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A tool to describe diet and eating behaviour in children at risk of malnutrition: the International Complementary Feeding Evaluation Tool (ICFET)

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ABSTRACT

Purpose: The International Complementary Feeding Evaluation tool (ICFET) is a new tool that provides a standardised description of caregiver feeding and child eating behaviour and diet in young children. It is designed to be relevant to undernutrition in low- and-middle-income countries (LMICs) and to be valid in multiple languages. This paper aims to describe the full content of the ICFET and its performance in various settings, cross-sectionally and longitudinally.

Method: ICFETs were completed by parents of 473 children aged 6–24 months in the UK, Kenya, Pakistan, and Guatemala. Repeated ICFETs were obtained for 62 children starting treatment for moderate acute malnutrition (MAM) in Kenya and Pakistan.

Findings: Solids were started much earlier in the UK than other countries; in Kenya and Pakistan self-feeding was less, and force feeding more common than in Guatemala and the UK. In the LMIC samples only 23 % children were eating foods from 5/8 of the recommended food groups daily. In the MAM treatment centres, Avidity was low: Kenya mean Z scores (SD) −1.76 (0.9); Pakistan −2.79 (0.9); and food refusal high: Kenya 0.77 (1.3), Pakistan 1.53 (0.9) compared to healthy UK infants; both showed moderate to good stability over time (Kenya Avidity Spearman's $r = 0.517$, $p = 0.023$ Refusal $r = 0.557$, $p = 0.013$; Pakistan Avidity $r = 0.959$, $p < 0.001$; Refusal 0.462 $p = 0.002$), suggesting that they are capturing enduring appetitive characteristics.

Conclusions: The ICFET provides valid eating and feeding behaviour measures which track within children over time, as well as a range of useful contextual measures of diet in the complementary feeding period.

1. Background

Wasting, or acute malnutrition, is still a major problem in children under 5 years in many lower- and middle-income countries (LMIC); many countries still have rates of above the SDG aim of 5 % (UNICEF, 2023b), two thirds of which are moderate wasting (MAM) (UNICEF, 2023a). Wasting is most common between ages 6–24 months, the period of complementary feeding, when infants and their carers must navigate a complex process of gradually introducing nutrient rich foods to supplement, and ultimately replace, breast milk (WHO, 2023a).

The role of child appetite and eating behaviour in malnutrition is potentially important (Abebe et al., 2017; Bentley et al., 1991; Dettwyler, 1989). Low appetite is well recognised as a feature of acute malnutrition (WHO, 2009) though active food refusal has been less studied (Mutoro et al., 2020). While low appetite may occur as a result of illness, or acute undernutrition itself, it may also be an enduring characteristic that places a child at risk of becoming malnourished, as we have shown previously in a more affluent setting (Wright et al., 2006).

Assessing feeding and eating behaviour (FEB) in the field is challenging, as most tools designed to assess FEB are aimed either at children with feeding disorders (Sanchez et al., 2015) or at risk of overnutrition (Wardle et al., 2001) and tend to be lengthy to complete. A further issue is that where field FEB questionnaires exist, they tend to be specific to the country where they were developed (Nahar et al., 2019; Rahman

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et al., 2022).

We have previously described the development of a short set of questions to assess FEB, which assessed universally relevant behaviours and concepts, designed to be valid between countries and in translation. We have previously shown that these have face and predictive validity in a range of settings and languages (C. M. Wright et al., 2021).

We have also shown that children with MAM tend to have been exposed to a number of different risk factors. These, range from poverty and poor hygiene, through deficient breast feeding or complementary feeding, to low appetite and high food refusal (Mutoro et al., 2021). The World Health organization (WHO) has recently provided updated advice on healthful complementary feeding (WHO, 2023a). WHO also recommends that all intervention approaches for MAM should involve individual history-taking to identify reversible risk factors and inform targeted advice, rather than just offering supplementary feeding (WHO, 2023b). Despite this, commonly, little or no individual history is taken, due to a lack of staff time (Charlotte Wright, Mutoro et al., 2020). While there are long established indicators of complementary feeding at a population level (WHO, 2021), these tend not to be detailed enough to inform targeted individual counselling by health workers. In particular they include little information on how and when the child is fed and how they respond to food.

We thus set out to design a tool which could identify reversible factors in individual children that are likely to cause or prolong undernutrition, including disordered eating and feeding behaviour. This tool, the International Complementary Feeding Evaluation tool (ICFET) (Charlotte Wright, Garcia et al., 2020; C. M. Wright et al., 2021) was designed to simultaneously assess diet, feeding and eating behaviour in children still being actively fed by parents. Our aim was to create a tool that was deliverable by interview or self-completion questionnaire, either on paper or via a mobile phone, that was detailed enough to be individually informative, yet brief enough to be useable in the field. While primarily designed as a survey tool, the aim was that the ICFET could also be used to facilitate individual, targeted counselling. To be useful at an individual level, the ICFET needed to capture aspects of diet and FEB which may vary between groups, or in response to treatment, but could be consistently identified in the same child (repeatability).

