NUTRIENT INTAKES, DIETARY DIVERSITY, HUNGER PERCEPTIONS AND ANTHROPOMETRY OF CHILDREN AGED 1 – 3 YEARS IN HOUSEHOLDS PRODUCING CROPS AND LIVESTOCK IN SOUTH AFRICA: A SECONDARY ANALYSIS OF NATIONAL FOOD CONSUMPTION SURVEY OF 1999

by

Lenkwetse Bolaane

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ABSTRACT

Children less than five years of age are at a risk of growth failure worldwide. The South African National Food Consumption Survey (NFCS) of 1999 showed that 25.5% of children aged 1 – 3 years were stunted. Poor growth of young children in developing countries (South Africa included) has been associated with multiple micronutrient deficiencies because of the use of starchy plant-based complementary foods with little variety, especially among resource poor households. Dietary diversification through the use of crop and livestock production has been recommended as a strategy to improve the micronutrient intake and food security of households in resource poor settings.

This study was a cross sectional secondary analysis of the South African NFCS of 1999 data, designed to investigate the impact of crop and livestock production on nutrient intake, dietary diversity, intake of selected food groups, hunger perceptions and anthropometric status of children aged 1 – 3 years in South Africa. Children from households producing crops only (n=211), crops and livestock (n=110), livestock only (n=93) and non-producers were compared at the national, in rural areas and among households with a total income of less than R12 000.00 per household per year.

In rural areas and among households with a total income of less than R12 000.00 per household per year, children in the crops and livestock group had higher nutrient intakes for energy, vitamin B_6, calcium and folate than the other groups ($p<0.05$), while the crops only group had higher nutrient intakes for vitamin A and vitamin C. The majority of children in all the four study groups had less than 67% of the RDAs for vitamin A, vitamin C, folate, calcium, iron and zinc. In addition, children in all the groups had a median dietary diversity score of four out of 13 food groups. In rural areas and among low income households, higher percentages (over 60%) of children in the crops only group consumed vegetables while the non-producers group was the lowest (47.7%). The non-producers group had the highest percentages of children consuming meat and meat products and the crops and livestock and livestock only groups had the lowest percentages. In both rural areas and among households with

low income, the majority of the households in all the study groups were experiencing hunger. In rural areas, one in five households were food secure.

Crop and livestock production improved the nutrient intake and the intake of vegetables of children in rural and poor households. However, nutrient intakes were not adequate to meet the recommended nutrient levels. The high levels of food insecurity require support of these households to increase crop and livestock production and, integration of nutrition education to increase the consumption of the produced products.

DECLARATION

I hereby declare that the research in this dissertation is of my own investigation. Where use was made of the work of others, this has been duly acknowledged in the text.

Signed: L Bolaane 1/12/06

Lenkwetse Bolaane **Date**

As supervisor, I agree to submission of this dissertation for examination:

Signed: Eleni Maunder 1/12/06

Prof. Eleni Maunder **Date**

As co-supervisor, I agree to submission of this dissertation for examination:

Signed: 1/12/06

Ms Jill Meaker **Date**

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DEDICATION

All women and children, particularly Motamorago Ramosamo who provided love, care and support for my son Pako Bolaane during the period of my studies and Botswana children who were victims of diarrhoea outbreak in January 2006.

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CHAPTER 1: INTRODUCTION: THE PROBLEM AND ITS SETTING

1.1 Introduction

The fifth world nutrition situation report showed that children below five years of age in developing countries are affected by under-nutrition, as 27.5 – 31.7% of these children were stunted and 22.2 – 27.3% were underweight (Haddad & Ross 2004, pp72-73). South African children are not an exception. McLachlan & Kuzwayo (1997, pp10-11) stated that the problem of under-nutrition persists among South African children below five years of age, especially among poor people.

The South African National Food Consumption Survey (NFCS) of 1999 revealed that 25.5% of children aged between 1 – 3 years were stunted whilst 13% of the children were underweight (Labadarios & Nel 1999, pp168-169). Similar results were reported in the South African vitamin A survey of 1994 where the prevalence of national stunting for children aged 6 – 71 months was 22.9%, whilst the underweight rate stood at 9.3% (South African Vitamin A Consultative Group [SAVACG] 1995).

Allen & Gillespie (2001, p24) identified the common causes of poor growth, specific to child feeding, for young children in developing countries as inadequate breastfeeding and inadequate quality or quantity of complementary foods. The Administrative Committee on Coordination Sub-Committee on Nutrition [ACC/SCN] (2000, p33) stated that breastfeeding supplies all the required nutrients for infants aged below six months, 50% of the nutrient requirements for infants aged 6 – 12 months and 33% of the nutrient requirements for children aged 12 – 24 months. This indicates that the bulk of the nutrient requirements for children after 12 months of age is obtained from complementary foods. Given the high nutrient requirements of children during this early period of life, the nutritional quality of complementary foods is critical. Fulfilling all the nutrient requirements of children after 12 months of age is difficult, particularly in resource poor settings with high levels of food insecurity.

The South African NFCS of 1999 showed that nutrient intakes from a 24 – hour recall for children aged 1 – 9 years did not meet 67% of the Recommended Dietary Allowances (RDAs) for energy, calcium, iron, zinc, selenium, vitamin A, vitamin D, vitamin C, vitamin E, riboflavin, niacin and vitamin B_6 (Steyn & Labadarios 1999, p242). In addition, the NFCS of 1999 showed that the foods available in households and eaten by children aged 1 – 9 years had low dietary variety. Children aged 1 – 3 years were the most affected by stunting (25.5%), compared to children aged 4 – 6 years (stunting 21%) and 7 – 9 years (stunting 13%) (Labadarios & Nel 1999, pp168-169). The high levels of stunting among children aged 1 – 3 years could in part be linked to low dietary intakes of certain nutrients.

A study in South Africa in the Stellenbosch district conducted on children 4 - 6 years of age showed that the diets of the children were low in energy, protein, vitamin A and zinc (Krige & Senekal 1997). According to Krige & Senekal (1997), inadequate intake of meat, fruits and vegetables were among the main causes of inadequate dietary intake. The NFCS of 1999 (MacIntyre & Labadarios 1999, p352) also showed that the diets of children mainly consisted of maize, white rice and potatoes and lacked meat, vegetables and fruits. Therefore, it could be assumed that children aged 1 – 3 years in similar households, would be at greater risk of inadequate nutrient intakes.

The literature cited above indicates that South African children are affected by growth failure linked to multiple micronutrient deficiencies in the diet attributed to the use of plant-based diets with little variety. Gibson, Ferguson & Lehrfeld (1998) emphasised that strategies to improve the nutrients of complementary foods of children in developing countries are required. The nutrient densities of plant source foods are generally high in thiamine, vitamin B_6, folic acid (folate), ascorbic acid, β-carotene calcium, iron and zinc (Brown *et al* 1998, p97). However, calcium, iron, zinc and β-carotene from plant source foods are poorly absorbed (Brown *et al* 1998, p97). Murphy & Allen (2003) suggested that plant based diets could be improved by using foods of animal origin. In addition, Murphy & Allen (2003) stated that foods of animal origin supply high amounts of different micronutrients that are not easily obtained when using plant source foods only particularly calcium, iron, zinc, riboflavin, vitamin A and vitamin B_{12}. Perlas & Gibson (2005) recently found that addition of animal foods to rice and maize based complementary foods of children in the Phillipines improved calcium, iron and zinc intake. However, Daelmans & Saadeh (2003, p13) and Dewey & Brown (2003) indicated that animal source foods are costly and it may be difficult for low-income groups to include animal source foods in their diets. Food-based strategies that promote increased production and intake of micronutrient rich foods are recommended in developing countries (Tontisirin, Nantel & Bhattacharjee 2002; Ruel & Levin 2000, p2). Production of micronutrient rich foods involves production of vegetables, fruits and small livestock (Ruel & Levin 2000, p2). Food production could also contribute to households' food security, to income generation, as well as to the social well-being of households. However, in developing countries, there has been a lack of the production of both crops and livestock production to improve micronutrient levels in the diet (Tontisirin *et al* 2002). Therefore, the priority for future research should be to promote the production of both crops and livestock production and to determine if this would have any influence on the micronutrient intake, food security, dietary diversity and nutritional status including anthropometric status of children from households in resource poor settings.

Figure 1.1 illustrates the conceptual framework for the current study. A combination of crop and livestock production is hypothesized to improve nutrient intake and dietary diversity in young children, as well as food supply of households. Eventually, child anthropometric status is hypothesized to increase because of improved nutrient intake, dietary diversity and household food supply.

