Factors affecting growth

Genetics
Parental size has a direct influence on a child’s growth potential and their predicted adult height; more so for height than weight. A child with short stature may be of concern because of possible illness or poor nutrition, but for a short child with short parents they are possibly genetically small. Extreme shortness may be due to a combination of genetic and non-genetic factors. Complex calculations can be performed to predict the child’s height potential based on their parents’ heights [1]. Calculate mid-parental height by adding both parents’ heights together and dividing by two. Charts are available to determine the predicted height based on mid-parental height. A child whose adjusted stature is still low should be investigated further for illness or poor nutrition. [1]. It is normal that five percent of all children will grow below the 5th centile on height for age charts and be healthy.

Ethnicity
It was traditionally believed that different ethnic groups show different patterns of growth; on average African-Caribbean groups are taller and heavier, and Asian and Chinese groups are shorter and lighter when compared with Caucasians [2]. More recently, the Multicentre Growth Reference Study group refuted this belief showing that variability in infant growth was greater within population groups than between the different country groups [3].

Birthweight
Small birth size may be associated with increased risk of cardiovascular diseases, suggesting that foetal under-nutrition may increase susceptibility to diseases occurring later in life. Evidence from animal studies suggests that the foetus may adapt to an adverse intrauterine environment by slowing down growth and metabolism, whereas large birth size may predict increased risk of obesity, diabetes and some cancers [4].

Birthweight is one of the most accessible and reliable indicators and universally measured [5]. In general, lower birth weight is associated with higher risk or morbidity [6]. At a population level, groups with lower mean birthweight often have higher infant mortality (e.g., infants of mothers who smoke, or of mothers from lower socioeconomic background). Asthma, lower developmental outcomes and hypertension have all been reported to be more common among small birth weight infants. [6].

A baby’s weight at birth is strongly associated with mortality risk during the first year, and to a lesser extent, with developmental problems in childhood and the risk of various diseases in adulthood, including cardiovascular disease and some cancers according to a recent systematic review [4].

Prematurity
A child born before 37 completed weeks gestation is considered preterm [7]. Weight is plotted on an appropriate intrauterine growth chart. In Victoria, these charts are based on data from Kitchen [8] and used until the expected birth date plus 2 weeks. Growth of premature infants is monitored by a paediatrician.

Hormones
Anomalies in circulating hormones such as growth hormone, insulin like growth factor, testosterone, oestrogen, thyroid hormone, cortisol, insulin affect birth weight and growth. For example, children who are large for gestational age at birth following
exposure to an intrauterine environment of either maternal diabetes or maternal obesity are at increased risk of developing metabolic syndrome. Given the increasing obesity prevalence, these findings have implications for perpetuating the cycle of obesity, insulin resistance and their consequences in subsequent generations [9].

**Nutritional**
The direct impact of Inadequate nutrition including energy, protein and micronutrients caused by illness, neglect, or food insecurity. Breastfed infants have been long-recognised to have different growth in the first year of life compared to non-breastfed babies. Significant difference between the growth rates of formula and breast fed infants was first reported in the DARLING (US) study [10] showing that BF infants grow more quickly initially, for the first 3 -6 months, and then more slowly over the next 6 – 9 months. At the end of 12 months, breastfed infants were generally 0.5 – 0 6 kg lighter than formula fed infants. Data from seven longitudinal studies of infant growth were pooled and this confirmed that infants breast fed for at least 12 months grew more rapidly in the first 2 months and less rapidly from 3 – 12 months [11]. This provided the rationale for formation of a working group to develop new standards.

**Environment**
General health and maternal age, parity, socio-economic status and substances such as smoking affect birth weight and growth [4] whilst infants born at high altitudes are known to be smaller babies believed due to lower oxygen. [6]

**References**