The aim of this paper is to describe the full content of the ICFET and its performance in various settings, cross-sectionally and longitudinally.

Specifically, our objectives were to.

1. Describe similarities and differences in diet and behaviour detected by the ICFET between different countries.
2. Describe eating behaviour in children with MAM and the extent to which this tracks within individual children as well as how it varies over time during treatment.

2. Methods

2.1. Participants and data collection

We collected cross-sectional and longitudinal data in a range of community settings to address our different objectives, as follows.

2.1.1. Comparison of ICFET results between countries

To address objective one, we further analysed the data collected in 2018–19 to develop the feeding and eating behaviour questions described previously (C. M. Wright et al., 2021). This comprised 1/a convenience sample of healthy children recruited via playgroups and word of mouth in Glasgow, UK and 2/children with wasting (Mid upper arm circumference, MUAC <12.5 cm or Weight for height WFH Z score < -2) as well as those with healthy growth, recruited with the help of community staff in child welfare clinics in an urban slum area of Nairobi, Kenya, in peri-urban districts of Lahore, Pakistan and in the rural district of Retalhuleu, Guatemala. All the children were aged 6–24 months, and over-sampling was used for some subgroups to obtain a good spread of ages and children with MAM. In the UK, parents completed the ICFET as a self-completion paper questionnaire. In other setting parents were interviewed by trained research students, or research assistants, using the ICFET as an interview schedule translated into Swahili (Kenya), Urdu (Pakistan) and Spanish (Guatemala).

2.1.2. Test stability over time and response to treatment

To address objective two, we used data collected in two LMIC settings. These were children with newly diagnosed moderate malnutrition (MUAC 11.5–12.5 cm or WFH -2 to -3SD) studied at the start of treatment in a pilot study in a nutrition clinic in Nairobi, Kenya aged mean (range) 10 (6–14) months, and as part of a trial in primary health clinics in Lahore Pakistan, aged 16.4 (8–25) months. The ICFET was completed by trained interviewers using the ICFET as an interview schedule translated into Swahili (Kenya), and Urdu (Pakistan) respectively. These children were mainly treated with Ready to Use Supplementary Foods (100 % in Kenya, 74 % in Pakistan) and were followed up after 2 and 4 weeks in Kenya and 4 weeks in Pakistan, with the core elements of the ICFET completed at every visit.

2.2. Ethics

All studies were conducted according to the guidelines of the Declaration of Helsinki. All the studies were approved by the Institutional Ethics Committee of University of Glasgow, College of MVLS REC (protocol codes 200160042, 200170117, 200180123, 200180033, 200180131 200170181). Individual country sub-studies were also reviewed as follows: AMREF Ethics and Scientific Review Committee in Kenya (P576-2018); Comité De Ética Independiente Facultad de Medicina Universidad Francisco Marroquín/Hospital Universitario Esperanza in Guatemala (CE/FM-UFM 30-19); Government of Punjab Provincial Bioethics Committee in Pakistan (1781/PA, 2257/PA).

2.3. Measures – the ICFET

This includes questions on duration of breastfeeding, age of first complementary feeding (see supplementary material) and a simple 24-h recall which records all eating occasions. This was used to derive the number of spoonable meals, snacks and drinks consumed. Snacks are separated into 'dry' finger foods such as bread, crisps, or confectionery which are energy dense and 'moist' snacks such as fruit or raw vegetables; drinks were recorded separately for milk and non-milk.

A food frequency table was also included, based on WHO dietary diversity food groups (WHO, 2021). For the 3 LMIC samples this included all the elements needed to exactly generate 6 of the 8 WHO indicators: Breast milk; starchy foods, pulses, dairy, meat/fish or eggs. For fruit and vegetables, parents rated the frequency of green leafy vegetables and fruit separately. The supporting information giving examples for typical foods were worded differently in each setting, to reflect availability of local foods. In Pakistan three items were used to capture staple starchy foods (bread, potatoes, and rice). In addition, parents reported intake of snack foods and cooking with oil.

The tool then includes 25 questions on eating and feeding behaviour, developed as described previously (C. M. Wright et al., 2021). Parents also reported whether the child fed themselves for spoonable meals and finger foods.

In addition, the ICFET includes three general health questions, while five motor milestone items and five food texture questions are also available on request. Socio economic questions proved too lengthy and variable between settings to create any sort of single short score, but three household hunger questions based on the FANTA approach were included (Coates, Swindale, & Paula Bilinsky, 2007), while for individual survey purposes locally relevant socio-economic scales were used. For first use in each language, the ICFET questions were forward translated by a bilingual lead researcher and then two back translations were obtained from other bilingual native speakers. These were checked

against the English original and the translation corrected as required.

In all settings, at each visit, the child was weighed using an electronic scale and length measured using a supine, rigid infantometer or height via a stadiometer.

