

OVERWEIGHT AND OBESITY

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LEARNING POINTS

- 1 About 22 to 30 per cent of toddlers become overweight or obese by five years of age.
- 2 Often parents do not realise their toddlers or children are overweight.
- 3 Body Mass Index (BMI) is a calculated relationship between height and weight and plotting BMI on a centile chart is used to assess overweight and obesity. On the UK charts a BMI over the 91st centile indicates overweight, and above the 98th centile is defined as obesity.
- 4 Normally the BMI of toddlers decreases from around their first birthday onwards as they become slimmer, until about five to six years, after which it begins to increase.
- 5 The vast majority of obesity is caused by an imbalance between energy intake from food and energy expenditure through activity levels, growth and development.
- 6 Some toddlers are born with poor appetite regulation and a tendency to overeat and become overweight.
- 7 Medical causes of obesity are rare but toddlers in whom excess energy intake has been ruled out should be referred to a paediatrician. Any toddler with a BMI over the 99.6th centile should also be referred.
- 8 Parental obesity is a very strong predictor of childhood obesity.
- 9 Healthy family lifestyles are the key to preventing childhood obesity and treating obesity in toddlers.
- 10 The toddler years are an ideal time for families to make lifestyle choices to prevent obesity in childhood.
- 11 Healthcare professionals need an empathetic and non-judgemental approach to empowering families to make lifestyle changes.

OVERWEIGHT AND OBESITY IN TODDLERS

USING BODY MASS INDEX (BMI) TO DEFINE AND DETECT OVERWEIGHT AND OBESITY

For children over two years of age

The most objective method of detecting obesity is to calculate body mass index (BMI) using accurate weight and height measurements, as clinical judgement is unreliable¹.

BMI is defined as weight in kilograms divided by the square of height in metres ($BMI = Wt/(Ht)^2$). Thus a toddler who weighs 13.2 kg and is 91cm tall has a BMI of 15.9 kg/m². The healthy BMI range for adults of 18.5–25 is not applicable to children as their BMI varies with age. The variation is different between boys and girls.

Calculating BMI

$$BMI = \frac{\text{Weight in kilograms}}{(\text{Height in metres})^2}$$

For a toddler with a weight of 13.2 kg and a height of 91cm (0.91m)

$$BMI = \frac{13.2}{0.91 \times 0.91} = 15.9 \text{ kg/m}^2$$

The BMI of toddlers should decrease as they become slimmer from when they begin walking until about five to six years of age. With increased mobility the toddler's energy expenditure rises and body fat is replaced with more muscle tissue. The BMI of obese toddlers may not decrease or may decrease less than expected.

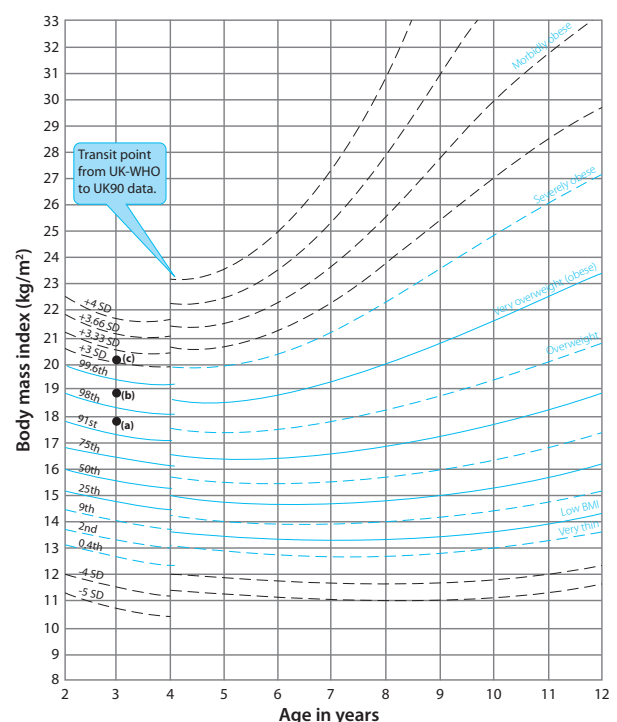
BMI for age centile charts are for children from two years of age. There is one for boys and one for girls [Figure 1 shows the boy's chart]. They can be ordered from www.healthforallchildren.co.uk and all healthcare professionals should have access to them. For children two to four years of age the World Health Organisation BMI reference curves are used. For children over four years the BMI reference curves of UK children measured in the 1990s when few children were overweight and obese are used.