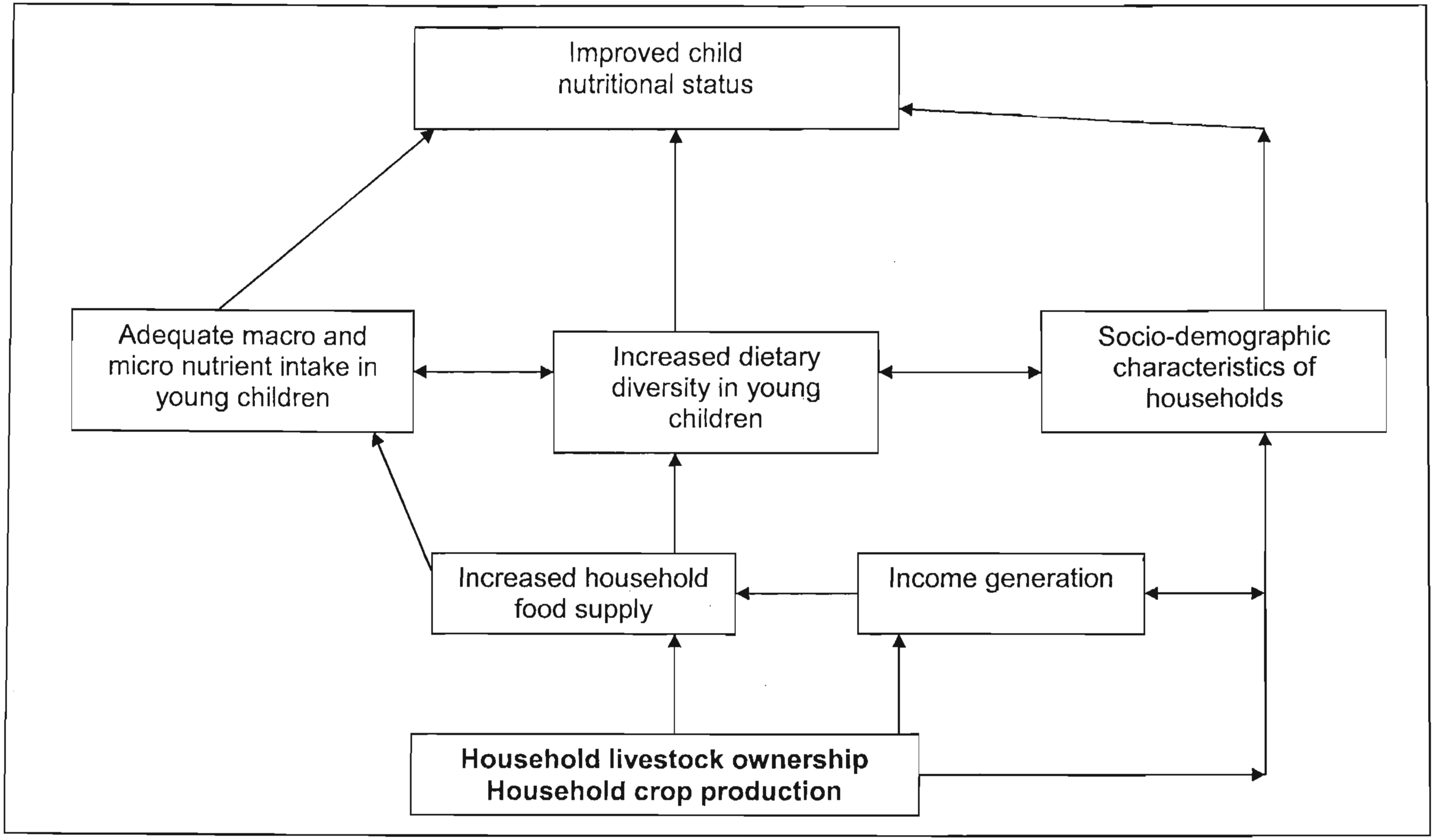

Figure 1.1: Graphical presentation of the conceptual framework for the study

1.2 Importance of the study

Child feeding during the complementary feeding period, particularly after 12 months of age, is difficult in developing countries including South Africa. Attaining a nutritionally adequate diet is difficult after 12 months of age. The availability of the data from the South African NFCS of 1999 on crop production and livestock ownership in households, as well as child nutrition, offered an opportunity to determine and compare child nutrition for children in households producing crops and livestock to households not producing crops and livestock. The study findings could contribute to the enhancement of nutrition strategies for child feeding by nutrition planners and policy makers. Appropriate targeting of resources is particularly important in developing countries where resources are limited. Moreover, the study results could highlight the importance of individual household and community empowerment for the improvement of child nutrition.

1.3 Statement of the problem

The aim of this study was to determine and compare nutrient intake, dietary diversity, intake of selected food groups, hunger perceptions and anthropometric status of children aged 1 – 3 years from households that produced crops and livestock to those not producing crops and livestock in South Africa.

1.4 Type of study

The study was a secondary analysis of data from the South African NFCS of 1999 with the aim to determine and compare the nutrient intake, dietary diversity, intake of selected food groups, hunger perceptions and anthropometric status of children aged 1 – 3 years from households with crops only, crops and livestock, livestock only and those without crops and livestock in South Africa.

1.5 Study objectives

Each objective stated includes each of the following groups from households:

- That produced crops only;
- That had crops and livestock;
- That produced livestock only;
- Without crops and livestock (non-producers).

In addition, these groups were compared at the national level, within rural areas and among the households with a total income of less than R12 000.00 per household per year. The crops only and non-producers were compared within urban areas.

1.5.1 To determine and compare the socio-demographic characteristics of children aged 1 – 3 years.

1.5.2 To determine and compare the nutrient intake of children aged 1 – 3 years in the last 24 hours.

1.5.3 To determine and compare the dietary diversity of the foods consumed by children aged 1 – 3 years in the last 24 hours.

1.5.4 To determine and compare the consumption of eggs, meat and milk by children aged 1 – 3 years in the last 24 hours.

1.5.5 To determine and compare the consumption of vegetables and fruits by children aged 1 – 3 years in the last 24 hours.

1.5.6 To determine and compare the perceptions of hunger for children aged 1 – 3 years and their households.

1.5.7 To determine and compare the anthropometric status of children aged 1 – 3 years.

1.6 Study parameters

The study determined and compared the nutrient intakes, dietary diversity, hunger perceptions and anthropometric status of children aged 1 – 3 years from households with crops only, livestock only, crops and livestock and those without crops and livestock in South Africa, using the South African NFCS of 1999 data. Households that produced maize only or onions only were excluded. Generally, maize is available in households and consumed by children. Few households (3 out of 371) produced onions only. In addition, the nutrient contribution from livestock was not calculated.

1.7 Study limitations

1.7.1 Information on the size of the plots for home gardens, as well as information on the amount of crops produced by households, was not known.

1.7.2 Although the study participants were asked the purpose of livestock production, households were not specifically asked whether the livestock owned were used for consumption and how much of the owned livestock and livestock products were used for consumption.

1.7.3 The sample sizes for each study group from households in urban areas and total household income of greater than R12000.00 per household per year were too small. Therefore, comparisons of the study groups in urban areas and for a total income of greater than R12 000.00 per household per year could not be made.

1.7.4 The contribution of crop and livestock production to the household income was not determined and, therefore, the contribution of income from crop and livestock production to household food security was not known.

1.7.5 The contribution of crops and livestock produced to nutrient intake was not measured. Therefore, any of the differences observed between the different groups was difficult to attribute to crops and livestock production.

1.8 Definition of terms

Children aged 1 – 3 years: children aged 12 – 47.9 months.

Complementary feeding: the period during which children are given foods or liquids along with continued breastfeeding (Allen & Gillespie 2001, p29; Brown, Dewey & Allen 1998, p3).

Crops and livestock group: children aged 1 – 3 years from households that produced and consumed crop and livestock produced. Households that produced maize only, onions only, crops only or livestock only were excluded from the group.

Crops only group: children aged 1 – 3 years from households that produced and consumed the crops grown. Households that produced maize only, onions only and those that owned livestock were excluded from the group.

Dietary diversity: the number of various food items or groups consumed over a specific period of time (Ruel 2002, p5).

Livestock only group: children aged 1 – 3 years from households that owned and consumed the livestock owned. Households that produced crops were excluded from the group.

Non-producers group: children aged 1 – 3 years from households without crops or livestock.

Problem nutrients: nutrients which have nutrient density in complementary foods less than the recommended nutrient values (Brown *et al* 1998, p99). The identified problem nutrients are iron, zinc, calcium, vitamin A, vitamin B_6, vitamin B_{12}, vitamin C, riboflavin, thiamine, niacin and folate. For this study, energy and protein are included.

Recommended Dietary Allowances: the levels of nutrients found sufficient to meet the nutrient needs of all healthy people (Food and Nutrition Board 1989, p1).

Secondary analysis study: analysis of the data that is already available, with a purpose different from the primary study's data (de Vos, Strydom, Fouché & Delport 2002, p326).

Stunting: low height-for-age (H/A) characterised by H/A z-score of less than -2 standard deviations of the median value of the reference growth for the National Centre for Health Statistics (NCHS) or the World Health Organization [WHO] (WHO 1995, p181).

Underweight: low weight-for-age (W/A) characterised by W/A z-score of less than -2 standard deviations of the median value of the reference growth for NCHS/WHO (WHO 1995, p181).

Wasting: weight loss due to food shortage or disease described with low weight-for-height (W/H) that is normally characterised by W/H z-score of less than -2 standard deviations of the median value of the reference growth for the NCHS/WHO (WHO 1995, p181).

1.9 Abbreviations

ACC/SCN:	Administrative Committee on Coordination/Sub-Committee on Nutrition
FANTA:	Food and Nutrition Technical Assistance
FAO:	Food and Agricultural Organization
FPFIP:	Food Procurement and Food Inventory Questionnaire
NCHS:	National Centre for Health Statistics
NE:	Niacin Equivalents
NFCS:	National Food Consumption Survey
QFFP:	Quantitative Food Frequency Questionnaire
RDA:	Recommended Dietary Allowances
RE:	Retinol Equivalent
SAVACG:	South Africa Vitamin A Consultative Group
UNICEF:	United Nations Children's Fund
WHO:	World Health Organization

1.10 Assumptions

1.10.1 The NFCS data was collected on children that were not sick.

1.10.2 The study participants answered the questions honestly.

1.10.3 A single 24-hour recall was administered and, thus, it is assumed that there was little day-to-day variation of the diets of the children as indicated by the three day 24-hour recall pilot study data from the NFCS of 1999.

1.10.4 The food consumed by children was not weighed: the portion sizes were obtained from the caregivers/mothers. It is assumed that the portion sizes recalled by NFCS of 1999 study subjects were correct.

1.10.5 Some households gave the purpose of owning livestock as slaughter and it was assumed that the livestock slaughtered were used for consumption.

1.11 Summary

Children over 12 months, especially children aged 1 – 3 years, are vulnerable to under-nutrition especially micronutrient deficiencies and stunting. In households from poor resource settings, inadequate dietary intakes have been linked to lack of dietary diversity. Agricultural activities are promoted to improve child nutrition. The purpose of the study was to determine and compare nutrient intake, dietary diversity, intake of selected food groups, hunger perceptions and anthropometric status of children aged 1 – 3 years from households that produced crops and livestock to those without crops and livestock in South Africa.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The conceptual framework (Section 1.1, Figure 1.1) for this study is centred on the link between agricultural production and child nutrition. The conceptual framework illustrates different pathways on how crop and/or livestock production could have an impact on child nutrition. The conceptual framework will serve as a guide to gather evidence on the relationship between child nutrition and agricultural interventions with regard to nutrient intake, dietary diversity, food security, consumption of animal foods, vegetables and fruits and child anthropometric status.

The ACC/SCN (2000, p33) indicated that between 12 – 24 months of age, breast milk supplies 33% of nutrient requirements. This indicates that 67% or more of nutrient needs should be supplied by complementary foods. However, Allen & Gillespie (2001, pvi), indicated that the micronutrient content of the complementary foods of many children in developing countries is not enough to meet the children's nutrient needs. Poor households in many developing countries fail to vary their diets and rely on starchy staples with little or no animal products, fruits and vegetables (Ruel 2003). The diets that mostly consist of plant staple foods are usually adequate in energy (Dewey & Brown 2003) but low in essential micronutrients (Dewey & Brown 2003; Food and Agriculture Organization [FAO] 2002, p3). Micronutrient deficiencies often occur in households affected by food insecurity in developing countries (Tontisirin *et al* 2002).