2.4. Analysis

In Kenya, Pakistan, and Guatemala the eight core items (Breast milk; starchy foods, pulses, dairy, meat/fish, eggs, fruit, and green leafy vegetables) were used to calculate the number of WHO food groups eaten daily and minimum dietary diversity was defined as eating from 5/8 of these groups daily or more often. In Pakistan where there were 3 starchy food items, these were combined by first converting them into frequencies per month, summing the 3 items and recoding the resulting variable (see supplementary material). In addition, individual items were used to identify whether a child had daily intake of meat/fish or eggs, dairy products, fruit, green leafy vegetable.

The questions on self-feeding used a 5-point scale from child only feeding self (1) to parents doing all feeding (5). These were recoded to 3 categories: mainly child (1&2), both (3), mainly parent (4&5).

The feeding behaviour questions were rated from (1) not at all to (5) all the time (see supplementary material). There were six questions related to appetite and enjoyment of food and the mean of these six answers was taken to create an Avidity score. In the same way five questions about food refusal or avoidance, three about force feeding and six about the carer's worries about their child's feeding were used to create Food refusal, Force feeding and Maternal feeding anxiety scores.

Using the distribution of scores seen in the total population of healthy children, the scores for Avidity and Food refusal were then categorised into roughly equal low, medium, and high tertiles, where a high Avidity and low Food refusal are desirable in this context. The thresholds used were Avidity: low <3, medium 3–3.99, high ≥4; Refusal: low <1.7, medium 1.7–2.39, high >2.4. Force feeding was categorised as absent (Score = 1) some (>1 and < 2.75) and high (≥2.75).

In addition, the scores for Avidity, Food refusal and Maternal feeding anxiety were expressed as Z scores, using the means and standard deviations for each score obtained in the healthy UK infants as references (Z score = (reference mean - observed value)/reference standard deviation). The UK data were used as a reference norm as they constituted a large sample of healthy children at low risk of malnutrition, but they were not assumed to be a standard for optimal health. Force feeding varied greatly from country to country and was not normally distributed, so could not be expressed as a Z score. In the malnourished children these scores were compared to the reference population using one sample *t*-test.

For longitudinal analyses, repeatability was tested using the Spearman's' non-parametric correlation of the scores at time one and two, while response to treatment was tested using the mean change in score over time, and paired *t*-test.

The length/height and weight data were used to calculate body mass index (BMI; weight (Kg)/Height(m)^2) and converted into Z scores relative to the WHO growth standard. Wasting was defined as BMI < -2SD.

2.4.1. Sample size and power

Our first paper describing the cross-sectional samples outlines this in detail (C. M. Wright et al., 2021). We estimated that with at least 50 in each subgroup, there was 80 % power at the 95 % level to detect a mean difference in eating behaviour Z scores of over half a standard deviation between each setting or group. For the longitudinal data, we drew on pilot data in Kenya and before and after data collected as part of a trial in Pakistan, that was ultimately not completed due to the COVID epidemic, so both samples were relatively small. However, post hoc calculations (using the Altmann Normogram (Altman, 1980)) would suggest that they had the power to detect within subject score differences of between 0.6 and 0.8 of a standard deviation.

3. Results

We studied 86 children in the UK sample, mean (SD) age 13.6 (5.7) months of whom just 3 were wasted (BMI < −2SD). In Kenya there were 157 children aged 12.5 (4.1), including 25 (16 %) who were wasted. In Pakistan there were 108 aged 15.8 (5.4) months, including 34 (32 %) who were wasted. In Guatemala there were 125 aged 15.3 (5.6) months including 15 (12 %) who were wasted.

3.1. Similarities and differences between different countries

For comparison of feeding patterns and behaviour between countries, first the healthy children only were compared in each country

Table 1
Complementary feeding practices in healthy children compared between countries.

	UK (n = 83)	Kenya (n = 132)	Pakistan (n = 74)	Guatemala (n = 108)	P Chi^2
Age of first solids (months)	% (N)	% (N)	% (N)	% (N)	
<4	9.6 % (7)	4.5 % (6)	1.4 % (1)	7.4 % (8)	
4-5	80.8 % (59)	12.1 % (16)	10.8 % (8)	29.6 % (32)	
6-7	8.2 % (6)	82.6 % (109)	67.6 % (50)	43.5 % (47)	
8m+	1.4 % (1)	0.8 % (1)	20.3 % (1)	19.4 % (21)	<0.001
Who mainly feeds child spoonable meals?					
Child	31.3 % (26)	12.1 % (16)	12.3 % (9)	57.0 % (61)	
Both	38.6 % (32	12.1 % (16)	38.4 % (28)	11.2 % (12)	
Carer	30.2 % (25)	75.8 % (100)	49.3 % (36)	31.8 % (34)	<0.001
Who mainly feeds child finger foods?					
Child	84.1 % (69)	43.7 % (55)	36.5 % (27)	84.1 % (90)	
Both	11.0 % (9)	26.2 % (22)	31.1 % (23)	0.9 % (1)	
Carer	4.9 % (4)	30.2 % (38)	32.4 % (24)	15 % (16)	<0.001
Level of force feeding					
None	82.9 % (68)	18.2 % (24)	24.3 % (18)	85.5 % (94)	
Some	14.6 % (12)	43.9 % (58)	62.2 % (46)	12.7 % (14)	
High	2.4 % (2)	37.9 % (58)	13.5 % (10)	1.8 % (2)	<0.001
Daily frequency of:	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	P ANOVA
Plated meals	2.73 (0.9)	2.83 (1.2)	1.42 (0.9)	2.71 (0.7)	<0.001
Dry finger foods	1.98 (1.2)	0.42 (0.8)	1.49 (0.8)	2.87 (1.2)	<0.001
Moist finger foods	1.80 (1.1)	0.95 (0.7)	0.64 (0.8)	0.63 (0.7)	<0.001
Milk drinks	2.33 (1.3)	1.38 (1.0)	3.23 (1.2)	1.36 (1.6)	<0.001
Eating and feeding behaviour[a]					
Avidity	0.03 (1.0)	−0.83 (1.1)	−2.1 (1.1)	0.18 (0.9)	<0.001
Food refusal	−0.05 (1.0)	0.73 (1.1)	−0.41 (1.7)	−0.48 (1.9)	<0.001
Maternal feeding anxiety	0.01 (1.0)	0.93 (1.1)	0.74 (1.2)	1.8 (1.4)	<0.001

