Investigating the impact of the Mary's Meals food in schools project in Blantyre, Malawi

September 2007

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"*If you cannot feed a hundred children, then feed just one*"

Mother Theresa

A moment of reflection……

We came to Malawi hearing of Mary's Meals through western eyes and western experiences. We volunteered our time and resources because we wanted to contribute to an organisation that touched us with their work - providing an essential hot, nutritious meal for children, which for some was one of the most substantial meals of their day. What we actually saw was so much more.

The contribution and difference that this project makes was particularly poignant within the preschool setting. In every centre, children waited patiently for their lukunli phala in the morning and their second meal of nsima and relish in the afternoon; quietly, anticipatory and hungrily.

At one of the centres, we were offered a bowl of likuni phala just as it was ready, and before the children were served. The look of complete and unadulterated hunger in the eyes of a four year old child standing next to us was indescribable. We didn't eat.

A little boy as young as five knows that the meal served at lunch may be the last hot meal he receives until he arrives at the centre the following day, so before eating, he secures a satiating moment in the evening by scooping half of his meal into the dirty chest pocket of his shirt. Or perhaps he was taking it home to feed a younger sibling. Other children were placing small portions of their meal into scraps of well used plastic bags and sucking on the outside to ensure that no food was wasted.

A five year old girl of a child headed family carries her one year old sister on her back – all day, every day. As the food provided by Mary's Meals was plated up you could see the hunger in her eyes. When the food was served she fed her sister first. A boy who had lost his both of his parents to AIDS, then lived with his grandparents until they passed, now lived with an extended family. With so many mouths to feed, his was always the last.

Think for a moment. Imagine getting up each morning, hungry and drained, having not had anything to eat from 1 pm the day before. You must prepare a fire to heat some water, do some household chores, bathe, and walk to work. If you did have anything for dinner the previous night, it was most likely a ¼ cupful of rice and one small spoon of vegetables.

Think how welcome and satisfying a hot bowl of porridge would be when you arrived at work, how crucial that hot meal would be. This is Mary's Meals. Food - facilitating health, facilitating knowledge, facilitating hope. £6.15 feeds one child a cup of nourishing likuni phala in school each day for one full year.

£6.15 is the cost of a two beers, a Chinese takeout or one packet of cigarettes. Please think about it.

A word of thanks:

This research would not have been possible without the kindness, patience and assistance of the following people:

Magnus MacFarlane-Barrow for his selflessness and devotion to such an important cause;

Maria Byers at SIR in Argyll for kindly giving the assistance that ultimately enabled this research to take place;

Peter Nkata and the team at SIR Malawi, whose hard work and dedication to improving the lives of the children of Malawi is surpassed only by their kindness, warmth and generosity;

Roderick and Margaret Banda, who enthusiastically cooked all of the food and shared all of their recipes so that we could make the diet based research as accurate as possible;

Professor Molyneux at Queen Elizabeth Hospital for taking time out of her incredibly busy schedule to give us a level of direction and advice that no book or journal could offer;

Finally, a huge thank you to the head teacher, staff and pupils at the following primary schools and pre-school centres for their warm welcome and endless enthusiasm:

Goleka primary school

Nanjiriri primary school

South-Lunzu primary school

Manja primary school

Chigumula primary school

St. James primary school
(Chilomoni)

Misesa primary school

Namaywawa primary school

Mzedi-Budawo pre-school

Namame pre-school

Mpemba pre-school

St. Marys Chimusa pre-school

Ndirande Parish pre-school

Bangwe pre-school

Abstract

Research was carried out over a 5 week period in Blanytre, Malawi to determine the nutritional requirements of children aged 4 to 6, 9 and 13 years. Methodology included anthropometrical measurements, 24 hour diet recall and 24 hour physical activity diaries, which were analysed to determine daily energy requirements. The composition of likuni phala was compared to the nutritional requirements of each age group alongside the nutritional content of food provided out with the programme. Findings indicated that children were achieving 100% of protein, iron and vitamin A requirements on days that they received food through Mary's Meals. In addition, approximately 70% of Vitamin A needs and over 50% most other micronutrient needs were consumed by the different age groups throughout the course of a day. Likuni phala contributed between 9 and 13% of daily energy requirements, and approximately 30% of actual daily energy intake.

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Introduction

Malawi, the 'warm heart of Africa', is a peaceful and beautiful country that is situated in Southern Eastern Africa, bordering Tanzania and Zambia. As with many African countries, the situation is dire. Malawi is the seventh poorest country in the world, and one of the most heavily populated (*Benson, Kaphuka, Kanyanda and Chinula 2002)*. Over half of the population live on less than $1 per day and face a continuous struggle against drought and crop failure (*UNICEF 2007).*

The staple crop is maize, but the past 10 years, Malawi has experienced at least 5 severe droughts and a number of cyclical floods that have damaged crops and led to periods of famine (*World Food Programme 2007)*. In addition to environmental issues, there is a growing HIV/AIDS pandemic which is now the leading death of adults in Malawi – at least 14% of the adult population are infected with HIV/AIDS (*National Satistical Office 2004*), with over 200 people dying from AIDS related illnesses every day. The consequence of this is a growing number of child headed families who struggle to cope with day to day existence.

Over half of children under five years of age are of low height for age (*Pendame 2001)*; 5% are wasted or severely malnourished; 22 % underweight or malnourished and half of 1 million orphans have lost one or both parents to AIDS (*UNICEF 2007*). Many children end up in orphanages and 25% of children die before they reach age 5.

A glimmer of hope

Mary's Meals, managed by Scottish charity Scottish International Relief (SIR) currently supplies food to children in 9 countries across the world, but began in Blantyre, Malawi in 2000 when a school

child was asked what SIR could provide him with that would help him most. He responded by saying that he would like enough food so that he had the energy to go to school and learn. And so the Mary's Meals food in schools programme was born.

With a team of just 18 people, SIR Malawi has been running the Mary's Meals programme for 7 years in pre schools that support children from orphanages. In the last 4 years the project has evolved to supply a meal a day to children in over 100 primary schools across the Blantyre region and beyond. The Mary's Meals food in schools programme is spreading quickly, currently supplying a meal a day to just under 250,000 children in Malawi alone. Due to the essentiality of the food supplied, the Mary's Meals programme also runs throughout the school holidays.

