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CLINICAL REVIEW

Weight faltering and failure to thrive in infancy and early childhood

Brian Shields *paediatric specialty registrar*¹, Ian Wacogne *consultant paediatrician*¹, Charlotte M Wright *professor of community child health/consultant paediatrician*²

¹Department of General Paediatrics, Birmingham Children's Hospital, Birmingham B4 6NH, UK; ²Paediatric Epidemiology and Community Health Unit, School of Medicine, College of Medical, Veterinary, and Life Sciences, University of Glasgow, Glasgow, UK

Weight faltering, or failure to thrive, is a childhood condition that provokes concern about possible neglect, deprivation, and organic illness. However, research over the past 20 years has brought the validity of this concern into question, leading to the proposal that management should be less aggressive.¹ We summarise the evidence base, discuss new developments, and provide a practical approach to management. Failure to thrive has been defined in a range of ways, with no overall accepted definition² but an essential element is subnormal growth or weight gain, hence the increasing use in recent years of the term weight faltering.

What is normal growth?

Growth charts rank a child's measurements against children of the same age and sex. If a child gains weight more slowly than their peers, their measurement moves to a lower centile (crosses centiles). The World Health Organization has proposed that its growth standards, based on healthy, relatively affluent, breastfed infants from six countries, should be used to represent healthy growth for babies internationally.³ These standards, along with UK birth and preterm growth data, have been incorporated into the UK-WHO growth charts⁴ as well as being adopted in other countries worldwide. Studies that assessed the growth pattern of representative samples of European children compared with these new charts found that these children tended to gain weight more rapidly.⁵ As a result, for example, only around 0.5% of UK children will be below the 2nd centile at 12 months.⁶ Previous epidemiological studies have shown that while healthy children will usually roughly progress along the same centile, moderate movements up and down the chart are common.⁷ The weights of larger babies tend to fall towards the average over time, while those of smaller babies move upwards: the phenomenon of regression to the mean.⁸

What is weight faltering?

Weight faltering describes a weight gain pattern rather than a diagnosis. It represents a spectrum from what may simply be a normal variant to children with serious problems. In clinical

practice, a weight that crosses more than two major centile spaces downwards is often the recommended threshold for concern¹ (a centile space is the distance between two major centile lines). On UK growth charts from 1990 this pattern would be seen in around 5% children, but on the new UK-WHO charts, centile crossing is much less common; a recent analysis of UK population based data suggest that after the first four months as few as 0.5% average children will cross two centile spaces.⁹ Regression to the mean describes how smaller babies will grow faster than larger babies and both will move towards the mean weight. Research assessment of weight gain uses a calculation of "conditional weight gain" to allow for regression to the mean automatically, but it is not feasible to use this approach in clinical practice.

What causes weight faltering?

It is plausible that weight faltering will occur as a consequence of inadequate nutrition, since energy requirements in infancy are very high.¹⁰ Observational studies of children with weight faltering have found that they eat less at test meals.^{11 12} There is also evidence that children with weight faltering show growth patterns suggesting chronic undernutrition. A study of children with weight faltering identified by population screening found that on average they had low body mass index and showed subsequent catch up weight gain,^{13 14} while a more recent cohort study found that children with both slow conditional weight gain and low body mass index went on to be relatively stunted in later childhood.⁹

Explaining why these children become undernourished is complex and the cause is usually multifactorial. Here we review the evidence for and against the roles of several factors that have been associated with weight faltering.

Organic disease

The traditional model of classifying causes of weight faltering as organic or non-organic is overly simplistic and places too much emphasis on organic causes. Major organic causes of

Summary

- Weight faltering is not a disease, but rather a description of a relatively common growth pattern
- It is most commonly caused by undernutrition relative to a child's specific energy requirements
- Causes tend to be multifactorial and often involve problems with diet and feeding behaviour that usually respond to simple targeted advice
- More rarely, weight faltering may be associated with neglect or maternal mental health problems or addiction
- The health visitor (public health nurse) is often best placed to assess and advise in the first instance
- Organic disease is rare in otherwise asymptomatic children, but it is reasonable to rule out organic disease if dietary and behavioural interventions are unsuccessful

Sources and selection criteria

We searched Pubmed, Medline, Embase, and the Cochrane Database of Systemic Reviews with key reference terms "failure to thrive," "growth faltering," and "weight faltering." We reviewed citations from key articles. We also used our personal archive of references.

weight faltering are rare, while weight faltering itself is common. Two UK population based studies found substantial organic disease in only 5-10% of children with slow weight gain.^{13 15} The conditions found were heterogeneous but all featured clear symptoms or signs suggesting underlying disease. Two earlier hospital based studies in the United States^{16 17} found that investigation in asymptomatic children with failure to thrive yielded no substantial new diagnoses of organic disease. This evidence suggests that organic disease is unlikely in children who are asymptomatic and well on examination, so that investigations should be planned to rule out rare major conditions (table 1) rather than to identify a cause of the weight faltering.