[a] Behaviour Z scores constructed by taking the mean of the constituent items per child, then standardised using UK data as reference.

(Table 1). Solids were started much earlier in the UK (90 % before age 6 months and only 1 % after 8 months) than in the other three countries, with around 20 % starting only after age 8 months in Guatemala and Pakistan. Plated meals were mainly offered just under three times per day, except in the Pakistani sample, where fewer meals were offered, and milk was offered far more often.

Over 80 % of children in the UK and Guatemala were self-feeding finger foods and 31 % and 57 % self-feeding spoonable foods, while any force feeding was reported for only around 15 %. In contrast any force feeding was common in Pakistan (76 %) and Kenya (82 %), with far fewer children self-feeding. Intriguingly, within countries there was no significant association between degree of self-feeding and force feeding (data not shown). Mean Z scores for avidity were consistently higher than food refusal but varied considerably; Kenyan children had the highest food refusal and Pakistani children the lowest avidity.

Dietary diversity was compared only for the LMIC countries (Table 2). There was no difference in minimum dietary diversity within countries between wasted and healthy children, so their data were combined. Overall, only 23 % children were eating 5/8 or more items daily, but this varied markedly by country, being highest in the Kenyan and lowest in the Pakistani samples. Around a fifth of children in all three countries were eating meat/fish or eggs daily, but the proportion having dairy products varied from 91 % in the Pakistani to only a quarter in Guatemalan sample. As well as a lot of milk, the Pakistani sample also ate the most snack foods.

3.2. Longitudinal data in children with moderate malnutrition

3.2.1. Kenya

In Kenya 19 children were studied aged mean (range) 10.5 (7.2–14.8) months at baseline. The 2 ICFETs were completed 4 weeks apart for 63 % (12) and after only 2 weeks for 37 % (7). Avidity scores were low, and refusal scores high compared to UK infants. Some force feeding was reported for all children on both occasions, and this was high for 58 % (11) at baseline and 68.4 % (13) at time two (Table 3).

Over time, the Avidity, Food refusal and Force-feeding scores showed moderate to strong correlation, but little change in mean values (Table 3).

3.2.2. Pakistan

There were 43 children in the Pakistan sample, first seen aged 16.4 (5.2) months and again one month later. Avidity scores were low, and refusal scores high compared to UK infants. Refusal and maternal anxiety scores significantly decreased over time, but avidity tended to worsen. High force feeding was reported for a majority of children: 76 % (31) at baseline and 73 % (29) at time 2, with little change over time. All scores showed strong correlation (Table 3).

Table 2
Dietary diversity for all children, wasted and healthy combined, compared by country. Values are % (number).

	Kenya (n = 142)	Pakistan (n = 69)	Guatemala (n = 80)	
Eats 5/8 food group items daily	45.1 % (64)	10.1 % (7)	7.5 % (6)	<0.001
Has daily intake of:				
Meat/fish or eggs	15.9 % (25)	20.4 % (22)	21.6 % (27)	0.44
Dairy product	66.2 % (104)	90.7 % (98)	25.6 % (32)	<0.001
Snack foods	14.0 % (22)	82.4 % (89)	29.6 % (37)	<0.001
Green leafy vegetables eaten:				
Never	5.1 % (8)	76.6 % (82)	4.1 % (5)	
Less than daily	40.8 % (85)	18.8 % (18)	82.9 % (16)	
Daily	54.1 (85)	6.5 % (7)	13.0 % (16)	<0.001
Fruit eaten				
Never	0.6 % (1)	15.9 % (17)	10.6 % (13)	
Less than daily	13.4 % (21)	33.6 % (36)	54.5 % (67)	
Daily	86.0 % (157)	50.5 % (54)	35.0 % (43)	<0.001

4. Discussion

The ICFET has been designed primarily to provide a standardised account of complementary feeding for use in trials and risk factor studies, which can be validly and easily translated into other languages. As it provides broad ranging information on potential underlying causes of MAM, it could also be used to inform individualised counselling. We have previously shown that the FEB questions have face validity in a number of languages and cultures and that the avidity score is positively associated with weight and BMI (C. M. Wright et al., 2021). We have also shown that when the behavioural questions are applied to children with disordered eating they demonstrate low appetite and high food refusal (C. Wright et al., 2024).

