An Evaluation of a Nutrition Program in a Remote Community in Central Australia

Ilan Warchivker, Angharad Hayter

6th National Rural Health Conference
Canberra, Australian Capital Territory, 4-7 March 2001
An evaluation of a nutrition program in a remote community in central Australia

Ilan Warchivker, Centre for Remote Health Alice Springs, Angharad Hayter, University of Melbourne

INTRODUCTION

The problem of child nutrition in Aboriginal communities in Australia generally and in the Northern Territory is well documented (Ruben and Walker 1995, NHMRC 1997, Skull et al 1997, Mackerras 1998). The infant population also suffers a high rate of hospitalisation especially for gastroenteritis and nutrition problems (Wakerman et al 1998). Most of these hospitalisations occurred prior to the age of 2 years. The average length of stay of children age <5 years in the Alice Springs Hospital for an episode of gastroenteritis between 1992–1995 was 14 days. This declined to 7.7 days in 1999. The national average length of stay for gastroenteritis is 2.05 days. Many of the children admitted to the hospital had a follow up admission to the Child Health Unit (CHU) until its closure in 1998.

Over the years there have been several interventions that have attempted to address the problem of child nutrition. Butlin (1997) argued that there is little documentation of the effectiveness of primary health care intervention to improve child nutrition in remote Aboriginal Communities. Lee et al (1995) and Mackerras (1998) examined community-based program in Top End communities in the Northern Territory.

Community members developed the structure of the program during three months of consultations. The researchers, through consultation with mothers, developed a revised form of individual growth monitoring — child growth velocity using computerised growth charts that ensured early detection of growth faltering and structure in the evaluation. The form of feedback to mothers was developed in consultation with mothers and modified overtime. The project is a collaborative effort between the mothers and carers of children under 3, the Pintubi Homeland Health Service, The Ngintaka Women’s Centre, the community store, the Centre for Remote Health and previously the Alice Springs Unit of the Menzies School of Health Research.

The program includes four main components: provision of meals, individual child growth monitoring and feedback to mothers, workshops at the women’s centre, and presentation to health staff and health committee members (Warchivker 2000). The program employs two nutrition workers on a part time basis. They are responsible to enlist children in the meals program and provide breakfast at the women’s centre and cook and deliver the lunches. Participation in the meals program is voluntary and carries a fortnightly fee. Health staff is responsible to weigh and report to the researcher children weight on a monthly basis. Health staff provides information to mothers and pass on information to the nutrition workers. The researcher is responsible for identifying children “at risk” and discuss the situation with the senior nutrition worker in order to finalise the list of mothers who should be encouraged to enlist in the meal
program. Workshops and individual feedback is provided on a quarterly basis and presentations to health staff and health committee are provided biannually. The program commenced in July 1998 and had a potential to influence the growth pattern of all children born in 1998 and later. The paper analyses the cost effectiveness of this community-based initiative.

**AIMS**

- To analyse the changes in prevalence of malnutrition and growth status in children aged 0 to 36 months from a remote Aboriginal community in central Australia over time.
- To analyse the changes in the reported occurrence of diarrhoeal disease in children aged 0 to 36 months from a remote Aboriginal community in central Australia over time.
- To analyse the impact of a community-based child nutrition program on the hospitalisation levels.
- To analyse the cost effectiveness of the intervention.

**EVALUATION METHODS**

This evaluation was conducted through a longitudinal retrospective review of community clinic records relating to child growth, malnutrition and diarrhoeal disease from January 1994 to June 2000. This period was divided into three timeframes: prior to the needs analysis (1.1.1994 – 30.6.1996), prior to the nutrition program (1.7.1996 – 30.6.1998), and post commencement of the nutrition program 1.7.1998 – 30.6.2000).

Anthropometric data was collected from individual’s clinic files by the researcher and local Aboriginal Health Workers (AHWs). Anthropometric data was not included if the child was dehydrated or receiving re-hydration treatment. Anthropometric data and statistical analysis were performed using EpiInfo 2000. Z-scores were calculated based on the 1977 NCHS/WHO reference. Only weight-for-age z-scores (WAZ) have been used for analysis because of the scarcity of other anthropometric measurements.

