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INTERVENTIONS TO PREVENT GROWTH FALTERING IN REMOTE INDIGENOUS COMMUNITIES

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1. INTRODUCTION

Growth faltering in early childhood is the failure to gain weight at a rate consistent with height growth. Significant growth faltering results in wasting (weight <80 per cent standard weight for height) and this poses a serious risk to the health and wellbeing of young children. Early childhood development sets a base for subsequent learning, behaviour and health over the life cycle.[1;2] Low birth weight and poor infant nutrition are associated with chronic disease later in life.[3] There is accumulating evidence that stunting, microcephaly, iron deficiency and borderline zinc and Vitamin A status during the vulnerable brain growth spurt period of 0 to two years has detrimental effects on immune, intestinal and cognitive functions.[4]

The reasons for growth faltering are numerous. Underlying organic disease is one evident cause, however, in most cases a number of factors are thought to combine to interfere with normal growth.[4;5]

Growth faltering is a common problem among Australian Indigenous children, and is frequently associated with low birth weight, social disadvantage (including low socio-economic circumstances, low levels of education, poor housing conditions and unsanitary living environments), poor diet, nutrition-infection interactions and enteric pathogens.[4-6] Only a small minority of cases were found to be caused by abuse or neglect.[5;7] In the case of Australian Indigenous children living in remote communities a common cause of growth failure is thought to be an insufficient intake of weaning foods.[4]

Malnutrition is considered by some to be the most significant health problem experienced by Indigenous children. In 2001, in three Top End communities in the Northern Territory, 14-23 per cent of children under 5-years were reported to be underweight, compared to an expected 3 per cent of non-Indigenous children.[4] In 1995 it was estimated that 20 per cent of all Aboriginal children in the Top End were malnourished.[8] Other states have reported similar problems. Failure to thrive has been noted as a serious problem among children between 4 to 6-months in the Cape York region.[9] In 2003 in the Kununurra region of Western Australia 31 per cent of children aged 5-years or under who attended an Aboriginal Health Service were considered children at risk, an assessment that included failure to thrive.[10] In Western Australian hospitals failure to thrive has been noted as an admission diagnosis in 11 per cent of Aboriginal children (0-4-years) compared to 5 per cent of non-Aboriginal children.[11]

In 2001, as part of school screening programs completed in eleven Top End remote Indigenous communities, 22 per cent of 4 to 10-year old children screened were found to be malnourished. A retrospective review of the infant growth records of these children identified that the average age of onset of growth faltering was 6.6 months (range 3.5 – 12-months) for stunted children and 8.9 months (range 7.5 – 18-months) for wasted children. All the children found to be stunted or wasted in primary school were known to have poor growth prior to school entry.[12]

Preventive or early intervention programs for growth faltering should avert adverse effects such as cognitive delay, feeding and behaviour problems and low maternal self-esteem.[5] Hospitalisation as a means to treat malnourished children and increase their weight has high relapse rates and is likely to be less cost effective than primary health care interventions.[4] The Growth Action and Assessment (GAA) program was developed and implemented in the Northern Territory (NT) about seven years ago in an effort to address the problem of growth faltering. Despite this program, growth faltering continues to be a significant problem, as the above figures show. Recently, additional resources in the form of funding for child health nurses have become available to strengthen child health services in the NT.

The evidence on the approaches or service models that would be most appropriate and effective in the remote Indigenous community context is not clear. The applicability of the available research/evidence to remote Australian Indigenous communities is questionable. Review methods that accept only the most rigorous study designs may have limited value for complex and context-sensitive questions.[13] Such questions may require attention to contextual and population characteristics, multiple outcomes, flexibility in delivering interventions and other factors. Alternative approaches to reviewing and weighing evidence are becoming more recognised as a practical alternative.[14]

The level of disadvantage experienced by Australian Indigenous people as a minority group in a rich developed country makes their situation somewhat unique. Programs that have been successful in Australian non-Indigenous communities or developing country contexts are not necessarily transferable to the remote Indigenous setting. Nutrition health promotion programs implemented at the national or state level may have limited potential to address the disadvantage experienced by Indigenous Australians that underlies high rates of growth faltering.[4]

Brewster[4] describes three levels of prevention for growth faltering in young children: 1) Ensure normal growth. Remove risk factors, for example in the antenatal period, promote breastfeeding, nutrition, childcare and hygiene education, immunisations, adult literacy, poverty alleviation and good environmental health; 2) The early detection and treatment of growth faltering. Activities for this include growth monitoring, anaemia and iron deficiency screening, dietary advice, low birth weight follow-up, micronutrient supplements, control of diarrhoeal disease and de-worming; 3) The clinical management of malnutrition to reduce complications including supplementary feeding, hospitalisation, iron and micronutrient treatment, support for families in crisis, home visiting, paediatric review, failure to thrive registers and case-management protocols.

Alternatively Batchelor[5], coming from the developed country context discussed community-based preventative programs centred around resources (income, debts, dietary knowledge), the purchase of food (budgeting, shopping, storage, the preparation of food (cooking facilities and skills), giving food to infants (meals offered when, where and how, a child's acceptance of food (eating behaviours and skills) and the physiology of individual children in being able to digest, absorb and metabolise food.

Interventions suitable to be integrated into a primary health care system of service delivery might incorporate elements of interventions suggested by both Brewster[4] and Batchelor[5].

RESEARCH QUESTION

This review will address the following question:

What preventive or health promotion program models/approaches [a] are most likely to improve patterns of growth faltering [b] in children ≤5 years of age in the Australian remote Indigenous community context [c], and do the models or the nature of the evidence vary depending on the age of the child?

Definitions

[a] These may include interventions that aim to influence organisational systems, practitioner behaviour, the role of carers and/or families or approaches that combine some or all of these elements. Such interventions might address community linkages, workforce profiles, health worker role definition (or other features of the delivery system design) and might include bio-medical, inter-disciplinary, educational, psycho-social, capacity building, family intervention, food supplementation and social marketing. Interventions may be implemented by managers, professionals or lay persons, community members or others.

[b] The negative departure from a child's expected growth path. Failure to gain, or actual loss of weight; a weight gain less than a specified value over a given period.[15]

And

Weight faltering defined as failure to gain weight for two months or more. (WHO 1986, The Growth Chart)

[c] The applicability of interventions will be considered in relation to the socio-economic, cultural, geographical and political circumstances of the populations where the interventions are conducted, as compared with the circumstances in remote Australian Indigenous communities.

2. METHODS

SEARCH STRATEGY

The search for relevant articles was completed in three stages. The first stage focused on identifying relevant systematic reviews; the second on identifying relevant primary studies; and the third, on identifying relevant reports in the grey literature.

The following electronic databases were searched:

Medline, CINAHL, PsychINFO, ERIC, SCI Expanded, Cochrane Library, Informit (Databases: Indigenous Australia, Family & Society Plus) and Health*InfoNet*.

The electronic database search strategy is outlined in Appendix 1. Searching was not restricted to a defined timeframe.

Two reviewers independently scanned the citations and abstracts for relevant articles. All citations selected were captured into Reference Manager. All potentially relevant citations were retrieved.

Internet world wide web pages of key stakeholder government and non-government agencies were searched using key words. Relevant articles were retrieved and added to the database. Search details are provided in Appendix 2.

The reference lists of relevant articles were examined for potentially relevant references, and those found relevant were retrieved.

RELEVANCE TESTING

All articles retrieved from searching multiple sources were subjected to relevance testing. To be relevant, studies had to meet all of the criteria given in Appendix 3.

Two reviewers independently rated all retrieved articles for relevance. Differences were resolved through consensus. The included studies are listed in Appendix 4 and the excluded studies listed in Appendix 5.

QUALITY ASSESSMENT RATING

A tool developed by health-evidence.ca[16] was used for assessing the methodological quality of review articles (Appendix 6). This tool provided for assessment of the quality of reviews using ten quality criteria. Reviews meeting seven or more quality criteria rate as "Strong", five or six criteria as "Moderate", and four or less criteria as "Weak".

For quantitative studies a tool developed by the Effective Public Health Practice Project was used for assessing the methodological quality of primary studies in public health.[17;18] This tool consists of six criteria:

- selection bias
- allocation bias
- confounders
- blinding of outcome assessors
- data collection methods
- withdrawals and dropouts

The six criteria were each rated as "strong", "moderate" or "weak" depending on characteristics of each criterion reported in the study. See Appendix 7a and 7b for the quality assessment tool and dictionary. Once the ratings of characteristics were totalled, each study then received an overall assessment and was ranked as one of the following:

- "A" – Clear evidence of benefit. A study showing a positive outcome with a minimum of five of the six quality criteria rated as strong.

- "B" - Some evidence of benefit. A study showing a positive outcome with three or four quality criteria rated as strong.

- "C" – A study showing a positive outcome or no effect with less than three quality criteria rated as strong. This rating includes two categories:

  1. No evidence of benefit (or harm) and methodological concerns. (A study shows no or negative effect and the study design is weak.)
  2. No clear evidence of benefit (or harm) due to methodological concerns. (A study reports some effect but the study design is weak.)

- "D" - A study with a minimum of five of the six quality criteria rated as strong. This rating includes two categories:

  1. Evidence of no benefit or harm. (A strong study that shows no difference and the confidence intervals around the estimated effect are narrow.)

  2. No evidence of benefit or harm. Further studies required. (A strong study where no statistically significant difference is shown but the confidence intervals around the estimated effect are wide.)

To assess the methodological quality of qualitative studies a tool was developed drawing on several existing qualitative study assessment tools.[19;20] See Appendix 8 for the assessment tool.