Until the programme began many children from the more impoverished areas were not attending school; it was a greater priority to find food. Since the Mary's Meals programme began, attendance has increased dramatically, and children are much more likely to complete their primary school education successfully. The aim of this research was to carry out a nutritional review of the Mary's Meals programme in and around Blantyre and to make recommendations to the SIR Malawi team accordingly. The researchers spent 5 weeks working with the charity and the schools involved to offer a snapshot of the impact of the project.

The importance of good nutrition

Currently, throughout the world, there are 300 million children who suffer from hunger and malnutrition (*World Health Organisation*). Many children suffer needlessly from conditions such as goitre, cretinism, night blindness, anaemia, rickets, pellagra and beriberi simply because they do not receive the vitamins and minerals that could be provided in one fortified meal.

Good nutrition is essential for day to day human function and a different amount of each nutrient is required each day for optimum growth, repair and maintenance. In order to understand the importance of the likuni phala porridge dish that is provided by Mary's Meals it is firstly essential to understand the necessity of these nutrients and the effects caused by deficiency. The following section is therefore designed to give a brief overview of the importance of the essential nutrients that are supplied to children in Malawi through the Mary's Meals programme.

The macronutrients

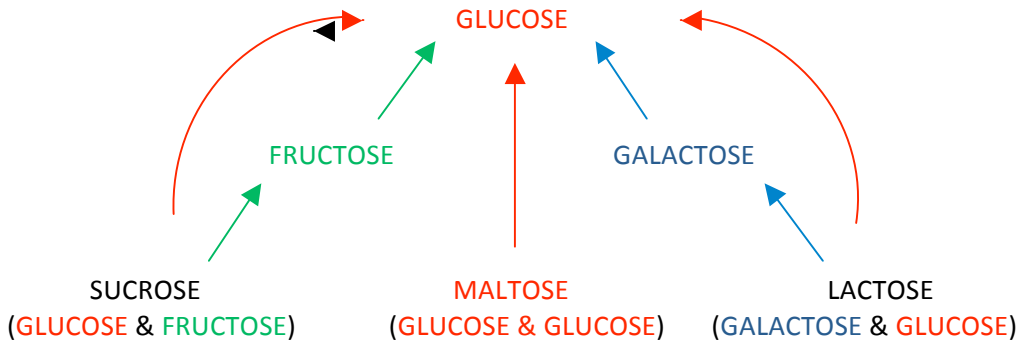
There are nutrients that are referred to as the 'macronutrients' – macro means 'big', and therefore the macronutrients are those that we require in a larger quantity. Sometimes the macronutrients are also referred to as the 'energy yielding' nutrients, because these are the nutrients that are broken down to provide energy to the human body.

There are 3 key energy yielding nutrients; carbohydrates, proteins and fat. Alcohol is also an energy yielding nutrient but due to its toxicity there are no daily recommendations for intake, only recommendations for safe upper limits.

Many foods contain carbohydrates. They can be 'complex', which means that they have a complex structure that combines carbohydrates with fibre and are therefore more difficult to break down in the intestinal tract. Refined carbohydrates are easier for the body to break down but contain less fibre, which is needed for transit of food through the intestine.

All carbohydrates are broken down into a simple sugar called glucose which is the preferred source of energy in the human body. The main function of carbohydrates is to provide energy that the body requires to function. In 1 gram of carbohydrate there are 3.75 kilocalories (kcal).

This diagram shows the breakdown of simple sugars:



One gram of fat contains 9kcals, which makes it the most energy dense of all of the energy yielding nutrients. There are 3 main types of fat; saturated fat, monounsaturated fat and polyunsaturated fat. Saturated fat is linked to health issues such as heart disease and should be eaten in moderation. Many of the polyunsaturated fats, such as the omega-3 fats found in fish and seed oil, are thought to have health benefits such as improvement of joints and reduced risk of heart disease. Fat is needed for energy, but is also used by the body for many other functions including hormone production.

Protein is essential for growth and maintenance. The building blocks of proteins are called 'amino acids'. There are 9 of these amino acids that are called 'essential amino acids' – they are essential because we cannot make them in our body and instead need to get them through our diet. Proteins are needed for a vast range of functions in the body including production of blood cells, enzymes, hormones, muscles, hair, skin and nails. Protein Energy Malnutrition (PEM) is common in the developing world and leads to conditions associated with starvation such as kwashiorkor.

The micronutrients

The body also requires vitamins and minerals. These are called 'micronutrients' because they are needed in very small amounts. However, each has essential roles in the day today protection and maintenance of the human body. There are many micronutrients that the body needs, each in a different quantity. The amount that is required is called the 'recommended nutrient intake', or RNI,

which is the amount that is required by 97.5% of a healthy population. Nutrient requirements vary with age and gender.

Vitamin A is a fat soluble vitamin that has many functions in the body. It acts as an antioxidant, it is needed for good sight, and it is involved in the differentiation of cells. Deficiency of vitamin A is common in Malawi and in most developing countries. Vitamin A deficiency can cause night blindness, which can eventually lead to the hardening of the eye and total blindness if untreated. Susceptibility to infection and hardening of mucous producing cells are also symptoms of vitamin A deficiency.

Thiamine (Vitamin B1) is a water soluble vitamin that is required for the breakdown of carbohydrates and some amino acids. Deficiency of thiamine is a disorder of the nervous system called 'beriberi' which tends to occur in developing countries where rice is the staple food.

Riboflavin (Vitamin B2) is a water soluble vitamin that is required for the breakdown of all energy yielding nutrients. Deficiency is called hyporiboflavinosis, and results from poor food supply, often exacerbated by poor food storage or processing. Symptoms include sore throat, swollen tongue, oedema of the membranes in the mouth and pharynx and dermatitis.

Niacin (Vitamin B3) is a water soluble vitamin that is also required for the breakdown of energy yielding nutrients. Deficiency of niacin is called 'pellagra'. It is a condition that is common where the staple crop is corn and maize and there is low consumption of protein. Pellagra is a chronic wasting disease. Symptoms include a symmetrical bilateral form of dermatitis, as well as dementia and diarrhoea.

Vitamin C is a water soluble vitamin that acts as an antioxidant in the body. It is also required for the production of collagen, a protein which gives skin its' elasticity. In addition, vitamin C assists with the absorption of non-haem iron. Deficiency of vitamin C is called 'Scurvy'. Symptoms include susceptibility to infection, joint pain, bleeding gums, poor wound healing, and iron deficiency anaemia.