In clinical practice the centiles lines marked on the UK BMI charts are used to define:

- overweight: 91st – 98th BMI for age centiles
- obese: at or above the 98th BMI for age centile

For historical reasons, national statistics define overweight as between the 85th and 95th BMI for age centiles and obesity as at or above the 95th BMI for age centile.

Fig. 1 UK-WHO BMI centile chart with three plots of three-year-old boys showing: (a) – overweight, (b) – obese, (c) – over the 99.6th centile, requiring referral



For infants and toddlers under the age of two years

A risk of overweight and obesity is present if:

- after eight weeks of age, the child's weight consistently crosses upwards across the weight for age centile lines or
- the weight centile is more than two centile spaces above the length for age centile

PREVALENCE IN THE UK

Obesity in toddlers has risen over the last two decades and recent national statistics show that around 13 per cent of English toddlers aged two to four years are obese and a further 16 per cent are overweight². The 2015–16 Child Measurement Programme in England found 9.3 per cent of children in reception are obese and a further 12.8 per cent are overweight³. The 2015 Health Survey in Scotland found 13 per cent of two to six year olds to be obese with a further 11 per cent overweight⁴.



CAUSES OF OVERWEIGHT AND OBESITY

Eating patterns, activity levels, ethnicity, genetics and environment all play a part in the development of obesity. Evidence is emerging that genetic differences may make some toddlers more susceptible to obesity in an obesogenic environment where food is readily and easily available^{5,6,7,8,9,10}. Nonetheless, the vast majority of overweight and obesity in toddlers is caused by energy intake in excess of energy requirements.



Key risk factors

- **Maternal obesity during pregnancy and/or excess gestational weight gain.** Babies born to a mother who was overweight when she conceived or who gained excess weight during pregnancy and/or developed gestational diabetes are particularly at risk. This may be because hormonal changes during their fetal development increase their risk of obesity¹¹.

- **parental obesity** of one or both parents – the risk is higher for children of an obese mother than of an obese father^{12,13,14}.
- **high birth weight**¹⁴.
- **rapid weight gain** or catch up growth in the first one to two years i.e. crossing upwards across the weight for age centile lines^{14,15,16}.
- **poor appetite control** leading to excess energy intake^{17,18}.
- **sedentary behaviour**: more than eight hours watching TV per week at three years¹⁴.
- **less than ten hours sleep** per day at three years¹⁴.



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Medical causes of overweight and obesity are rare but if poor appetite control and environmental factors have been excluded, obese toddlers can be referred to a paediatric endocrinologist. The rare medical causes include:

- endocrine disorders often signalled by short stature such as hypothyroidism, Cushing's syndrome, growth hormone deficiency and leptin deficiency
- chromosomal disorders such as Prader-Willi syndrome

The characteristics of children with poor appetite control who overeat include:

- particularly enjoying food
- eating very quickly
- eating when they are not hungry
- asking for food outside their meals and planned snacks and so eating more frequently
- asking for food when bored
- eating all the food they are given ('plate clearers')
- asking for food whenever they see it and eating whenever they see accessible food

CONSEQUENCES OF OVERWEIGHT AND OBESITY

Excess weight gain accumulates as extra adipose tissue (fat) which contributes to the physical and metabolic changes seen in obesity.

Obese toddlers who remain obese into childhood will be at risk of:

- increased severity of asthma and other respiratory disease
- orthopaedic problems
- lower levels of fitness
- social discrimination that can lead to:
 - low self-esteem
 - lower quality of life
 - lower academic achievement
- increased risk of insulin resistance and type II diabetes
- higher incidence of atherosclerosis
- increased risk of cardiovascular disease

An overweight child is five times more likely to become an obese adult than a normal weight child¹⁹.

LIFESTYLE IDEALS TO PREVENT OBESITY

Because preschool children are dependent on parents and carers for their food and opportunities for physical activity, it is parents and carers who must take responsibility for a healthy family lifestyle^{20,21,22}. However, providing food is an emotional issue for parents and many are more concerned about their toddlers being underweight than overweight²³. Initiatives to improve lifestyles in families at risk of obesity need to be undertaken sensitively and should involve support for parents to improve their parenting skills²⁴. Home visits by healthcare professionals during pregnancy and infancy may be helpful because this is a time when parents are receptive to advice on healthy family lifestyles²⁵.