To assess the body of evidence associated with each intervention and formulate recommendations concerning the relevance of interventions for the remote Indigenous context a method/process developed by the National Health and Medical Research Council[21] (NHMRC) was adapted and used. After critical appraisal, studies using the same or similar interventions

were grouped. Interventions were then appraised according to the body of evidence available and a recommendation made. The five components that were considered in assessing the body of evidence were:

- volume of evidence
- consistency of the study results
- the potential clinical impact of the proposed recommendation
- the generalisability of the body of evidence to the target population
- the applicability of the body of evidence to the Australian healthcare context

Other Measures of Relevance

Watson, White et al[22] report that in Australia there is a low take-up of opportunities to participate in prevention and early intervention programs by the most vulnerable families for whom programs were mostly intended. Overall they suggest that the reason for this is the stigma seen to be associated with participating in this type of program. The reasons for Australian Indigenous families not participating are considered to be more complex. The general failure to carefully evaluate prevention and early intervention programs means there is little or no evidence available to inform the development of programs that will be successful in attracting Indigenous people to participate.[22]

Data were extracted to gain information about intervention development, design and the implementation methodology used, cost/cost effectiveness and issues concerning health system or health service delivery. The data extraction form used and its dictionary are attached (Appendix 9a & 9b). This approach was taken to ascertain if study interventions and the methodologies used matched current thinking around achieving sustainable health improvements. This approach was also used to see if interventions are suitable to use, and feasible to implement, in remote Indigenous communities. The indicators used were decided upon after scoping the literature and identifying key common themes.[4;23-29]

The key practices thought to enhance the success of a program that were identified include: the use of participatory methods; a focus on the family; intersectoral cooperation; and cultural appropriateness.

Common causes of growth faltering identified include: inadequate child care behaviours (not introducing healthy weaning food in appropriate amounts from six months; not encouraging children to eat and drink nourishing food when unwell); inadequate prevention and control of disease (poor sanitation and personal hygiene, unhygienic food handling); inappropriate health seeking behaviours; food insecurity and failing to promote exclusive breastfeeding to six months of age.[25;29]

Studies were reviewed to see if the intervention addressed specific components of primary care service systems. The definitions of source components was based on the Chronic Care Model[30] and included: organisational influence; external links; self-management support; decision support; delivery system design; information systems; and integration. While this model was developed for chronic illness care, the model components appear highly relevant to the health centre systems required to support effective child health service delivery.

DATA EXTRACTION

Standardised instruments for data extraction were used for qualitative and quantitative studies. Data on the demographic characteristics of respondents, the characteristics of the interventions, outcome measures and other variables were collected. See Appendix 7a, 9a and 10 for the data extraction tools.

3. RESULTS

The search strategy identified 140 studies that were potentially relevant for the review. Of these 58 were determined to be relevant. A Figure providing an overview of the search process and search results is in Appendix 11.

The methodological rigour of the studies was highly variable. This reflects the diversity of the study designs used, types of intervention, and difficulties associated with carrying out studies in contexts of poverty.

CHARACTERISTICS OF RELEVANT STUDIES

Seven reviews and 51 articles were considered relevant. Thirteen articles were found to be related to six studies, reducing the total number of independent studies to 44. Overall a total of 44 studies and seven reviews were included as relevant.

Characteristics of Study Participants and Contexts
The populations included in the developing and developed country studies were all considered at high risk of failure to thrive. The countries and contexts in which the studies were completed are listed in the following Table.

Table 1. Country and study contexts

			CONTEXT				
Countries							
Bangladesh	Rural	Urban	Rural & urban	Semi-rural	Peri-urban	Remote	Unsure
Low/Medium Income							
Bangladesh	2						
Brazil		1					
Central Java	1						
China	1						
Egypt		1					
Ghana	2						
Guatemala	1						
India	3	3	1				
Indonesia	5						
Iran	2						
Mexico				1			
Mozambique	1						
Nepal	1						
Peru		1			1		
Senegal							1
South Africa	1		1				
Thailand	1						
Tanzania	1		1				
Vietnam	3						
Four developing countries			1				
High Income							
USA – disadvantaged and minority groups			2				
Australia – remote Indigenous communities						4	
Total	25	6	6	1	1	4	1

Interventions

Interventions included the use of single and multifaceted approaches. Studies using multifaceted interventions have been listed under several different intervention categories. For example, one study using iron, or iron and zinc, or multiple micronutrients as an intervention is listed under each of these categories. Doing this resulted in the actual number of interventions being studied to be 112 within the 44 discrete studies. Details of included studies are listed in Appendix 4. Where details of a study were retrieved from more than one article they are grouped.

Either one or a combination of the following interventions were used: food supplements (children and pregnant or lactating women), growth monitoring, education/counselling (for carers of children, community

workers or health workers), deworming, vitamin and mineral supplements, multiple micronutrient supplements and multifaceted studies.

Study Designs
Study designs used included systematic and narrative reviews (7), randomised controlled trials (RCT) (18), quasi-experimental designs (cohorts are assembled according to whether or not exposure to the intervention has occurred) (3), controlled before and after (CBA) designs (4) and other (19). In the latter category the study designs were generally considered very poor with few or no quality criteria met. The reviewers allocated these studies to design groups such as descriptive study (2), observational study (2), program evaluation (2), cohort with matched, unmatched or historic control (8), before and after with no control (1), and cross sectional survey (4).

4. OUTCOMES

SUPPLEMENTARY/COMPLEMENTARY FEEDING PROGRAMS FOR CHILDREN

Eighteen studies are included in this category. Study designs include: two literature reviews (Caulfield 1999[31]; Sguassero 2005[32]), five RCTs (Bhandari 2001[33]; Bhandari 2004[34]; Lartey 1999[35]; Husaini 1991[36;37]; Schroeder 1995[38-40]), one CBA study (Gupta 1984[41]), two cohort studies with matched concurrent controls (Cisse 2002[42]; John 1993[43]), one cohort study with historic controls (Warchivker 2003[44]), two cohort studies with unmatched concurrent controls (Schelp 1990[45-47]; Tandon 1989[48]), one before and after study with no controls (Ghoneim 2004[49]), one post intervention cross sectional survey with matched controls (Hossain 2005[50]), one cross sectional survey (Black 2004[51]), one cross sectional follow-up study with a comparison group (Mackintosh 2002[52]) and one post intervention cross sectional comparison of intervention and control regions (Center for Health Research 2002[53]).

Interventions include providing children with food at child care centres and community nutrition rehabilitation centres; the regional distribution of food; providing food to individual children or to children and all members of their family; and comparing types of food and/or food fortified with micronutrients supplied. The interventions with a feeding program component also generally had a nutrition education component.

2. Supplementary/Complementary feeding programs for children[1]

Intervention	Quality of Studies			Findings
	Strong[2]	Mod[3]	Weak[4]	
Feeding Programs 16 studies 2 reviews	1 1	3 1	12	Three studies show some evidence of benefit. Two studies show no evidence of benefit with further studies required. Seven studies show no clear evidence of benefit due to methodological concerns. Four studies show no evidence of benefit and methodological concerns. The good quality review reports no evidence of benefit with further studies required. The moderate quality review reports some evidence of benefit

[1]This intervention represents one component of a larger multifaceted intervention in most studies. [2]Met ≥5/6 quality criteria. [3]Met 3-4/6 quality criteria. [4]Met < 3 quality criteria.

The terms supplementary and complementary are sometimes used interchangeably. However, complementary food (sometimes called weaning food or breast milk supplement) is any food that is suitable as a complement to breast milk or infant formula when either becomes insufficient to satisfy an infant's nutritional requirements.[54] Whereas

supplementary feeding is defined as the provision of extra food to poor children or families beyond the normal ration of their home diets.[32] Studies using both these terms are grouped in this review.

Providing food supplementations to prevent growth faltering was addressed in different ways in each of the studies. Some studies focused on food supplementation, for example, by providing additional food to counter known dietary deficiencies. Other studies focused more on the introduction of complementary foods to boost protein-energy intake. In many studies issues concerning weaning and the introduction of a transitional diet among low socio-economic groups are addressed. The length of time that participants were exposed to an intervention varied from between 12 weeks for some trials and up to eight years for comprehensive programs integrated within a primary health care service delivery system.

The findings of the studies are mixed. In particular, the findings from poorly designed studies are highly variable. The design of one study (Center for Health Research 2002[53]) was so poor its findings were not taken into consideration. The one strong study (Bhandari 2001[33]) compared different interventions and the use of a control group (C), and aimed to determine if micronutrient-fortified food supplementation supported by counselling (FS), or nutrition counselling (NC) alone, or home visits (V) alone, would significantly improve the growth of children between four and 12 months of age. No statistically significant difference was shown between the groups ([n (per cent)] $\leq$2 WHZ at 52 weeks: FS 15 (17.2), NC 12 (12.4), V 14 (15.4), C 15 (16.1)).

Two studies of moderate quality (Husaini 1991[36;37]; Schroeder 1995[38-40]) are both complex in their designs and include data from follow-up studies. In one study (Husaini 1991[36;37]) infants in nine centres received a twice a day dietary supplement for 14 weeks while infants in 11 centres served as controls. This study shows supplementation having a highly significant effect on children's growth (F=34.63; P<0.001). In the other moderate study (Schroeder 1995[38-40]) data from a study conducted in the period 1969 – 1977 was analysed along with data collected as part of a follow-up study in 1988 – 1989. In this study children were provided with a fortified high-energy, high protein gruel-like beverage (163kcal per cup) or a fortified low-energy no-protein drink (59kcal per cup). During the first year of life each 100kcal/d of supplement was associated with approximately 9mm in additional length gain and 350g in additional weight gain. The benefit decreased to approximately 5mm in length gain and 250g in weight in the second year of life. Between 24 and 36 months of age the supplement only had a significant impact on length. No impact on growth was shown between three and seven years of age.

Several of the studies in this category were evaluations of large regionally or centrally implemented multifaceted programs (Black 2004[51]; Gupta 1984[41]; Hossain 2005[50]; Mackintosh 2002[52]; Schelp 1990[45-47]; Tandon 1989[48]). The level of complexity in evaluating these large scale multifaceted programs caused the designs of these studies to be generally rated as weak. One study (Mackintosh 2002[52]) based the development of the intervention on Positive Deviance Theory.