Iron is a mineral that is required in the production of haemoglobin, the red pigment in blood that transports the oxygen. Deficiency of iron leads to malaise and eventually to iron deficiency anaemia, characterised by severe malaise, an inability to concentrate and a pale complexion. Haem iron is found in meat products and is more readily absorbed than iron from non haem, or vegetable sources.

Calcium is a mineral required for strong teeth and bones, as well as acting as a coenzyme in blood clotting mechanisms. It is also necessary for the contraction of cardiac muscle. Deficiency leads to a weakness of bones called osteoporosis. Calcium can be found in dairy produce, small fish (where the whole fish is eaten) and some vegetables.

Zinc is found mostly in meat products and some shellfish. It is involved in the metabolism of the energy yielding nutrients protein, carbohydrate and alcohol, as well as DNA and RNA synthesis. It is also involved in antioxidant activity. Deficiency of zinc manifests as impaired growth or maturation, reduced immune function, low sperm count and weight loss.

Table to show dietary sources of vitamins and minerals:

Vitamin	Good-to-moderate dietary sources
Vitamin A	Meat products, orange coloured fruits and vegetables
Thiamine (B1)	Pork, organ meats, whole grains, and legumes
Riboflavin (B2)	Milk and dairy products, meats, and green vegetables
Niacin (B3)	Liver, lean meats, grains, and legumes
Folate	Meat products, green leafy vegetables
Vitamin B12	Meat and meat products
Vitamin C	Fruit, especially citrus, vegetables, potatoes
Iron	Meat products, green leafy vegetables
Calcium	Dairy products, some vegetables
Zinc	Mainly meat products and shellfish
Iodine	Iodinized salt

Nutrient deficiencies in Malawi

The most common nutrient deficiencies in Malawi are vitamin A deficiency, iron deficiency, and iodine deficiency. Vitamin A deficiency is a widespread problem in Malawi. The National Micronutrient Survey of 2001 (Pendame 2004) showed that almost 60% of preschool children, 38% of school children have serum retinol values <20μg/dL. The highest prevalence of iron deficiency anemia was found in preschool children (80%); research also found that 22% of school children were anaemic.

In Malawi, salt fortification with iodine is now mandatory. Voluntary fortification includes likuni phala, maize meal and skimmed milk powder. Currently the Ministry of Trade is working with the private sector to fortify sugar with vitamin A also (*World Food Programme 2007).*

The World Food Programme, the Ministry of Health and a wide range of Non Governmental Organisations (NGO's) in Malawi are currently distributing fortified food to those who are malnourished. The likuni phala distributed through Mary's Meals is fortified to the same nutrient specification as the likuni phala distributed by the World Food Programme.

Table 1: Micronutrient recommended intake

Group	Vit A* (µg/d)	Thiamin (mg/d)	Riboflavin (mg/d)	Niacin (mg/d)	Folate (µg/d)	Vit B12 (µg/d)	Vit C (mg/d)	Iron** (mg/d)	Calcium (mg/d)	Zinc (mg/d)
Infants and children										
0–6 months	375	0.2	0.3	2	80	0.4	25	-	300	2.8
7–12 months	400	0.3	0.4	4	80	0.7	30	9.3	400	4.1
1–3 yrs	400	0.5	0.5	6	150	0.9	30	5.8	500	4.1
4–6 yrs	450	0.6	0.6	8	200	1.2	30	6.3	600	4.8
7–9 yrs	500	0.9	0.9	12	300	1.8	35	8.9	700	5.6
Adolescents										
Females, 10–18 yrs	600	1.1	1.0	16	400	2.4	40	32.7	1300	7.2
Males, 10–18 yrs	600	1.2	1.3	16	400	2.4	40	18.8	1300	8.6
Adults										
Females, 19+ yrs	500	1.1	1.1	14	400	2.4	45	29.4	1000	4.9
Males, 19+ yrs	600	1.2	1.3	16	400	2.4	45	13.7	1000	7.0
Pregnant women	800	1.4	1.4	18	600	2.6	55	***	1200	av 7.0
Lactating women	850	1.5	1.6	17	500	2.8	70	15	1000	av 8.8

*Vitamin A is listed as recommended daily safe amount rather than recommended daily intake due to it's ability to cause toxicity

**Iron is listed at requirements at 10% bioavailability; at 0-6 mths iron stores are sufficient

***There is difficulty calculating exact dietary iron requirements in pregnant women. WHO recommends daily supplements of 100mg iron to women in the 3rd trimester

The following table shows the daily recommended intake for each of the vitamins and minerals that are added to the likuni phala porridge.

Aims and objectives of this research

The aim of this research was to assess the impact that the Mary's Meals programme is having on the nutritional status of the beneficiaries, and to identify any key differences in beneficiaries that could be attributed to gender, location of school and family circumstances in order that the programme can review it's food distribution.

The aims of the research were:

1. To determine the average Body Mass Index (BMI) of children aged 4-6, 9 and 13 (male and female) by recording height and weight measurements of children at 8 schools and 6 pre schools in the Blantyre area;

2. To gather information regarding average daily physical activity levels (PAL) of male and female students aged 9 and 13 so that average nutritional requirements for the 2 age groups could be determined using FAO/WHO standard equations;

3. To gather information regarding the family situation of the child to determine any significant difference in the BMI and energy expenditure children who are (1) still living with parents; (2) single orphaned and still living with one parent (3) single or double orphaned children who live with extended family; (4) children who have assumed the role of head of family following maternal morbidity;

4. To calculate the nutritional value of one portion of likuni phala (fortified maize based porridge) and the nutritional value of one portion of nsima (maize flour cooked with water), and to calculate what proportion of the children's required daily nutritional amount is supplied by Mary's Meals;

5. To gather information regarding foods consumed by each of the sub groups throughout the course of an average day in addition to the food supplied by Mary's Meals to determine the percentage of daily intake that derives from Mary's Meals, and the percentage that is consumed out with the project;

6. To determine the physical activity levels and average levels of dietary intake of the children aged 4 to 6 years through qualitative interviews with the volunteer staff at each pre-school centre.

