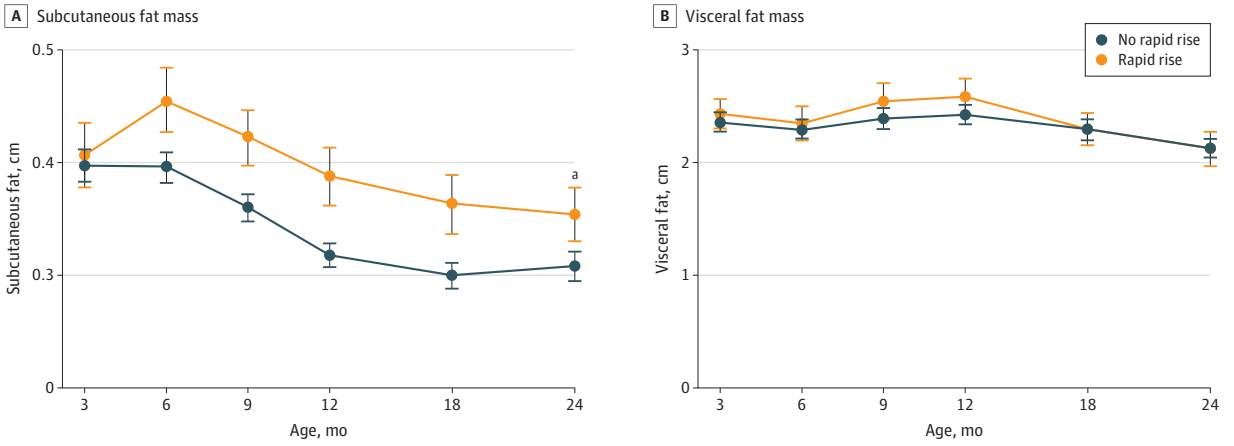
Furthermore, we noted that FFM trajectories were similar in infants with and without a rapid increase in FM% SDS; however, when corrected for length, the FFMI trajectories were higher in infants with a rapid increase in FM% SDS, suggesting that these infants gained more muscle mass. Higher trajectories of FFMI in infants with a rapid increase in FM% SDS are likely due to lower length trajectories in these infants.

Figure 2. Trajectories During the First 2 Years of Life in Infants With a Rapid Increase in Fat Mass Percentage Standard Deviation Score vs No Rapid Increase



Values are estimated marginal means (lower-upper bound), corrected for sex.

Figure 3. Abdominal Subcutaneous and Visceral Fat Mass Trajectories During the First 2 Years of Life in Infants With a Rapid Increase in Fat Mass Percentage Standard Deviation Score vs No Rapid Increase



Values are estimated marginal means (lower-upper bound), corrected for sex.

Infants with a rapid increase in FM% SDS had a lower birth weight SDS compared with infants without a rapid increase, but most of them (95.4%) had a birth weight well within the reference range of −2 to +2 SDS. Differences in birth weight might

contribute to neonatal body composition,[36] but other studies suggested that associations between a rapid increase in weight and obesity were independent of birth weight.[15,29,37] Our findings thus suggest that a rapid increase in FM% SDS is relatively common in healthy, term-born infants with a normal birth weight SDS. No significant differences were found for mother's prepregnancy BMI and weight gain during pregnancy in the total group.

Notably, the percentage of infants with exclusive breastfeeding until age 3 months was not substantially different between infants with and without a rapid increase in FM% SDS. This nonsignificant finding might be explained by the fact that the median duration exceeded 3 months in both groups. It has been reported that exclusive breastfeeding of less than 3 months may be associated with rapid weight gain, leading to higher BMI and FM development in later life[11]; thus, it remains important to support exclusive breastfeeding for at least 3 months.

We found no difference in the age at introduction of solid foods between both groups, which is in line with previous studies reporting no associations between age at solid food introduction and later body composition.[38,39]

Limitations

This study has limitations. Detailed eating patterns after introduction of solid food have not been investigated, which is a limitation of the study, as this might also influence body composition trajectories in early life. In addition, we did not start the study directly after birth, but at age 1 month. Recruited neonates had to visit the hospital for measurements, which was too much of a burden for both infants and mothers in the first days after birth.

Conclusions

It has been reported that a rapid increase in weight in early life associates with more adiposity and a less favorable health profile at age 21 years and beyond. The findings of this study suggest that a rapid increase in FM% SDS in the first 6 months of life leads to more adiposity at 2 years. These findings apparently support a critical window for adiposity programming in the first 6 months of life.

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Concept and design: de Fluiter, Breij, Hokken-Koelega.
Acquisition, analysis, or interpretation of data: de Fluiter, van Beijsterveldt, Acton, Hokken-Koelega.
Drafting of the manuscript: de Fluiter, Hokken-Koelega.
Critical revision of the manuscript for important intellectual content: van Beijsterveldt, Breij, Acton, Hokken-Koelega.
Statistical analysis: de Fluiter, Hokken-Koelega.
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Administrative, technical, or material support: van Beijsterveldt, Hokken-Koelega.
Supervision: Breij, Hokken-Koelega.

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