Two studies in this category address issues of cost. One study (Ghoneim 2004[49]) conducted in Egypt gives the actual cost of providing two meals a day to children attending a child care centre. The other Australian study (Warchivker 2003[44]) discusses monies saved in terms of reduced length of hospital stay and savings made in treatment and transportation to hospital costs.

The good quality review (Sguassero 2005[32]) reports that it is difficult to assess the impact of supplementary feeding on growth in young children living under poor socio-economic and environmental conditions due to the lack of research and the poor quality of many existing studies. The authors of this review conclude that there is no evidence to show that supplementary feeding prevents growth faltering among preschool children and further studies are required.

The second review (Caulfield 1999[31]) is of moderate quality. This review assessed programs (complementary feeding programs) to improve dietary intake and growth in six to twelve month old infants in developing countries. Four programs were identified that reported improvements in dietary intakes of 71 to 164 kcal/day and changes in growth of -0.08 to 0.87 SD. The authors of this review identified that although the effect size due to this intervention appears small it has the potential to have a significant impact at the population level.

Table 3. Assessment of evidence – Supplementary/Complementary feeding programs for children

Indicator	Rating
1. Volume & quality of evidence	Excellent (several level I or II studies with low risk of bias)
2. Consistency	Good (most studies consistent and inconsistency can be explained)
3. Clinical impact	Poor (slight or restricted clinical impact)
4. Generalisability	Satisfactory (not directly generalisable to the target population but could be sensibly applied)
5. Applicability	Satisfactory (probably applicable to Australian healthcare context with some caveats)
Recommendation	The body of evidence provides some support for the intervention but care should be taken in its application

Findings:
Supplementary/complementary feeding programs to prevent growth faltering has been assessed in one strong, three moderate and 12 weak studies. Two reviews were also assessed (one strong and one moderate). Three studies show some evidence of benefit. Two studies show no evidence of benefit with further studies required. Seven studies show no clear evidence of benefit due to methodological concerns. Four studies show no evidence of benefit and methodological concerns. The good quality review reports no evidence of benefit with further studies required.

The moderate quality review reports some evidence of benefit. Overall we consider that the evidence for the effectiveness of supplementary/complementary feeding programs for children is uncertain. In general, feeding programs should only be considered in situations where food insecurity is a major problem and where feeding programs are supported by the local community. Such programs should only be seen as a relatively short term solution.

SUPPLEMENTARY FEEDING PROGRAMS FOR PREGNANT/LACTATING WOMEN

There are three studies (Black 2004[51]; Gupta 1984[41]; Hossain 2005[50]) in this category. All supplementary feeding programs for pregnant/lactating women were implemented in conjunction with children's feeding programs. All the studies included a nutrition education component. In one USA study (Black 2004[51]) the mothers of non-breast fed infants were provided with milk formula and infant cereal, while breast feeding mothers were provided with a food package to enhance their own nutritional status. Other issues concerning the quality and evidence of these studies are addressed under the previous heading.

Table 4. Feeding programs for pregnant/lactating women[1]

Intervention	Quality of Studies			Findings
	Strong[2]	Mod[3]	Weak[4]	
Feeding programs for pregnant/lactating women 3 Studies		1	2	Two studies show no clear evidence of benefit due to methodological concerns. One study shows no evidence of benefit and methodological concerns

[1]This intervention represents one component of a larger multifaceted intervention in most studies. [2]Met ≥5/6 quality criteria. [3]Met 3-4/6 quality criteria. [4]Met < 3 quality criteria.

Table 5. Assessment of evidence – feeding programs for pregnant/lactating women

Indicator	Rating
1. Volume & quality of evidence	Poor (Level IV studies or Level I to III studies with high risk of bias)
2. Consistency	Satisfactory (some inconsistency, reflecting genuine uncertainty around question)
3. Clinical impact	Poor (slight or restricted clinical impact)
4. Generalisability	Poor (not directly generalisable to target population and hard to judge whether it is sensible to apply)
5. Applicability	Satisfactory (probably applicable to Australian healthcare context with some caveats)
Recommendation	The body of evidence is weak and recommendations must be applied with caution

Findings:

Feeding programs for pregnant and/or lactating women to prevent growth faltering among children were included in complex interventions assessed in one moderate study and two weak studies. Two studies show no clear evidence of benefit due to methodological concerns. One study shows no evidence of benefit and methodological concerns. Our overall assessment is that the evidence for the effectiveness of supplementary/complementary feeding programs for pregnant and/or lactating women to prevent growth faltering in children is uncertain. In general, feeding programs for pregnant/lactating women should only be considered in situations where food insecurity is a major problem and where feeding programs are supported by the local community. Such programs should only be seen as a relatively short term solution.

GROWTH MONITORING

Eleven studies are included in this intervention category. All the studies were multifaceted. Study designs included two reviews (Panpanich 1999[55]; Roberfroid 2005[56]), one RCT (Schroeder & Pachon 2002[57]), two quasi-experimental (Guldan 2000[58]; Penny 2005[59]), one CBA (Walsh 2002[60]), one cross sectional follow-up study with a comparison group (Mackintosh 2002[52]), two cohort studies with historic controls (Smith 2000[61]; Warchivker 2003[44]), one observational (Schellenberg 2004[62]), and one cohort study with unmatched concurrent controls (Schelp 1990[45-47]).

Interventions were used in isolation or combined with other intervention components such as improving the anthropometric skills of health workers, educating mothers about child growth using growth monitoring, home visiting to monitor growth, and growth monitoring as one activity within a comprehensive program.

6. Growth monitoring[1]

Intervention	Quality of Studies			Findings
	Strong[2]	Mod[3]	Weak[4]	
Growth Monitoring 9 studies 2 reviews	1 1	2 1	6	One study shows some evidence of benefit. One study shows no evidence of benefit with further studies required. Three studies show no clear evidence of benefit due to methodological concerns. Four studies show no evidence of benefit and methodological concerns. Both reviews show no evidence of benefit with further studies required. The high quality review concludes that the evidence was inadequate to firmly support inclusion or exclusion of the intervention from programs. The narrative review found there was some evidence of benefit. It considered that it may be included in programs but additional evaluation is warranted

[1]This intervention represents one component of a larger multifaceted intervention in most studies. [2]Met ≥5/6 quality criteria. [3]Met 3-4/6 quality criteria. [4]Met < 3 quality criteria.

Seven of the studies were multifaceted. All the studies included an educational component directed at either carers or health workers. The intervention in the one strong study (Schroeder & Pachon 2002[57;63]) consisted of three activities (growth monitoring, a feeding rehabilitation program incorporating a nutrition education component and deworming). The results of one moderate study (Guldan 2000[58]) indicate some evidence of benefit. In the study by Penny et al[59] the adjusted mean changes in weight gain, length gain, and Z-scores were all significantly better in the intervention area than in the control area. However, these changes were not statistically significant (adjusted difference WHZ: 0.048 (95 per cent CI: -0.139,0.237) $P = 0.609$). In the other study (Guldan 2000) the intervention consisted of growth monitoring and nutrition counselling at home. The intervention included giving mothers growth charts and feeding guideline handbooks. In the text of this study it is reported that no significant differences were seen in the WHZ-scores between the intervention and comparison groups. However, data were provided that show intervention children were heavier (P = 0.004) and longer (P= 0.022) than control children at 12 months of age.

Some of the studies considered to have weak or moderate study designs (e.g. Penny 2005[59] or Mackintosh 2002[52]) were integrated within a primary health care service delivery system. In these studies attempts were made to address the underlying causes of the problem. In some studies there is evidence to suggest that program best practice principles had been adopted in the intervention development and implementation phases. The studies did not include information that suggested that their interventions were developed and implemented based on theory. One study (Schellenberg 2004[62]) reports that the cost of providing integrated essential

child-health interventions from the same facility is not associated with higher costs than programs delivered by different health personnel or agencies. Rather that the cost of care per child <5 years was found to be US$4.90 cheaper.

The good quality review (Panpanich 1999[55]) requires updating but its findings are still considered relevant. This review reports that the evidence identified provided little information to evaluate the benefits and harms of growth monitoring. The second review (Roberfroid 2005[64]) supports this finding, concluding that there is too little scientific evidence to indiscriminately support international promotion of growth monitoring programs. In the review by Panpanich and Garner[55] concern is raised as to whether growth monitoring creates undue maternal anxiety and also whether the intervention is cost effective.

Table 7. Assessment of evidence – Growth monitoring

Indicator	Rating
1. Volume & quality of evidence	Good (one or two Level II studies with low risk of bias or SR/multiple Level III studies with low risk of bias)
2. Consistency	Good (most studies consistent and inconsistency can be explained)
3. Clinical impact	Satisfactory (moderate clinical impact)
4. Generalisability	Good (directly generalisable to target population with some caveats)
5. Applicability	Good (applicable to Australian healthcare context with few caveats)
Recommendation	The body of evidence can be trusted to guide practice in most situations

Findings:

Growth monitoring to prevent growth faltering has been assessed in one strong, two moderate and six weak studies, also in two reviews (one strong and one moderate). One study shows some evidence of no benefit; one study shows no evidence of benefit with further studies required; three studies show no clear evidence of benefit due to methodological concerns; four studies show no evidence of benefit and methodological concern. The strong review concludes that the evidence is inadequate to firmly support inclusion or exclusion of growth monitoring from programs. The moderate review reports that there is some evidence of benefit and that growth monitoring may be included in programs but additional evaluation is warranted. Our overall assessment is that growth monitoring should be considered in programs that aim to prevent failure-to-thrive. However, there is a need to ensure that this intervention is integrated into a broader primary health care program that includes assessment of major risks to child health in the remote Indigenous community context. These programs need to ensure early follow-up and effective action on detecting growth

faltering. In particular, there is a need to treat common infections and specific nutrient deficiencies. Adverse home circumstances also need to be addressed, although there is no evidence of benefit of social assessment or interventions on growth faltering.