Methods of data collection

8 schools of a similar size were randomly selected for this research. 4 schools were close to Blantyre city and 4 were further away from the city (please see map, app.1). Of the schools selected, 4 had been involved with the Mary's Meals programme for a minimum of 2 years and 4 had only recently joined the programme. All children who participated were aged 9 and 13. Age groups were broken down into further sub groups depending on their family situation:

Sub group	Definition
Sub group 1	Both parents still alive
Sub group 2	Single orphaned child – mother is still alive and child lives with mother
Sub group 3	Single or double orphaned child, the child lives with extended family
Sub group 4	Single or double orphaned child, the child has become head of the family

Total number of participants for duration of research (for tables showing sample sizes from each school and centre please see app. 2):

	Total # participants	Total # Boys	Total # Girls	Total # age 5	Total # age 9	Total # age 13
Sub group 1	440	185	255	164	205	71
Sub group 2	324	155	169	95	97	132
Sub group 3	243	113	130	35	76	132
Sub group 4	150	64	86	71	29	50
TOTAL #'s	**1157**	**517**	**640**	**365**	**407**	**385**

Data was collected using the following methods:

Determination of average Body Mass Index: approximately 100 children from each primary school were measured and their weight and height was recorded. Of the children selected, approximately 50 were aged 9 and approximately 50 were aged 13. The sample group was spread evenly over the 4 categories. The measurements taken were used to determine height for age and the body mass index of each child. In the pre-schools all children aged 4 to 6 were measured and their weight and height was recorded. This data was used to determine the body mass index of each child.

Determination of energy requirements: the average weight, height and gender of each age group was used to calculate the average BMR (Basal Metabolic Rate) using FAO/WHO standard equations. Of the children selected from each primary school, a random sample of approximately 35 children aged 9 and 13 were selected to complete a 24 hour physical activity diary. Interviews were also carried out with staff at the preschools to determine average physical activity levels of the children in the 4 to 6 age bracket. FAO standard physical activity ratios (PAR) were used to determine the physical activity level (PAL) for the 24 hour period for each activity diary. This PAL was then multiplied by the results from the BMR equations to determine energy requirements for males and females from each age bracket.

Nutritional composition of the meal provided: information regarding the composition of the likuni phala at dry weight was provided by the factory; at each school the portion size of the likuni phala and the nsima offered to the different age groups was measured. From this data the daily average nutritional offering from Mary's Meals to children aged 4 to 6, 9 and 13 at each of the schools was calculated.

Nutritional composition of other food received throughout day: The 35 children from each school were then asked to show what they had eaten or drank over the 24 hour period preceding the research. Pots were set up with common food choices such as nyemba (bean and tomato based dish), nsima, rice, vegetables and meat. Children were given a plate and asked to demonstrate the portion of each food item consumed after leaving school the day before until arriving at school that morning.

Each food item was weighed and noted. The average amount of food consumed by each age group and sub group was calculated and entered into WinDiets for nutritional analysis. In order to determine the food consumed out with the Mary's Meals programme in the pre school group, interviews were carried out with centre volunteers to ascertain what the centre children normally ate outside of the school day.

Results

All participating children were measured for weight and height, and results were recorded in Microsoft excel for analysis. Weight and height records were used to determine Body Mass Index (BMI), and height records were used to determine percentile of height for age (see tables 8 and 9).

In order to determine the energy requirements of children, the BMR was first calculated using the collated weight and height information. To determine BMR in kcal for each age group the following FAO/WHO calculations were applied:

Males aged 3-10	22.7W + 495
Females aged 3-10	22.5W + 499
Males aged 10-18	16.6W +77H + 572
Females aged 10-18	7.4W + 482H +217

W (weight); H (height)

Physical activity levels (PAL) were determined for each age, gender and category using the data collected in the physical activity diaries and FAO/WHO standard physical activity ratios.

The results identified the average PAL for each category as follows:

Age	Gender	category	PAL
9	f	1	2.2
		2	2.2
		3	2.1
		4	2.2
9	m	1	2.2
		2	2.1
		3	2.2
		4	2.1
13	f	1	2.1
		2	2
		3	2.1
		4	2.1
	m	1	2.1
		2	2
		3	2.1
		4	2.1

Child BMR results were sorted by age, gender and category. The PAL for each category was multiplied by the BMR to calculate the average daily requirements for each child. The average energy requirements for each category were then calculated. These average energy requirements are listed in table 2. The average energy requirement for each age and gender was also calculated, and is shown in table 3.

Table 2: Table to show average BMI and energy requirements for age and gender:

age	gender	category	average weight for age	average height for age	average BMI	average kcal req'd
4 to 6	f	1	15.4	1.01	15.3	1269
		2	15.5	1.00	15.6	1272
		3	15.2	1.00	15.4	1261
		4	15.2	1.00	14.9	1260
4 to 6	m	1	15.8	1.01	15.6	1280
		2	16.1	1.02	15.5	1290
		3	16.2	1.02	15.6	1294
		4	15.5	1.00	15.5	1270
9	f	1	27.0	1.30	16.0	2433
		2	27.2	1.30	16.1	2446
		3	28.7	1.32	16.3	2405
		4	27.3	1.27	16.7	2447
9	m	1	26.8	1.28	16.2	2426
		2	27.2	1.31	15.9	2336
		3	28.0	1.31	16.2	2486
		4	27.0	1.28	16.4	2324
13	f	1	48.4	1.52	20.8	2751
		2	45.2	1.51	19.7	2557
		3	46.2	1.51	20.1	2707
		4	44.0	1.50	19.5	2658
13	m	1	43.5	1.53	18.5	2963
		2	41.1	1.51	17.8	2741
		3	43.3	1.53	18.3	2960
		4	38.9	1.50	17.2	2799

The energy requirements for each group were entered into tables alongside the micronutrient breakdown of the likuni phala. This information was used to calculate daily percentage of energy and other nutrients obtained through food items supplied by Mary's Meals and through food consumed elsewhere by boys and girls aged 9 and 13 from each of the four categories (tables 11 to 26).

Body Mass Index, percentiles and Z scores

The body mass index (BMI) was calculated for each child using the equation weight (kg)/height (m)², and an average BMI was then calculated for each category (see table 2). These average BMI's were plotted on WHO standard percentile and WHZ score charts in order to determine weight for height, which is an indicator of acute malnutrition (see appendices 3 to 6). For results see table 8. The research found that all groups with the exception of the category 4 females aged 4-6 and males aged 13 placed over the 50th percentile. Females aged 4-6 sat on average at the 48th percentile. Males aged 13 who were grouped as category 4 had the lowest percentile average of 35 (z score 0.6 STD -). Research therefore indicates that none of the groups had average low weight-for-height (WHZ <-2). This finding is in keeping with the 2001 micronutrient survey, which found that only 4.7% of preschool children had a WHZ score of <-2, which indicates little wasting at the time that the research was carried out.