Changing eating habits is usually difficult, but particularly so for parents and families who:

- do not understand the principles of healthy eating
- use food and sweet drinks to reward, treat or comfort their toddlers and themselves
- do not have the cooking skills necessary to prepare simple home-cooked food and instead rely on convenience foods, which are usually higher in energy, fat, sugar and salt

- do not have set mealtimes, either as a family or for their toddlers, and consequently frequent snacking forms part of their eating pattern

Healthcare professionals report that running group sessions for parents where they learn to prepare meals from fresh ingredients improves their cooking skills and their knowledge of healthy eating, and empowers parents to provide healthier family meals.

During Infancy

Breastfeeding

Breast milk is the ideal milk for infants for many health reasons and some studies show a significantly reduced risk of childhood obesity with breastfeeding, especially when breastfeeding continues for seven months or more²⁶. However other studies have shown no association²⁷ and there are many confounding lifestyle factors throughout the toddler years and early childhood, in addition to the mode of milk feeding during infancy, that may contribute to the development of obesity²⁸.



Responsive Bottle Feeding

Whether it is breast milk or breastfeeding that reduces the risk remains controversial; bottle fed infants, consuming either expressed breast milk or formula milk, consume more energy and gain more weight than breastfed infants and this may be due to the mother having more control over the quantity of milk that the infant drinks than that of a breastfed infant²⁹. Infants should **not** be encouraged to finish every bottle but be allowed to stop feeding when they signal they have had enough by stopping sucking and turning away from the bottle when it is offered.

Formula milks have more energy than colostrum and formula-fed infants lose less weight in the first few days after birth. The growth rate and pattern of formula-fed infants is different to that of exclusively breastfed babies and this is why UK growth charts for under-fives are now based on the World Health Organisation (WHO) measurements of healthy breast-fed infants³⁰.

