GUIDELINE	
Growth - birth to 18 years	
Scope (Staff):	Community health staff
Scope (Area):	CAHS-CH, WACHS

Child Safe Organisation Statement of Commitment

The Child and Adolescent Health Service (CAHS) commits to being a child safe organisation by meeting the National Child Safe Principles and National Child Safe Standards. This is a commitment to a strong culture supported by robust policy documents to ensure the safety and wellbeing of children at CAHS.

This document should be read in conjunction with this DISCLAIMER

Contents

Aim

To provide information on the expected growth patterns from birth through to adolescence to support the early identification of growth concerns.

Risk

Delays in identifying deviations with growth, may negatively impact on children developing to the best of their potential.

Background

Growth is a very important indicator of overall health, development and wellbeing. Poor growth in-utero and early childhood is associated with short and long term effects including increased rate of childhood infection and the development of lifestyle diseases including coronary heart disease, high blood pressure and diabetes.[1, 2] Over-nutrition and obesity are also linked to poorer health outcomes. Both body size during the early years of life and an unexpected increase in infant growth trajectory are associated with a risk of later overweight and obesity in childhood and adulthood.[3-5]

Monitoring growth is important in:

- early identification and initiation of effective strategies in response to deviations in growth patterns
- reviewing the impact of implemented strategies.

Providing parents with information on how nutrition, physical activity, genetics and illness can affect growth is important in promoting optimum growth.

Minor fluctuations in growth in an otherwise healthy and alert infant or child may be of no immediate concern. However, unexpected increases, decreases or stasis in growth trajectories from a previously established rate of growth, may be an early indicator of underlying health or developmental issues.

Nurses are well placed to conduct growth assessments, including weight, length or height, head circumference and body mass index (BMI), at relevant universal contacts and at additional contacts, as required. It is most meaningful when nurses undertake a holistic view of the child (and family) by gathering information from parents, identifying risk and protective factors, completing age appropriate observations and assessments (including growth) using suitable tools, reviewing previous health professional assessments (if available) and acting on clinical judgement.[6]

Key Points

- Growth charts are not diagnostic tools and decisions about growth deviations should never be determined solely by these charts.[7]
- Holistic assessments will include considering gestational age and birth weight, previously established rates of growth, feeding or nutritional assessments, physical assessment, elimination and health status, developmental milestones and enquiry about parental stature.

- Growth assessment involves multiple measurements over time for weight, length or height, head circumference and BMI (over 2 years); followed by precise plotting on appropriate growth charts and correct interpretation of the percentiles to determine growth trajectories.
- Very few children grow along the same percentile line from birth.[5]
- Growth is considered healthy when the child's weight and length or height generally track along percentile lines. Children do not always grow along the same percentile for height and weight, but they generally track along or between percentile curves.[5]
- Growth measurements and outcomes of the growth assessment should be recorded in electronic records. Discuss findings and growth patterns with parents.
- Serial growth measurements will be undertaken and plotted on age and gender-appropriate growth charts, as part of a holistic assessment and prior to determining relevant care planning.
- Growth deviations may be characterised by serial growth measurements indicating unexpected increases or decreases or stasis on the percentile lines, from a previously established rate of growth.
- Fenton charts have been developed for infants born less than 37 weeks gestational age and can be used up to 50 weeks gestation age (10 weeks post-term age).

Factors influencing growth

A holistic view of the child (and family) requires an understanding of what influences growth. This includes considering genetics and epigenetics; birth weight; nutrition, environmental and health and wellbeing factors (including adverse life-events) when undertaking growth assessments.[5] These factors may be modifiable (nutritional intake, feeding difficulties, activity levels, acute illness) or non-modifiable (genetic disorders, chronic health conditions). It is the modifiable risk factors that can be managed to decrease the effects of these risks.