Table 3: Table to show average energy requirements for age:

age	gender	category	average energy req's	average
4 to 6	f	1	1269	
		2	1272	
		3	1261	
		4	1260	1266
4 to 6	m	1	1280	
		2	1290	
		3	1294	
		4	1270	1284
9	f	1	2433	
		2	2446	
		3	2405	
		4	2447	2433
9	m	1	2426	
		2	2336	
		3	2486	
		4	2324	2393
13	f	1	2751	
		2	2557	
		3	2707	
		4	2658	2668
13	m	1	2963	
		2	2741	
		3	2960	
		4	2799	2866

However, more research is required to assess the Body Mass Index of children over a period of time, and particularly through the 'hungry months', from December to March.

Height for age was plotted on a CDC standard stature percentile chart, to assess the percentage of children whose growth is stunted, which can be symptomatic of chronic protein energy malnutrition (see appendices 7 and 8). The results can be seen in table 9. Because the children measured in preschool were aged between 4 and 6, and at times the volunteers did not know the exact age of the child, there was not enough information to plot accurate height for age statistics from the data gathered in this report.

However, research for average height for age of children aged 9 shows that girls from categories 1 and 2 sat on the 32nd percentile, and girls from category 3 sat on the 46th percentile. There was a significant difference with the average height for age of the category 4 9 year old girls who sat on the 17th percentile. There was also a significant difference between height for age in boys and girls from the 9 years age group, where boys aged 9 from category 1 and 4 sat on the 19th percentile, and boys from categories 2 and 3 sat on the 28th percentile. 13 year old girls from category 1 had a significantly higher height for age than other girls aged 13, with an average percentile of 24 compared to 19.5 (HAZ <-1), 19.5 (HAZ <-1), and 17.5 (HAZ <-1), for the other 3 groups respectively. Again, there was a significant difference between average percentile of boys from categories 1 and 3, who sat on the 37th percentile, and boys from categories 2 and 4, who sat on the 23rd (HAZ <-1), and 20th (HAZ <-1), respectively.

None of the average percentile scores fell under the 10th percentile, which indicates low height for age (HAZ <- 2). On average, 9 year old girls had the highest average percentile of 31.9, 9 year old boys had an average percentile of 23.5, 13 year old girls had the lowest average percentile of 20.1 (HAZ <-1), and 13 year old boys had an average percentile of 29.5.

Table 4 shows the average BMI by group A and group B, which represents the length of time that the school has been funded through Mary's Meals. These results indicate that on average the BMI of children who attend schools that have been funded through Mary's Meals for a substantial length of time (group A) have a slightly higher BMI than children who attend a school that has recently received the funded likuni phala (group B), the exception being girls aged 13 years.

Table 4: Table to show average BMI for age and gender by school (primary school):

age	gender	school code	group	ave. weight for age	ave. height for age	ave. per group	ave. BMI	ave.per group
9	f	CHI	A	25.8	1.28		15.7	
		GOL	A	31.7	1.35		17.2	
		NAN	A	27.8	1.31		16.2	
		STJ	A	26	1.27	1.30	16	16.3
		MAN	B	26.7	1.31		15.5	
		MIS	B	27.6	1.31		16.1	
		NAM	B	27.8	1.32		16	
		SOU	B	26.9	1.28	1.31	16.5	16.0
9	m	CHI	A	26.6	1.29		16.1	
		GOL	A	29.7	1.32		17.1	
		NAN	A	28.6	1.34		15.9	
		STJ	A	26	1.26	1.30	16.3	16.4
		MAN	B	26.5	1.29		15.8	
		MIS	B	27.5	1.31		16	
		NAM	B	26.9	1.29		16.1	
		SOU	B	27	1.28	1.29	16.3	16.1
13	f	CHI	A	44.5	1.51		19.3	
		GOL	A	45.7	1.53		19.6	
		NAN	A	44.8	1.49		20.1	
		STJ	A	48.1	1.51	1.51	21	20.0
		MAN	B	50.6	1.56		20.8	
		MIS	B	39.5	1.47		18.1	
		NAM	B	48.6	1.51		21.3	
		SOU	B	46.9	1.52	1.52	20.2	20.1
13	m	CHI	A	41.1	1.52		17.7	
		GOL	A	43.9	1.54		18.3	
		NAN	A	39.6	1.5		17.7	
		STJ	A	43.4	1.52	1.52	18.7	18.1
		MAN	B	45.9	1.56		18.8	
		MIS	B	34.9	1.46		16.2	
		NAM	B	42.1	1.54		17.8	
		SOU	B	43.6	1.53	1.52	18.5	17.8

Table 5: Table to show average BMI for age and gender by school (preschool):

age	gender	school code	yr mm began	ave. weight for age	ave height for age	average BMI
4 to 6	f	MZE	2005	14.5	1.01	14.1
		MPE	2005	15.5	1.00	15.3
		NME	2000	15.9	1.00	15.4
		BAN	2000	16.6	1.02	15.8
		NDI	2002	14.7	0.96	15.9
		STM	2005	15.7	0.99	16.0
4 to 6	m	NME	2000	16.0	1.05	14.4
		MZE	2005	15.9	1.02	15.3
		MPE	2005	16.8	1.03	15.9
		NDI	2002	15.1	0.97	15.9
		STM	2005	15.5	0.98	16.0
		BAN	2000	16.9	1.02	16.1

Table 6: Table to show differences in portion size of food items between preschools:

By portion size likuni phala	(g)
Ndirande Parish (NDI)	226
Namame (NME)	244
Mzedi-Butawo (MZE)	266
Bangwe (BAN)	288
St. Marys Chimusa (STM)	720
Mpemba*	no information
by portion size nsima	**(g)**
Namame (NME)	182
Ndirande Parish (NDI)	198
Mzedi-Butawo (MZE)	260
Bangwe (BAN)	260
St. Marys Chimusa (STM)	550
Mpemba*	no information
by portion size both	**(g)**
Ndirande Parish	424
Namame	426
Mzedi-Butawo	526
Bangwe	548
St. Marys Chimusa	1270
Mpemba*	no information

Table 7: Table to show variance in portion sizes of Likuni Phala:

school name	code	min. serving (g)	max serving (g)	ave. serving (g)	variance (g)
Goleka	GOL	294	458	369.5	164
Nanjiriri	NAN	330	600	486	270
South-Lunzu	SOU	284	558	446	275
Manja	MAN	395	405	400	10
Chigumula	CHI	74	633	330.5	559
St James	STJ	250	500	375	250
Misesa	MIS	236	556	460	320
Namaywawa	NAM	no information	no information	no information	no information