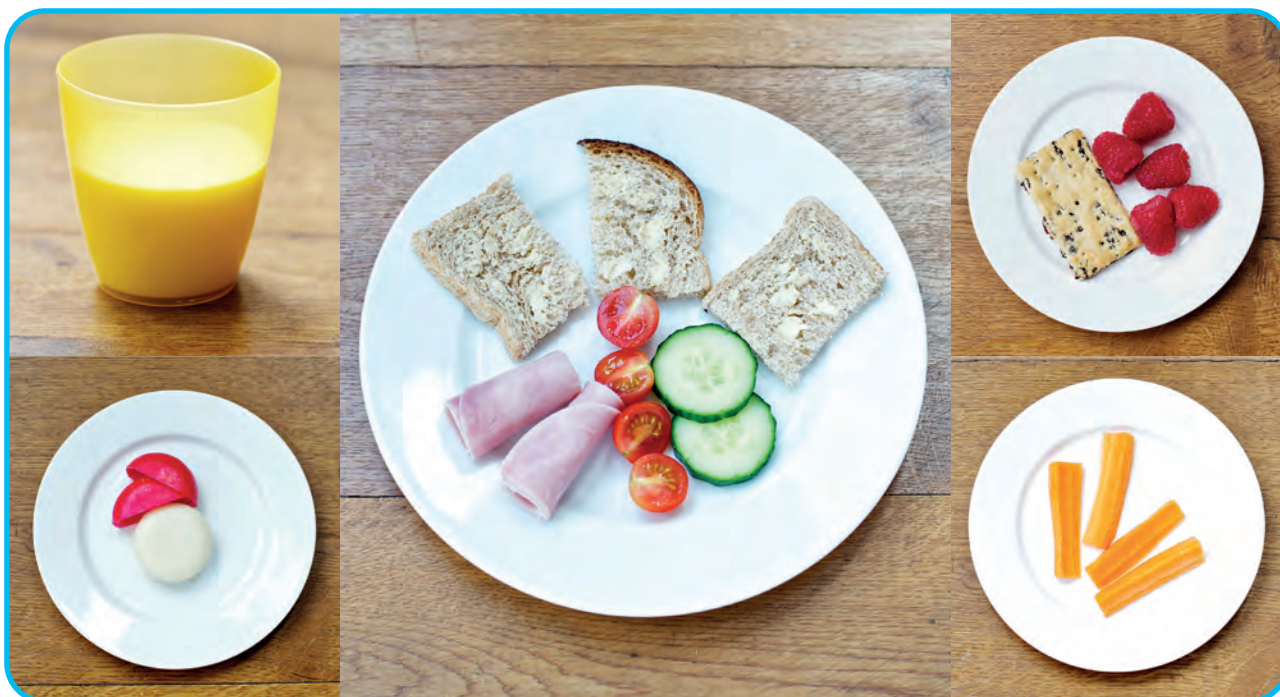
Complementary Feeding

A small increase in obesity risk has been found in infants beginning complementary foods before four months but complementary feeding beginning any time after four months does not affect obesity risk³¹. During early weaning, offering infants vegetables and fruit as both spoon-fed and finger foods will help them learn to like the smell, taste and texture of these low energy foods. Research shows infants accustomed to these foods early in weaning eat more of them during childhood³².

Responsive Complementary Feeding

Parents need to accept the signals that their infant has eaten enough, such as turning their head away from food or keeping their mouth shut. Coercing infants to eat more than they want to eat can result in overfeeding and excess weight gain³³. As infants' feeding skills develop and they begin to eat more food, their milk intake should be allowed to decrease.





See Factsheet 1.3 for further information on portion sizes

During the Toddler Years

Encouraging healthy eating and portion size control

- Offering appropriate portions sizes as listed in Table 1 – toddlers need less food than some parents think and some children will eat more if large portion sizes are given.
- Responsive feeding means allowing toddlers to stop eating when they indicate they have had enough without coaxing, pressuring, bribing or rewarding children to eat more of specific foods or finish everything on their plate.
- Feeding toddlers to a routine of three meals and two to three planned snacks and not giving food outside these times, especially not to comfort, treat or keep toddlers quiet.
- Encouraging children who eat very quickly to eat more slowly.
- Offering more wholegrain foods that are more filling.
- Offering foods that require chewing and take longer to consume.
- Family meals – toddlers learn by copying, so parents need to adopt healthy eating patterns themselves and eat with their toddlers as often as possible. Ideally the family should all eat together in a calm, relaxed atmosphere with the TV switched off and no other distractions.
- Hugging or cuddling children to cheer them up rather than giving them food – parents, themselves, should not eat when they are bored or unhappy.
- Limiting foods high in fat and sugar and keeping them out of sight – small amounts of these foods are acceptable (see Table 1) but many toddlers eat these foods to excess – particularly sweet drinks and high-fat snack foods such as crisps. Preschool children naturally prefer energy dense foods^{34,35}, but entirely restricting these foods can lead to them becoming more desirable. They are best given about once a week without comment or implying that they are treats, rewards or 'naughty but nice'.
- Healthcare professionals can help parents to plan more nutritious meals and snacks that can be substituted for the high-fat and high-sugar foods that they may normally offer.