Socioeconomic and educational status

Weight faltering has traditionally been seen as a manifestation of poverty. While this is still likely to be true in poorer societies, there is good evidence from three large, population based studies that in the United Kingdom there is no significant association between low socioeconomic status, poor educational attainment, and weight faltering.^{18 19 20} All three studies identified children with slow conditional weight gain in infancy. One study¹⁸ found no association with either social class or educational status, while the other two found weak U shaped associations, with slightly higher prevalence in the most and least deprived groups.^{19 20} This lack of association probably reflects the safety net of modern welfare systems, which prioritise support to families with young children.

Neglect

A cohort study of 97 children with weight faltering identified by population screening found evidence of neglect in only 5%.¹³ However, another population based study found that the risk of being placed on the child protection register was four times higher in weight faltering children than in controls.²¹ Thus, as neglect and abuse are rare and weight faltering common, so neglect may be seen more commonly in association with weight faltering, but most children with weight faltering are not neglected.

Feeding and eating difficulties

Several observational studies have shown that feeding difficulties such as low appetite, weak suck, and weaning difficulties are associated with weight faltering.^{18 20 22 23} Two observational case-control studies found associated differences in maternal feeding behaviour.^{12 24} For example, infants with weight faltering had significantly fewer positive interactions (where parents anticipate and support a child's needs) during

meals than controls. It is not clear whether this association is causal or simply a maternal adaptive response to their child's eating behaviour.²⁴

Maternal depression

One case-control study found an association between weight faltering and maternal depression; significantly more mothers in the weight faltering group scored above the threshold for depression on the Edinburgh Postnatal Depression Scale.²⁵ However, in three medium to large cohort studies one found no link,²⁶ another found an association that had disappeared by 12 months,²⁰ and a third it was only seen in later onset weight faltering.²⁷

Variation with age

The population study of children with weight faltering described above found that although children were identified at a mean age of 15.5 months, the slowing of their weight gain began in the early weeks and 50% had already crossed the screening threshold by age 6 months.¹³ A large whole population study found that weight faltering seen in the first 2 weeks of life was associated with perinatal factors such as preterm birth and maternal smoking, while later onset was associated with organic disease and feeding problems.²⁷

What are the potential consequences of weight faltering?

A number of consequences have been postulated, including impaired growth, cognition, and behaviour. Early studies suggested major long term cognitive effects.²⁸ A systematic review and a meta-analysis both found only small effects (3-5 IQ points)^{29 30} and a similar result was found in a more recent cohort study.³¹

Weight faltering children in two population based studies followed up at age 6-9 years were found to be significantly shorter and lighter and to have smaller heads than controls.^{15 32} A randomised control trial found that children receiving a primary care based intervention for weight faltering were heavier and taller at age 4 years than untreated controls,¹⁴ suggesting that growth outcomes are potentially reversible. One systematic review, which included studies from developing countries, concluded that immune, gastrointestinal, and cardiac dysfunction recovered with correction of malnutrition, but other effects, such as impairment in cognition, attention, and behaviour, were permanent.³³

In summary, current evidence suggests that weight faltering in infancy does have an effect on long term growth and may have a small effect on cognition.

How can a child with weight faltering be identified?

Concerns about weight faltering tend to arise as a result of routine weighing. All babies should be weighed during the first week as part of the assessment of feeding (usually around the time of immunisations) and at eight weeks, 12 weeks, 16 weeks, one year, and whenever concerns are raised.³⁴ The study described above suggested that a useful threshold for closer assessment is a fall through two centile spaces on the UK-WHO charts—although for infants with birth weights below the ninth centile, a fall through one centile space should trigger concern, while infants above the 91st centile could be allowed to cross three centile spaces.⁹ Weighing alone does not distinguish slow growth from thinness, so where there is concern length should also be measured.⁴ The UK department of health guidance on the UK-WHO growth charts also suggests that children below the 0.4th centile for weight or with a body mass index below the second centile should be carefully assessed,³⁴ but children with low weight, length, or body mass index along with weight faltering are probably most at risk.⁹

What history and examination are required?

The first necessity is to confirm that weight faltering is truly persistent and substantial: weight may dip sharply after minor illnesses, or a plotting error may have occurred. Measure and plot current weight and length, with re-plotting of previous measurements on an appropriate centile chart. Adjust for prematurity in infants born before 37 completed weeks, up to age 2 years. If both the weight and length centiles are low this suggests slow growth, rather than weight faltering, so measuring parental heights may also be informative.