Table 8: Table to show average percentile and z score for age and gender:

age	gender	category	average weight	average height	average BMI	percentile	z score
4 to 6	f	1	15.4	1.01	15.3	50	0 STD
		2	15.5	1.00	15.6	60	0.2 STD +
		3	15.2	1.00	15.4	53	0.1 STD +
		4	15.2	1.24	14.9	48	0.3 STD -
4 to 6	m	1	15.8	1.01	15.6	60	0.25 STD +
		2	16.1	1.02	15.5	59	0.2 STD +
		3	16.2	1.02	15.6	60	0.25 STD +
		4	15.5	1.00	15.5	59	0.2 STD +
9	f	1	27.0	1.30	16.0	50	0.2 STD -
		2	27.2	1.30	16.1	50	0.2 STD -
		3	28.7	1.32	16.3	51	0.25 STD -
		4	27.3	1.27	16.7	52	0.26 STD -
9	m	1	26.8	1.28	16.2	52	0.2 STD +
		2	27.2	1.31	15.9	50	0.1 STD -
		3	28.0	1.31	16.2	52	0.2 STD +
		4	27.0	1.28	16.4	54	0.1 STD -
13	f	1	48.4	1.52	20.8	60	0.3 STD +
		2	45.2	1.51	19.7	59	0.28 STD +
		3	46.2	1.51	20.1	60	0.29 STD +
		4	44.0	1.50	19.5	59	0.2 STD +
13	m	1	43.5	1.53	18.5	54	0.1 STD +
		2	41.1	1.51	17.8	45	0.2 STD -
		3	43.3	1.53	18.3	52	0.07 STD +
		4	38.9	1.50	17.2	35	0.6 STD -

Preschool children

There was no correlation between the length of time a preschool had been funded by Mary's Meals and the BMI of the children present (see table 5). However, as with the primary schools there was a variation in portion size noted at the preschools which can be seen in table 7, and further research found that in the preschools the amount of food given corresponded to the BMI of the children, with the exception of Ndirande Parish which indicated small portion sizes and highest BMI (see tables 6 and 6).

Table 9: table to show height for age and gender:

age	gender	category	average height for age	percentile
9	f	1	1.30	32.0
		2	1.30	32.0
		3	1.32	46.0
		4	1.27	17.5
9	m	1	1.28	19.0
		2	1.31	28.0
		3	1.31	28.0
		4	1.28	19.0
13	f	1	1.52	24.0
		2	1.51	19.5
		3	1.51	19.5
		4	1.50	17.5
13	m	1	1.53	37.5
		2	1.51	23.0
		3	1.53	37.5
		4	1.50	20.0

Portion size information regarding food items at preschools was collected and the nutritional composition of the average portion size was analysed using the Windiets dietary analysis programme, which is based on the food composition tables of Widdowson and McCance. The average portion size of likuni phala at the preschools was 43g dry weight and this amount was therefore used in the analysis of dietary intake.

In addition to the likuni phala, nsima and various relishes are supplied to the preschools and funded through the Mary's Meals programme. Interviews with volunteers at the 6 preschools that participated in this research indicated that the children from categories 3 and 4 do not receive any food out with the centre. As the children were too young to complete the 24 hour diet recall, the analysis of the diet of the children aged 4 to 6 is based only on the food that they receive at the preschool.

The likuni phala supplied to the preschools differs to the likuli phala supplied to the primary schools in that it has milk powder added at the factory. In spite of this, the information supplied regarding calorific content in 100g showed no significant difference in the amount of energy yielding nutrients present.

It was found that preschool children obtain 13% of their energy needs from the likuni phala (see table 10).Results show that 40% of the energy needs of the 4 to 6 age group are met through the food supplied by Mary's Meals. In addition, the daily Vitamin C and iron requirements are exceeded, and 87% of the Vitamin requirement is achieved. It is important to note that many children that attend preschool often consume little or no food across the weekend.

Results indicate that 86% of dietary niacin is also consumed. However, it must be noted that the niacin present in maize is in an indigestible form, and therefore much of the 44% daily requirement found in the nsima will not be absorbed. With regard to other B Vitamins, 74% of thiamine, 60% of riboflavin and 57% of vitamin B12 requirements were also met.

Half of the daily calcium requirements and 70% of zinc requirements are achieved. A further 1g of iodised salt is now added to the likuni phala at the factory but was not listed on the nutrient breakdown. This means that iodine levels noted on the tables are underestimated.

Table 10: table to show average dietary intake, age 4-6 yrs from food supplied by Mary's Meals:

Nutrient		RNI* 4-6 yrs	per 100g dry	likuni phala (ave = 43g)	Nsima (ave = 290g)	Relish (ave)	l.p %	**Nsima %**	**Relish %**	**% req's met**
Protein	g	19.7	15	6	4.3	10.5	33	22	53	108
Energy	kcal	1275	391	168	164	172	13	13	13	40
Vitamin A**	µg	450	277	119	2.00	271	27	0	60	87
Thiamin (B1)	mg	0.6	0.128	0	0.14	0.25	9	23	42	74
Riboflavin (B2)	mg	0.6	0.448	0	0.04	0.13	32	7	22	60
Niacin (B3)	mg	8	4.8	2	1.30	3.50	26	16	44	86
Folate	µg	200	60	26	0	52	13	0	26	39
Vitamin B12	µg	1.2	1.2	1	0	0.17	43	0	14	57
Vitamin C	mg	30	48	21	1.4	22.2	69	5	74	147
Iron (Fe)***	mg	6.3	8	3	1.9	2.6	55	30	41	126
Calcium (Ca)	mg	600	100	43	8	242	7	1	40	49
Zinc (Zn)	mg	4.8	5	2	0	1.2	45	0	25	70
Iodine	µg	90	0	0	0	12	0	0	13	13

Fortification based on World Food Programme (WFP) specifications (www.wfp.org)

*Recommended Nutrient Intake (RNI) is the daily intake which meets the nutritional requirements of almost all (97.5) apparently healthy individuals in an age- and sex- specific population (WHO 2005)
** Vitamin A is listed as recommended safe intakes instead of RNI's
***Iron estimated at 10% bioavailability

SOURCE FOR RNI's : Vitamin and mineral requirements in human nutrition; World Health Organisation, 2005

Children aged 9 and 13

Data was collected from a sample of children aged 9 and 13 to assess the food consumed out with the Mary's Meals programme in the 24 hours preceding the weight and height analysis. This data was entered into a Microsoft Excel data sheet, and the average food intake by age, gender and category was analysed using the Windiets programme. The nutritional composition of the daily food intake was entered into tables alongside the nutritional composition of one portion of the likuni phala to determine the daily energy and nutrient intake of children from each age group, gender category. For results see tables 11 to 26.