Genetics and epigenetics

Parental size (particularly stature) has a direct influence on a child's growth potential and predicted adult height. When concerns with a child's growth have been identified, parental stature should be considered as part of the assessment. For example, a short child with short parents may be a genetically small, healthy child (particularly in the absence of illness or poor nutritional intake). However, where there are sustained nurse or parental concerns further assessments and care planning may be required.[5]

Genetic disorders and chromosomal abnormalities such as Prader-Willi syndrome, Turner Syndrome, and Trisomy 21 (Down syndrome) have the potential to alter a child's growth. For example, children with Trisomy 21 typically have lower birth weights and have slower growth patterns, than other children.[8] Nurses will use clinical judgement when assessing growth for children with a physical disability.

Birth weight

Birth weight is a reliable indicator of not only the infant's health but also subsequent health risks in adulthood.[9] A normal full term birthweight is considered to be between 2500 and 4000 grams.[10, 11] Adverse health outcomes for children small for gestational age (SGA) at birth include higher mortality rates, asthma, developmental issues and hypertension.[12] Low

birth weight infants (less than 2500 grams) born at or near term are expected to track along a lower percentile on the weight for age growth charts, compared to other infants.[5] These infants may move to a higher percentile over time or may continue to follow their own line below the 3rd percentile.[5] Most SGA infants catch up in their first six months after birth.[13]

It is important to consider the potential impact of pregnancy-related factors, such as gestational diabetes, on the size of an infant at birth. These infants may not grow along the same percentile from birth; rather their growth curve may move to a lower percentile.[5] However, infants who are large for gestational age (LGA) at birth have a higher risk of developing obesity and metabolic syndrome later in life.[5]

Infants born prematurely (before 37 weeks gestation) or who are born SGA may also be at increased risk of cardiovascular diseases, suggesting that foetal under-nutrition may increase susceptibility to diseases occurring later in life.[14]

Nutrition

Nutrition directly impacts growth patterns and growth trajectories. Inadequate nutritional intake including energy, protein and micronutrients can slow growth potentially leading to growth faltering. Conversely, overfeeding associated with rapid weight gains may result in overweight or obesity.[5] Refer to the *Growth – static or downward trajectory* guideline and the *Overweight and obesity* guideline for more information.

Infant formulas with higher protein levels are associated with higher weight in the first two (2) years of life, but has no effect on length.[7] Further research linking protein level in infant formula and cow's milk with obesity and chronic disease in adulthood, has led to recommendations for infant formula composition to promote growth rates similar to that of breastfeeding infants.[7] There is convincing evidence for infants who breastfeed having reduced risk of becoming obese in childhood, adolescence and early adulthood, compared to infants who are infant formula fed.[7]

Nutritional requirements cannot be standardised for all infants, as factors such as age, gender, and health status all need to be considered. Feeding volumes fluctuate from feed to feed and from day to day. A holistic assessment including a growth assessment of weight, length and head circumference (HC) determines if nutritional requirements are being adequately met.

Children and adolescents should eat enough nutritious foods to grow and develop. The *Australian Dietary Guidelines* recommend eating a wide variety of nutritious foods from the five food groups every day and limit intake of foods containing saturated fat, added salt and added sugars.[15] In addition, the *Australian Dietary Guidelines* provide information on the number of serves and serving sizes for specific age groups. For more information on nutrition, protein levels of different milks and healthy eating, refer to the guidelines *Nutrition birth-12 months* and *Nutrition 1-11 years.*

Environment

Maternal health, age, parity, socio-economic status and substance usage such as smoking can affect birth weight and growth.[14]

Health and wellbeing

Frequent infections, developmental delays, feeding difficulties, long term medications, medical conditions, illness and food insecurity[16] can all affect infant and young children's growth.[5]

Expected growth patterns

Preterm infants

A child born before 37 completed weeks of gestation is considered preterm. Expected growth patterns of preterm infants will depend on gestational age, birth weight, race/ethnicity, and other factors. The optimal rate of weight gain or catch up growth is not known. There are concerns that rapid weight gain early in life may promote growth of excess fat cells and increase later risk of chronic illness.[17] Measurements for these infants are plotted using the corrected (postnatal) age for prematurity. They are not expected to grow as term infants.

Infants (0-2 years)

Birth weight, length and head circumference measurements provide the first reference point for ongoing growth monitoring.