NUTRITION EDUCATION/COUNSELLING

Twenty-eight studies are included in this intervention category. Twenty studies include multifaceted interventions and eight studies consist of a single intervention. Of the 28 studies five are RCTs (Bhandari 2004[34]; Bhandari 2001[33]; Santos 2001[65]; Pant 1996[66,67]; Schroeder & Pachon 2002[57,63]), three Quasi-Experimental (Guldan 2000[58]; Penny 2005[59]; Brown 1992[68]), three CBA studies (Malekafzali 2000[69]; Gupta 1984[41]; Walsh 2002[60]) and 17 studies are of various other designs. In this group of studies with multifaceted interventions there are a large number of studies of poor research/evaluation design and generally poor intervention design.

Nutrition education and counselling interventions involved increasing the skills of medical officers, registered nurses, community health workers and volunteers. Some studies also aimed to increase the knowledge and change the behaviour of the mothers of young children, grandmothers, child care workers and communities. Various methodologies were used including one-to-one motivational counselling, skills transfer, individual and group education sessions, the distribution of written information and awareness raising/educational strategies such as videos and posters.

In the studies with a multifaceted intervention the nutrition education component was generally linked to other intervention components such as growth monitoring, feeding programs, modifying the environment, health service delivery, and community development activities.

There is great variability in the characteristics of the interventions used in the eight studies that focused on nutrition education alone (Aguayo 2004[70]; Brown 1992[68]; Ghosh 2002[71]; Guldan 2000[58]; McEnery 1986[72]; Pant 1996[66,67]; Santos 2001[65]; Sullivan 1990[73]). Two studies (Aguayo 2004[70]; Santos 2001[65]) involved the education of health workers (doctors, nurses), one involved specialised antenatal education (McEnery 1986[72]) and another (Guldan 2000[58]) pregnant women and carers of infants <1 year of age. A further study focused on providing nutrition education while home visiting (Brown 1992[68]). Two studies focused on increasing the nutritional knowledge of mothers and grandmothers (Ghosh 2002[71]; Pant 1996[66,67]). One study provided more general health, child care and nutrition education (including hygiene improvement) (Sullivan 1990[73]).

Table 8. Nutrition education/counselling[1]

Intervention	Quality of Studies			Findings
	Strong[2]	Mod[3]	Weak[4]	
Nutrition education as part of a multifaceted study 20 studies	2	4	14	Two strong studies show no evidence of benefit with further studies required. One moderate study shows some evidence of benefit. Three moderate studies show no evidence of benefit and methodological concerns. The results of the remaining 14 studies are mixed. Some show no clear evidence of benefit due to methodological concerns, and others show no evidence of benefit and methodological concerns
Nutrition education (single interventions studies) 8 studies	1	1	6	Two studies show some evidence of benefit. Two studies no clear evidence of benefit due to methodological concerns. Four studies show no evidence of benefit and methodological concerns

[1]This intervention represents one component of a larger multifaceted intervention in most studies. [2]Met ≥5/6 quality criteria. [3]Met 3-4/6 quality criteria. [4]Met < 3 quality criteria.

The strong study (Schroeder & Pachon 2002[57;63]) using a multifaceted intervention (a growth monitoring program, feeding rehabilitation program that incorporated a nutrition education program, deworming and health monitoring) found no difference between the children who received the intervention and the comparison group (WHZ (SD): Intervention -1.25 (0.67) vs Control -1.39 (0.68); P = 0.12). Of the two strong studies that included single interventions, one study (Santos 2001[65]) provided nutrition counselling for doctors. The other (Bhandari 2001[33]) compared food supplementation and nutrition counselling (FS) with providing nutrition counselling alone (NC) and home visiting alone (V), and with a comparison group (C) that received no intervention. The results of the former study (Santos 2001[65]) indicate some evidence of benefit due to the intervention (WHZ [mean (SD)]: Intervention: 0.04 (1.35); Control -0.05 (1.43); P =0.3). The latter study (Bhandari 2001[33]) found no evidence of benefit ([n (per cent)] ≤2 W HZ at 52 weeks: FS 15 (17.2), NC 12 (12.4), V 14 (15.4), C 15 (16.1)).

One study (Sheikholeslam 2004[74]) was considered to have a weak study design but a strong intervention design that met some of the best practice criteria (one out of four criteria); attempted to address some underlying causes (four out of four criteria); and integrated the intervention within a primary health care service delivery system (five out of seven criteria). Four studies whose interventions were found to show some evidence of benefit (Bhandari 2004[34]; Guldan 2000[58]; Penny 2005[59]; Santos 2001[65]) also met some criteria concerning program best practice, addressing the underlying causes of the problem and integrating the intervention within a primary health care service delivery system.

The studies in this category do not include information that suggests that their interventions were developed and implemented based on theory. Information concerning the cost effectiveness of interventions is not provided.

Table 9. Assessment of evidence – nutrition educational/counselling

Indicator	Rating
1. Volume & quality of evidence	Good (one or two Level II studies with low risk of bias or SR/multiple Level III studies with low risk of bias)
2. Consistency	Good (most studies consistent and inconsistency can be explained)
3. Clinical impact	Satisfactory (moderate clinical impact)
4. Generalisability	Satisfactory (not directly generalisable to the target population but be sensibly applied)
5. Applicability	Satisfactory (probably applicable to Australian healthcare context with some caveats)
Recommendation[1]	The body of evidence provides some support for the intervention but care should be taken in its application

[1]Assessment of evidence for this intervention fell between the categories "Body of evidence can be trusted to guide practice in most situations", and the "Body of evidence provides some support for intervention but care should be taken in its application". The more conservative recommendation is provided in the Table.

Findings:
Nutrition education/counselling to prevent growth faltering among children has been assessed in three strong studies, five moderate studies and 20 weak studies. Of the strong and moderate studies two studies show no evidence of benefit with further studies required. Three studies show some evidence of benefit and for three studies there was no evidence of benefit and methodological concerns. The results of the remaining 20 studies are mixed. Some show no clear evidence of benefit due to methodological concerns and others no evidence of benefit and methodological concerns. Our overall assessment is that there is some evidence to support a positive effect of community based nutrition education/counselling interventions that involve carers, community health workers, community representatives, that are designed to meet program best practice requirements, and that are well integrated into primary health care service delivery systems. There is some evidence that developing the nutrition educational/counselling skills of doctors is of benefit. These interventions require ongoing evaluation and refinement.

DEWORMING

Three studies are included in this category, one review (Dickson 2000[75]) and two studies. Study designs included one RCT (Schroeder & Pachon 2002[57;63]) and one cohort study with unmatched concurrent controls (Schelp 1990[45-47]).

10. **Deworming[1]**

Intervention	Quality of Studies			Findings
	Strong[2]	Mod[3]	Weak[4]	
Deworming 2 Studies 1 Review	1 1		1	The strong study shows no evidence of benefit with further studies required. The weak study shows no evidence of benefit and methodological concerns. The review shows clear evidence of small benefit

[1]This intervention represents one component of a larger multifaceted intervention in most studies. [2]Met ≥5/6 quality criteria. [3]Met 3-4/6 quality criteria. [4]Met < 3 quality criteria.

Both of the studies that included deworming as an intervention component were multifaceted. Both studies used anthelminthic chemotherapeutic treatment. The study (Schelp 1990[45-47]) that provides uncertain evidence met only one of six study design quality indicators and is considered weak. In this study it is reported that growth improvement only occurred after the comprehensive intervention had been in place for two years and nine months. In the strong study (Schroeder & Pachon 2002[57;63]) children in the intervention communities did not show statistically better growth than those in the comparison communities ($P = 0.12$).

Both these studies appear to have integrated their multifaceted interventions into primary health care service delivery systems, but there is little detailed information about this. One study (Schelp 1990[45-47]) clearly tried to address some underlying causes of the problem including inadequate child care and better prevention and control of disease. No information was provided on the cost/cost effectiveness of interventions.

The conclusions of the review (Dickson 2000[75]) include that there is some limited evidence that routine treatment of children in areas where helminths are common has small effects on weight gain, but this is not consistent between trials. Overall the review reports that there is uncertain evidence of benefit.

Table 11. Assessment of evidence - deworming

Indicator	Rating
1. Volume & quality of evidence	Good (one or two Level II studies with low risk of bias or SR/multiple Level III studies with low risk of bias)
2. Consistency	Good (most studies consistent and inconsistency can be explained)
3. Clinical impact	Satisfactory (moderate clinical impact)
4. Generalisability	Good (directly generalisable to target population with some caveats)
5. Applicability	Good (applicable to Australian healthcare context with few caveats)
Recommendation	The body of evidence can be trusted to guide practice in most situations

Findings:
Deworming using single or multiple treatments of anthelminthic chemotherapeutic treatments to prevent growth faltering has been assessed in one strong and one weak study and in one strong review. The strong study shows no evidence of benefit with further studies required. The weak study shows no evidence of benefit and methodological concerns. The review shows clear evidence of small benefit. Our overall assessment is that single or repeated chemotherapeutic treatment of helminth infections in children has been shown to have small effects on weight gain when the population is known to suffer from high worm infestation rates.

VITAMIN AND MINERAL SUPPLEMENTATION

Twelve studies and two literature reviews assessed vitamin and/or mineral supplementation. Eleven studies are RCTs, and one a cross sectional survey. The population in each of the studies was known to be at risk of vitamin or mineral deficiencies and wasting and stunting. Eight studies include the use of more than one intervention type and a placebo; one study compared the effect of two different interventions but had no control group; three studies assessed a single intervention with a control group.