The analyses described in this paper first aimed to compare findings in different settings and found marked differences by country in age of first solids, self- and force-feeding. We further aimed to assess the use of the ICFET in the context of malnutrition and found that in MAM treatment centres children showed low Avidity and high Food Refusal. We found that individual children's scores tracked moderately over time, and detected changes in response to intervention in Pakistan, but not in Kenya.

Many studies currently report on aspects of complementary feeding, but without a standard, yet concise data collection tool, individual research teams have to design their own instruments or procedures (for example Flax et al., 2022) which are then not easily compared from study to study. One centre has described a complementary feeding index, based on the standard WHO indicators, which quantifies the extent which complementary feeding meets recommendations (Rahman et al., 2022), but this has not yet, as far as we know, been tested in other languages or settings.

It is helpful to be able make comparisons of how complementary feeding progresses between different settings and cultures to better understand where nutritional problems may arise. There were striking differences in the age of first complementary feeding between settings, with UK children starting much earlier and some Pakistani children starting very late. In LMICS late introduction of solids is associated with stunting and underweight (Marriott et al., 2012). Early complementary feeding (before age 6 months) has been associated with increased risk of infection (Kramer & Kakuma, 2012) and of breastfeeding cessation (Lessa et al., 2020) though trials have found no difference in weight gain on those starting solids before 6 months in healthy (Wells et al., 2012) or preterm infants (Gupta et al., 2017; Vissers et al., 2025).

In the current study dietary diversity was generally low and did not vary between healthy and MAM children. In other studies, low dietary diversity has been associated with increased risk of both stunting and underweight, where large multi-country samples have been combined (Marriott et al., 2012) but in practice these effects may not be detected in smaller, more homogeneous samples. The items that contributed to diversity varied greatly by country, in particular reliance on cow's milk. This is noteworthy because, for non-breastfeeding infants under the age of 2, early studies found an association between high intakes of milk and anaemia (SACN, 2018) and current recommendation are for a daily intake of 200–500 ml of animal milk (WHO, 2021).

Most assessments of complementary feeding do not include any element of feeding and eating behaviour, and most FEB scales have been designed for use in older children and more affluent settings. One FEB scale (Nahar et al., 2019) has been developed in Bangladesh, and has been used to describe an improvement in appetite in stunted children fed an enriched diet (Naila et al., 2021) but this has not yet been tested in other settings. Inter-country comparisons of FEB have been made for older children in more affluent settings (Proserpio et al., 2020; Rioux et al., 2019). One study used a French food rejection scale to compare French and British children and found less neophobia in UK children (Rioux et al., 2019) but another examined the same characteristic using

Table 3
Degree of change and tracking of feeding behaviour and maternal anxiety in moderately malnourished children in Kenya and Pakistan followed for 2–4 weeks.

Kenya	Time 1 Mean (SD)	Time 2 Mean (SD)	Mean Difference[c] (95 % CI)	p[d]	r[e]	P[e]
Avidity[a]	−1.76 (0.9) **	−1.46 (0.8) ***	0.30 (−0.01 to 0.62)	0.06	0.517	0.023
Refusal[a]	0.77 (1.3) *	0.48 (1.3)	−0.28 (−0.83 to 0.26)	0.28	0.557	0.013
Maternal feeding anxiety[a]	0.8 (10.9) **	0.45 (0.9)*	−0.35 (−0.88 to 0.17)	0.26	0.192	0.43
	Median (range)	**Median (range)**				
Force feeding[b]	2.75 (1.5–4)	3.00 (1.5–3.8)			0.467	0.044
Pakistan						
Avidity[a]	−2.79 (0.9)***	−2.91 (0.82)***	−0.12 (−0.2 to −0.04)	0.005	0.959	<0.001
Refusal[a]	1.53 (0.9)***	1.03 (0.81)***	−0.50 (−0.7 to −0.3)	<0.001	0.462	0.002
Maternal feeding anxiety[a]	−1.05 (1.3)***	−1.47 (1.06)***	−0.42 (−0.6 to −0.2)	<0.001	0.753	<0.001
	Median (range)	**Median (range)**				
Force feeding[b]	3 (1–3)	3 (1–3)			0.836	<0.001

***P < 0.001 **P < 0.01 * P < 0.05 compared to UK children.
[a] Z score constructed by taking the mean of the constituent items per child, then standardised using UK data as reference.
[b] Constructed by taking the mean of the constituent items per child.
[c] Between time 1 and 2.
[d] Paired *t*-test.
[e] Spearman's correlation time 1 to time 2.

an Italian scale in 5 European countries and found that UK children had the highest levels (Proserpio et al., 2020). This illustrates the importance of testing the extent to which tools are truly measuring the same, valid behaviours when transferred between settings, or translated.