Weight

The majority of healthy, full-term infants lose weight in the first days following birth, which is considered physiologically normal.[18] This is usually due to fluid balance adjustment and consumption of small amounts of colostrum.[19] Infants born via caesarean section have higher weight loss when compared to vaginal births. Other variables associated with weight loss are gestational age, higher weight at birth, female sex, advanced maternal age (>40 years) and jaundice.[20]

Whilst there is insufficient evidence to indicate what is a normal physiological weight loss[18], statements from authoritative organisations suggest a loss of between 7 to 10 percent within the first few days to first week of life.[7, 18] Approximately 85% of infants will regain birth weight by 2 weeks of age.

Infants and young children have a relatively higher proportion of fat as a normal component of growth, which may reflect the wide variation in what is considered expected or perceived, normal weight gain.[4]

- The WHO states it is not possible to recommend an expected minimum weight gain that would be appropriate for all infants or children with the same starting weight.[21] The WHO also emphasises the significance of interpreting growth trajectories on age and gender-appropriate growth charts.[21]
- Data from seven (7) longitudinal studies of infant growth, determined that infants who breastfeed for at least twelve (12) months grew more rapidly in the first two (2) months and less rapidly from three (3) to twelve (12) months of age.[22] In a Western Australian study, infants who breastfed for more than twelve (12) months were leaner at one (1) year of age.[23]
- The *Infant Feeding Guidelines* indicate that, in general, weight gain should be assessed on a four (4) week average, once the infant is back to birth weight. However, growth trajectories are the most important factor and means of assessing growth.[7] Whilst the *Infant Feeding Guidelines* provide an approximate guide for weight gain for infants in the first twelve (12) months of life, they do not consider infant gender and birth weights.

Length

During the first few years of life, linear growth is rapid (on average 8-12 cm per year).[24]

- Infants grow between 18 to 25 cm during the first year of life.[25]

- Children between 1 and 2 years grow between 10-13 cm per year.[25]

Head circumference

Head growth, a reflection of brain growth, is also rapid during the first year of life.

- The average head circumference at birth is 34 - 35 cm, 44cm at 6 months and 47 cm at 1 year.[26]

Children (2- 11 years)

The literature suggests that children typically:

- gain approximately 2 kg per year between two years and puberty.[27]
- grow in length and height on average approximately 5-6 cm per year.[24, 25]

During middle childhood BMI falls as children become relatively leaner, and then increases as puberty approaches and body composition approaches to that of adulthood. BMI-for-Age percentile charts reflect these normal, predicted changes of BMI throughout childhood.[4] It is important to note that age-related increases in BMI are associated with increases in fat mass and fat-free mass (muscle and bone); which in turn are influenced by age, gender and puberty.[28]

Adolescents (12-18 years)

Adolescence can be described as the period between childhood and maturity during which the process of growing up occurs. During this time, the individual undergoes physical, psychological and social changes.[29] Although the order of many of the changes appears to be universal, their timing and the speed of change vary among and even within individuals. Both the characteristics of an individual (e.g. sex) and external factors (e.g. inadequate nutrition) influence these changes.[29]

Different organisations and literature provide more specific age ranges with the World Health Organization (WHO) defining adolescence as the period between 10 and 19 years of age [30] and others starting at age 12 and extending to 20 years. For the purposes of this document, it is defined as 12-18 years.

Many biological changes take place during the adolescent years. Most obvious are the physical changes, for example, increases in height, acquisition of muscle mass, the distribution of body fat and the development of secondary sexual characteristics.[29]

One of the characteristics of puberty is the adolescent ‘growth spurt’.[29] This is regulated by the complex, inter-related production of a number of hormones. Males aged 12 to 17 may experience a growth spurt (peaking between 13 and 15 years) characterised by a gain in height of up to ten (10) cm in the year of peak growth velocity.[31] Females may experience a growth spurt between the ages of 9.5 and 14.5 years (peaking between 11 and 13.5 years) characterised by a gain in height of up to 9 cm in the year of peak growth velocity.[31] Females with an early onset of menarche will have a higher fat mass, especially at the end of puberty, which continues to exist into young adulthood.[32]

In instances where puberty is delayed, growth in height may slow until such time that a ‘growth spurt’ occurs until the child’s genetically determined height is reached.[31] Noticeable growth is almost complete at 18 years in females and 20 years in males; longitudinal studies have indicated an average figure of 16.25 years (females) and 17.75 years (males) with a normal variation of ±2 years.[27]

Refer to Appendix A: *Possible causes of abnormal child growth* for information on growth pattern deviations.