Table 12. Vitamin and mineral supplementation studies[1]

Intervention	Quality of Studies			Findings
	Strong[2]	Mod[3]	Weak[4]	
Zinc 1 study 1 review	1 1			The strong study shows clear evidence of benefit. The strong review shows evidence of no benefit
Iron 6 studies 1 review	4	2 1		Two studies show some evidence of benefit. Four studies show no evidence of benefit with further studies required. The review reports some evidence of benefit among anaemic children
Iron and Zinc 1 study	1			This study shows no evidence of benefit with further studies required
Multiple Micronutrient 8 studies 1 review	4	3 1	1	One strong study shows clear evidence of benefit. One strong study shows some evidence of benefit. Five studies show no evidence of benefit with further studies required. The review reports that the evidence of the effectiveness of multiple micronutrient supplements is mixed. The quality of the one weak study was too poor to take into account
Vitamin A 5 studies 1 review	1	3 1	1	Two studies show some evidence of benefit. One study shows no evidence of benefit with further studies required. Two studies show no clear evidence of benefit due to methodological concerns. The review concludes that vitamin A supplementation is unlikely to prevent growth faltering among children who are mildly to moderately deficient

[1]Categories are not mutually exclusive; some studies compared up to three different interventions. Each intervention is listed under its own category. Some studies and one review are included more than once. [2]Met $\geq 5/6$ quality criteria. [3]Met 3-4/6 quality criteria. [4]Met < 3 quality criteria.

ZINC

One study (Lind 2004[76]) and one review (Brown 2002[77]) are included in this category. In the study zinc was shown to have clear evidence of benefit (WHZ: Daily zinc -0.69, Placebo -1.03). Known or suspected zinc deficiency among the study population is most likely to have influenced the choice of intervention. The single intervention was delivered under controlled trial conditions by local fieldworkers. No indication was given that this was integrated into a broader primary health care service delivery system, or that program best practice issues were addressed when implementing the intervention. The study provided no information on the cost effectiveness of the intervention.

The findings of the good quality review (change in WHZ weighted mean effect size: -0.018 (95 per cent CI: -0.132,0.097; P=0.77)) show evidence of no benefit. There was no clear pattern of response, with eight studies showing a positive effect and seven studies a negative effect. Growth responses were greater in children with low initial weight-for-age z-scores and in those aged > 6 months with low initial height-for-age z-scores. The authors[77] conclude that zinc supplementation should be considered to promote growth in populations at risk of zinc deficiency, especially when there are elevated rates of underweight or stunting.

Table 13. Assessment of evidence – zinc supplementation

Indicator	Rating
1. Volume & quality of evidence	Good (one or two level II studies with low risk of bias or SR/multiple Level III studies with low risk of bias)
2. Consistency	Satisfactory (some inconsistency, reflecting genuine uncertainty around question)
3. Clinical impact	Poor (slight or restricted clinical impact)
4. Generalisability	Satisfactory (not directly generalisable to the target population but could be sensibly applied)
5. Applicability	Poor[1] (not applicable to Australian healthcare context)
Recommendation	The body of evidence provides some support for the intervention but care should be taken in its application

[1]The extent of the problem of zinc deficiency among Indigenous children is unclear.

Findings:
Zinc supplementation has been assessed in one strong study and one strong review. The strong study shows clear evidence of benefit. The strong review shows evidence of no benefit. There is clear evidence that the intervention will improve height. Our overall assessment is that zinc supplementation should only be considered in populations where zinc

deficiency is known to be a common underlying factor in underweight and stunting.

IRON

Six studies (Hop 2005[78]; Lind 2004[76]; Lopez de Romana 2005[79]; Smuts 2005[80]; Untoro 2005[81] , Smuts & Lombard 2005[80]) and one review (Rivera 2003[82]) are included in this category. One study (Smuts & Lombard 2005[80]) consists of pooled data from four of the five included studies. This study found some evidence of benefit for daily iron supplementation (mean WHZ: daily iron (0.46) vs daily multiple micronutrients (0.76), weekly micronutrients (0.50) and daily placebo (0.46). Lind et al[76] identified that the proportion of children with wasting at 12 months was significantly higher (21.5 per cent, P <0.05) among the children who received daily iron supplementation compared to those who received daily zinc or daily iron and zinc supplementation. Overall the studies show that iron supplementation was unable to prevent growth faltering in all the high risk populations included in these studies.

Each study consisted of a single intervention which was delivered under controlled trial conditions. In all the studies the underlying cause/s of growth faltering was not addressed. There is no indication that the interventions were integrated into a broader primary health care service delivery system, or that program best practice issues were directly addressed when implementing the intervention. No information was provided on the cost effectiveness of the intervention.

The findings of the review (Rivera 2003[82]) are consistent with the results of the studies. The review noted that in studies where the population was anaemic a positive impact on growth was demonstrated. In the studies that did not select for iron status, but a high (>50 per cent) prevalence of anaemia was noted, a growth response to iron was demonstrated. However, no effect on growth was shown in the studies that selected only children without anaemia. The review concludes that there is some evidence of benefit of iron supplementation among anaemic children, while noting that iron supplementation has no effect on the growth of children who are not anaemic.

Table 14. Assessment of evidence – Iron supplementation

Indicator	Rating
1. Volume & quality of evidence	Excellent (several level I or II studies with low risk of bias)
2. Consistency	Good (most studies consistent and inconsistency can be explained)
3. Clinical impact	Poor (slight or restricted clinical impact)
4. Generalisability	Satisfactory (not directly generalisable to the target population but could be sensibly applied)
5. Applicability	Satisfactory (probably applicable to Australian healthcare context with some caveats)
Recommendation	The body of evidence can be trusted to guide practice in most situations

Findings:

Iron supplementation to prevent growth faltering has been assessed in six studies and one review. Two studies show some evidence of benefit. Four studies show no evidence of benefit with further studies required. The review reports some evidence of benefit among anaemic children. Our overall assessment is that iron supplementation should only be considered in populations where iron deficiency is known to be a common underlying factor contributing to growth faltering.

IRON AND ZINC

Only one strong study (Lind 2004[76]) used a combination of iron and zinc supplementation as an intervention. This study found evidence of no benefit of iron and zinc supplementation (mean WHZ: -0.86) compared with daily zinc (mean WHZ: -0.69) and daily iron (mean WHZ: -0.95) and the daily placebo (mean WHZ: -1.03). The study population was considered likely to be at high risk of iron and zinc deficiency. The overall anthropometric status of children deteriorated significantly from six to 12 months of age. The prevalence of stunting and wasting increased significantly in the groups that received daily iron and zinc supplementation or daily iron or daily zinc. The single intervention was delivered under controlled trial conditions by local fieldworkers. There is no indication that delivery of the intervention was integrated into a broader primary health care service delivery system, or that program best practice issues were addressed when implementing the intervention. No information was provided about the cost effectiveness of the intervention.

Table 15. Assessment of evidence - Iron and zinc supplementation

Indicator	Rating
1. Volume & quality of evidence	Good (one or two Level II studies with low risk of bias or SR/multiple Level III studies with low risk of bias)
2. Consistency	Good (most studies consistent and inconsistency can be explained)
3. Clinical impact	Poor (slight or restricted clinical impact)
4. Generalisability	Satisfactory (not directly generalisable to the target population but could be sensibly applied)
5. Applicability	Satisfactory (probably applicable to Australian healthcare context with some caveats)
Recommendation	The body of evidence provides some support for the intervention but care should be taken in its application

Findings:

Iron and zinc supplementation to prevent growth faltering has been assessed in one strong study. Currently there is no evidence of benefit in using iron and zinc supplementation to prevent growth faltering. Further studies are required. Our overall assessment is that iron and zinc supplementation should only be considered in populations where iron and zinc deficiency is known to be a common underlying factor contributing to growth faltering.

MULTIPLE MICRONUTRIENT SUPPLEMENTATION

Eight studies (Center for Health Research 2002[53]; Hop 2005[78]; Lartey 1999[35]; Lopez de Romana 2005[79]; Rivera 2001[83]; Smuts 2005[84]; Smuts & Lombard 2005[80]; Untoro 2005[81]) and one review (Rivera 2003[82]) are included in this category. The micronutrients used in the studies contained at least iron, zinc and a form of vitamin A. One strong study (Rivera 2001[83]) shows clear evidence of benefit. In this study a statistically significant association was shown for improvements in standard weight for height and micronutrient supplementation ($P <0.05$). Two studies (Smuts & Lombard 2005[80], Hop 2005[78]) found that providing daily micronutrient supplements marginally improved growth or slowed weight loss. One of these studies (Smuts & Lombard 2005[80]) used aggregated data from four studies of similar design conducted in different countries. The intervention compared providing daily multiple micronutrient supplementation with a daily placebo, daily iron, and weekly micronutrient supplementation. Daily multiple micronutrient supplementation was found to have some benefit (mean WHZ: 0.76) compared to the other interventions (mean WHZ: daily iron: 0.46; weekly multiple micronutrient: 0.50 and daily placebo: 0.46). Each of the studies in this category consisted of a single intervention which was delivered under controlled trial conditions. The study populations in all the studies were at high risk for growth faltering. The underlying causes of growth faltering were not addressed in any of the studies. There was no

indication that the interventions were integrated into a broader primary health care service delivery system, or that program best practice issues were addressed when implementing the intervention. No information was provided about the cost effectiveness of the intervention.

The findings of the review (Rivera 2003[82]) indicate that the evidence to support the effectiveness of micronutrient supplementation to prevent growth faltering is mixed. This is consistent with our interpretation of the findings of the independent studies. The review concludes that there is some evidence to support the inclusion of animal food sources and micro nutrient supplementation in programs.

16. Assessment of evidence – Multiple micronutrient supplementation

Indicator	Rating
1. Volume & quality of evidence	Excellent (several I or II studies with low risk of bias)
2. Consistency	Satisfactory (some inconsistency, reflecting genuine uncertainty around the intervention)
3. Clinical impact	Poor (slight or restricted clinical impact)
4. Generalisability	Satisfactory (not directly generalisable to the target population but could be sensibly applied)
5. Applicability	Poor[1] (not applicable to Australian healthcare context)
Recommendation	The body of evidence provides some support for the intervention but care should be taken in its application

[1]The extent of the problem of micronutrient deficiency among Indigenous children is unclear.