Tables 11 and 12 show that on average, the energy provided by one portion of likuni phala equates to 10% of the daily needs of 9 year olds and 8.5% of the needs of 13 year olds. In addition, results combining the daily intake from both the likuni phala and the food consumed out with the programme indicate that overall, children aged 9 obtain just 33% of their daily energy needs, and 13 year old children obtain just 31% of their required energy amount.

Table 15 shows the total % of daily dietary requirement achieved by 9 year old boys and girls from food received through Mary's Meals and food received elsewhere. Results indicate that on average,

children aged 9 are consuming adequate protein, and exceeding required levels of iron and vitamin C. One third of protein requirements, 54% of iron requirements and 82% of Vitamin C requirements in supplied in the likuni phala.

Likuni phala also supplies 40% of the required daily intake of Vitamin B12, which can only be obtained through consumption of meat and meat products. The dietary analysis programme indicated low levels of meat and meat product consumption, making fortification all the more significant.

Table 11: Table to show % daily requirements from Likuni phala; children aged 9

Nutrient		RNI 9 yrs (f)	RNI 9 yrs (m)	Likuni phala: per 60g serving	other food g (f)	other food g (m)	% l.p (f)	% l.p (m)
Protein	g	28.3	28.3	9	18.8	19.6	32	32
Energy	kcal	2433	2393	235	554	579	10	10
Vitamin A**	µg	500	500	166.00	226	170	33	33
Thiamin (B1)	mg	0.9	0.9	0.08	0.42	0.45	9	9
Riboflavin (B2)	mg	0.9	0.9	0.27	0.24	0.23	30	30
Niacin (B3)	mg	12	12	2.88	7.5	7.8	24	24
Folate	µg	300	300	36	46	54	12	12
Vitamin B12	µg	1.8	1.8	0.72	0.33	0.15	40	40
Vitamin C	mg	35	35	28.8	58.1	47.2	82	82
Iron (Fe)***	mg	8.9	8.9	4.8	4.8	4.9	54	54
Calcium (Ca)	mg	700	700	60	157	141	9	9
Zinc (Zn)	mg	5.6	5.6	3	1.6	1.6	54	54
Iodine	µg	120	120	0	20	24	0	0

Fortification based on World Food Programme (WFP) specifications (www.wfp.org)

Tables 12 and 21 show that likuni phala provides one fifth of the required daily protein, one third of the required daily iron and zinc, and over 70% of the required daily vitamin C of 13 year olds. For both 9 years and 13 years, likuni phala provides 33% and 28% respectively, of daily vitamin A requirements. In conjunction with food provided out with Mary's Meals, children are achieving, on average, over 70% of the recommended intake for Vitamin A. Research is required to compare retinol levels of children funded through Mary's Meals to the national average.

Table 13 and 14 demonstrate actual daily intake of food and the average percentage of the daily intake that each age group receive from the likuni phala meal. More detailed breakdown by category can be seen in tables 15 to 26.

Research indicates that on average, the likuni phala makes up 30% of the energy intake of 9 year olds and 27% of 13 year olds. In the 9 year old age group, approximately 50% of the iron and riboflavin intake came from the likuni phala as did two thirds of Vitamin B12 intake for this age group. In addition, the likuni phala made up between 40 and 50% of the daily Vitamin A requirements.

Table 12: Table to show % daily requirements from Likuni phala; children age 13

Nutrient		RNI 13 yrs (f)	RNI 13 yrs (m)	per 60g serving	Food in g: other foods (f)	other foods (m)	% l.p (f)	% l.p (m)
Protein	g	41.2	42.1	9	20.3	20.3	22	21
Energy	kcal	2668	2866	234.6	623	627	9	8
Vitamin A**	µg	600	600	166.4	244	284	28	28
Thiamin (B1)	mg	1.1	1.2	0.08	0.51	0.46	7	7
Riboflavin (B2)	mg	1.0	1.3	0.27	0.30	0.26	27	21
Niacin (B3)	mg	16	16	2.88	8.2	7.70	18	18
Folate	µg	400	400	36	50	47	9	9
Vitamin B12	µg	2.4	2.4	0.72	0.3	0.25	30	30
Vitamin C	mg	40	40	28.8	70.8	50	72	72
Iron (Fe)***	mg	14.0	14.6	4.8	5.6	3.9	34	33
Calcium (Ca)	mg	1300	1300	60	161	133	5	5
Zinc (Zn)	mg	8.6	7.2	3	1.4	2	35	42
Iodine	µg	150	150	0	26	25	0	0

Fortification based on World Food Programme (WFP) specifications (www.wfp.org)

Table 13: Table to show % dietary intake from Likuni Phala; children age 9

Nutrient		per 60g serving l.p	other food g (f)	other food g (m)	total intake (f)	total intake (m)	% intake l.p (f)	%intake l.p (m)
Protein	g	9	18.8	19.6	28	29	32	31
Energy	kcal	235	554	579	789	814	30	29
Vitamin A**	µg	166.00	226	170	392	336	42	49
Thiamin (B1)	mg	0.08	0.42	0.45	1	1	16	15
Riboflavin (B2)	mg	0.27	0.24	0.23	1	1	53	54
Niacin (B3)	mg	2.88	7.5	7.8	10	11	28	27
Folate	µg	36	46	54	82	90	44	40
Vitamin B12	µg	0.72	0.33	0.15	1	1	69	83
Vitamin C	mg	28.8	58.1	47.2	87	76	33	38
Iron (Fe)***	mg	4.8	4.8	4.9	10	10	50	49
Calcium (Ca)	mg	60	157	141	217	201	28	30
Zinc (Zn)	mg	3	1.6	1.6	5	5	65	65
Iodine	µg	0	20	24	20	24	0	0

Fortification based on World Food Programme (WFP) specifications (www.wfp.org)

Table 14 shows that the percentage of actual intake Vitamin B12 from likuni phala in the 13 year old is almost 70%, iron is 46% and Vitamin A is almost 40% on average for males and females. In addition, 31% of the daily intake of protein in this age group comes from likuni phala.