Assessing child and adolescent growth

Growth trajectory, the change in growth over time, is a more sensitive index of growth than a single measurement.[5] One-off measurements plotted on a growth chart describe a child's size and may be useful to screen children at nutritional risk however they do not describe a child's growth. To describe a child's pattern of growth, *serial* measurements over time, plotted on a growth chart are needed. Growth assessment involves looking at the overall trajectory of weight-for-age, length-for-age and weight compared to length, or BMI-for- age (over 2 years) to determine whether a child is tracking along the growth curves or crossing percentiles upwards or downwards. **The direction of serial measurements on the curve is more important than the actual percentile.[5]** Growth assessment opportunities in community health are described in Appendix B.

Growth charts – use and interpretation

Growth measurements are plotted on an age and gender-appropriate growth chart to show how a child/adolescent is growing. Monitoring also provides opportunities to give anticipatory guidance to support the development of healthy lifestyles to promote healthy growth and development.[5]

Growth charts are not diagnostic and therefore should be used in conjunction with a holistic assessment, to contribute to forming an overall clinical impression, prior to making any care planning decisions. The next section describes which charts to use for each age group and the interpretation of child and adolescent growth in each.

Preterm infants

Fenton charts have been developed for preterm infants with a birth gestational age of less than 37 weeks and can be used up to 50 weeks gestation age (10 weeks post-term age).[33] Infants are then transitioned onto the WHO growth charts between 40 and 50 weeks gestation.

The Fenton growth chart for preterm infants accommodates the World Health Organization Growth Standard and reflects actual age instead of completed weeks, in order to improve preterm infant growth monitoring.[33]These charts are a reference for growth, as ideal growth patterns of preterm infants remains undefined.[33]

Measurements for these infants are plotted using the corrected (postnatal) age for prematurity which should be used until 2 years of age (or until the child 'catches' up, whichever is sooner.)

Corrected age is determined by subtracting the number of weeks of prematurity (a term pregnancy is 40 weeks) from the actual or chronological age.[5] For example, an infant at 12 weeks postnatal age, who was born at 30 weeks gestation, has a corrected age of two (2) weeks. This can be represented as: 12 –10 *(40 minus 30 = 10)* = 2 weeks corrected age.

Children (0-2 years)

In WA community health services, the *WHO growth charts (0-2 years)* for weight, length and head circumference are used as a standard of how children should grow. These charts show optimal growth rather than average growth and are based on breastfeeding as the norm.[5] They are intended to be used for all children, regardless of ethnicity, socioeconomic background and type of feeding.[5, 34]

If there are concerns with growth status for a child under 6 months of age, nurses should use the *WHO 0-6 month charts* to monitor and document serial weight, length and head circumference measurements.

Percentiles are commonly used in the clinical or community setting because they indicate simply and clearly a child's position within the context of the reference population and dictate the expected percentage of a population being above or below a percentile. Most children will grow along their own growth curve; sometimes this is on one of the curves of the chart, but more often it is between two of the curves on the chart.[5]

For example, in the WHO growth charts, the:

- 3rd percentile indicates that 3 in approximately 100 children are below this line
- 50th percentile indicates that half the children at any age are above this line and half are below this line.
- 97th percentile indicates that 3 in approximately 100 children are above this line.