Records of clinic attendance for diarrhoeal disease were collected from individual clinic files by the researcher and local AHWs. A visit to the clinic was counted as a new episode provided it was 7 days or more since the last presentation with the same complaint (following Ratnaike et al 1987). Multiple visits during a seven-day period were counted as one episode.

Hospital admissions analysis included gastroenteritis and nutritional problems using the diagnostic-related groups (DRGs) — DRGs 335/350 and 531, 532, and 533. Visitors to the community were excluded from the data. The reporting is done for financial years to reflect more accurately the impact of the program.
Hospital expenditure estimates were based on the national (DRGs) cost weights. Two adjustments of these cost weights were done. Firstly costs were proportionally increased to account for the different length of stay (LOS) of Aboriginal children at Alice Springs Hospital. Secondly an adjustment was made to account for declining costs associated with longer LOS especially for DRGs 350 and 531. Evacuation costs were obtained from THS records. The cost analysis utilised expenditure related to the Royal Flying Doctor Services.

The following analysis costs the different components of hospitalisation and evacuation-related costs in the community, and transfer of children and carers compared with the community-based prevention of gastroenteritis and nutritional problems. Sensitivity analysis was also conducted. No attempt was made to analyse the potential long-term benefits of the intervention.

RESULTS

75 children aged 0 to 36 months were involved in the evaluation of growth, malnutrition and diarrhoeal disease.

Growth status at birth

Birth weights were available for 73 of the 75 children. The mean birth weight for the 73 children was 2.98 kg. In the Northern Territory the mean birth weight in 1998 was 3.313 kg for Aboriginal Children and 3.327 kg for non-Aboriginal children. The proportion of low birth children (17.3%) is higher than the Northern Territory average of Aboriginal population (12%) in 1998. The mean birth weight has increased since the nutrition program commenced. A scatter plot of weight for age z-scores at birth is provided in Figure 1.

Growth status and the prevalence of malnutrition of children aged 0 to 36 months

Figure 2 outlines the distribution of z-scores in the three study periods. The mean WAZ and proportion of WAZs below the reference mean (WAZ=0) were both significant (p<0.05).

The growth status and the prevalence of malnutrition of these children were significantly worse than the reference population for all study periods. There was a decline in the mean WAZ and an increase in the proportion of WAZs below the reference mean from the first to the second study period despite an improvement in the prevalence of malnutrition during this time (Table 1).

Between the second and the third period the mean WAZ and proportion of WAZs below the reference mean improved as did the prevalence of malnutrition. Therefore a significant improvement in both the growth status and the prevalence of malnutrition was only seen after the introduction of the nutrition program.
Figure 1  Scatter plot of weight-for-age z-scores (WAZ) at birth and mean birth WAZ for each year of birth (dotted line)*

* Three children born in 1991 are included in the sample because they have been analysed in the timeframe of the project. Not all children born in 1991 are included in this figure. As a result 1991 mean birth Z-score is not reflective of the true mean birth Z-score for this year. Similarly, only children born in the January–June 2000 period were included in the year 2000 data.

Figure 2  Distribution of weight-for-age z-scores for each study period
Table 1  Growth status and the prevalence of malnutrition for children aged 0 to 36 months

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Mean age (months)</td>
<td>17.3</td>
<td>17.3</td>
</tr>
<tr>
<td>Prevalence of malnutrition (%)</td>
<td>40.56</td>
<td>30.20 (−25.54%)</td>
</tr>
<tr>
<td>Mean WAZ</td>
<td>−0.845</td>
<td>−1.001</td>
</tr>
<tr>
<td>SD of mean WAZ</td>
<td>0.942</td>
<td>0.860</td>
</tr>
<tr>
<td>% below reference mean (WAZ&lt;0)</td>
<td>85.71</td>
<td>90.0 (4.78%)</td>
</tr>
</tbody>
</table>

All prevalence of malnutrition and % below reference mean were statistically significant p-value <0.05
(Brackets) show the direction and proportional change from the previous study period.
* Indicates statistical significance (p<0.05)

Growth status and the prevalence of malnutrition at different age groups

Figure 3 shows the decline in mean WAZ with age for each study period. The largest proportional decline in mean WAZ occurred in the first study period. In the second study period the mean WAZ at 0–4 months is much lower due to the higher number of small babies born during this period (see Table1). For the third study period, faltering of growth does not occur until after 5–9 months. The mean WAZ become comparable for each study period after 25–29 months.