If weight faltering is confirmed, exclude underlying medical problems by history and medical examination, including auscultation of the chest and assessment of whether neurodevelopment is appropriate for age. Assuming this is normal, a thorough dietary history should then be taken by the member of the primary care team with most access to the family. In the United Kingdom this would be the health visitor, a public health nurse with responsibility to monitor all pre-school children, as they have good contextual family knowledge and can offer non-stigmatising advice. Some key areas that should be covered are:

- history of milk feeding
- age of weaning
- range and types of food now taken
- mealtime routine and eating and feeding behaviour
- ask the family to complete a three day food diary for a fuller and more accurate picture
- if possible observe a meal being taken

It is also important to probe for evidence of psychosocial factors such as maternal depression.

What investigations are required?

Investigations should not usually be undertaken in primary care, but should be deferred until paediatric assessment has taken

place. Undertake investigations only if signs or symptoms of disease are present, or where weight faltering is persistent or severe. There is no formal evidence to suggest an ideal routine set of investigations, but the table shows a suggested schedule of tests to rule out possible pathology, which should usually be undertaken all at once to avoid multiple blood tests.

What management options are available for children with weight faltering?

The figure↓ shows a graded response to weight faltering.

Community-based management

Early studies of failure to thrive were hospital based, but in recent years structured ambulatory management has been recognised as more cost-effective.³⁵ It may also benefit development,³⁶ is more acceptable to patients and their families, and is more likely to succeed.¹⁴ With appropriate training in mealtime observations and food diaries, health visitors can make wide ranging and effective assessments, and can support families to improve feeding and increase calorie intake (see box).

A trial in the United Kingdom of structured health visitor intervention, including basic dietetics training and regular follow-up, showed better growth in the trial group.¹⁴ A US intervention trial of weekly home visits by trained lay home visitors versus follow-up in a multidisciplinary nutrition clinic showed similar improvements in weight and height for age in both groups, but the intervention group also showed better receptive language and cognitive development.³⁶ Another UK study comparing specialist health visitor intervention with conventional care showed no difference in weight outcomes, but the intervention group had 50% less hospital admissions and defaulted fewer hospital and health visitor appointments.³⁵ If such programmes are to succeed it is important for health visitors to be able to access specialist support, particularly for more complex or severe cases. Dietetic input is likely to be most commonly accessed.

Monitoring progress

The key measure of improvement should be recovery in the weight gain pattern—a rise up through the centiles (catch-up) that usually begins within four to eight weeks of a successful intervention such as dietary advice. Plotting on the neonatal and infant close monitoring chart allows detailed assessment of change over time and allows for gestation if the child was preterm.³⁷ It is still important not to measure too frequently. Optimal intervals and timings for measurement have not been formally established, but the Royal College of Paediatrics and Child Health suggest weighing no more than monthly before age 6 months, every two months aged 6-12 months, and every three months after that.³⁴ A child can be said to have recovered once their current centile is within 1-2 centile spaces of their earlier position, which may take several months. Some children may show only partial recovery while others may remain within the same low centile. If such children are not markedly underweight for their height and their growth in length is steady and proportionate to their parental heights, it may have to be accepted that they are showing a variant pattern of normal growth.⁹

The role of specialist input

Dietician assessment

For confirmed weight faltering without medical features, refer initially to a paediatric trained dietician in most cases. Referral

Possible strategies for increasing energy intake in children aged over 9 months³³*Dietary*

- Three meals and two snacks each day
- Increase number and variety of foods offered
- Increase energy density of usual foods (for example, add cheese, margarine, cream)
- Limit milk intake to 500 mL per day
- Avoid excessive intake of fruit juice and squash

Behavioural

- Offer meals at regular times with other family members
- Praise when food is eaten, ignore when not
- Limit meal time to 30 minutes
- Eat at same time as child
- Avoid meal time conflict
- Never force feed

can usually only be done by the primary care doctor, but some pathways allow direct access through specialist health visitors. The primary role of the dietician is to optimise the existing diet and advise on meal time management, rather than to identify deficiencies. For this purpose a single home visit may be more effective than clinic review.¹ The dietician can assess the adequacy of the current diet to supply essential nutrients and offer targeted advice about enhancing the diet. Paediatric dieticians can also advise effectively on the management of basic feeding behavioural problems. Although high energy supplement drinks are often suggested for weight faltering, evidence from older children suggests that they do not improve weight gain³⁸ and may even depress solid food intake.^{39 40}

Paediatrician

Given the value of community based management, infants need only be referred to a secondary care paediatrician if they show features suggesting an associated illness or have severe weight faltering (a fall through two or more centile spaces on the UK-WHO chart) that has persisted despite community and dietetic interventions. In practice all a paediatrician will do is reassess the growth data, undertake investigations to exclude organic pathology, and then usually reinforce previous dietary advice.