Parents and professionals should not feel under pressure to try and ensure that the child's height or weight should be on or near the 50th percentile at any age.[5] Very few infants grow along the same percentile line from birth, with up to half of these infants crossing at least one percentile (up or down), most often occurring in the first six (6) months and up to twelve (12) months of age. In addition, children do not always follow the same percentile for length or height and weight, but they generally track along or between percentile lines.[5]

Questions often arise about children in the lower or higher percentile ranges (<3rd or >97th percentile). Small parents tend to have smaller children, and the small healthy normal child of short parents should not raise concern. Usually in this case, growth is steady in the lower centiles, but the large baby born to small parents may cross down centile lines before settling on their intended line.[24, 35]

It is important to note that there will always be a bottom and top 3%; these measures do not necessarily indicate a growth problem.

Sometimes **z-scores** are used to describe growth. They indicate the degree to which a measurement deviates from the mean (average) of a population standard. Z-scores are particularly useful for measurements at the extremes of a distribution (<3rd and >97th percentile.) Z-scores are useful for population and research purposes and are also used in clinical practice.[5] For comparison purposes, the 50th percentile is equal to a z-score of zero (0).[5] For more information refer to Appendix C.

Children and young people (2-18 years)

The WHO, National Health and Medical Research Council (NHMRC) and Chronic Disease Prevention and Health Promotion (CDC) recommend the use of BMI charts when measuring growth in children over the age of two.[4, 21, 36] The BMI characterises the relative proportion between the child's weight and height. It is a valid predictor of adiposity and is considered the recommended clinical standard for defining underweight, overweight and obesity in children older than two (2) in non-specialist clinical settings. For more information on the use of BMI, refer to *BMI assessment - child health* and *BMI assessment – primary school.*

WA community health services use both the WHO 2-5 years charts and the BMI charts from the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (CDC 2000) to assess growth for

children who are two (2) years and older. They should be used as guidance for further assessment, referral or intervention, rather than a criterion for classifying children.[4, 5, 34] Physical growth assessment is currently not provided by nurses in children older than primary school age (through the School Entry Health Assessment). However, BMIs are still valid for this age group.

BMI is a score calculated as the ratio of an individual's weight in kilograms to height in metres squared (kg/m^2). While BMI does not distinguish between fat, muscle or fluid it can be used to measure excess body weight for height.[4]In children, the BMI score is adjusted for age and gender (on BMI-for-Age and gender percentile growth charts), in order to account for growth and body fat changes that occur as part of normal development.[4] Interpretation of BMI in children and adolescents aged 2-18 years is based on growth percentile charts which use BMI-for-age reference values. BMI charts are different to WHO growth charts in that a percentile score of >85% or < 5% can indicate a child/adolescent being at risk of negative health outcomes. Specific guidance and explanation is given in the *BMI assessment policies (for child health and primary school)* on actions, conversation points with parents, referral and follow-up for children in these ranges.

BMI is interpreted differently for children and adults, even though it is calculated using the same formula as adult BMI. Children and adolescent's BMI is age and gender-specific because the amount of body fat changes with age and the amount of body fat differs between girls and boys. During primary school ages, BMI falls as children become relatively leaner, and then increases as puberty approaches and body composition approaches that of adulthood.[5] The CDC BMI-for-age growth charts take into account these differences and visually show BMI as a percentile ranking.[37]

When growth is a concern, the policy documents in the table below provide more guidance about assessments, trajectories, management strategies and referral options.

Related policies, procedures and guidelines
The following documents can be accessed in the **Clinical Nursing Manual** via the HealthPoint link, internet link or for WACHS staff in the WACHS Policy link
Body Mass Index assessment – child health
Body Mass Index assessment - primary school
Breastfeeding and lactation assessment
Eating disorders
Growth – static or downward trajectory
Head circumference assessment
Height assessment 2 and over
Length assessment 0 – 2 years
Nutrition birth to 12 months

Nutrition 1-11 years
Overweight and obesity
Physical assessment 0 - 4 years
Universal contact guidelines
Weight assessment 0 - 2 years
Weight assessment 2 and over