It is well recognized that animal source foods supply multiple micronutrients energy and protein in adequate amounts that are easily absorbable (Murphy & Allen 2003; Neumann 2000). The different micronutrients that are mainly supplied animal source foods are calcium, iron, zinc, riboflavin, vitamin A and vitamin B_{12} (Murphy & Allen 2003). However, availability and accessibility of animal source foods by poor households is a limiting factor because animal source foods are costly (Dewey & Brown 2003). Vegetables mostly supply high amounts of vitamin A (β-carotene), vitamin C, calcium and iron, whereas fruits provide mostly vitamin A and vitamin C (King & Burgess 1996, p49). The bioavailability of vitamin A, calcium and iron in plant source foods is low (Brown *et al* 1998, p97). Therefore, a varied diet that contains different food items from animals, vegetables and fruits could supply adequate amounts of the required nutrients.

Animal source foods supply multiple micronutrients simultaneously (Murphy & Allen 2003; Neumann 2000), yet, agricultural production, especially livestock production, and promotion to increase micronutrient intake has received little attention (Tontisirin *et al* 2002). The question that may arise is whether a combination of crop and livestock production in poor households would improve child nutrition?

This chapter will first look at the nutrient intakes of children aged 1 – 3 years, with special emphasis on the micronutrient intakes of South African children. Thereafter, an overview of the different strategies that have been used in developing countries to improve micronutrient intakes of children will be highlighted and then detailed information on strategies that use agricultural production will be given. Thirdly, hunger perceptions of the households engaged in agricultural production and of their children will be discussed and, lastly, the anthropometric status of the children in relation to agricultural production interventions will be highlighted. The research methods that have been used, especially for the measurement of dietary diversity, will be discussed. The main aim of the literature review is to determine how crop and livestock production contributes to overall child nutrition with regard to the above outlined themes.

2.2 Nutrient intake

Diets of many children in developing countries often predominantly consist of plant-based staples with little variety (Ruel 2003; Faber, Phungula, Venter, Dhansay & Benadé 2002a; Ruel & Levin 2000, p1). Diets that are low in variety are often deficient in vitamins and minerals such as vitamin A, vitamin C, iron and zinc (FAO 2002, p3). There are nutrients that are commonly known to be deficient in the diets of children during the complementary feeding period and the next section addresses these nutrients.

2.2.1 Problem nutrients during the complementary feeding period

Problem nutrients are defined as the nutrients that have their nutrient densities in complementary foods lower than the estimated amounts required by infants (Brown *et al* 1998, p99). The problem nutrients were identified by comparing the actual nutrient densities of the complementary foods consumed by breastfed children with the estimated required nutrient densities of the complementary foods (Dewey & Brown 2003; Brown *et al* 1998, p99). Dewey & Brown (2003) suggested that the results of the identified problem nutrients should be treated with caution because the populations from the different countries have different food composition databases, and the databases often have limitations such as missing data for certain foods.

In the process of the identification of problem nutrients, Dewey & Brown (2003) used the World Health Organization (WHO)/FAO 2002 Recommended Nutrient Intakes, the WHO/United Nations Children's Fund (UNICEF) 1998 report (Brown *et al* 1998, p99) and the Institute of Medicine new Dietary Reference Values (1997 – 2001) for the United States of America (USA). Dewey & Brown (2003) used studies from Bangladesh, Ghana, Guatemala, Peru, Mexico and the USA for identification of the problem nutrients. Dewey & Brown (2003) identified the problem nutrients using children in the age groups 6 – 8 months, 9 – 11 months and 12 – 23 months. Iron, zinc and vitamin B_6 were the problem nutrients in most developing countries while riboflavin and niacin were identified as problem nutrients for some populations. The results for calcium, vitamin A, vitamin C, thiamine and folate varied depending on a set of reference values used.

During the identification of problem nutrients, Brown *et al* (1998, p99) compared the actual densities of complementary foods consumed by children in Mexico, Peru and USA with the British Daily Reference values of the Department of Health 1991. Brown *et al* (1998, pp96-102) identified the problem nutrients using children in age groups used by Dewey & Brown 2003. The nutrients that had their nutrient densities less than the required amounts for most countries were calcium, iron and zinc. Vitamin A nutrient density was greater than the required amount for all the three countries. However, Brown et al (1998, p102) selected vitamin A as a problem nutrient because of high prevalence of vitamin A deficiency in young children in most developing countries. Riboflavin was also considered as a problem nutrient depending on the magnitude of reliance on cereals by young children.

In summary, the identified problem nutrients are iron, zinc, vitamin A, calcium, riboflavin, niacin, vitamin B_6, vitamin C, thiamine and folate. Calcium, iron and zinc are more problematic than the other problem nutrients. The children 6 – 8 months in Peru had the lowest intakes for calcium, iron and zinc (Brown *et al* 1998, pp100-101) than other children from other countries. Iron recorded the lowest value of less than one tenth of the average desired nutrient density per 100kcal For calcium, the lowest range was less than a quarter of the average desired nutrient density and zinc was 50% of the average desired nutrient density. Dewey & Brown (2003) also included protein when determining problem nutrients and found that protein from complementary foods consumed by all the children from different countries was higher than the recommended amounts. Although protein was not included among the problem nutrients, Brown *et al* (1998, p80-81) reported that reliance on plant based foods with low intake of protein from foods of animal origin may limit growth. Vitamin B_{12} is found only in animal foods (Murphy & Allen 2003). Therefore, the identified problem nutrients as well as protein, energy and vitamin B_{12} will be the focus of this study.

2.2.2 Nutrient intakes of children aged 1 – 3 years in South Africa

The South African NFCS of 1999 for children aged 1 – 9 years showed that the diets of these children were predominantly based on plant food sources, namely, maize, white rice and potatoes as indicated by the quantitative food frequency questionnaire [QFFQ] (MacIntyre & Labadarios 1999, p352). In addition, the 24-hour recall method questionnaire also indicated that plant based foods mainly consumed by children were maize and brown bread (Steyn & Labadarios 1999, p245). The difference between the results may be due to methodological issues. The QFFQ collected data on food items consumed in the previous six months for children over two years old, and one month for children 12 – 23 months old (MacIntyre & Labadarios 1999, p317). The 24-hour recall questionnaire collected data on foods consumed by children in the past 24 hours (Steyn & Labadarios 1999, p221). Diets that are low in variety are often deficient in vitamins and minerals (FAO 2002, p3). This is supported by the 24 hour recall questionnaire data which showed that the nutrient intakes of children aged 1 – 9 years were below 67% of the RDAs for energy, calcium, iron, zinc, selenium, vitamin A, vitamin D, vitamin C, vitamin E, riboflavin, niacin and vitamin B_6 (Steyn & Labadarios 1999, p242).

The nutrient intake of the nutrients identified as potential problem nutrients, energy and protein for children aged 1 – 3 years during the South African NFCS of 1999 are as presented in Table 2.1. Protein and thiamine were the only two nutrients that adequately met the RDA levels for children at the national level and in rural areas. The results in Table 2.1 indicate that children in the rural areas had lower nutrient intakes for all the selected nutrients than children in urban areas. Moreover, the majority of children aged 1 – 3 years in rural areas consumed less than 67% of the RDA for vitamin A, vitamin B_6, vitamin B_{12}, vitamin C, calcium, iron, zinc, folate and niacin.

Another national level study in South Africa that determined the nutritional status of young children was the SAVACG survey of 1994 (SAVACG 1995) that determined nutrient blood concentrations for vitamin A and iron in children aged 6 – 71 months. The study results showed that the prevalence of sub-clinical vitamin A deficiency was 33% at the national level (n = 4283). The prevalence of sub-clinical vitamin A deficiency was higher in rural areas (38%, n = 2168) than in urban areas (25%, n = 2040) with a statistical significance of $p<0.001$. Iron deficiency at the national level was 21.4%, rural areas 21.1% and 20.7% for urban areas. These findings are supported by the low dietary intake of vitamin A and iron from the South African NFCS of 1999 when using the results of 24-hour recall for children aged 1 – 3 years (Steyn & Labadarios 1999, pp260-280). During the NFCS of 1999, biochemical status for vitamin A and iron were not measured, but nutrient intakes were assessed. The NFCS of 1999 results for vitamin A and iron were low, such that 65% and 79% of children at the national level consumed less than 67% of the RDAs for vitamin A and iron respectively. The NFCS of 1999 24-hour recall nutrient intake results for vitamin A and iron for children aged 1 – 3 years are as shown in Table 2.1.

Table 2.1: Median 24-hour recall nutrient intake of the selected nutrients and the percentages of children consuming less than 67% of the RDAs for the selected nutrients from the NFCS of 1999 for children aged 1 – 3 years in South Africa

Nutrient (Median intake)	**RDA**[θ]	**National (RSA) Median (Q1-Q3)**[Ψ] **n = 1308**	**Rural Median (Q1-Q3) n = 644**	**Urban Median (Q1-Q3) n = 664**	**P-value rural/ urban**	**% of children consuming < 67% RDA**		
						RSA n = 1308	**Rural n = 644**	**Urban n = 664**
Energy (kJ)	5460	3887 (2839-5263)	3678 (2743-4832)	4209 (2933-5571)	0.0001	45	49	41
Protein (g)	16	28 (18.3-40.5)	25.5 (17-36)	30 (20-44)	0.0001	8.5	8.0	8.5
Vitamin A (RE)	400	176 (71-384)	133 (51-322)	204 (95-425)	0.0001	65	70	60
Thiamine (mg)	0.5	0.5 (0.4-0.7)	0.5 (0.4-0.7)	0.5 (0.4-0.7)	0.64	22	21	22
Riboflavin (mg)	0.5	0.4 (0.2-0.8)	0.4 (0.2-0.6)	0.5 (0.3-1.0)	0.0001	39	48	31
Niacin (NE)	6	4.4 (2.4-7.6)	3.7 (2.2-6.3)	5.2 (2.8-8.9)	0.0001	47	54	39
Folate (µg)	150	70 (42-121)	61 (38-105)	80 (47-135)	0.0006	68	74	62
Vitamin B_6 (mg)	0.5	0.4 (0.2-0.6)	0.3 (0.2-0.5)	0.5 (0.2-0.8)	0.0001	44	51	37
Vitamin B_{12} (µg)	0.9	0.8 (0.1-2.0)	0.5 (0.0-1.5)	1.1 (0.3-2.6)	0.0009	45	53	37
Vitamin C (mg)	40	14 (3-33)	10 (2-25)	18 (5-41)	0.0001	69	78	62
Calcium (mg)	500	235 (105-436)	214 (93-405)	253 (129-472)	0.019	65	68	62
Iron (mg)	10	3.9 (2.4-6.2)	3.7 (2.4-6.0)	4.2 (2.4-6.4)	0.39	79	80	78
Zinc (mg)	10	3.6 (2.3-5.5)	3.3 (2.2-4.9)	3.9 (2.4-6.1)	0.0001	86	90	82

Source: After Steyn & Labadarios 1999, pp260-280

[θ]USA RDA of 1989 as used in the analysis of the South Africa NFCS of 1999

[Ψ]: Q stands for quartile; Q1 is first quartile and Q3 third quartile

A review of district level studies in South Africa also showed a trend of low nutrient intakes. A study was conducted by van Staden, Langenhoven, Donald & Laubscher (1994) on children below five years of age to determine the main dietary related reasons why the children attending the Bishop Lavis Clinic in Cape Town were not growing well. Two groups of children were compared: children who did not gain weight for more than three months when weighed on three consecutive visits and the control group. The control group consisted of children who had gained weight well since birth. The results showed that nutrient intakes of the children from the group not gaining weight well had a lower intake of most nutrients than the control group. The low nutrient intakes by children not gaining weight were attributed to low consumption of food items from the meat, vegetables and fruit groups. Van Staden *et al* (1994), concluded that diet quality was amongst the reasons why children did not grow well. The socio-economic status of the study children was not determined.