Findings:

Multiple micronutrient supplementation to prevent growth faltering has been assessed in four strong studies, three moderate studies and in one moderate review. One strong study shows clear evidence of benefit. One strong study shows some evidence of benefit. Five studies show no evidence of benefit with further studies required. The review reports that the evidence of the effectiveness of multiple micronutrient supplements is mixed. Our overall assessment is that multiple micronutrient supplementation should be considered in populations where micronutrient deficiency is known to be a common underlying factor causing growth faltering.

VITAMIN A

Five studies (Hadi 200085; Kirkwood 199686; Lartey 199935; Pant 199666;67; West 198887) and one review (Rivera 200382) are included in this category. In five studies the evidence to support the effectiveness of vitamin A to prevent growth faltering is mixed. This is likely due to the level of vitamin A deficiency varying between study populations. One strong study (Hadi 200085) shows some evidence of benefit from the intervention. In this study there was no overall difference in weight increment between the treatment groups (mean difference: 0.01 (95 per cent CI: -0.02,0.04). However, children with low serum retinol concentrations had a four month weight increment of 152g (95 per cent CI: 97,207) and height increment of 0.39cm (95 per cent CI: -0.24,0.53) greater than that in the placebo group. The size of the effect was dependant on the vitamin A status and the age of the children targeted.

All of the studies consisted of a single intervention which was delivered under controlled trial conditions. The underlying causes of growth faltering in study populations were not addressed. In all the studies there is no

indication that the interventions were integrated into a broader primary health care service delivery system, or that program best practice issues were addressed. One study (Pant 1996[66;67]) completed a cost effectiveness comparison study of the interventions vitamin A supplementation and nutrition education to prevent growth faltering. It was found that for each measure of health status used in the study that the most cost effective improvement can be achieved by distributing vitamin A in capsular form.

The findings of the review (Rivera 2003[82]) include that vitamin A supplementation is unlikely to improve the growth of young children who are only mildly to moderately vitamin A deficient. However, in cases of severe vitamin A deficiency vitamin A supplementation can lead to improved growth. The review recommends that vitamin A supplementation be considered for inclusion in programs for populations where vitamin A deficiency is known to be a problem.

Table 17. **Assessment of evidence – Vitamin A supplementation**

Indicator	Rating
1. Volume & quality of evidence	Good (one or two Level II studies with low risk of bias or SR/multiple Level III studies with low risk of bias)
2. Consistency	Satisfactory (some inconsistency, reflecting genuine uncertainty around the intervention)
3. Clinical impact	Poor (slight or restricted clinical impact)
4. Generalisability	Satisfactory (not directly generalisable to the target population but could be sensibly applied)
5. Applicability	Poor (not applicable to Australian healthcare context)
Recommendation	The body of evidence provides some support for the intervention but care should be taken in its application

Findings:
Vitamin A supplementation to prevent growth faltering has been assessed in one strong study, three moderate studies and one weak study, and in one moderate review. Two studies show some evidence of benefit. One study shows no evidence of benefit with further studies required. Two studies show no clear evidence of benefit due to methodological concerns. The findings of the one moderate review indicate that severe vitamin A deficiency contributes to growth faltering among young children. However, among young children who are only mildly to moderately vitamin A deficient this supplement is unlikely to prevent growth faltering. Our overall assessment is that vitamin A supplementation should be considered in populations where vitamin A deficiency is known to be a common underlying factor causing growth faltering.

MULTIFACETED INTERVENTIONS

There are 20 studies that include multifaceted interventions. Study designs include: two RCTs (Bhandari 2004[34]; Schroeder & Pachon 2002[57;63]), two Quasi-experimental (Guldan 2000[58]; Penny 2005[59]), three CBA studies (Gupta 1984[41]; Malekafzali 2000[69]; Walsh 2002[60]) and 13 studies using other study designs. There are a large number of studies with poor research/evaluation design and generally poor intervention design. Many of the intervention components that make up the multifaceted interventions used in these studies have been addressed under previous headings.

Multifaceted interventions consist of a combination of more than one intervention method/activity including nutrition education/counseling; growth monitoring; vitamin, mineral and/or food supplementation and deworming. Additional intervention components in some of the studies include: addressing maternal literacy; water, sanitation and hygiene initiatives; safe food handling education and skills; liaising with community leaders; neighbourhood meetings; home gardening; income generation; store education and recommendations; immunisation; schistosomiasis transmission control; provision of drinking water; and employment projects.

Table 18. Multifaceted interventions

Intervention	Quality of Studies			Findings (Outcome SHW or per cent Wasting)
	Strong[1]	Mod[2]	Weak[3]	
Multifaceted interventions 20 studies	1	3	16	Of strong and moderate studies, two studies show some evidence of benefit. One study shows no evidence of benefit with further studies required. One study shows no clear evidence of benefit due to methodological concerns. Among the 16 studies considered to have weak designs the results are mixed, showing no evidence of benefit due to methodological concerns or no evidence of benefit and methodological concerns

[1]Met ≥5/6 quality criteria. [2]Met 3-4/6 quality criteria. [3]Met < 3 quality criteria.

The key components of the intervention in the one strong study (Schroeder & Pachon 2002[57;63]) are identified as a growth monitoring program, a comprehensive feeding rehabilitation and nutrition education program and deworming. More details concerning the results of this study are provided under the intervention heading 'nutrition education/counselling'. The interventions in the three moderate studies (Bhandari 2004[34]; Guldan 2000[58]; Penny 2005[59]) are made up of a number of closely related components, for example improving nutrition counselling and the anthropometric skills of health workers, the development of nutrition health education materials and nutrition promotion activities. In some studies (Gupta 1984[41]; Malekafzali 2000[69]; Sheikholeslam 2004[74]; Schelp 1990[45-47];

Tandon 1989[48]; Tanner 1987[88]; Walsh 2002[60]; Warchivker 2003[44]) the intervention consisted of three or more components and the study design more closely resembled the post evaluation of a comprehensive program or international aid project. These studies meet one or no quality criteria. The results of these studies are mixed. Included among these studies are evaluations of the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) (USA), the UNICEF Rapid Response Complementary Food Initiative (Indonesia), the Integrated Child Development Services (India), and the Integrated Management of Childhood Illness Strategy (IMCI) (Tanzania).

No explicit theory was described in any of the studies to provide an understanding of what informed the study design or the choice of intervention and implementation methodologies. The extent that studies included or addressed best practice criteria, the underlying causes of the problem, or that the intervention was integrated into a primary health care service delivery system, was variable.

Table 19. Assessment of evidence – Multifaceted interventions

Indicator	Rating
1. Volume & quality of evidence	Good (one or two Level II studies with low risk of bias or SR/multiple Level III studies with low risk of bias)
2. Consistency	Good (most studies consistent and inconsistency can be explained)
3. Clinical impact	Satisfactory (moderate clinical impact)
4. Generalisability	Satisfactory (not directly generalisable to the target population but be sensibly applied)
	Satisfactory (probably applicable to Australian healthcare context with some caveats)
Recommendation[1]	The body of evidence provides some support for the intervention but care should be taken in its application

[1]Assessment of evidence for this intervention fell between the categories "Body of evidence can be trusted to guide practice in most situations", and the "Body of evidence provides some support for intervention but care should be taken in its application". The more conservative recommendation is provided in the Table.

Findings:
Multifaceted interventions to prevent growth faltering among children have been assessed in one strong, three moderate and 16 weak studies. Two studies show some evidence of benefit. One study shows no evidence of benefit with further studies required. One study shows no clear evidence of benefit due to methodological concerns. Among the 16 studies considered to have weak designs the results were mixed, showing no evidence of benefit due to methodological concerns or no evidence of benefit and

methodological concerns. Our overall assessment is that there is some evidence to support the good effect of multifaceted interventions that involve carers, community health workers, community representatives, that are designed to meet program best practice requirements, address the underlying causes of growth faltering, and that are well integrated into primary health care service delivery systems. However, these interventions require ongoing evaluation and refinement.

OTHER MEASURES OF RELEVANCE

Selected concepts/factors related to the approaches taken to develop or implement an intervention, whether studies/programs in designing or implementing interventions addressed commonly recognised causes of growth faltering, or whether interventions/programs addressed any factors related to a health system or health service delivery are reported here.

Table 20. Numbers of studies showing positive/no effect according to approaches used to develop or implement interventions (all studies)

Approaches	Positive Effect		$\chi^{2\#}$	p-value
	No	Yes		
Participatory methods				
No	21	10		
Yes	6	1	3.3	0.19
Unsure	6	0		
Focus on the family				
No	24	10		
Yes	3	1	2.35	0.31
Unsure	6	0		
Intersectoral cooperation				
No	26	11		
Yes	3	0	2.77	0.25
Unsure	4	0		
Cultural appropriateness				
No	18	1		
Yes	6	3	3.79	0.15
Unsure	9	0		
Any				
No	17	8		
Yes	13	3	1.99	0.37
Unsure	3	0		

$^{\#}\chi^2 = $ Chi^2

Only a small number of studies provided data concerning how interventions were developed and implemented. Studies which reported using participatory methods, family focussed methods, intersectoral cooperation, or culturally appropriate methods were not more likely to report a positive effect. However, this may be because of the inadequacies of the reporting of this information, and it is not possible to draw clear conclusions about the approach to the development of the intervention and the effectiveness of the interventions. Analysing the data including only the strong studies provided similar results.