Related CAHS-CH resources and forms
The following resources can be accessed from the CAHS-Community Health Resources page on HealthPoint
Baby's first foods
Breastfeeding Assessment Guide
Body Mass Index Boys (CHS430B)
Body Mass Index Girls (CHS430A)
Fenton Growth Chart (external link)
How children develop (0-12 years)
Practice guide for Community Health Nurses
Tips to support healthy choices (2 – 5 years)
Toddler tucker
World Health Organization Chart 0 - 6 months
World Health Organization Growth Charts (CHS800A series)- (0-2 years and 2-5 years)
Nutrition Resource Catalogue

Related external resources
Australian Dietary Guidelines summary
Australia's Physical Activity and Sedentary Behaviour Guidelines Pamphlets available- 0-5years; 5-12 years; and Families. To order phone 1800 020 103
Infant Feeding Guidelines

Raising Children Network
Royal Children's Hospital - Child growth learning resource

Appendix A: Possible causes of abnormal child growth

Note: Causes listed in **bold text** are more common.[5]

Percentile trajectory	Possible causes	Indicators
Weight - Increasing percentiles	**Energy imbalance**	Excessive food
	Endocrine disorders	Hypothyroidism, Excess cortisol (Cushing's), Pituitary disease
	Genetic disorders	Trisomy 21, Prader-Willi
Weight - Decreasing percentiles	**Acute illness**	Short term illness, vomiting, diarrhoea
	Chronic illness	Including but not limited to cardiac, respiratory gastrointestinal, renal disease
	Physical and/or developmental concerns	Neurological conditions, cerebral palsy
	Nutritional	Inadequate energy intake
Height - Increasing percentiles	Endocrine disorders	Excessive growth hormone, Hyperthyroidism
Height - Decreasing percentiles	Endocrine disorders	Growth hormone deficiency, Hypothyroidism
	Chronic illness	Chronic anaemia, chronic illness, Systemic failure (renal and cardiac)
	Genetics	Chromosomal disorders
	Nutritional	Long-term primary or secondary malnutrition, i.e., infection, iron deficiency anaemia
Head circumference - increasing percentiles	Hydrocephalus, chromosomal abnormality, developmental delay	
Head circumference - decreasing percentiles	Prenatal insult	Maternal substance abuse, maternal infection
	Birth complication	
	Chromosomal abnormality	

Appendix B: Growth assessment opportunities in community health

Growth assessment opportunities	When to conduct growth assessment	Charts to use
Universal contacts with length, weight, and head circumference	0-14 days 8 weeks 4 months 12 months	**WHO 0-2 years and/or** **WHO 0- 6 months chart** (if growth concerns)
Universal Plus contacts with height, weight and head circumference	Birth to 2 years	**WHO 0-2 year charts and/or** **WHO 0- 6 months chart** (if growth concerns)
Universal and Universal Plus contacts with height, weight and BMI	2 years	**WHO 2-5 years** **CDC BMI charts**
School Entry Health Assessment (SEHA) with height, weight and BMI	School entry	**CDC BMI chart**
Targeted primary school assessment with height, weight and BMI	4 years plus	**CDC BMI chart**
No assessments recommended for secondary school age students		

Appendix C: Z-scores and percentiles

Z-scores describe the distance from the median (midpoint) in terms of standard deviations and are comparable between different age groups and allow comparisons across children at different growth lines.[5]