A study was conducted in the Stellenbosch district on farm labourers' children aged 4 – 6 years (Krige & Senekal 1997) to determine possible factors that might have led to the poor nutritional status of the children. Dietary intake was determined by weighing the food consumed by the children at crèches and recall of the food consumed at home. The two dietary records were combined to make a full-day intake record. The study showed that more than 80% of the undernourished (children with stunting, underweight and wasting grouped together) children consumed less than 67% of the RDA for zinc, calcium and vitamin A while more than 40% consumed less than 67% of the RDA for iron, vitamin B_{12}, niacin, riboflavin and vitamin C. Seventy-nine percent of well nourished children consumed less than 67% of the RDA for calcium and 40% of the children consumed less than 67% of the RDA for vitamin A, vitamin C, riboflavin and iron. The inadequate intake of the nutrients was attributed to low consumption of food items from the milk, meat, vegetable and fruit groups. The study by Krige & Senekal (1997) investigated older children, compared to younger children aged 1 – 3 years who are the focus of the current study who would be even at greater risk of nutritional problems. Children aged 1 – 3 years have higher nutrient requirements from complementary foods and less nutrient needs from breast milk (ACC/SCN 2000, p33). This 1 – 3 year age group would be at greater risk of lower nutrient intakes, as these children have higher growth rates compared to children aged 4 – 6 years (Food and Nutrition Board 2001, p39).

The NFCS of 1999, SAVACG (1995) and the studies by Krige & Senekal (1997) and van Staden *et al* (1994) all linked low intake of micronutrients to inadequate consumption of animal products, vegetables and fruits. Thus, it could be assumed that increased consumption of these food items could increase the micronutrient intake of children.

The supply of low amounts of vitamins and minerals places children at risk of developing micronutrient deficiencies (Ruel & Levin 2000, p1). Micronutrient deficiencies often cause impaired growth and reduced learning capacity (Food and Agriculture Organization & International Life Sciences Institute [FAO & ILSI] 1997, p1). In addition, micronutrient deficiencies lower the immune system and increase susceptibility to diseases (Allen & Gillespie 2001, p26). Therefore, it is important to address the micronutrient needs of children.

2.3 Strategies to improve micronutrient intake

In the fight against micronutrient deficiencies, the aim should be to come up with a strategy that will address multiple micronutrient deficiencies. The most commonly utilized strategies to combat micronutrient deficiencies are supplementation, food fortification, dietary diversification (Kennedy, Nantel & Shetty 2002; FAO & ILSI 1997, p3) and nutrition education (FAO & ILSI 1997, p3) which can be viewed as part of dietary diversification. Food fortification and dietary diversity are food based strategies used as long term measures to address micronutrient deficiencies (Kennedy *et al* 2002). Nutrition education has been widely used to combat micronutrient deficiencies (Tontisirin *et al* 2002; FAO & ILSI 1997, p8) and it is often integrated into food production projects to increase intervention impact (Ruel & Levin 2000, p10). Food Based Dietary Guidelines (FBDGs) are often used as the nutrition education tool to promote the consumption of micronutrient dense foods (Tontisirin *et al* 2002). This section will give a brief overview of what is known about the above-mentioned strategies and then focus on dietary diversification using crop and livestock production. Supplementation will be discussed first, followed by food fortification and then, lastly, dietary diversity.

Supplementation is the process in which micronutrients are supplied to the target population in the form of pills or syrups (Kennedy *et al* 2002). Supplementation is normally used as a short-term measure for vulnerable groups at risk of micronutrient deficiencies (Kennedy *et al* 2002; Shrimpton & Schultink 2002). Apart from the fact that supplementation is for short-term purposes, Dewey & Brown (2003) and Shrimpton & Schultink (2002) stated that micronutrient supplementation is costly and creates dependency on external distributors. In addition, Yeudall, Gibson, Cullinan & Mtimuni (2005) stated that supplementation is not a sustainable long-term measure to combat micronutrient malnutrition. Even though micronutrient supplementation has limitations, Tontisirin et al (2002) suggested that supplementation of high-risk populations would be beneficial under certain circumstances, such as children who need therapeutic treatment. In addition, Dewey & Brown (2003) indicated that vitamin A supplementation has been successful in reducing vitamin A deficiency in pre-school children of at risk populations in developing countries.

Vitamin A supplementation has been widely used in Eastern and Southern Africa to control vitamin A deficiency in children (de Wagt 2001). Rivera, Gonzâlez-Cossio, Flores, Romero, Rivera, Tèllez-Rojo, Rosado & Brown (2001) cautioned that single micronutrient supplementation may not be adequate because multiple micronutrient deficiencies are widespread in developing countries. A review of multiple micronutrient supplementation studies by Allen & Gillespie (2001, pp38-39) in The Gambia, Vietnam, Mexico and Guatemala produced mixed results. The interventions were conducted on children aged between 6 – 24 months and lasted for three to 12 months in different countries (age and duration different for each country). The multiple micronutrient supplements only improved iron blood concentrations in The Gambia. Vitamin A and vitamin E were improved in Mexico; iron, zinc and vitamin A in Vietnam and there was no significant improvement of the micronutrients status in Guatemala.

Food fortification is the addition of one or more micronutrients to commonly consumed foods (Kennedy *et al* 2002). Allen & Gillespie (2001, pp52-53) reviewed food fortification interventions that aimed to improve nutrient intake of young children in developing countries. Two national programmes in Chile and Peru fortified milk with iron and, in Peru, biscuits were also fortified with iron. The national fortification programmes in the two countries reduced the prevalence of anaemia in children. Allen & Gillespie (2001, p52) also reviewed small-scale interventions in Guatemala, Thailand and South Africa and found that iron status of children was improved in all three countries. Iron was used to fortify sugar in Guatemala, fish sauce in rural Thailand and curry powder for a South Asian community in South Africa. Multiple micronutrient fortification trials have been conducted in some developing countries. A study in South Africa (van Stuijvenburg, Dhansay, Smuts, Lombard, Jogessar & Benadè 2001) found that the fortified biscuit significantly improved serum retinol and iodine concentrations levels of children aged 6 – 11 years. In Botswana, a multinutrient fortified beverage improved ferritin, folate and riboflavin blood concentrations of children aged 6 – 11 years (Abrams, Mushi,Hilmers, Griffin,Davila & Allen 2003). In Tanzania, a multinutrient fortified beverage significantly improved haemoglobin and serum retinol concentrations levels of primary school children aged 6 – 11 years (Ash, Tatala, Frongillo, Ndossi & Latham 2003). Multiple micronutrient fortification of seasoning powder in Thailand improved haemoglobin, iodine and zinc concentrations levels (Winichagoon, McKenzie, Chavasit, Pongcharoen, Gowachirapant, Boonpraderm, Bailey, Wasantwisut & Gibson 2006). However, Dewey & Brown (2003) criticized food fortification on the basis that quality control systems may not be adequate; agriculture may be undermined if local foods are not used for food fortification and the fortified products may not be accessible in rural areas where communities produce their own food products.

The NFCS of 1999 identified food items that were commonly consumed that could be used for food fortification (food vehicles) as maize, sugar, tea, whole milk and brown bread (Maunder & Labadarios 1999, p494). Following the survey, food fortification of maize and wheat flour (including baked bread) became mandatory in South Africa on the 7th of October 2003 (Department of Health 2003). The nutrients mandatory for food fortification are vitamin A, thiamine, riboflavin, niacin, pyridoxine, folic acid, iron and zinc (Department of Health 2003; South Africa Government Gazette 2003, p9). Locally produced food products are used for food fortification.

The NFCS of 1999 (Maunder & Labadarios 1999, p509) found that 48% of the households living in rural areas produced crops and most of the households used the produced crops for consumption. Maize was the most commonly produced crop and

75% of the households that produced maize used it for consumption. This indicates that households that consume produced maize products may not benefit from food fortification unless the produced crops are consumed along with other fortified food products such as maize meal and bread.

Dietary diversity is promoted to help increase energy and nutrient intakes, especially in developing countries where the diets of some vulnerable groups, such as children, are often based on starchy plant staples with little or no animal food products, vegetables and fruits. According to Ruel (2002, p5), dietary diversity is defined as the number of different foods or food groups consumed over a set period of time, which normally ranges from one to seven days. The FAO (2002, p3) suggested that adding nutrient rich foods to the diets through the use of small livestock and home gardens to increase dietary diversity could reduce micronutrient deficiencies. This process empowers individuals and households to be self-reliant as the households are responsible for producing food for themselves (Ruel & Levin 2000, p3). The FAO (2002, 3) reported that home gardens and livestock ownership also assist in increasing household food supplies. Moreover, Tontisirin *et al* (2002) emphasized that strategies that promote the production and consumption of the foods produced are more sustainable because they do not depend on external financial support for continuity of the interventions.

The next section will give a review of evidence to determine whether dietary diversification using crops and/or livestock could improve micronutrient intakes.

2.4 Impact of crops and/or livestock production interventions on nutrient intake

The review of literature for this section will be divided into three sections: crops only interventions, livestock only interventions and a combination of crops and livestock interventions.