Table 1 Healthy eating recommendations and portion sizes for toddlers

The Five Food Groups		One toddler-size portion is about:
Bread, rice, potatoes, pasta and other starchy foods <ul style="list-style-type: none"> • Offer at each meal and at some snacks • Choose whole grain often 		<ul style="list-style-type: none"> • ½–1 slice whole grain or white bread or ¼–¾ bread roll • 3–6 heaped Tbs whole grain or fortified breakfast cereal without a sugarcoating. No need to add extra sugar – sweeten naturally with dried or fresh fruit • 5–8 Tbs of hot cereal like porridge made up with milk • 2–5 Tbs of rice or pasta • ½–1½ egg sized potatoes or 1–4 Tbs of mashed potato • ½–2 crispbreads or 1–3 crackers
Fruit and vegetables <ul style="list-style-type: none"> • Offer at each meal and at some snacks 		<ul style="list-style-type: none"> • ¼–½ medium apple, orange, ¼–¾ pear or ¼–1 medium banana • 3–10 small berries or grapes • 2–4 Tbs raw, freshly cooked, stewed or mashed fruit • 1–3 Tbs raw or cooked vegetables
Milk, cheese and yogurt <ul style="list-style-type: none"> • 3 toddler portions per day • No bottles of milk • Give whole milk rather than lower fat milks from 12 months of age until at least 2 years of age 		<ul style="list-style-type: none"> • 3–4 oz (100–120 ml) whole cows' milk as a drink in a cup • 1 small pot (125 ml) yogurt or 2 x 60g pots of fromage frais • 2–4 Tbs grated cheese • Cheese in a sandwich or on a piece of pizza • 5–7 Tbs custard or 4–6 Tbs milk pudding
Meat, fish, eggs, nuts and pulses <ul style="list-style-type: none"> • 2 to 3 toddler portions per day 		<ul style="list-style-type: none"> • 2–4 Tbs ground, chopped or cubed lean meats, fish or poultry • ½–1 whole egg • 2–4 Tbs whole pulses (beans, lentils, dahl) or 1–2 Tbs hummus • ½–1 Tbs peanut butter or 1–2 Tbs ground or crushed nuts
Oils, butter and fat spreads <ul style="list-style-type: none"> • Include small amounts twice a day • Choose high omega 3 oils e.g. rapeseed, olive and soya oils 		<ul style="list-style-type: none"> • 1 Tsp oil • 1 Tsp butter or fat spread • 1–2 Tsp mayonnaise • 1 Tbs cream
Sugary foods and packet snacks <ul style="list-style-type: none"> • Toddlers under two years of age have lower energy requirements and should not be offered any sweet puddings, cakes, biscuits, confectionery, chocolate or savoury snacks such as crisps. • Over two years of age you can offer small amounts of sweet foods and salty snack foods occasionally but these should not be a regular part of a toddler's everyday foods. 		<p>Once a day:</p> <ul style="list-style-type: none"> • ½–1 digestive biscuit or 1–2 small biscuits or 1 small slice cake or pudding • 1 Tsp jam or honey or added sugar <p>If given, limit to once a week only:</p> <ul style="list-style-type: none"> • 4–6 crisps or 2–4 sweets or 1 small fun-sized chocolate bar or a sweet drink such as squash or fruit juice

Tbs = tablespoons Tsp = teaspoons

See Factsheets 1.1 and 1.2 for further information about healthy eating.



Encouraging physical activity

Most toddlers do not need encouragement to play and will enjoy active play particularly with their parents. Encouraging active play every day promotes the development of skills and co-ordination that will allow them to enjoy sport as they get older. Praising toddlers when they are active will encourage them to do more.

The Department of Health now recommends that under-fives who can walk should be physically active for at least three hours each day³⁶. This can be made up of short episodes spread over the whole day. Any active play inside or outside as well as walking, climbing stairs, bouncing on a trampoline, dancing, running, walking to nursery, and other similar activities all count.

Limiting sedentary behaviour

Many toddlers spend a lot of sedentary time being occupied by a TV/DVD/tablet. There are no evidence-based guidelines for this in the UK, but in the US The American Academy of Pediatrics recommend:

- extremely limited screen time for under two years of age and only with a parent watching with them and explaining e.g. video chatting with family members
- toddlers over two years of age are limited to one hour of media time per day³⁷

In the UK three year olds who watched TV for more than eight hours a week (which is over one hour per day) were at a higher risk of becoming obese at seven years old than those who watched less¹⁴. Parents may need help exploring physical activities that can be substituted for sedentary behaviour such as watching TV or DVDs or playing on tablets.

Getting enough sleep

Toddlers normally sleep for a total of about 12 hours in each 24, including daytime naps, and this is important for growth. Three year olds in the UK who were sleeping for less than ten hours per 24 hours were found to be at greater risk of being obese at seven years¹⁴.

Programmes to prevent obesity in preschool or childcare settings could incorporate a range of components rather than focusing on parental education alone²⁴. Ideas include:

- interactive cookery demonstrations, videos and group discussions on issues such as meal planning, appropriate portion sizes, shopping for food and drink and using only non-food rewards to treat or comfort a toddler
- interactive demonstrations, videos and group discussions on physical activity including:
 - ideas for activities
 - encouraging more walking instead of always using the car or pushing toddlers around in a pushchair
 - opportunities for active play
 - availability of local facilities
 - safety concerns

To facilitate this guidance healthcare professionals need to have local knowledge of facilities where toddlers can enjoy physical activity. Where facilities and opportunities are poor, practitioners could lobby their local authority to provide affordable activities for families of young children through Children's Centres. For example, this may include a regular weekly subsidised parent/toddler swim or an organised parent/toddler health walk or active play group.

TREATING OVERWEIGHT AND OBESITY

Clinical Commissioning Groups should have a locally agreed protocol based on NICE guidelines for treating childhood obesity³⁸. Scottish guidance recommends that toddlers with a BMI over the 99.6th centile (plot (c) in Fig. 1) should be referred to a paediatrician for investigation³⁵.