Our comparisons revealed striking inter-country differences in the use of force feeding, which at a country level seemed to be inversely related to how much the infants were allowed to feed themselves. There were also quite marked differences in levels of perceived avidity and food refusal between settings, even though we have previously shown that the scale items used were equally meaningful in the same or similar settings (C. M. Wright et al., 2021).

Few studies have formally tested how well FEB scales perform over time. One study in a more affluent setting examined feeding behaviour in a longitudinal sample, but only to test the extent to which the different scale elements remained valid at different ages (Jansen et al., 2016). For tools that will be used in a clinical setting it is important to examine the extent to which they track (correlate) in individuals over time, but also if they respond to intervention, in terms of mean changes. In this study, the Avidity and Food Refusal scores showed reasonable tracking over time in terms of moderate to high correlation. They also showed significant mean changes with treatment in Pakistan, with food refusal improving, but avidity worsening, but not in Kenya. It is still not clear what effect use of supplementary foods have of on FEB in children with MAM. We hypothesise that while some children may be more enthusiastic about RUSF compared to family foods, others are likely to just lose their appetite for other foods, so that overall, there might be no net change. There is a real need to study this in more detail, and we had aimed to do this in Pakistan as a trial, but COVID prevented its completion. Maternal feeding anxiety was increased in Kenya, showed weak correlation over time and no significant change, while in Pakistan there was low anxiety which further diminished with treatment. Maternal feeding anxiety thus may not be useful as a universal measure.

4.1. Strengths and limitations

A strength of this analysis is the range of settings in which the ICFET has been used. The LMIC cross sectional samples were collected using pragmatic sampling, particularly aimed at including children with MAM, in order to compare them to healthy children (C. M. Wright et al., 2021). In the UK setting, there was no obvious representative sampling frame to access healthy pre-school children in this age range, so we opted to access families via any setting likely to include young children, as well as using snowball sampling. These samples are thus not fully representative, so they should not be viewed as descriptions of complementary feeding norms in their respective settings, so much as an illustration of how much these characteristics can vary.

The current ICFET food frequency tool replicates all the WHO recommended dietary diversity food groups, except for fruit and vegetables, where the grouping differs slightly. The WHO food groups identify as one item any fruit or vegetable rich in vitamin A and another item as all other fruit and vegetables. While this is useful for population surveys, this is not so useful for assessing individual children, as these elements can be hard to elicit at interview and are not so informative about general diet. We thus elected to ask separately about green leafy vegetables and any fruit. In addition, we also included items on snack foods and the use of oil in cooking, in order to advise properly on a high energy diet, which did not then form part of the WHO diet diversity calculation. Our analysis demonstrated quite marked differences in snacking patterns, and the need for information about these has recently been highlighted, as the double burden of malnutrition becomes an increasing issue (WHO, 2023a). However, as we complete this paper, new 24-h recall diet quality questionnaires for infant and young child feeding (ICYF) have been developed for use in a wide range of languages and adapted for individual countries (Herforth et al., 2025), which include assessment of all standard IYCF indicators (WHO, 2021), including intake of high energy foods, and are linked to a calculator for automated data analysis (Global-Diet-Quality-Project, 2024). We would thus recommend that the ICFET food frequency questionnaire now be replaced by the IYCF Diet Quality Questionnaire.

The LMIC feeding and eating behaviour scores were compared to the healthy UK infants. These provide a fixed point of reference in healthy children at low risk of malnutrition, but are not intended to represent a standard of optimal behaviours, so much as a fixed reference for comparison. A limitation is that this reference will not strictly apply for children above the classic complementary feeding age range of 6–24 months. It seems likely that the ICFET could still be useful in young children beyond the age of 24 months, when they are still at least partly being fed by their parents, but it will be important in future to formally test the ICFET in older preschool children.

4.2. Implications

We still know very little about normal feeding and eating behaviour and how it relates to undernutrition and other pathological FEB states. This tool is intended to be the beginning of a process of enquiry, not to provide definitive answers. Once we have a standard metric, this provides the opportunity for comparison between different populations which may itself inform our understanding of the underlying causes of malnutrition at a population and individual level. It is important to recognise that there may be substantial intercountry differences, so that

groups of healthy children should be included in such surveys, not just children with MAM. As well as being useful for trials and surveys, the ICFET can also be used to ensure that a full feeding history has been collected to inform individualised advice and could be used for a trial of targeted counselling.

4.3. Conclusions

We have developed a complementary feeding assessment tool that provides a standardised set of questions, at an age when assessing diet is complex. It can be easily and validly translated into local languages and is stable over time. It can be, used in trials and risk factor studies as well as targeted nutritional counselling.