2.4.1 Impact of the production of crops only on nutrient intake

Eight (8) studies were found to evaluate the impact of the production of crops only on nutrient intake. A summary of the studies is shown in Table 2.2. Two studies related to crop production and nutrient intake were found in South Africa and the rest are from other developing countries. Seven (7) of the studies were targeted to rural households and one in the Philippines assessed both rural and urban households. Seven (7) of the eight (8) studies combined nutrition education with crop production to improve vitamin A intake, except for one study in South Africa.

Faber, Venter & Benadè (2002b) conducted a study on children aged 2 – 5 years from low socio-economic households in a rural area in KwaZulu-Natal. Faber *et al* (2002b) integrated home gardens into a community-based growth monitoring programme to increase the consumption of vitamin A rich foods. The caregivers from the households in the experimental village were trained how to grow vitamin A rich vegetables at their homes and how to prepare the vegetables. The inhabitants of the control village were not trained. Out of thirteen nutrients analysed, the project adequately increased vitamin A intake of the children in the experimental village, as well as four other nutrients.

Another study in South Africa was conducted by Schmidt & Vorster (1995) to determine the effects of vegetable gardens on the nutritional status of children aged 6 – 13 years from a rural area in Kudumane District. The district consisted mainly of poor households. The experimental group consisted of children from households that participated in communal vegetable gardens and the control group had children from households not participating in communal gardens. Nutrition education training was not provided. Nutrient intake was analysed for energy and protein, which did not differ between the control and experimental groups (Table 2.2) and were all below the RDAs for both groups.

Table 2.2: Impact of the production of crops only on the nutrient intake of young children

<table>
<tr><th>Author(s) and country</th><th>Purpose of study</th><th>Type of intervention</th><th>Study subjects</th><th colspan="6">Study findings</th></tr>
<tr><td rowspan="2">Taher et al 2004, Bangladesh</td><td rowspan="2">Determine impact of home gardening on vitamin A intake</td><td rowspan="2">Home gardening for rural farmers, nutrition education; 1999-2000, twelve months</td><td rowspan="2">House-holds with children 6-59 months</td><td colspan="3">1999 baseline vitamin A intake from vegetables and fruits 10 RE (n =719) in children</td><td colspan="3">2000 after intervention, vitamin A intake of children from vegetables and fruits 40 RE (n =719)</td></tr>
<tr><td colspan="6">Significant increase from 1999-2000, p<0.001</td></tr>
<tr><td>Faber et al 2002b, South Africa</td><td>Determine impact of home gardening and growth monitoring combined on vitamin A intake</td><td>Experimental-control; Feb 1999- Feb 2000; home gardening; nutrition education; growth monitoring, rural area</td><td>House-holds with children 2-5 years old</td><td colspan="6">Thirteen nutrients intakes were assessed. Children from households with gardens: vitamin A, riboflavin, vitamin B_6, vitamin C intakes were significantly higher than the nutrient intakes of children in households without gardens ($p<0.05$) and calcium had a tendency. Each group had 50 children</td></tr>
<tr><td rowspan="5">Smitasiri & Dhanamitta 1999 Thailand</td><td rowspan="5">To sustain progress made in improving behaviour change especially for vitamin A in previous years</td><td rowspan="5">Community especially women participation. Promote green vegetable home gardens, Technical assistance, Intervention/ control, rural area, 1996-1997</td><td rowspan="5">House-holds with children 2 – 5 years</td><td></td><td colspan="2">Intervention intakes</td><td colspan="3">Control intakes</td></tr>
<tr><td></td><td>Vit A[a, b]</td><td>Fat</td><td></td><td>Vit A[a]</td><td>Fat[c]</td></tr>
<tr><td>1996</td><td>133%
n =171</td><td>18%</td><td>1996</td><td>101%
n = 146</td><td>17%</td></tr>
<tr><td>1997</td><td>142%
n = 152</td><td>21%</td><td>1997</td><td>158%
n = 136</td><td>22%</td></tr>
<tr><td colspan="6">[a] % of RDA for vit A; [b] significant increase from 1996-1997, p<0.05; [c] Recommended level 20-30% of total energy intake</td></tr>
</table>

Table 2.2 continued: Impact of the production of crops only on nutrient intake of young children

<table>
<tr><th>Author(s) and country</th><th>Purpose of study</th><th>Type of intervention</th><th>Study subjects</th><th colspan="5">Study findings</th></tr>
<tr><td rowspan="6">Smitasiri & Dhanamitta 1999 Thailand continued</td><td rowspan="6">To sustain progress made in improving behaviour change especially for vitamin A in previous years</td><td rowspan="6">Use results of project from 1989 to 1995 and social marketing strategy to increase vitamin A intake
Focus on women
Promote green vegetable gardens</td><td rowspan="6">House-holds with children aged 2 – 5 years</td><td colspan="5">Children aged 2 – 5 years</td></tr>
<tr><td></td><td colspan="2">Intervention intakes</td><td colspan="2">Control intakes</td></tr>
<tr><td></td><td>Iron</td><td>Vit C</td><td>Iron</td><td>Vit C</td></tr>
<tr><td>1996</td><td>65%</td><td>14%</td><td>55%</td><td>14%</td></tr>
<tr><td>1997</td><td>63%</td><td>19%</td><td>73%</td><td>19%</td></tr>
<tr><td colspan="5">Iron and Vit C intakes as % of RDAs; p<0.05 iron significant increase for control group 1996-1997</td></tr>
<tr><td rowspan="2">Phillips et al 1996 Guatemala</td><td rowspan="2">Determine cost and effectiveness of vitamin A interventions (including gardening)</td><td rowspan="2">Home garden and nutrition education, seeds and technical assistance provided,</td><td rowspan="2">Children, pregnant and lactating mothers</td><td colspan="2">Project area sample n = 300.</td><td colspan="3">Non project area n = 300</td></tr>
<tr><td colspan="5">Children from non-project area were 3.5 times at risk of vitamin A deficiency; p<0.01.</td></tr>
<tr><td rowspan="2">Schmidt & Vorster 1995, South Africa</td><td rowspan="2">Determine if vegetable production increased vegetable consumption and nutritional status</td><td rowspan="2">Communal vegetable garden in rural area.
Experimental-control
No nutrition education</td><td rowspan="2">6 – 13 years old children</td><td colspan="2">Experimental (n=18):
Mean (SD)
Energy: 3006.2 (1726.3) kJ
Protein: 25.6 (22.16)g</td><td colspan="3">Control (n =18):
Mean (SD)
Energy: 3489.9 (1973.6)kJ
Protein: 26.6 (17.57)g</td></tr>
<tr><td colspan="5">7 -14 years RDAs: energy 6903-15480 kJ; protein 34-46g. P-values not available
NB: 1kcal = 4.184 kJ</td></tr>
</table>

Table 2.2 continued: Impact of the production of crops only on nutrient intake of young children

Author(s) and country	Purpose of study	Type of intervention	Study subjects	Study findings
Attig *et al* 1993 Thailand	Promote home gardening to combat vitamin A deficiency using behavioural change social marketing approach	Home garden; Nutrition education; community involved; creative social marketing strategies; Experimental-control rural villages	Preschool children Pregnant mothers, Lactating women	Project covered 34 villages and 122 000 people, n-values not provided. In Experimental villages, significant increases from 1989 to 1991 for vitamin A intake: Pregnant women; 201 ± 425 RE to 428 ± 391 RE. Lactating mothers; 269 ± 355 RE to 476 ± 618 RE. No significant changes in control villages stated, but p-values not provided.
Solon *et al* 1979 Phillipines (Cebu)	Evaluate effectiveness of three vitamin A intervention strategies (horticulture, vitamin A capsules and fortification)	Public health, nutrition education and horticulture; seeds and seedlings; 2 rural and 2 urban areas included. Lasted for 2 years 1973 to 1975	Children aged 1- 6 years and 7 – 16 years	Total sample for three intervention strategies was 1715 children, n-value for each intervention not given. Vitamin A intake values were not given. In rural areas: vitamin A intake increased but was not significant In urban squatters, there was a significant increase in vitamin A intake. t-value significance set at 0.05 level

Six studies from other developing countries were identified (Table 2.2). The general focus of the studies was to improve vitamin A intake of children, pregnant women and lactating mothers. A study in Bangladesh (Taher, Talukder, Sarkar, Bushamuka, Hall, De Pee, Moench-Pfanner, Kiess & Bloem 2004) was conducted to determine the impact of home gardening on vitamin A status. The home gardening project was promoted by the Helen Keller International (HKI) organization and targeted rural households with children aged 6 – 59 months. The non-governmental organizations, especially HKI, in Bangladesh provided nutrition education to the targeted households. The main aim was to increase production of vegetables and fruits in the area, as well as consumption of vegetables and fruits rich in vitamin A through community empowerment. This was the only study that involved non-governmental organizations throughout the project. The project intervention started in 1999 and evaluation was done in 2000 on 719 households using semi quantitative 24-hour recall method. The study findings showed that vitamin A intake from vegetables and fruits significantly increased ($p<0.001$) from 10 RE in 1999 to 40 RE in 2000 for children aged 6 – 59 months.

Similar vitamin A intake results were found in rural Thailand (Smitasiri & Dhanamitta 1999; Attig, Dhanamitta, Ittikom & Smitasiri 1993). Attig *et al* (1993) promoted home gardening of vitamin A-rich foods using intensive nutrition education strategy of social marketing. The strategy was made up of twelve elements that emphasised community empowerment and participation, appropriate messages for the target audience and a multidisciplinary approach. The social marketing project was evaluated after two years and positive results were found. In 1996, Smitasiri & Dhanamitta (1999) embarked on follow-up social marketing of a vitamin A-rich food project to determine if improvements of vitamin A intake and knowledge made from 1989 to 1995 were continued. The project involved the community, different government sectors, women as leaders of intervention implementation and technical assistance, including provision of financial and other input resources for gardening. The vitamin A intake of children aged 2 – 5 years improved considerably from 1996 to 1997. Moreover, Phillips, Sanghvi, Suårez, McKigney & Fiedler (1996) and Solon, Fernandez, Latham and Popkin (1979) found improved vitamin A intakes of children in Guatemala and the Philippines respectively. In Guatemala (Phillips *et al* 1996), food production strategies used to improve vitamin A intake included home gardening, nutrition education, seeds and assistance on how to start gardens. After one year, households with gardens had better vitamin A intake and their children were at a lower risk of vitamin A deficiency compared to households without gardens whose children were at three and half times greater risk of developing vitamin A deficiency. In the Philippines, Solon *et al* (1979) reported that horticulture combined with public health and nutrition education improved vitamin A intake in both rural and urban areas. However, the impact of the intervention showed significant improvement in urban squatters but not in rural areas.