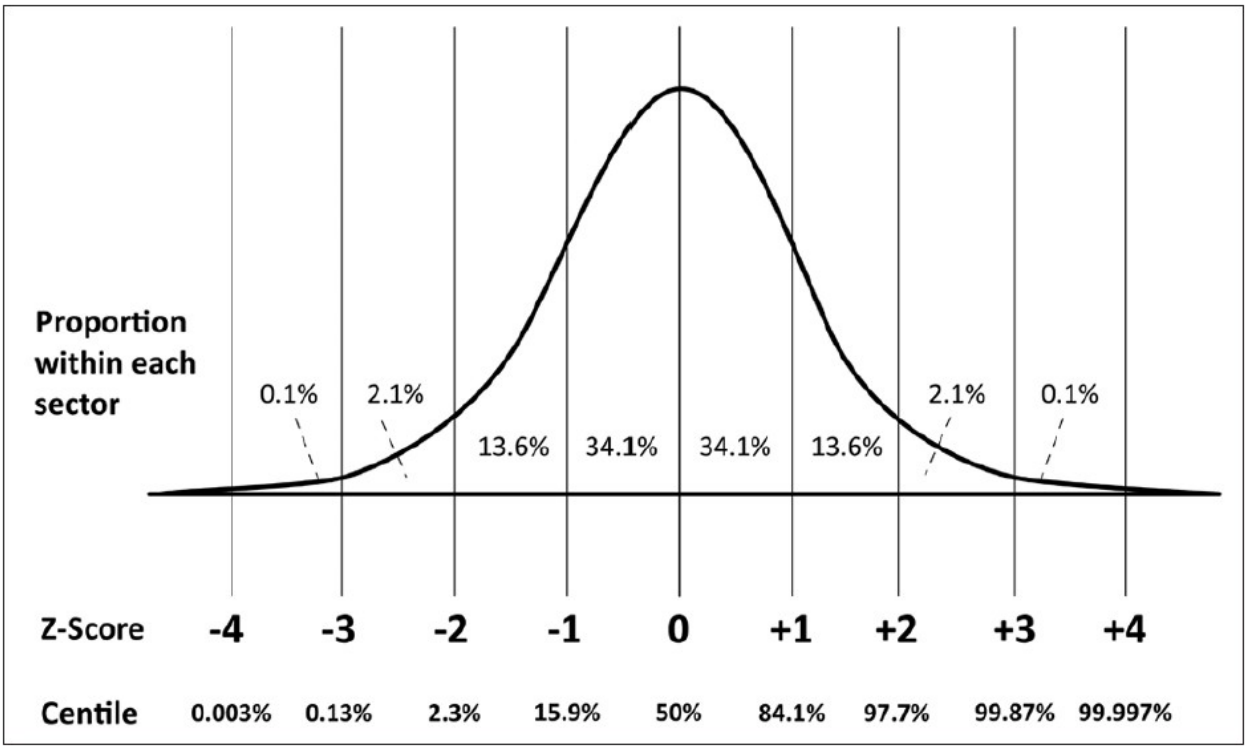
The normal population range is from -2 to +2 standard deviation z-scores with the medial z-score being zero.[5] Cut off points are used to classify population prevalence of malnutrition, stunting, wasting (thinness), at risk of overweight, overweight and obesity.[38]

The use of z-scores is particularly helpful when assessing the growth of a child whose height and weight measurements fall well below or above standard percentile values or when comparing populations that use different standards.

In statistical terms:

- 34.13% of the population lies between 0 and -1 (or +1)
- 13.59% between -1 and -2 (or between +1 and +2)
- 2.14% between -2 and -3 (or between +2 and+3)
- the remaining 0.14% of the data lies below -3 (or above +3).[21]

These numerical statistics are represented in the diagram below. Note that the 'Centile' numbers closely correspond to the **WHO growth chart percentiles** used by Western Australia.



Annals of Pediatric Cardiology - Images

The table below demonstrates percentile z-score conversion values which may be useful for when nurses are reading and interpreting literature.[38] The figures in bold closely correspond to the WHO growth chart percentiles used by Western Australia.

Percentiles	Z-scores
0.2nd	–3
2.3rd	–2
2.5th	**–1.96**
5th	–1.64
15th	**–1.04**
16th	–1
50th	**0 (median)**
84th	+1
85th	**+1.04**
95th	+1.64
97.5th	+1.96
97.7th	**+2**
99.8th	+3

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Document Owner:	Nurse Director, Community Health		
Reviewer / Team:	Clinical Nursing Policy Team		
Date First Issued:	December 2014	Last Reviewed:	Dec 2017
Amendment Dates:	19/08/21	Next Review Date:	1 February 2024
Approved by:	Community Health Clinical Nursing Policy Governance Group	Date:	18 December 2020
Endorsed by:	Executive Director Nursing	Date:	1 February 2021
Standards Applicable:	NSQHS Standards:  Child Safe Standards: 1, 3, 4, 7, 10		

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