Figure 3  Mean WAZ at different groups
Figure 4 shows that the mean WAZ of children born in the community generally improved in the first four months of life. Children born in 1999 and 1997 experienced an increase in mean WAZ between the age group 0–4 and 5–9. In all other years there was a decline in mean WAZ after the age of 5 months and children do not experience a catch up growth after the age of 14 months.

**Occurrence of diarrhoeal disease in children aged 0 to 36 months**

The reported incidence of diarrhoea increased with age for the three study periods up to a peak age group (different for each study period), after which a decline was evident. It is also clear that (except for 0–4 months) the incidence of diarrhoea was lower across all age groups since the introduction of the nutrition program. The largest decline between the first/second study periods and the third study period occurred in the age group 15–19 months.
As shown in Table 2, the number of clinic visits per year and clinic visits per child-year declined with each subsequent study period. However, the reported incidence of diarrhoea (episodes per child-year) only declined after the introduction of the nutrition program.

### Table 2  Reported occurrence of diarrhoeal disease in children aged 0 to 36 months

<table>
<thead>
<tr>
<th>Study period</th>
<th>Number of children</th>
<th>Number of clinic visits per year</th>
<th>Clinic visits per child-year</th>
<th>Episodes per child-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to the needs analysis</td>
<td>35</td>
<td>153</td>
<td>4.36</td>
<td>1.93</td>
</tr>
<tr>
<td>Prior to the nutrition program</td>
<td>40</td>
<td>134</td>
<td>3.37</td>
<td>2.07</td>
</tr>
<tr>
<td>Nutrition program</td>
<td>40</td>
<td>100</td>
<td>2.50</td>
<td>1.52</td>
</tr>
</tbody>
</table>

**Hospitalisation**

The trend in hospital admission has been declining since 1993–94. The largest decline in hospital admissions (70%) occurred since the commencement of the nutrition program in July 1998. This level of hospitalisation was sustained in 1999–2000 despite an increase in the number of children born in the community during this time. This reduction in hospitalisation accounted for 34% of the total regional decline in gastroenteritis and nutrition problems related hospital admissions between 1997–98 and 1998–99 in this age group.
**Figure 6** Number of hospital admissions of children age 0–5 for gastroenteritis and nutrition problem from June 1993 to July 2000

---

**Cost effectiveness**

In analysing the cost effectiveness of the intervention we compare the clinic, transport and accommodation, and hospitalisation costs of the treatment and prevention related activities in the 2 years prior and 2 years post commencement of the project. Table 3 presents the results of this analysis. The analysis shows that the project is cost effective.

Over a period of two years the potential cost savings resulting from the introduction of the nutrition project were $133,780. Most of the potential savings relate to hospitalisation and evacuation costs, despite the introduction of the nutrition program account for 88.7% of total potential cost savings.

The reduction in costs associated with treatment and preparation for evacuation at the primary level account for 11.3% of the potential cost savings. A substantial amount of these resources could be reallocated for other primary health care activities.

**Table 3** Cost effectiveness analysis: a four year comparison*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalisation, evacuation, and prevention</td>
<td>360,600</td>
<td>241,900</td>
<td>118,700</td>
</tr>
<tr>
<td>Preparation for evacuation at the clinic</td>
<td>15,400</td>
<td>3,700</td>
<td>11,700</td>
</tr>
<tr>
<td>Treatment of cost of children with diarrhoea</td>
<td>8,940</td>
<td>5,560</td>
<td>3,380</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>384,940</td>
<td>251,160</td>
<td><strong>133,780</strong></td>
</tr>
</tbody>
</table>

* All cost are calculated in 2000 Australian Dollars (September Quarter)
A sensitivity analysis was conducted to analyse the potential cost savings under different assumptions. The most influential factor is a change in the number of prevented hospitalisations. The results of the sensitivity analysis indicate that the break-even point of introducing a community-based nutrition program is a reduction of 30–35% in hospitalisations for a community with a similar population size and similar pattern of hospitalisations and similar distance from the referral hospital.