Overall, the agricultural crop production projects in five (5) out of six (6) studies that aimed to improve vitamin A intake had improved vitamin A intake. Two (2) studies assessed other selected nutrients apart from vitamin A. One study was in South Africa (Faber *et al* 2002b) and the other in Thailand (Smitasiri & Dhanamitta 1999). The study by Faber *et al* (2002b) increased intake of vitamin A, as well as other nutrients. The positive impact of crop production on vitamin A is supported by Jaarsveld, Faber, Tanumihardjo, Nestel, Lombard & Benadè (2005) who found that production of orange-fleshed sweet potatoes increased vitamin A liver stores of children in South Africa.

The study projects that increased nutrient intake had nutrition education, women's involvement, community participation and/or support, with resources for crop production. A review of different agricultural projects by Berti, Krasevec & FitzGerald (2004) revealed that nutrition education, consideration of gender issues and support with agricultural inputs were important aspects in programmes that improved child nutrition. The limitation of the reviewed studies was that the focus was mainly on improving vitamin A intake but, (Yeudall *et al* 2005) indicated that multiple micronutrient malnutrition is a problem in developing countries. As already highlighted (section 2.2.2), South Africa is not an exception. The study by Faber *et al* (2002b) was the only one that assessed the impact of home gardens on macronutrients and micronutrients intakes and showed improvement in some nutrients, namely, riboflavin, vitamin A, vitamin C and vitamin B_6.

2.4.2 Impact of the production of livestock only on nutrient intake

Three studies related to the production of livestock only and nutrient intake were identified. A summary of the results is shown in Table 2.3. One study was found in Ethiopia (Ahmed, Jabbar & Ehui 2000) and two in India (Begum 1994; Alderman 1987).

Table 2.3 indicates that the studies on the impact of livestock production predominantly focused on milk production income generating activities in rural areas. In Ethiopia (Ahmed *et al* 2000) and India (Alderman 1987), crossbreed cows were used to increase milk production as part of income generating activities. Milk consumption was not promoted in all the study projects. However, from the assessed nutrients (energy, protein or vitamin A), the nutrient intakes of the households in the experimental group were higher than the nutrient intakes of the control households for all three studies. All three studies assessed energy and protein intake and one study in Ethiopia (Ahmed *et al* 2000) also included retinol (vitamin A) and iron. Only one study (Begum 1994) assessed the nutrient intakes of children. The authors of the three studies (Ahmed *et al* 2000; Begum 1994; Alderman 1987) concluded that dairy development projects increase milk production, which improves the energy and protein intake of poor households.

Table 2.3: Impact of the production of livestock only on the nutrient intake of young children

Author(s) and country	Purpose of study	Type of intervention	Study subjects	Study findings		
Ahmed *et al* 2000 Ethiopia	Identify link between new dairy technologies and improved human nutrition (calorie intake)	Study in Holetta area; Targeted poor households; Experimental/control; crossbred cows introduced to increase milk production 1993-1997	House-holds willing to pay fixed cost and to maintain cows		Experimental (n = 80)	Control (n = 60)
				Energy[Я] (kJ)	9757	8196
				Fat (g)	19.6	15.8
				Protein (g)	70.3	62.1
				Retinol (μg)	38.8	27.1
				Iron (μg)	74.2	65.5
				In experimental group, all nutrients significantly increased, $p<0.05$		
Begum 1994 India	Determine if children in income generating dairy project had better nutrient intake	Dairy development project; rural families; four groups of households compared: large milk producers, marginal producers, small producers and non-producers	Pre-school children from families in dairy projects	There were 90 children in each group. Children from groups of marginal producers and large milk producers had protein intakes of range 18 – 23 g and small and non-producers groups had protein intake of range 15 – 20 g. Average energy intake for the four groups was 2573 – 4096 kJ, lowest in non producers group and highest in large producers group		

Key: [Я] energy, 1 kcal = 4.184 kJ

Table 2.3 continued: Impact of the production of livestock only on the nutrient intake of young children

Author(s) and country	Purpose of study	Type of intervention	Study subjects	Study findings
Alderman 1987 India, Karnataka	Increase dairy production using crossbreed cows and buffalos through formation of cooperatives especially in rural areas	Dairy development project; experimental/ control; 42 villages had cooperatives (intervention group) and 10 villages had no cooperatives (control group). Total sample of 806 households	Rural households with and without cooperatives	In the first three rounds (from five rounds): Energy intake for the households with cooperatives was slightly higher than for non-cooperative households especially for the first round. Protein intake also had similar findings.

Range of first three rounds	Cooperative	Non-cooperative
Energy [Я] (kJ)	10372 – 11109	9560 - 10866
Protein (g)	59 - 66	54 - 64

Key: [Я] energy, 1 kcal = 4.184 kJ

2.4.3 Impact of the production of both crops and livestock on nutrient intake

Little research has been done on the integration of both crop and livestock production to improve child nutrient intake. Only one study was found to assess the impact of production of crops and livestock on nutrient intake at the household level (English & Badcock 1998). A summary of the results is shown in Table 2.4.

The study conducted in Vietnam (English & Badcock 1998) combined vegetables, fruits, small husbandry and fish ponds in the same household garden. The project was targeted at households with children less than five years of age and the households were encouraged to consume a balanced diet containing a variety of foods rather than a rice-based staple diet. The experimental group had 72 children and the control group 99 children. Nutrition education included demonstrations on the preparation of foods and discussions on diets that promote healthy eating. Dietary analysis was done for energy, protein, iron, vitamin A and vitamin C and the results are shown in Table 2.4. The experimental group had significantly higher nutrient intakes for the analysed nutrients than the control group.

Table 2.4: Impact of the production of both crops and livestock on the nutrient intake of children less than five years old in rural Vietnam (English & Badcock 1998).

Group	**Nutrient** (at follow up)				
	Energy[Я] (kJ)	Protein (g)	Vitamin A (µg)	Vitamin C (mg)	Iron (mg)
Experimental (n = 72)	2573	17.2	100	26.0	2.6
Control (n=99)	2050	13.1	50	18.8	1.6
P-value	<0.0001	<0.0001	0.0022	not significant	<0.0001

Key: [Я] energy, 1 kcal = 4.184 kJ

The study results from Vietnam (English & Badcock 1998) show that combining crops and livestock could increase the nutrient intake of children in rural areas. However, more research is required, as the integration of crop and livestock production to improve nutrient intake has not been well researched.

2.5 Dietary diversity

There is a concern worldwide that the diets of children in developing countries lack diversity. As already highlighted in Chapter 1, South African children are affected by stunting and micronutrient deficiencies that are linked to a lack of dietary diversity. Home gardens and livestock production are often promoted to increase dietary diversity (FAO 2002, p3) and nutrition education increases awareness of the importance of the food produced. No study was found to assess the impact of agricultural production on dietary diversity. Section 2.10.1 will give a detailed explanation of how dietary diversity is measured.

2.6 Consumption of eggs, meat and milk by children

Animal source foods supply different vitamins and minerals, especially calcium, iron, zinc and vitamin A (Neumann 2000). Animal-based foods are the only sources of vitamin B_{12} (Murphy & Allen 2003; Neumann 2000). Milk products are vital sources of calcium and meat provides substantial amounts of readily absorbable iron and zinc (Neumann 2000). Some intervention studies on the contribution of animal source foods on the diet of children have been conducted in some developing countries such as Kenya (Murphy, Gewa, Liang, Grillenberger, Bwibo & Neumann 2003) and Malawi (Yeudall *et al* 2005). In Kenya (Murphy *et al* 2003), four groups of school children were given either githeri (local vegetable stew), githeri and milk, githeri and meat and the fourth group served as the controls. The group that received milk had increased intake of vitamin B_{12}, vitamin A, riboflavin and calcium compared to the control group. The meat group also had increased nutrient intakes of vitamin B_{12}, vitamin A, calcium, iron and Zinc. Murphy et al (2003) is supported by Yeudall et al (2005) who also found that children aged 30 – 90 months in Malaw,i who were in the intervention group (receiving maize-based staple with fish), had higher nutrient intakes for vitamin B_{12}, calcium, iron and zinc than the control group (receiving maize-based staple). Smitasiri & Chotiboriboon (2003) recommend that community based programs are needed at the grassroots level to link production, accessibility and consumption of animal source foods by the vulnerable groups. This data shows that livestock ownership could be beneficial to the children by improving their dietary intake.

2.6.1 Impact of the production of livestock only on the consumption of eggs, meat and milk by children

Only one study in Ethiopia (Ayele & Peacock 2003) was found to assess the impact of the production of livestock only on the consumption of milk. The study was targeted at poor female-headed households with children aged 6 months to 6 years. In 1998, the Dairy Goat Development project was extended to increase milk consumption and income of households. The extension process engaged women to improve their knowledge and skills so that they could better manage the project activities. In 2000, the project was evaluated in the Gorogutu district in 39 households to assess milk consumption. The study results showed that after two years of project intervention, 91% of the children aged 6 months to 6 years consumed milk 4 to 7 days a week compared to 38% of children before the project.

Generally, consumption of meat and meat products has not been well researched. In South Africa, studies revealed that households that kept livestock slaughtered the livestock owned for special occasions (Aliber & Modiselle 2002, p66; Leroy, van Rooyen, D'Haese & de Winter 2001). This needs further investigation.

2.6.2 Impact of the production of both crops and livestock on the consumption of eggs, meat and milk by children

Only one study was found in rural Ethiopia (Ayalew, Gebriel & Kassa 1999) to assess the impact of the production of crops and livestock combined on consumption of milk by children below five years of age. The aim of the project was to improve the vitamin A status of women and children through integration of gardening into the existing dairy goat development project in the two districts of Gursum and Kombolcha. Households were trained on how to start gardens and seeds were distributed to households with goats (experimental group). In addition, households were provided with nutrition education to promote production and consumption of vitamin A rich foods. Women were the main target for this project. Children from households in the intervention group had a significantly higher frequency of the consumption of milk, 4.5 times a week, than children who were not in the intervention group, who consumed milk 2.5 times a week ($p < 0.01$).

2.7 Consumption of vegetables and fruits by children

The food-based strategies that engage in agricultural production are promoted to improve consumption of vegetables and fruits. A review of literature identified that most studies promoted production of crops only and few promoted both crops and livestock. Studies that engaged in production of livestock only did not assess the consumption of vegetables and fruits.