Table 21. Numbers of studies reporting common underlying causes of growth faltering (all studies)

Approaches	Positive Effect		$\chi^{2\#}$	p-value
	No	Yes		
Inadequate child care				
No	20	10		
Yes	12	1	3.5	0.17
Unsure	1	0		
Inadequate prevention and control of disease				
No	18	11		
Yes	13	0	7.6	0.02
Unsure	2	0		
Food Insecurity				
No	26	11		
Yes	5	0	2.77	0.25
Unsure	2	0		
Failure to promote breastfeeding				
No	17	8		
Yes	11	3	2.41	0.30
Unsure	5	0		
Any				
No	15	8		
Yes	18	3	2.46	0.12

#χ^2 = Chi^2

A minority of the studies explicitly mentioned addressing the underlying causes of growth faltering in their intervention approach. Inadequate child care and inadequate prevention and control of disease were the underlying causes most frequently addressed in studies (30 per cent). This is possibly because these issues may be seen to be more amenable to educational type approaches to health improvement. Less frequently addressed were breastfeeding promotion and food insecurity. The studies which reported interventions targeting specific underlying causes of growth faltering were not more likely to show a positive effect. The result (p=0.02) for the category 'inadequate prevention and control of disease' is likely to be spurious. These findings are opposite to what might be expected, and are an isolated finding based on small numbers. The general lack of an association between interventions specifically designed to address underlying causes and the effectiveness of these interventions may well be due to inadequate reporting of intervention design. Analysing the data including only the strong studies provided similar results.

Few studies reported on factors related to intervention/program design and delivery and health system or health service delivery system factors. Thirty studies made no mention of any of the seven service model components (organisational influence, external links, self-management support, decision support, delivery system design, information systems, integration), eight studies reported on one factor, two studies on two factors, three studies on three factors and one study on five factors.

Table 22. Numbers of studies reporting system model components by demonstrated effect

Model Components Reported	Positive Effect		$\chi^{2\#}$	p-value
	No	Yes		
Organisational influence				
No	25	10		
Yes	4	0	1.54	0.46
Unsure	3	1		
External links				
No	30	10		
Yes	0	1	4.0	0.13
Unsure	3	0		
Self management support				
No	24	10		
Yes	7	1	1.69	0.43
Unsure	2	0		
Decision support				
No	29	9		
Yes	2	2	2.03	0.36
Unsure	2	0		
Delivery system design				
No	24	9		
Yes	4	2	1.98	0.37
Unsure	5	0		
Information systems				
No	31	11		
Yes	1	0	0.70	0.71
Unsure	1	0		
Integration				
No	28	11		
Yes	3	0	1.88	0.39
Unsure	2	0		

[#]χ^2 = Chi^2

Much like what was reported in the previous two tables, there is no clear relationship between intervention/program effectiveness and system model components. The likely reasons for this are the same as the above points on intervention design. Analysing the data including only the strong studies provided similar results.

5. DISCUSSION

The nature of the interventions to prevent growth faltering that have been the subject of research is diverse. The quality of the research evidence is variable and generally poor. Many reports focus on specific interventions rather than program models and the reporting of information on intervention design and implementation is generally inadequate. The major findings of our review of the research evidence are listed below:

While the evidence is not strong, the interventions which are most clearly supported by the research evidence are:
- Interventions to strengthen community based nutrition education/counselling
- Interventions to strengthen the nutrition education/counselling skills of doctors
- Multifaceted interventions

Interventions for which the research evidence neither clearly supports implementation of new programs or withdrawal of existing programs include:
- Supplementary/complementary feeding programs for children and pregnant and lactating women
- Multiple micronutrient supplementation

Interventions for which there is no research evidence of benefit include:
- Growth monitoring programs
- Iron supplementation for children who are not anaemic
- Iron and zinc supplementation

There is clear evidence that zinc supplementation is of no benefit in preventing growth faltering (insufficient weight gain for height) but it does increase height.

Interventions for which there is some evidence of benefit in specific populations include:
- Vitamin A supplementation in populations where there is moderate to severe vitamin A deficiency
- Chemotherapeutic treatment of helminth infestations in populations where there are high infestation rates

In general, these findings are consistent with the recommendations and advice reported by key national and international child health agencies.[23;25;29;89]

It is also clear from the research evidence (and other literature) that other factors need to be considered in assessing the evidence. Factors that can modify the impact of an intervention include: the characteristics of the participants (in particular age); the level of any deficiency; the intensity and duration of the proposed program; the type of workers who are to deliver the intervention; and the approach to implementation and delivery.[22;29]

In remote Australian Indigenous communities the rates of exclusive breastfeeding to six months of age (or longer) remain high. The late introduction (and the insufficient intake) of weaning foods is considered to partially explain why young children living in these communities experience high rates of growth faltering and iron-deficiency anaemia.[4;15] A national survey of Indigenous children living in remote communities shows high rates of food insecurity.[90] Food insecurity is defined as not having sufficient food; experiencing hunger as a result of running out of food and being unable to afford more; eating a poor quality diet as a result of limited food options; anxiety about acquiring food; or having to rely on food relief.[91]

Children living in situations of food insecurity (including where the normal weaning diet is traditionally poor or delayed) require additional food for healthy growth.[15] The child health literature is generally supportive of food supplementation programs among disadvantaged children, with some provisos.[23;89] For example, Brewster[4] argues that when the adverse socioeconomic circumstances of a child's environment cannot easily be changed then providing adequate nutrition during the weaning period will reduce the risk of growth faltering. This position is supported by the National Aboriginal Community Controlled Health Organisation (NACCHO) who argue that nutritional supplementation programs are urgently needed in order to ensure that no Aboriginal child in rural or remote Australia suffers from malnutrition.[29;92] On the other hand, Wright[7] argues that there is almost never a role for food supplementation in managing failure-to-thrive. Wright suggests that very young children (toddlers) with failure-to-thrive often have a low intake of immature, low energy foods, with a high fluid intake. Accordingly, the aim of management should be towards hastening the progression of children eating more energy dense solid foods. Wright[7] further argues that the food offered as a supplement needs to complement children's learnt food preferences, otherwise children are likely to reject the supplement offered.

We found little information that addresses ongoing food insecurity in remote communities and how this impacts on the health and wellbeing of children. In the past options to reduce the food insecurity problem in communities have included: the withholding of an amount of social security money and giving the equivalent amount as food vouchers; the provision of budgeting/home economics education; extending community food services available to vulnerable adults (frail aged and people with severe disabilities) to include children; and improving the food storage facilities in houses.[28] We found no research evidence that describes whether these options are currently in use in remote Indigenous communities, or if they are effective in preventing growth faltering.

In developing countries the causes of food insecurity are somewhat different to the problem as it occurs in Australia. There, except in cases of extreme poverty or emergency situations, long term approaches are more frequently employed, for example poverty alleviation programs and improved agricultural practices.[23;29]

In the context of remote Indigenous communities other broader issues around the provision of food supplements also need to be taken into

account. Food supplementation programs that aim to provide for 'catch-up growth' for individual children with failure-to-thrive are separate to this discussion. These include the history of colonisation which may make interventions such as community feeding programs politically sensitive and which may invoke memories of food handouts, disempowerment and paternalism.[93] Other concerns include the need to avoid creating dependency, the failure of such programs to address the underlying causes of food insecurity, and the overall feasibility of a food supplementation program (the level of community support, the number of families willing to participate).[22]

There is limited information available about the extent of any vitamin or mineral deficiency among young Aboriginal children living in remote communities.[94] Therefore the impact of providing children with vitamin and mineral supplements to prevent growth faltering is unknown. Brewster[4] states that many Aboriginal children in the Northern Territory have iron deficiency, which in combination with wasting and microcephaly, is likely to be important contributors to the health disadvantage that Aboriginal children suffer. He argues that the most beneficial intervention to reduce iron deficiency is to improve the intake of iron rich solid foods during the weaning period. In addition, this intervention, if successful, is likely to improve the overall nutritional status of children. Brewster[4] also argues that in the short term micronutrient supplementation programs are likely to be more effective than haphazard clinical screening to identify deficiencies. However, he questions the feasibility of using this approach in remote Indigenous communities where adherence might be anticipated to be poor. Others argue that there is a strong case for addressing micronutrient deficiencies not selectively but as a combined therapy as diets deficient in zinc are also likely to be deficient in iron and vitamin A.[29] More information is required about the level of any vitamin or mineral deficiency among Aboriginal children, and what might be causing this, before a clear decision can be made to include micronutrient supplementation in a program.

In northern Australia hookworm and other parasites are thought to contribute to iron deficiency among Indigenous children.[4] However, the prevalence of hookworm among Aboriginal children admitted to the Royal Darwin Hospital was found to be low (0.75 per cent), and that this was mostly likely due to the routine use of deworming treatments (albendazole) in remote communities. Despite children in remote communities routinely receiving anthelminthics, iron deficiency and poor growth remain prevalent. Hookworm infestation is unlikely to be a significant contributor to iron deficiency in this population. Consequently, Brewster[4] argues that routine deworming programs in remote communities are of lower priority than hygiene and nutritional interventions to promote children's health.[4] Dickson, Awasthi *et al*[5] have expressed concern that the long term impact of repeated treatments of anthelminthic drug therapy on children's health is not known.

Currently growth monitoring plays a central role in Indigenous child health programs in the Northern Territory through the government's Growth, Assessment and Action Program (GAA). However, the potential benefits from routine monitoring of children's growth are considered to be small

when compared with the cost.[23;26;55] More cost effective ways of monitoring and evaluating the growth of children have been suggested.[25;26] Concern has also been expressed that despite routine monitoring some health staff fail to recognise children whose growth is faltering.[7] Additionally, growth monitoring is often performed without any intervention occurring when growth faltering is identified.[4;55] Growth monitoring is perceived as not causing harm. However, it may actually cause caregivers unnecessary anxiety.[55] Among vulnerable and disadvantaged groups there is now a trend for child health programs to shift away from monitoring growth to population-based assessment with generalised dissemination of key messages to improve nutrition related behaviour.[25] The resource constraints in remote Australian Indigenous communities are less severe than in other settings where poor child growth is prevalent. In communities where the risk of growth faltering is high and where there are fewer barriers to effective early intervention, monitoring the growth of young children is likely to remain an important strategy.[56] Roberfroid, Kolsteren *et al*[56] note that it is difficult to imagine a childcare program that does not include some form of regular anthropometric measurement. Rather, it is the frequency of measurement and other factors that need to be modified to match the resources available and other needs of the community.