CRediT authorship contribution statement

Charlotte M. Wright: Writing – review & editing, Writing – original draft, Supervision, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Antonina Mutoro:** Writing – review & editing, Project administration, Methodology, Investigation, Conceptualization. **Beatrice Milligan:** Writing – review & editing, Project administration, Methodology, Investigation. **Amara Khan:** Writing – review & editing, Project administration, Methodology, Investigation, Formal analysis. **Victor Alfonso:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation. **Ada L. Garcia:** Writing – review & editing, Supervision, Project administration, Methodology, Conceptualization.

Conflict of interest disclosures (includes financial disclosures)

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethics

All studies were conducted according to the guidelines of the Declaration of Helsinki.All the studies were approved by the Institutional Ethics Committee of University of Glasgow, College of MVLS REC (protocol codes 200160042, 200170117, 200180123, 200180033, 200180131 200170181). Individual country sub-studies were also reviewed as follows: AMREF Ethics and Scientific Review Committee in Kenya (P576-2018); Comité De Ética Independiente Facultad de Medicina Universidad Francisco Marroquín/Hospital Universitario Esperanza in Guatemala (CE/FM-UFM 30-19); Government of Punjab Provincial Bioethics Committee in Pakistan (1781/PA, 2257/PA).

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2025.108383.

Data availability

Data will be made available on request.

References

Abebe, Z., Haki, G. D., & Baye, K. (2017). Child feeding style is associated with food intake and linear growth in rural Ethiopia. *Appetite, 116*, 132–138.
Altman, D. G. (1980). Statistics and ethics in medical research: III how large a sample? *British Medical Journal, 281*, 1336–1338.
Bentley, M. E., Stallings, R. Y., Fukumoto, M., & Elder, J. A. (1991). Maternal feeding behavior and child acceptance of food during diarrhea, convalescence, and health in the central Sierra of Peru. *American Journal of Public Health, 81*, 43–47.
Coates, J., Swindale, A., & Paula, B. (2007). *Household Food Insecurity Access Scale (HFIAS) for measurement of household food access: Indicator guide (v. 3)*. In. Washington, D.C.: FHI 360/FANTA.
Dettwyler, K. A. (1989). Interaction of anorexia and cultural beliefs in infant malnutrition in Mali. *American Journal of Human Biology, 1*, 683–695.
Flax, V. L., Ipadeola, A., Schnefke, C. H., Kwasu, S., Mikail, A. A., Bose, S., Brower, A. O., & Edwards, S. (2022). Complementary feeding social and behavior change communication for fathers and mothers improves children's consumption of fish and eggs and minimum meal frequency in Kaduna State, Nigeria. *Current Developments in Nutrition, 6*, Article nzac075.
Global-Diet-Quality-Project. (2024). *Diet Quality Questionnaire (DQQ) IYCF indicator guide and calculator* (Vol 2025). dietquality.org.
Gupta, S., Agarwal, R., Aggarwal, K. C., Chellani, H., Duggal, A., Arya, S., Bhatia, S., Sankar, M. J., Sreenivas, V., Jain, V., Gupta, A. K., Deorari, A. K., & Paul, V. K. (2017). Complementary feeding at 4 versus 6 months of age for preterm infants born at less than 34 weeks of gestation: A randomised, open-label, multicentre trial. *Lancet Global Health, 5*, e501–e511.
Herforth, A. W., Sokourenko, K., Gonzalez, B. C., Uyar, B. T. M., Bulungu, A. L. S., & Vogliano, C. (2025). Adaptation of the diet quality questionnaire as a global public good for use in 140 countries. *Current Developments in Nutrition, 9*.
Jansen, E., Williams, K. E., Mallan, K. M., Nicholson, J. M., & Daniels, L. A. (2016). The Feeding Practices and Structure Questionnaire (FPSQ-28): A parsimonious version validated for longitudinal use from 2 to 5 years. *Appetite, 100*, 172–180.
Kramer, M. S., & Kakuma, R. (2012). Optimal duration of exclusive breastfeeding. *Cochrane Database of Systematic Reviews*, Article CD003517.
Lessa, A., Garcia, A. L., Emmett, P., Crozier, S., Robinson, S., Godfrey, K. M., & Wright, C. M. (2020). Does early introduction of solid feeding lead to early cessation of breastfeeding? *Maternal and Child Nutrition*, Article e12944.
Marriott, B. P., White, A., Hadden, L., Davies, J. C., & Wallingford, J. C. (2012). World Health Organization (WHO) infant and young child feeding indicators: Associations with growth measures in 14 low-income countries. *Maternal and Child Nutrition, 8*, 354–370.
Mutoro, A. N., Garcia, A. L., Kimani-Murage, E. W., & Wright, C. M. (2020). Eating and feeding behaviours in children in low-income areas in Nairobi, Kenya. *Maternal and Child Nutrition*, Article e13023.
Mutoro, A. N., Garcia, A. L., Kimani-Murage, E. W., & Wright, C. M. (2021). Prevalence and overlap of known undernutrition risk factors in children in Nairobi Kenya. *Maternal and Child Nutrition*, Article e13261.
Nahar, B., Hossain, M., Ickes, S. B., Naila, N. N., Mahfuz, M., Hossain, D., Denno, D. M., Walson, J., & Ahmed, T. (2019). Development and validation of a tool to assess appetite of children in low income settings. *Appetite, 134*, 182–192.
Naila, N. N., Mahfuz, M., Hossain, M., Arndt, M., Walson, J. L., Nahar, B., & Ahmed, T. (2021). Improvement in appetite among stunted children receiving nutritional intervention in Bangladesh: Results from a community-based study. *European Journal of Clinical Nutrition, 75*, 1359–1367.
Proserpio, C., Almli, V. L., Sandvik, P., Sandell, M., Methven, L., Wallner, M., Jilani, H., Zeinstra, G. G., Alfaro, B., & Laureati, M. (2020). Cross-national differences in child food neophobia: A comparison of five European countries. *Food Quality and Preference, 81*.
Rahman, A., Bhuiyan, M. B., & Das, S. K. (2022). Effect of short-term educational intervention on complementary feeding index among infants in rural Bangladesh: A randomized control trial. *BMC Nutrition, 8*, 73.
Rioux, C., Lafraire, J., Picard, D., & Blissett, J. (2019). Food rejection in young children: Validation of the child food rejection scale in English and cross-cultural examination in the UK and France. *Food Quality and Preference, 73*, 19–24.
SACN. (2018). *Feeding in the first year*. London: Public Health England.
Sanchez, K., Spittle, A. J., Allinson, L., & Morgan, A. (2015). Parent questionnaires measuring feeding disorders in preschool children: A systematic review. *Developmental Medicine and Child Neurology, 57*, 798–807.
UNICEF. (2023a). *Levels and trends in child malnutrition: UNICEF/WHO/World Bank group joint child malnutrition estimates: Key findings of the 2023 edition*.
UNICEF. (2023b). *The State of the world's children*. UNICEF.
Vissers, K. M., Feskens, E. J. M., van Goudoever, J. B., & Janse, A. J. (2025). Timing of complementary feeding in preterm infants and prevalence of overweight and obesity: A randomized clinical trial. *JAMA Network Open, 8*, Article e252968.
Wardle, J., Guthrie, C. A., Sanderson, S., & Rapoport, L. (2001). Development of the children's eating behaviour questionnaire. *Journal of Child Psychology and Psychiatry, 42*, 963–970.
Wells, J. C., Jonsdottir, O. H., Hibberd, P. L., Fewtrell, M. S., Thorsdottir, I., Eaton, S., Lucas, A., Gunnlaugsson, G., & Kleinman, R. E. (2012). Randomized controlled trial of 4 compared with 6 mo of exclusive breastfeeding in Iceland: Differences in breast-