NICE guidelines recommend that^{38,20}:

- a supportive environment should be created that helps overweight or obese children and their families to make lifestyle changes
- decisions on the approach to management of a child's overweight or obesity should be made in partnership with the child and family and be tailored to the needs and preferences of both
- weight management interventions should include behaviour change strategies to increase physical activity levels or decrease inactivity, improving eating behaviour and the quality of the diet and reducing energy intake
- dietary changes should be individualised, tailored to food preference and allow for flexible approaches to reducing calorie intake

Healthcare professionals need to be sensitive when discussing the issue as most parents do not recognise that their toddlers are overweight or obese. Parents could be asked how they feel about their child's weight as a way of beginning a discussion. Measurement of the toddler's weight and height/length could then be offered. Showing parents how the BMI of their overweight/obese toddler relates to the normal range, by using the BMI centile chart, is a good way to continue the discussion.



Unless parents acknowledge that there is a problem and are ready to change their lifestyle there is little that can be achieved for an overweight or obese toddler.

There is usually no need for overweight toddlers and young children to actively lose weight, but weight gain needs to be slowed or stopped temporarily through healthy eating and physical activity so that BMI declines as the child grows taller.

The aim of treatment is to improve the energy imbalance and this will be achieved by a combination of any of the following:

- supporting parents of children with poor appetite control
- decreasing the energy intake from food and drinks by limiting portion sizes, snacking, and high calorie foods and drinks
- increasing physical activity
- decreasing sedentary behaviour
- ensuring adequate sleep for growth

The barriers to making these changes may be considerable for some families because of:

- the family lifestyle
- lack of knowledge of what a healthy balanced diet is
- lack of cooking skills to prepare lower energy foods
- housing and immediate local environment
- limited finances

SUPPORTING PARENTS TO MAKE LIFESTYLE CHANGES

The whole family needs to make lifestyle changes that become a normal part of their family life so that they are maintained long-term.

At the outset healthcare professionals should initiate a sensitive discussion with parents to determine which factors in their lifestyle are contributing to obesity. Parents are likely to be aware of factors but they may involve emotional issues making change seem more difficult²³.

Once contributing factors have been identified, healthcare professionals should help parents explore which of these factors they feel they may be able to change. There will be pros and cons and solutions may not always be clear cut. For instance, excess sedentary behaviour and lack of physical activity could be a major factor for a family living in a cramped flat in a high-rise building with no access to a playground or garden. Taking a toddler to play outside would impact on the time a busy parent might have to prepare ideal foods. A carefully structured assessment of need will enable healthcare professionals to support parents in balancing needs and priorities.

It is important to encourage families to set small achievable goals. Up to three could be tackled at one time. If there are financial concerns or if both parents need to work and have limited free time, parents may be encouraged to share a care plan with staff in the child's day care setting.

With time, when these changes have been made and sustained, the family can be encouraged to consider another set of lifestyle changes.



Support for parents who are not ready to make lifestyle changes

Parents need help to understand that obesity is a clinical condition with health implications rather than just a question of how someone looks³⁸. Discuss the benefits of making family lifestyle changes and give them details of someone they can contact when they are ready to consider making changes²⁰.

Lifestyle changes may benefit from:

- **Goal setting.** Begin by agreeing simple goals for behaviour change and what benefits they will achieve. Make sure the goals will not lead to conflict between family members and limit the number of goals to three or less. Make the goals SMART (Table 2). Keep records of the goals and the achievements so that they can be reviewed when necessary. When goals are not achieved, make it an opportunity to re-evaluate motivation and the complexity or effort required to achieve that goal.
- **Reward systems.** Toddlers are more willing to repeat behaviours that are rewarded with parental attention and praise. Parents should be encouraged to praise their toddlers for good behaviour and never to use food or drinks as rewards. More suitable rewards are time spent together with parents, for example, playing indoor games, reading books, going swimming or playing in the park.
- **Removing inconsistencies in the family environment.** Parents should limit the availability of foods and triggers that lead to overeating. Ideally they should, for example:
 - not bring high-calorie, low-nutrient foods into the house at all
 - buy an individual packet rather than multi packs of snack foods or biscuits that must be stored somewhere in the house
 - not go to 'all-you-can-eat' style restaurants
 - have set mealtimes, preferably with all the family eating together
 - have readily available healthy snacks to use at planned snack times in-between meals
 - resist spontaneous snack rewards or incentives inside and outside the home

