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An exploration of body composition in healthy early and full term infants using Air Displacement Plethysmography shortly after birth

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Abstract

Background: The Developmental Origin of Health and Disease theory suggests environmental factors during gestation are important early predictors of later disease. There is a wealth of evidence identifying an association between low and extreme birth weights and an increased risk of adverse health outcomes in later life. The importance of growth in early life led to standardised monitoring of body weight, length and head circumference at birth and throughout infancy. Evidence now suggests body composition, specifically adiposity, in early life to be a better marker of poor health outcomes in later life. Gestation is a continuum and during each week of gestation the foetus continues to accrue fat mass (FM) and fat free mass (FFM), which are not routinely measured at birth. Development of air displacement plethysmography (ADP) presents a valid and reliable technique to measure FM and FFM of infants at birth. Majority of infants are born at term gestation (37 to <42 weeks). Early term infants (37 to <39 weeks) have a higher risk of developing adverse clinical outcomes and later health issues compared to full term infants (39 to <42 weeks). It is currently unknown whether there are differences in FM and FFM between infants born early versus full term.

Aim: To investigate the FM and FFM of healthy early and full term New Zealand (NZ) infants within three days of birth.

Methods: Healthy term infants were recruited from Auckland City Hospital (ACH), NZ as part of this cross-sectional observation study. Weight, length and waist circumference were measured using standardised techniques. ADP was used to measure FM and FFM of infants. Infants were grouped into early or full term categories. Waist circumference was divided by length to give the waist to length ratio (WLR). Two indices of length-normalised body composition were calculated: a FM index (FMI) and FFM index (FFMI) derived by dividing FM and FFM values (kg) by length² (m²). Independent 2-tailed t-tests were used to compare the body composition measurements between early and full term infants and between genders.

Results: 255 healthy term infants were recruited. There were no differences in the percentage of FM and FFM between early term and full term infants (10.2±4.0% vs 11.1±4.1%, $P=0.109$ and 90.0±4.0% vs 89.0±4.1%, $P=0.110$). Full term infants had significantly higher FMI and FFMI compared to early term infants (1.44±0.6 vs 1.26±0.06, $P=0.02$ and 11.3±1.0 vs 10.8±0.96, $P<0.001$). Early term males had significantly heavier body weights ($P=0.04$), FFM (2793.1±332.9g vs 2619.7±315.4g, $P=0.003$), FFM % (90.8±3.8% vs 88.7±4.0%, $P=0.009$), FMI (1.15±0.55 vs 1.38±0.56, $P=0.039$) and lower FM % (9.2±3.8% vs

11.3±4.0%, $P=0.009$) than female early term infants. No gender differences within full term infants were noted in FM (g), FFM (g), FM %, FFM %, FMI or FFMI.

Conclusion: The results of this study suggest full term infants continue to gain FM and FFM along the same trajectories as that at early term gestation although they have greater FMI and FFMI than early term infants. While there were gender differences in body composition noted between early term infants, they were no longer apparent within the full term infants. This study identified the need to investigate the body composition changes of healthy early and full term infants at different time periods following birth. This will allow observation of factors which influence body composition in early life.

Keywords: *Early term, full term, infant, body composition, air displacement plethysmography, adiposity*

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Abbreviations list

Abbreviation	Definition
ACH	Auckland City Hospital
ADP	Air displacement plethysmography
BIA	Bioelectrical impedance analysis
BMI	Body mass index
cm	Centimeter
CS	Caesarian section
CVD	Cardiovascular disease
DLW	Doubly labeled water
DXA	Dual-energy X-ray absorptiometry
FFM	Fat free mass
FM	Fat mass
FMI	Fat mass index
FFMI	Fat free mass index
FFM %	Fat free mass percentage
FM %	Fat mass percentage
g	Gram
LGA	Large-for-gestational age
N	Number
NZ	New Zealand
SGA	Small-for-gestational age
TBW	Total body water
US	United States
WLR	Waist-to-length ratio
<	less than
>	greater than