**DISCUSSION**

In contrast to a cross-sectional study, a longitudinal study provides a useful and more accurate way to describe child growth and diarrhoeal disease over time, and especially in relation to an intervention such as the nutrition program. Longitudinal studies can allow for possible analysis of changes related to seasonal, disease and socio-environmental influences and diarrhoea on child growth. However, longitudinal studies tend to be more time consuming, costly and technically difficult, so it is not surprising that there are very few other similar studies.

This study has highlighted the benefits of assessing the overall growth status of a study population in addition to reporting the prevalence of malnutrition. It has provided more detailed information about the age when growth faltering occurs and the changes in growth status of the study population over time and in relation to the introduction of the nutrition program.

**Growth status and the prevalence of malnutrition aged 0 to 36 months**

Over the entire study period the majority of the study population had poorer growth status and higher levels of malnutrition when compared to the reference population. It was only after the introduction of the nutrition program that a significant improvement in growth status and decline in the prevalence of malnutrition occurred.

Improvements in growth status and malnutrition occurred particularly in the first year of life. The nutrition program is less likely to have an impact on older children since they may have already experienced months of poor growth in their early months of life. Our experience suggests that a catch-up growth is difficult to achieve and is very difficult to sustain.

A further analysis of malnutrition in the third study period was done for children born after the introduction of the program. There were no malnourished children among the cohort born in 1999 and 2000. Similarly the mean z-score of children aged 14 months and over in the third period is partly attributed to children born in 1997 who reached the age of 14 months when the nutrition program commenced in July 1998. The ability of the program to have a positive impact on these children has been limited. This is because of the difficulty in improving the catch up growth after a decline in growth velocity especially in the first 10 months of life.

Some of the patterns of growth and malnutrition seen here are partly related to the mobility of children in and out of the community and the movement of children from one study period to another. For example an adjusted mean Z-score to account for
population mobility in timeframe 1 will be –1.191 for the 25–29 months group and -1.04 for the 30–36 month group and in timeframe 2 it will be –1.37 for 25–29 months group and –1.218 for the 30–36 months group. Thus population mobility accounted for most of the differentiation between these age groups. The better mean Z-score in the age of 30–36 months is due to children movement in and out of the community or missing weight records. (Does this need to be mentioned in the methods?)

The decline in both the prevalence of malnutrition and the rate of hospitalisations and the overall improvement in growth status of these children indicate an association between the commencement of the nutrition program. The overall improvement in the growth status and the decline in the prevalence of malnutrition indicate that the improvement was not limited to the children who participated in the meals program of the nutrition initiative. The improvement may also be attributed to other components of the program such as nutrition education, active follow-up of children not growing well, increased support for families.

Diarrhoeal disease

This section of the study provides community-based information on the reported incidence of diarrhoea, and therefore gives a more accurate assessment of the incidence of the disease than hospital-based studies can provide. However it still has limitations in that the data from clinic records relates only to the reported incidence of diarrhoea, and may underestimate the true incidence of diarrhoea since some children may not have visited the clinic during an episode of diarrhoea.

The reported incidence of diarrhoea increased in the second study period compared to the first. This trend was reversed in the third period with 28% decline in the reported incidence of diarrhoea. It was not possible to determine whether this decline is directly related to the nutrition program itself. However, given the turn-around in the increasing trend of diarrhoea prior to the program, it is likely that the program had some positive effect. This may have occurred through improved primary care management, increased awareness of the detrimental nutritional effects of the disease (through community-based nutrition education) and the improved growth status of young children may have had some influence in the decline. Some of the patterns seen here may also be explained by the mobility of children in and out of the community and by the movement of some children from one study period to the next.