milk intake by stable-isotope probe. *The American Journal of Clinical Nutrition, 96*, 73–79.
WHO. (2009). *Management of severe malnutrition: A manual for physicians and other senior health workers*. Geneva: World Health Organization.
WHO. (2021). Indicators for assessing infant and young child feeding practices: Definitions and measurement methods. In *Geneva: World Health Organization and the United Nations Children's Fund (UNICEF)*.
WHO. (2023a). *WHO guideline for complementary feeding of infants and young children 6–23 months of age*. Geneva: World Health Organization.
WHO. (2023b). In *WHO guideline on the prevention and management of wasting and nutritional oedema (acute malnutrition) in infants and children under 5 years* (Vol 2023). Geneva: World Health Organization.
Wright, C., Garcia, A., Mutoro, A., Khan, A., Milligan, B., Traynor, O., Bryant-Waugh, R., Kimani-Murage, E., & Mayén, V. A. (2020a). Are malnourished children hungry? Use of the International Complementary Feeding Assessment Tool (ICFET) to describe diet and eating behavior. *Current Developments in Nutrition, 4*, 924-924.
Wright, C. M., Gurney, J. M., Mutoro, A. N., Shum, C., Khan, A., Milligan, B., Indriani, W., Georgiou, L., Chambers, S., Bryant-Waugh, R., & Garcia, A. L. (2021). Development of a scale to measure infant eating behaviour worldwide. *Nutrients, 13*.
Wright, C., Mutoro, A., & Garcia, A. L. (2024). Testing the validity of the International Complementary Feeding Evaluation Tool (ICFET) to detect disordered feeding and stability over time. *Maternal and Child Nutrition, 20*, Article e13579.
Wright, C., Mutoro, A., Grieve, E., Garcia, A., Donfouet, H. P., & Kimani-Murage, E. (2020b). The cost of a counseling-based intervention for Moderate Acute Malnutrition (MAM) in Kenya compared to treatment with ready-to-use foods (RUF). *Current Developments in Nutrition, 4*, 926-926.
Wright, C. M., Parkinson, K. N., & Drewett, R. F. (2006). How does maternal and child feeding behavior relate to weight gain and failure to thrive? Data from a prospective birth cohort. *Pediatrics, 117*, 1262–1269.