Table 14: Table to show % dietary intake from Likuni Phala; children age 13

Nutrient		per 60g serving l.p	other food g (f)	other food g (m)	total intake (f)	total intake (m)	% intake l.p (f)	%intake l.p (m)
Protein	g	9	20.3	20.3	29.3	29.3	31	31
Energy	kcal	234.6	623	627	857.6	861.6	27	27
Vitamin A**	µg	166.40	244	284	410.4	450.4	41	37
Thiamin (B1)	mg	0.08	0.51	0.46	0.59	0.54	14	15
Riboflavin (B2)	mg	0.27	0.30	0.26	0.57	0.53	47	51
Niacin (B3)	mg	2.88	8.2	7.70	11.1	10.6	26	27
Folate	µg	36	50	47	86	83	42	43
Vitamin B12	µg	0.72	0.3	0.25	1.02	0.97	71	74
Vitamin C	mg	28.8	70.8	50	99.6	78.8	29	37
Iron (Fe)***	mg	4.8	5.6	3.9	10.4	8.7	46	55
Calcium (Ca)	mg	60	161	133	221	193	27	31
Zinc (Zn)	mg	3	1.4	2	4.4	5	68	60
Iodine	µg	0	26	25	26	25	0	0

Fortification based on World Food Programme (WFP) specifications (www.wfp.org)

It should be noted that the Windiets programme did not contain some of the food items that were common in Malawi and so the foods consumed were substituted with the closest available food item in the data bank. This may impact slightly on the analysis of dietary intake (goat was substituted with lamb, maize flour with sifted cornmeal flour, pumpkin leaves with rape leaves and utaka, matemba and usipa with whiting). In particular, it was difficult to ascertain the nutritional composition of sugar cane. After intensive research, it was determined that the sucrose availability in sugar cane is approximately 10% of the total weight and this was the figure that was used to calculate the energy content of the sugar cane consumed (*www.sucrose.com/learn.html).*

Conclusions

Consideration should be given to the high energy requirements and low levels of energy intake identified in this research. In order to provide a meal that is suitable to the energy and nutritional needs of the target group, the current composition of the likuni phala may need to be reviewed.

To do this effectively, it should not be done in isolation. Sound collaborative partnerships need to be developed with the World Food Programme, UNICEF, GOAL outreach programme, the nutrition department of the Queen Elizabeth hospital and other NGO's and charities working in a similar field

to fully assess this and other research, and to develop a likuni phala that is not only specific to the requirements of the target group but one that has no contraindication with other supplemented and fortified dishes. Some micronutrients, when given in abundance, can have harmful effects, particularly Vitamin A and iron.

An option to increase the energy intake is to combine the likuni phala with the energy dense supplement 'Chiponde', although consideration would need to be given to the overall intake of the above mentioned nutrients, and to allergy of nut.

It is important to note that the majority of the niacin present in the dietary analysis from foods other than the likuni phala is derived from unfortified maize. The dietary analysis programme does not take into consideration the bioavailability of niacin from maize and corn, which is very low. Therefore it can be assumed that the actual amount of niacin available in the diet is significantly lower than the amount demonstrated in the tables. More research is required to determine the actual level of available niacin in the processed unfortified maize available in Malawi.

In addition to the iodine listed in the tables, a further 1g of iodised salt is added to 100g of the likuni phala mix. This information was not on the breakdown sheet supplied to the researchers at the time that the results were analysed and so is not included in any of the tables. Research is required to determine the difference in iodine levels that result from this fortification. Research is also required to determine the nutritional content of some of the foods local to Malawi so that analysis of dietary recall is more exact.

The Mary's Meals programme allocates 60g dry likuni phala flour per child per day. Therefore for this research, an average portion size of likuni phala per child aged 9 years and 13 years was estimated at 400ml, which is equal to one cupful, and equates to 60g dry weight. It must be noted that portion sizes of likuni phala varied considerably both within and between schools. Variation in portion sizes can be seen in table 7.

Portion size was not dependant of age of child but more on the container that the child presented at the school on that day. Monitoring systems are required to ensure that all children are receiving a suitable and consistent amount of likuni phala. In addition, the time at which the likuni phala is served varied greatly between the 8 schools, from 9.00am until midday. Preschools were found to serve meals at specific times.

With regards to health and hygiene, it was noted that in some of the preschools faecal waste and urine was present on the floor, and methods of removal were not hygienic, mainly due to lack of resources and volunteer time. There was no evidence of disinfectant and sanitary materials, particularly with relation to hand washing, when food was being prepared and eaten. Food poisoning is a major concern, especially in immune-compromised children who have a lower ability to fight infection.

HACCP (Hazard Analysis and Critical Control Points) systems are widely used by food programmes in many countries across the world to ensure safe food hygiene practice. The World Food Programme necessitates HACCP systems in partner organisations, including RAB processors where Mary's Meals likuni phala is produced. HACCP standards should also be implemented across the Mary's Meals

programme, with particular emphasis on personal hygiene, staff and volunteer training, pest control and stock control.

For this research, eight schools and 6 preschools currently involved in the Mary's Meals programme were randomly selected. The only factors that determined their selection was the length of time that they had been involved with the project and their location in the Blantyre region to ensure a wide spread. When carrying out research it is important to consider other compounding factors that may have influenced the data:

- Socioeconomic status of each child
- Size of each family and the impact this has on the amount of food available to each child
- The area in which each school was located; amount of arable land available to each family, cost of local produce, socioeconomic status, employment level, average income
- Time of year that the research was carried out (this research was not carried out in the hungry season)
- Seasonal produce available (certain products such as sugar cane were readily available to add to energy intake)
- Other health factors that would contribute to low weight for height and low BMI i.e. HIV/AIDS

Although a valid method of data collection, 24 hour recall diaries cannot be considered to be representative of the overall diet of a person. For more detailed and accurate research, a five day diet diary is recommended that includes coverage of weekend days. Anthropometric measurements in future research should include MUAC (mid upper arm circumference) measurements.

Future research is also required to determine, on a broader scale, the food consumed by children out with the Mary's Meals programme to clearly identify the need to supply a supplemental meal. It is also essential how this varies from school to school, area to area, and country to country. Other markers of success could be evaluated, such as records of absence from school through illness.

To conclude, although the level of energy supplied is low, likuni phala contributes greatly to the daily micronutrient and protein requirements of the school children in and around Blantyre, and more importantly, contributes significantly to the daily intake of children aged 9 and 13, who might otherwise not eat through the course of a day. One should never underestimate the importance of a filling meal to a hungry child regardless of nutrient content.

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