Table 2: Examples of good and poor SMART Goals

Aspect of goal	Good examples	Poor examples
Specific	Have water in place of sweetened squashes, juices, smoothies and fizzy drinks. If fruit juice is used, dilute it well using one part juice to about ten parts water	Choose healthy drinks
Measurable	Limit crisps for everyone to four to six crisps at one meal each week	Eat fewer crisps
Achievable	1. Toddlers can walk the last 200 metres to nursery rather than being pushed in the buggy or driven in the car 2. Use the stairs rather than escalators or lifts in the shopping centre – particularly when not encumbered with heavy shopping or pushchairs	1. Walk all the way to nursery (which might be over a mile and too far for a toddler to walk) 2. Only use stairs, never escalators (the family may live at the top of a tall tower block)
Relevant	Include fruit with each meal	Eat more pomegranates
Time limited	Go swimming on Saturday afternoons this month	Go swimming more often this year

OVERWEIGHT AND OBESITY GUIDANCE & TIPS FOR PARENTS



- Obesity in children is now common and obese children tend to remain obese as they grow up and become adults.
- Obese children have a weight that is too great for their height. The excess weight is stored as fat which affects their health. They are more likely to get problems with their legs, more severe asthma, high blood pressure, heart disease and diabetes. They are also more likely to be bullied.
- They do not have to lose weight. By staying the same weight they will get slimmer as they grow taller.
- Medical causes of obesity are very rare and most children become overweight because they eat more than they need.
- Check that your toddler is eating appropriate portion sizes – you can find them at <https://www.infantandtoddlerforum.org/portion-sizes-table>
- There are no medicines to treat young children who are obese. A healthy family lifestyle will prevent and treat overweight or obesity. You may need to make changes such as:
 - increasing the time when you are all active – walking, playing together e.g. ball games, dancing, swimming. Praise your children when they are active. For example: 'You are good at running and you run so fast now.'
 - decreasing the time you spend in sedentary pursuits – such as sitting watching TV or playing computer games.
 - eating a healthy diet and limiting foods high in fat or sugar such as crisps, sweets, and sweet drinks to once a week or less.
- Make small gradual changes to family behaviour by making a list of changes you think will be possible for your family. Choose up to three changes and discuss them in your family and decide when you will start each change.
- Talk to your extended family, such as grandparents, aunts and uncles, about the changes you are making so that they will not undermine them when they see your toddler. Also tell any other people who come to your home, such as baby sitters and friends.
- Praise your children when they make these changes. They are more likely to follow them again as they like praise from parents.
- Choose rewards other than food for your children. Do not give sweets or high-fat foods such as crisps as treats or for comfort and do not keep them in the house.
- When the changes are successful choose up to three more to change.

Children with poor appetite control

Some children enjoy eating so much they are not necessarily aware when they have had enough to eat. They ask for food outside of meal and snack times and when they are bored. Some want to eat food whenever they see it.

- Only offer food at meal and planned snack times and do not use food to reward, treat or to comfort or change your child's mood.
- Plan meals and snacks for the day (plan for three meals and two snacks) and tell your child what they can expect. Stick to your plan and carry healthy snacks with you when you go out.
- Suggest a non-food activity when children ask for food outside of planned eating times.
- Plan in the more desirable, high calorie foods about once per week; for example, an ice cream when at the park on Sunday, some chocolate after swimming on Friday, or cake at a birthday party.



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from pregnancy to preschool

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Glossary

Cushing's syndrome: caused by excessive levels of the hormone cortisol which causes rapid weight gain, particularly of the trunk and face

endocrine disorders: abnormalities of hormone secretion or action

growth hormone: a hormone secreted by the pituitary gland which stimulates growth and cell reproduction. It controls the growth in toddlers and young children

hypothyroidism: insufficient production of thyroid hormone by the thyroid gland

leptin: a hormone secreted by adipose tissue, that plays a key role in regulating energy intake and energy expenditure, including the regulation of appetite and metabolism

Prader-Willi syndrome: a condition due to a chromosomal abnormality. Babies are floppy at birth and go on to develop obesity due to an excessive appetite and overeating. Other characteristics are small hands and feet, mental retardation, poor emotional and social development and immature development of sexual organs and other sexual characteristics



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