A study with a similar methodology based in a remote Aboriginal community of South Australia showed that the reported incidence in under five year olds was 1.24 episodes per child-year (Ratnaike et al 1987). This was lower than the reported incidences shown in this study, but may be expected given that the incidence of diarrhoea generally declines with age after 2 to 3 years of age.

Hospitalisation

The ability of the program to sustain the reduction in hospital admission that was achieved in the first year indicates the positive long-term impact of the program. It suggests that the decline achieved in the first year was no coincidence. A reduction of this magnitude in the context of a declining trend in hospitalisation is a remarkable achievement. The hospitalisation results are impressive for two additional reasons. Firstly it occurred despite the low average birth weight experienced by children born in

Cost effectiveness
An estimation of the potential cost savings suggests that investment in child health is cost effective and a low risk investment. The study shows large potential savings to the health care system in relation to young children at both the primary and secondary health sectors. At this stage these cost savings can release staff to engage in other health care activities. The cost effectiveness of this project is sensitive to the level of reduction in hospitalisation and the composition of hospitalisation. The cost of the intervention can be reduced after the program fully operational through changes in the structure of the nutrition program. The cost of monitoring, education and evaluation can be substantially reduced after the first two years of operation.

CONCLUSION
The study shows that a well designed nutrition program initiated and developed through community participation can achieve substantial improvement in the growth of children age 4–36 months. It is an example of an effective collaboration between community members, a research institution and service providers. This collaboration did not diminish the level “ownership” of this program from community members.

The crucial age in which growth is affected is at the ages of 4–8 months. It is crucial that any community-based intervention will address this age group. We have not been able to report any major incidence of catch up growth. Thus reliance on the prospect of catch up growth is not recommended based on this evidence.

A positive impact that may be ascribed to the project was noticeable also among children who did not participate in the meals on wheels program. The project attracted participants outside the target age group. It generated local employment, empowered mothers and nutrition workers, and possibly had a generally positive effect on health of children in the community and on the understanding of mothers in relation to the issues impacting on child growth.

Our results show an association between the program and child growth and an impressive decrease in the level of hospitalisation from this community. One of the major strengths of this project is that it has a high level of community control. It has an education component that is individual and community orientated. It is a good example of collaboration between different agencies in the community, health professionals and researchers.

The potential cost savings at the secondary sector can only be realised if a regional strategy of funding community-based intervention is developed and supported. The benefits of this type of intervention are likely to have a positive longer-term effect on adult disease. These possible benefits were not analysed as part of this study.
ACKNOWLEDGMENTS

The Rural Health Support Education and Training section of the Commonwealth Department of Health and Aged Care provided financial support for this project. The results described in this evaluation were achieved due to the commitment of the nutrition workers Rosie Nampitjinpa, and Marie Nungurrayi at Ngintaka Women’s Centre. Ongoing supporting efforts for the project from the PHHS health committee, PHHS staff, Ngintaka staff and chairwomen, and participating mothers and carers are greatly appreciated. This paper is partly based on results from Angharad Hayter’s Bachelor of Medical Science project that benefited greatly from comments by Dr Dorothy Meckerras.

REFERENCES

Butlin A, Cashel K, Lee A, Phyland P & Taylor V 1997, Food and Nutrition Programs for Aboriginal and Torres Strait Islander People, Office for Aboriginal and Torres Strait Islander Health Services, Commonwealth Department of Health and Family Services, Canberra.


AUTHORS

Ilan Warchivker is a health economist and has been working in remote and rural health service delivery since arriving in Alice Springs in 1994. His main activities as a health economist have involved economic analysis of health services to remote Aboriginal communities in central Australia. He was instrumental in developing a resource allocation method for health resources in the remote regions of central Australia.

Ilan’s research interests include resource allocation in remote areas, implementation of research findings, evaluation of health services, and support of community public health initiatives, and elimination of health inequalities associated with socioeconomic factors.

Angahard Hayter is a medical student at Melbourne University. She is interested in public health and paediatrics. Last year she took a year off medical studies to complete a Bachelor of Medical Science. Currently she is completing her final year of medicine at Melbourne University.