Nutrition education/counselling interventions are commonly included in multifaceted interventions to prevent growth faltering. In general, nutrition education focuses on empowering individuals or families to make appropriate choices of foods by using scientific knowledge.[4] On the other hand nutrition counselling involves providing information but focuses more on motivating behaviour change. In remote Indigenous communities nutrition education programs have been heavily relied upon to promote healthy eating practices and the healthy growth of children. Brewster[4] asserts that changing behaviour must be the clear intention of effective nutrition promotion programs. However, systemic barriers to behaviour change such as the availability and price of healthy food will need to be addressed in order for behaviour change strategies to achieve their potential. The poor availability and high cost of healthy food in many remote communities is a widely recognised problem.

Evaluating the success of nutrition education programs in terms of behaviour change is difficult. We did not find any relevant research or evaluation evidence on this topic. Nevertheless, it is likely that group education and one-to-one counselling will be considered important components of any program designed to prevent growth faltering, while approaches to raising knowledge and awareness in this area should continue to be refined to meet local needs. However, the effectiveness of such strategies in isolation is likely to be limited.

In remote Indigenous communities growth faltering that progresses to failure-to-thrive is likely to be exacerbated by nutrition-infection interactions. Late weaning, iron deficient weaning foods, a high burden of infection, and tropical enteropathy syndrome are likely to be the major contributors to growth faltering among children living in remote Indigenous communities.[4] Hence, interventions that address undernutrition and poor personal and environmental hygiene are required.[4;23;29] This approach is

supported by Caulfield, Richard et al[25] who argue that among disadvantaged groups growth faltering is best combated with programs that combine disease control strategies with the promotion of breastfeeding and optimal complementary feeding strategies. This leads to the need for multifaceted interventions to address each of these factors in a strategic and co-ordinated manner.[89] Watson, White et al[22] argue that in Australian Indigenous communities, given the levels of severe and multiple disadvantage, the use of well resourced multiple interventions are especially important. The National Health and Medical Council (NHMRC) advocates the use of multi-faceted interventions to eradicate malnutrition, including improved physical infrastructure, better food supplies, health and nutrition education and access to clinical care.[89] Multifaceted interventions are considered more beneficial because a range of activities to address health and nutrition are offered, while some consider it can also lead to improved organisational efficiency.[23] On the other hand, multifaceted interventions are more costly as well as more difficult to monitor and evaluate.

In the absence of research evidence of the effectiveness of program or health promotion approaches, the recommendations of key national and international child health agencies provide an important basis for policy and program development. For example, Mason, Sanders et al[23] consider that to deliver a multifaceted community health and nutrition program (in developing countries) there is a need to use facility based (health centre) and outreach approaches that complement the activities of each other. In addition, support and guidance needs to be provided to community workers from central levels of organisation. The need remains for some programs to run centrally (for example, food fortification). They advocate that multifaceted interventions are required to improve nutrition and prevent growth faltering in communities. Also, those intervention components should be readily able to integrate into existing primary health care activities.

Brewster[4] argues that there is evidence that communities with a high prevalence of failure-to-thrive warrant a nutritional intervention program targeted to 'at risk' families with children under three years of age. He believes programs should include food and micronutrient supplements, environmental health improvements, health and nutrition education, and psychosocial and supportive clinical follow up. On the other hand, the World Health Organization suggests that the processes of planning and implementing nutrition programs, and the quality of personnel, are more critical to program effectiveness than the specific content or type of intervention.[95] This is supported by Lee's[96] finding in her nutrition-based research completed in remote Indigenous communities. She found that developing trusting relationships with Aboriginal people living in remote communities was a key factor in them agreeing to participate in a nutrition health promotion program.

LIMITATIONS

The search strategy used to identify studies and reports potentially relevant for this review appears to have been successful. Checking the reference lists of the systematic and narrative literature reviews indicated that few

studies were missed. However, it is possible that some unpublished evaluations or reports on projects and programs were not identified, and therefore the potential for publication bias should be considered.

Some studies and reports were reviewed which might have otherwise been excluded on the grounds of poor study design. These were assessed in an attempt to gain more information on program design and implementation issues that may be useful in considering options for future policy and program development. However, information on program design and implementation was generally inadequate for this purpose. Similarly there was generally inadequate information to determine the relative effectiveness of different interventions or programs in children of different ages.

IMPLICATIONS FOR POLICY AND PRACTICE

In May 2006 the National Health and Medical Research Council[97] (NHMRC) published a report concerning recent and current policies of Australian governments in the broad area of child health and wellbeing. In this report the priority implication for child health policy was that existing policies need to be better coordinated.[97] Also, the report emphasised the need to identify any gaps in existing policy. This is considered necessary as currently child health policies are developed in several sectors and are implemented across several portfolios as well through several levels of government (for example health, welfare and education). This results in a fragmented approach to program development and the delivery of services. The NHMRC[97] argues that the current approach to early childhood health policies acts as a block to the collection, connection and comprehensive analysis of data and the accurate measurement of outcomes. This fragmented policy approach to improving Indigenous children's health cascades down to the community level. It makes it more difficult for health workers and others to take a strategic approach, in particular, to address Indigenous child health problems arising from a mix of complex issues. These issues include poor living conditions, overcrowding, low socio-economic status, high levels of family and community dysfunction, and poor access to early intervention and social support services.

Nationally there appears to be general agreement about the focus of child health policies that aim to improve the growth and development of Indigenous children. The focus includes: promoting the health of pregnant Indigenous women; reducing the comparatively high number of low birth weight babies born to Indigenous women; promoting the healthy growth and wellbeing of Indigenous children by promoting breastfeeding, immunisation and through parenting, nutrition, and other community programs.

Important implications for policy and practice from the general literature include:
- There is an ongoing need to strengthen resources and capacity at community level to plan and implement preventative programs using culturally appropriate and participatory methods, with a focus on the family.

- Interventions should be selected on the basis of evidence of potential impact and on feasibility in the local context.

- The importance of many factors that are more or less outside the influence of the health sectors highlights the need for good co-ordination and co-operation between agencies in order to develop and implement more multifaceted and comprehensive programs.

- There is a need to enhance the acceptability of interventions to caregivers, families and the wider community in order to effectively engage with families on a continuing basis.

The implications for policy and practice from the research evidence included in this review are:

- Community based nutrition education/counselling interventions that involve carers, community health workers, community representatives, that are designed to meet program best practice requirements, address the underlying causes of growth faltering, and focus on nutrition behaviour change may prevent growth faltering. These interventions require ongoing evaluation and refinement.

- Multifaceted interventions that involve carers, community health workers, community representatives, that are designed to meet program best practice requirements, address the underlying causes of growth faltering, and that are well integrated into primary health care systems may prevent growth faltering. These interventions require ongoing evaluation and refinement.

- In general, community feeding programs should only be implemented in situations where food insecurity is a major problem and where feeding programs are supported by the local community. Such programs should only be seen as a relatively short term solution.

- Growth monitoring can be included in programs that aim to prevent failure-to-thrive. However, there is a need to ensure that this intervention is integrated into a broader primary health care program that includes assessment of other major risks to child health. These programs need to ensure early follow-up and that effective action is taken on detecting growth is faltering. In particular, there is a need to treat common infections, specific nutrient deficiencies, and to ensure that an appropriate quantity of suitable food is available to the child on an ongoing basis.

- Vitamin and mineral supplementation (iron, zinc, iron and zinc, vitamin A, multiple micronutrients) should only be considered in populations where a deficiency is known to be a common underlying factor causing growth faltering.

- Deworming as a means to prevent growth faltering should be used in populations known to suffer from high rates of infestation, and should be used in association with other interventions that will prevent reinfestation, for example improved sanitation and hand washing.

IMPLICATIONS FOR FURTHER RESEARCH

In view of the paucity of high-quality data on interventions to prevent growth faltering, in particular in the Australian Indigenous context, further well-conducted research is required that addresses the key causes of growth faltering.

Research is required on three levels. Firstly, research is needed to determine the main causes of growth faltering in remote Indigenous communities. Secondly, once more information is available on the causes of growth faltering, to develop and trial interventions that are designed to address these causes. Thirdly, there is a need to develop and trial study designs that are suitable for assessing the effectiveness of multifaceted interventions. Without a better understanding of the issues that underlie growth faltering, and good evidence on the effectiveness of interventions, the challenge of reducing the prevalence of growth faltering and failure-to-thrive among Aboriginal children will remain difficult to address.

6. CONCLUSION

The majority of the studies addressing the prevention of growth faltering were found to be of poor quality. Only four studies focused on the poor growth of Australian Indigenous children and these were rated to be of poor quality. The evidence that is available to support the use of some interventions to prevent growth faltering is not strong and the effects are modest. Overall, there is little high quality evidence that clearly supports the use of any interventions.

Many of the interventions appeared to be poorly designed. The extent that this was due to the difficulties associated with conducting research in the context of poverty, disadvantage, and limited resources is not clear.

Growth faltering among Australian Indigenous children living in remote communities is underpinned by a number of complex social, cultural, economic and environmental factors. The complex nature of growth faltering (and the importance of the problem) is reflected by the number of different types of interventions tested. It is clear that the serious consequences of growth faltering require immediate measures to limit its impact, as well as longer term measures to address the underlying causes of the problem. Well designed research studies will be required to determine the role of population-based preventive strategies in this process.

In addition to the clear need for better evidence to support specific preventive interventions, there is also a need for better evidence on approaches to the implementation of interventions. This applies especially in the case of remote Indigenous communities where the cause of extreme disadvantage is more complex than poverty alone. Given the lack of evidence to support simple preventive interventions delivered by external services, we recommend that community members are made aware of the seriousness of the problems and advised on its likely causes and potential approaches to interventions. Hopefully, community members will be able to participate in identifying appropriate approaches to preventing growth faltering at local and regional levels.

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