# The importance of body composition as a primary outcome in trials on MAM

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Our understanding of the effects of moderate-acute malnutrition (MAM) in early life is primarily based on measures of anthropometry – mostly weight and height, which are often converted to age- and sex-specific z-scores, but which may also be expressed as weight-for-height, or body mass index (BMI), also in z-score format. Another widely used outcome is mid-upper arm circumference (MUAC). These data provide indices of stunting (short stature) and wasting (low weight for age), which are often categorized using cut-offs. Much information can be gained from such measurements, and data can be compared across populations because of the standardized format. However, the 'abstract' nature of anthropometry means that much is also concealed by these outcomes.

Measurement of body composition represents a novel approach to nutritional status. The simplest approach aims to differentiate fat from lean mass. These two traits have very different implications for short- and long-term outcomes. Fat represents a store of energy that may fund immune function or future growth. Lean tissue represents functional tissue, which may also contribute to immune function. The relative ratio of fat to lean provides an indication of the allocation of energy between 'completed growth' and 'investment potential'. Low levels of fat may indicate reduced resilience to ecological stresses, whereas low levels of lean mass indicate exposure to cumulative stresses. The relative 'survival' value of fat versus lean tissue in early life remains uncertain, hence it is unclear what constitutes the optimum pattern of tissue accretion, and whether variation in fat and lean accretion across populations represents local adaptation or pathology. Equally, it remains unclear whether public health interventions should promote lean mass, fat, or a particular ratio of the two.

Measurement of body composition in early life is now possible through several techniques. Air displacement plethysmography can be used between birth and six months, providing the density of lean tissue has not been perturbed by malnutrition. Measurement of body water by isotope dilution is the only technique that can be used in all age groups, but likewise is only accurate if lean tissue hydration is within the normal range. Bio-electrical impedance analysis has conventionally been used to predict body water, but has low accuracy in individuals. However, Bio-electrical Impedance Vector Analysis (BIVA) is showing greater promise for differentiating variability in lean tissue from variability in hydration. MAM may affect not only fat and lean masses, but also the composition of lean tissue, and BIVA is emerging as a valuable approach for assessing these effects.

A key step forward is to produce reference data for such techniques, enabling individual data or studies to be assessed relative to normal ranges. Reference data has now been published for air displacement plethysmography in Ethiopian infants, while BIVA data is also being acquired. Other studies have collected isotope measurements of body water in large samples. Emerging data on body composition are rapidly describing the characteristics of MAM, and will clarify its aetiology and response to treatment.