2.7.1 Impact of the production of crops only on the consumption of vegetables and fruits by children

Seven (7) studies were found to assess the impact of production of crops only on the consumption of vegetables and fruits in rural areas. A summary of the studies is in Table 2.5. Three studies were conducted in Bangladesh (Taher *et al* 2004, Talukder, Kiess, Huq, de Pee, Darnton-Hill & Bloem 2000; Greiner & Mitra 1995) and four other studies were from Nepal (Jones, Specio, Shrestha, Brown & Allen 2005), South Africa (Faber *et al* 2002a), Tanzania (Kidala, Greiner & Gebre-Medhin 2000) and Kenya (Hagenimana, Oyunga, Low, Njoroge, Gichuki & Kabira 1999). All the studies used nutrition education to promote home gardening and consumption of vegetables and/or fruits. Two studies in Bangladesh (Talukder *et al* 2000; Greiner & Mitra 1995) and one in Kenya (Hagenimana *et al* 1999) involved women at all stages of programme development and implementation.

All the above study projects improved the consumption of vegetables and/or fruits. Talukder *et al* (2000) assessed the consumption of vegetables in relation to the type of home gardens available in households which were traditional, improved and developed. According to Talukder *et al* (2000), traditional gardens do not produce a variety of vegetables and fruits and the traditional crops that are produced are seasonal. Talukder *et al* (2000) further explained that improved gardens produce a variety of crops that do not last throughout the year and developed gardens produce a variety of crops throughout the year. The study results indicated that the frequency of the consumption of vegetables was higher in developed gardens than in traditional gardens.

Five (5) studies assessed vegetable consumption and, all improved vegetable consumption. In addition, two (2) studies assessed the consumption of fruits and all improved intake of fruits. One study assessed the intake of vitamin A-rich foods and the intake was improved.

Table 2.5: Impact of the production of crops only on the consumption of vegetables and fruits by children

Author(s) and country	Purpose of study	Type of intervention	Study subjects	Study findings	
Jones *et al* 2005 Nepal	Promote home gardens to increase vitamin A and iron intake (study in Rupandehi and Kailbastu districts in poor region with high Vit A deficiency)	Home gardens; rural areas; nutrition education using lectures and hands- on activities; focus on peoples' needs; produced year-round vegetables; intervention/ control in one region	House-holds with and without home gardens in selected districts	Experimental group (n = 430) consumed more vegetables and fruits promoted during the study than control group (n = 389) p<0.001 From the 16 vitamin A crops promoted: 15% to 100% households in experimental group consumed crops and 2% to 80% households in control group consumed crops	
Taher *et al* 2004, Bangladesh	Investigates changes of vitamin A intake	Home gardening and nutrition education of rural households. 12 months intervention	6 -59 months children	Baseline 1999 (n = 719): 36% consumed vegetables from own garden at least 3 days/week	Post-intervention 2000: (n = 719) 78% consumed vegetables from own gar-den at least 3 days/week
				P < 0.001	
Faber *et al* 2002a, South Africa	Determine if intake of yellow and dark green vegetables increase with home gardening	Home gardening and nutrition education of rural households. Experi-mental/controlled 20 months intervention	2-5 years old children	At follow-up, from experi-mental group (n=108), 85% consumed spinach, 80% carrots and 43% butternut squash.	At follow-up, from control group (n=100), 34% consumed spinach, 21% carrots and 4% butternut squash.
				P = 0.001 for all vegetables	

Table 2.5 continued: Impact of the production of crops only on the consumption of vegetables and fruits by children

Author(s) and country	Purpose of study	Type of intervention	Study subjects	Study findings
Kidala *et al* 2000, Tanzania	To determine long-term effects on horticulture and nutrition education on vitamin A	Horticulture and nutrition education in rural areas Experimental/ controlled five year follow-up	6 – 71 months children	At end of study: experimental group consumption of dark green leafy vegetables 4.5 times and control 3.2 a week Experimental: 65% (n = 75) consumed vitamin A rich foods more than 7 times a week Control: 37% (n = 71) consumed vitamin A rich foods more than 7 times a week p=0.001
Talukder *et al* 2000 Bangladesh	Addresses the lessons for development and expansion of home gardening programme from small-scale to national scale after one	Home gardening Nutrition education; planting demonstrations Non-governmental Organization, rural areas Women participation Improving traditional gardens; Multidiscipline	House-holds with children	n = 10,107. Consumption of vegetables in a week by the households with developed gardens was greater than for households with traditional gardens. Frequency of consumption of vegetables by children in the last week according to type of garden: No garden 22 times; Improved garden 30 times Traditional gardens 25 times; Developed garden 35 times NB: Traditional gardens: seasonal and no variety of crops Improved gardens: variety of crops produced but crops are seasonal Developed gardens: produce variety of crops throughout the year

Table 2.5 continued: Impact of the production of crops only on the consumption of vegetables and fruits by children

<table>
<tr><th>Author(s) and country</th><th>Purpose of study</th><th>Type of intervention</th><th>Study subjects</th><th colspan="5">Study findings</th></tr>
<tr><td>Hagenimana et al 1999 Kenya</td><td>To increase dietary intake of vitamin A among at-risk children</td><td>Promotion of orange-fleshed sweet potatoes; Target women; nutrition education; community participation; Two areas Ndhiwa/Nyarongi and Rongo were included in the study</td><td>House-holds with children under five years old</td><td colspan="5">HKI food frequency method was used to estimate dietary intake of vitamin A rich foods consumed per week:

Ndhiwa/Nyarongi (n=154): Intervention group; HKI score increased from 4.2 to 5.8, p=0.0015. Control group; HKI score decreased from 4.3 to 3.0.
Rongo (n=159): Intervention group: HKI score increased from 6.5 to 7.1 and Control group; HKI score decreased from 6.8 to 6.1.
Production and consumption of sweet potatoes was high in Rongo before the study.</td></tr>
<tr><td rowspan="6">Greiner & Mitra 1995 Bangladesh</td><td rowspan="6">Evaluate impact of Worldview International Project aimed to increase production and consumption of high-carotene foods in Gaibandah District</td><td rowspan="6">Home garden, nutrition education, community participation, women involvement, demonstrations on how to start gardens, modern and traditional media combined, poor villages, multidiscipline, experimental/ control</td><td rowspan="6">House-holds with children aged 1- 6 years old</td><td colspan="5">Consumption of green leafy vegetables (GLV) and yellow fruits by children aged 1 – 6 years in the study</td></tr>
<tr><td rowspan="2"></td><td colspan="2">Experiment area</td><td colspan="2">control area</td></tr>
<tr><td>1992
n = 2559</td><td>1993
n = 2522</td><td>1992
n = 2529</td><td>1993
n = 2518</td></tr>
<tr><td>GLV</td><td>39.7%</td><td>52.2%</td><td>33.8%</td><td>25.9%</td></tr>
<tr><td>Yellow fruits</td><td>9.1%</td><td>21.1%</td><td>6.6%</td><td>18.6%</td></tr>
<tr><td colspan="5">Significant increase of the frequency consumption of GLV and fruits for project area ($p < 0.05$) and for fruits in non-project area
Note: children in the control area had higher socio-economic status than those in the experimental area</td></tr>
</table>

2.7.2 Impact of the production of both crops and livestock on the consumption of vegetables and fruits by children

Three (3) studies that combined household crop and livestock production with regard to the consumption of vegetables and fruits were found in Nepal (Helen Keller International-Nepal [HKI-Nepal] 2004), Ethiopia (Ayalew *et al* 1999) and Vietnam (English & Badcock 1998). Table 2.6 gives a summary of the three studies. The study in Vietnam combined vegetables, fruits, small animal husbandry and fish ponds in the same household garden (English & Badcock 1998). In Ethiopia (Ayalew *et al* 1999), vitamin A-rich vegetables were integrated into an existing dairy goat development project. In Nepal (HKI-Nepal 2004), home gardening was promoted along with poultry farms in poor villages. All three studies incorporated demonstrations on how to establish gardens and nutrition education in rural areas. The production and consumption of vegetables and fruits was improved in all three studies. In Nepal (HKI-Nepal 2004), children consumed more vegetables than fruits and, in Vietnam (English & Badcock 1998), the experimental group consumed more fruits and vegetables than the control group. The study in Ethiopia (Ayalew *et al* 1999) only promoted vegetables and the intervention improved intake of vegetables.

Overall, all the three studies improved the intake of vegetables. Moreover, two studies that promoted consumption of fruits improved fruit intake. The three studies indicate that crop and livestock production increased consumption of vegetables and fruits though the emphasis was mainly on vitamin A rich foods.

Table 2.6: Impact of the production of both crops and livestock on the consumption of vegetables and fruits by children

<table>
<tr><th>Author(s) and country</th><th>Purpose of study</th><th>Type of intervention</th><th>Study subjects</th><th>Study findings</th></tr>
<tr><td>Helen Keller International/ Nepal 2004
Nepal</td><td>Increase intake of micronutrients with special reference to vitamin A</td><td>Home garden and animal husbandry (poultry farms), nutrition education, women involvement, rural area, community participation, planting demonstrations, seeds/seedlings, poultry, intervention from May 2002 to October 2003, 18 months</td><td>House-holds with children aged 6 – 59 months</td><td>Percentage of children that consumed vegetables and fruits in the last three (3) days. Round 1 March to June 2003 and round 2 July to October 2003.
<table>
<tr><th></th><th>Round 1
n = 221</th><th>Round 2
n = 225</th></tr>
<tr><td>Dark green leafy vegetables</td><td>53%</td><td>92%</td></tr>
<tr><td>Red/orange/yellow vegetables</td><td>12%</td><td>60%</td></tr>
<tr><td>Red/orange/yellow fruits</td><td>10%</td><td>42%</td></tr>
</table></td></tr>
<tr><td>Ayalew et al 1999
Ethiopia</td><td>Improve vitamin A status among women and young children by building on existing dairy goat project</td><td>Complement dairy goat project with health and nutrition informa-tion, hands-on training for gardening, distribution of seeds to households, multisectorial approach, rural poor Gursum and Kombolcha districts, experimental (had goats) and control (had no goats).</td><td>House-holds with children under five years old</td><td>After 13 months of intervention:
<table>
<tr><th></th><th>Expt n = 214</th><th>Control n = 106</th></tr>
<tr><td>Pumpkin intake</td><td>2.5 times/week</td><td>1.8 times/week</td></tr>
<tr><td>Sweet potato</td><td>2.8 times/week</td><td>2.0 times/week</td></tr>
</table>
pumpkin p<0.05
sweet potato p<0.01</td></tr>
</table>

Table 2.6 continued: Impact of the production of both crops and livestock on the consumption of vegetable and fruits by children

Author(s) and country	Purpose of study	Type of intervention	Study subjects	Study findings	
English & Badcock 1998, Vietnam	To reduce vitamin A deficiency	Home garden combined crops and livestock, Nutrition education, multidiscipline, planting demonstrations, 1991 to 1993 (two years intervention), experimental-control; rural households	Less than 5 years old children	Experimental (n= 72) each day consumed: 35.7g vegetables and 44.4g fruits	Control (n= 99) each day consumed: 24.1g vegetables and 11.6g fruits
				Vegetables p = 0.0142; fruits p = 0.0006	

2.8 Hunger perceptions

According to Latham (1997, p15) and Campbell (1991), food security is defined as "access by all people at all times to enough food for an active healthy life." Food security has three important components which are availability, accessibility and utilisation (Latham 1997, pp15-19) and these are highlighted below;

- Availability: this entails consistent and sufficient supply of variety and safe food for all individuals from year to year,
- Accessibility is ensured when each household family member has access to food to meet the nutritional requirements. Access to food depends on income available to household and if the household access culturally acceptable foods in socially acceptable way.
- Utilisation of food: This is to ensure that food is of good quality, safe and this should be ensured throughout the food chain.