Inpatient monitoring is not advisable, except in very extreme circumstances. Hospitals are an unnatural place in which to assess feeding and mother-child interaction and the risk of hospital acquired infection is present.

Social work

Weight faltering on its own, even if it is severe, does not require a social work referral. Referral is only appropriate in cases where the family has major social problems, such as drug or alcohol abuse, or where direct evidence suggests abuse or neglect. Families may lack adequate resources to ensure that a child is well nourished, and engagement of social services, treating these as "children in need," can enable families to access appropriate support.

Psychology

Indications for involvement from psychology include pronounced food refusal or very anxious, stressful mealtimes. A meal time video observation has been suggested as the basis for structured supportive feedback and advice as well as for working with the parents to control anxiety.⁴¹

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Tips for non-specialists

- Look at the weight gain pattern over time rather than single measurements
- Measure length in addition to weight whenever weight faltering is suspected
- Weight faltering is common in infancy and mostly occurs in otherwise healthy children living in non-neglecting environments
- Weight faltering can cause long term stunting and developmental delay if not reversed
- Involve the health visitor (public health nurse) before considering specialist referral
- A dietary assessment often reveals problems that respond well to simple advice
- High energy milks or supplement drinks are not likely to be helpful and should not be started in primary care

Additional educational resources*For clinicians*

UK-WHO 0-4 years growth chart resources (www.rcpch.ac.uk/child-health/research-projects/uk-who-growth-charts-early-years/uk-who-0-4-years-growth-charts-initi)—guidance from the Royal College of Paediatrics and Child Health

Maternal and child nutrition (www.nice.org.uk/PH011)—NICE guidance for midwives, health visitors, pharmacists, and other primary care services to improve the nutrition of pregnant and breastfeeding mothers and children in low income households

Faltering growth (www.gp-training.net/training/tutorials/clinical/paediatrics/pgrowth2.htm)—guidance on managing weight faltering in primary care

For patients

Healthy eating (www.eatwell.gov.uk)—NHS guidance on healthy eating and nutrition for children, parents and families

Your baby's first solid foods (www.nhs.uk/Conditions/pregnancy-and-baby/Pages/solid-foods-weaning.aspx)—NHS guidance on weaning infants

Box: Questions for future research:

Do any behavioural interventions prevent weight faltering—for example, a baby led weaning approach to reduce the risk of force feeding by mothers and avoidant eating behaviours in the child?

Are children with weight faltering more or less likely to go on to be obese as adults or to have long term health effects?

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Table

Table 1 | Possible investigations to be undertaken in secondary care

Investigation	Indication	Condition being sought
Full blood count	Any persistent weight faltering	Anaemia, leukaemia
Ferritin	Any persistent weight faltering	Iron deficiency
Urea and electrolytes	Any persistent weight faltering	Renal failure, electrolyte abnormalities
Thyroid function tests	Any persistent weight faltering	Thyroid disorders
Coeliac blood tests	Any persistent weight faltering	Coeliac disease
Midstream urine	Any persistent weight faltering	Urinary tract infection
Chromosome analysis	Girls	Turner's syndrome
Chest radiograph	Infants under 3 months; history of respiratory infection	Cardiac anomalies; cystic fibrosis
Sweat test	History of respiratory infection	Cystic fibrosis
Vitamin D levels	Solid diet is limited, dark skin colour	Rickets

Figure

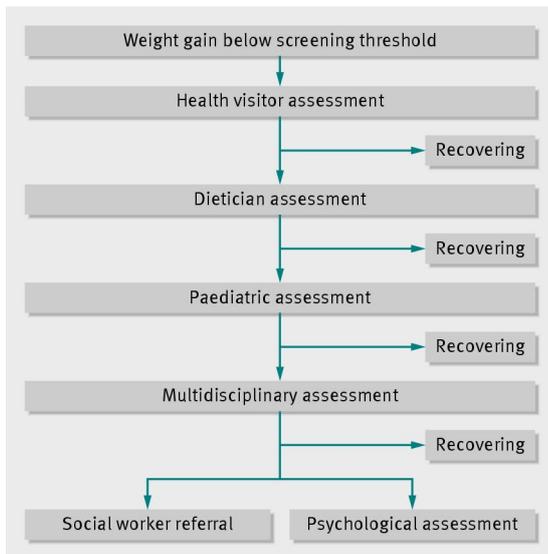


Fig 1 Graded response to weight faltering