The level of food security differs at the household and national levels as the Department of Agriculture (2002, p16) and the ACC/SCN (1997, p83) stated that if national food security exists, it does not mean that all households will meet food security. According to Latham (1997, p341), "household food security is the ability of the household to secure enough food to provide for all the nutrient requirements of all members of the household." The three key components of food security are important to achieve this. Household food insecurity is inadequate food supply caused by different factors such as food shortage and inappropriate distribution of food within the household (Latham 1997, p20). Strategic targeting of resources will be required for the food insecure groups to increase availability and access to food.

Latham (1997, p348) suggested that agricultural food production that is targeted especially at the poor and driven by them could improve household food security. This is supported by Marsh (1998) who stated that food production that is managed by households is more reliable and sustainable than nutrition projects that are controlled by governments in combating food insecurity. Midmore, Niñez & Venkataraman (1991, p6) stated that emphasis on the commercialization of agriculture exacerbates the problem of food insecurity among the poor, which in turn leads to low intake of vegetables and fruits because of increased food prices. The

Integrated Food Security Strategy of South Africa of 2002 advocates for food insecure households to take the lead in their own development (Department of Agriculture 2002, p25).

2.8.1 Impact of the production of crops and/or livestock on food security

Home gardens provide direct access to food, which is vital for improving household food security (Marsh 1998). Home gardens that are tailored to local preferences and resource conditions can be a sustainable strategy for improving the household food security and income of the poor (Midmore *et al* 1991, pp14-15). Faber *et al* (2002a) conducted a study in South Africa on children aged 2 – 5 years using home gardens to improve dietary intakes of yellow and dark green leafy vegetables. Impact on food security was not the primary aim of the project and food security was not specifically measured. However, when caregivers were asked what difference the project made, it appeared to have impacted on food security as 33% of the respondents stated that they did not have to buy vegetables and 21% said the project assisted in poverty alleviation. However, it must not be assumed that food secure households will have good nutritional status (Department of Agriculture 2002, p31; Latham 1997, p18).

The Role of Agriculture Project indicated that rural households that were involved in agricultural activities in Indonesia and Mexico were often less poor compared to households that were not engaged in agricultural activities (FAO 2004, p11). According to Kirsten, Townsend & Gibson (1998) and Schmidt & Vorster (1995), livestock and/or crop production also contribute indirectly to household food security. Kirsten *et al* (1998) found that in KwaZulu-Natal, fewer stunted children were from crop-producing households that had an income from crops three times greater than that of non-crop-producing households. Schmidt & Vorster (1995) suggested that income generated from agricultural production could be used to purchase other food products. Schmidt & Vorster (1995) are supported by Aliber & Modiselle (2002, p66) who pointed out that households in Gauteng and KwaZulu-Natal that kept livestock used income generated from livestock to purchase food. Cameron (2003, p27) also indicated that 29% of the households participating in the South Africa Heifer Project in KwaZulu-Natal used income from the sales of the animals owned to purchase groceries.

A third of poor households in South Africa spent 35% of their total food share on grain food products (Statistics South Africa 2002, p60). This is supported by Rose & Charlton (2002) who revealed that among 62.1% of rural households in South Africa, the money spent on food was not enough to buy a basic and nutritionally adequate diet.

Little research linked agricultural production and hunger perceptions among households. Only one study was identified in South Africa (Hirschowitz & Orkin 1995, p20). Hirschowitz & Orkin (1995, p20) assessed the levels of hunger among households below the minimum living level, with a total monthly income of less than R899.00 and also engaged in subsistence agriculture. The household member responsible for health care was asked if household members often, sometimes, occasionally or never go hungry. Fewer households from households engaged in subsistence agriculture reported that their household members occasionally went hungry. Literature also shows that studies that increased the production and consumption of vegetables and fruits concluded that household food security was improved (Helen Keller International-Nepal 2004; Faber *et al* 2002a) but the authors never assessed if the households had enough food to meet their daily needs throughout the year. There was no specific measure of food security; the households with gardens were asked how the gardens contribute to their households needs. In South Africa, food stocks (home produce supply) change with seasons (McLachlan & Kuzwayo 1997, p23) and when food stocks are depleted, households start buying basic foods (Mebrahtu, Pelletier & Pinstrup-Andersen 1995, p237). The South African NFCS of 1999 revealed that 93% and 94% of households purchased milk and maize respectively which were among the most commonly consumed food products (Maunder & Labadarios 1999, p534).

2.9 Anthropometric status of children

Anthropometric status indices are widely used to assess growth in children (Schmidt & Vorster 1995; World Health Organization [WHO] 1995, p161). The widely used anthropometric indices for children are stunting, underweight and wasting (Allen & Gillespie 2001, p23; ACC/SCN 2000, p5; WHO 1995, p162). Stunting is referred to as low height-for-age and it reflects failure to reach optimal growth as a result of cumulative process of inadequate nutritional inadequacies or poor health (WHO 1995, p164). Underweight is low weight-for-age (Allen & Gillespie 2001, p24; WHO 1995, p170) and is affected by both stunting and wasting which makes its interpretation difficult (ACC/SCN 2000, p7). Wasting is low weight-for-height (ACC/SCN 2000, p7; WHO 1995, p165). Wasting denotes current episodes of illnesses or food shortage that resulted in severe weight loss (Allen & Gillespie 2001, p24; ACC/SCN 2000, p7).

The United Nations Child's Fund (UNICEF) conceptual framework on the causes of malnutrition showed that the causes of malnutrition are multifaceted (UNICEF 1998, p24). The underlying causes of malnutrition, which impact on dietary intake and diseases are: insufficient access to food; inadequate care for women and children; and insufficient health services and poor environmental conditions (UNICEF 1998, p23-24).

2.9.1 Anthropometric status of children aged 1 – 3 years in South Africa

At the national level, the South African NFCS of 1999 showed that 25.5% of children aged 1 – 3 years were stunted, 13% of children were underweight and 4% were wasted (Labadarios & Nel 1999, pp168-169). Children aged 1 – 3 years were more affected by stunting than older children. The prevalence of stunting was 20.7% for children 4 – 6 years and 13% for children 7 – 9 years. The children aged 1 – 3 years in rural areas were more affected than in urban areas. In rural areas 30.3% of children were stunted, 15.1% were underweight and 5.5% wasted. In urban areas, 20.9% were stunted, 9.7% underweight and 2.6% wasted. Table 2.7 shows a comparison of anthropometric indicators of children aged 1 – 3 years living in rural and urban areas. In addition, the results of SAVACG survey of 1994 (SAVACG 1995) for children aged 6 – 71 months are reported in Table 2.7. The prevalence of stunting was 22.9%, underweight 9.3% and wasting 2.6%. It should be noted that the data reported here from the NFCS and SAVACG survey had children of different age groups and are not directly comparable.

Table 2.7 Comparison of rural and urban anthropometric indicators for children aged 1 – 3 years from national surveys in South Africa

Anthropometric indicator	**NFCS of 1999** (Labadarios & Nel 1999, p207)			**SAVACG of 1994** (SAVACG 1995)		
	RSA (n = 1198)	**Rural (n = 581)**	**Urban (n = 617)**	**RSA (n)**	**Rural (n)**	**Urban (n)**
Stunting (< -2SD) %	25.5	30.3	20.9	22.9 (10871)	27.0 (6094)	16.1 (4777)
Underweight (< -2SD) %	12.4	15.1	9.7	9.3 (11238)	10.7 (6343)	6.9 (4895)
Wasting (< -2SD) %	4.0	5.5	2.6	2.6 (10819)	2.8 (6062)	2.1 (4757)

2.9.2 Impact of the production of crops only on the anthropometric status of children

Research has not found a strong link between crop production and child growth. Two out of three studies that determined the relationship between crop production and child anthropometric status showed that crop production did not improve anthropometric status (Makhotla & Hendriks 2004; Faber, Phungula, Venter, Dhansay, Benadè 2001). Table 2.8 gives a summary of the three studies. Makhotla & Hendriks (2004) conducted secondary a analysis study in Lesotho to determine the impact of home gardening on the growth of children less than five years old in rural households. This secondary analysis study used existing data from the Food, Health and Community Nutrition Programme survey of 1999, and selected data on vegetable production and the nutritional status of preschool children. A total of 2015 households had gardens and 673 did not have gardens. Nutrition education was not combined with crop production and the households used traditional methods to produce crops. The results showed that stunting, underweight and wasting were highly prevalent among children from households with gardens and without gardens. However, in one district (Quthing), the presence of home gardening was associated with lower underweight ($p=0.000$) and wasting ($p=0.010$).

In South Africa, Faber *et al* (2001) also indicated that a home gardening project did not improve the anthropometric status of children aged 2 – 5 years old. The study was conducted in a rural community and intense nutrition education was integrated with growth monitoring promotion. The project was started in 1999 and it promoted yellow and dark green leafy vegetables. Height and weight measurements were taken at baseline and after 12 months and 20 months since the project started. The results showed that the project did not improve the anthropometric status of children. This would be expected because animal source foods were not included and Allen & Gillespie (2001, p33) reported that intake of animal source foods was associated with better growth in Peru, Mexico, Kenya and Egypt.

The public health, nutrition and health education and horticulture project by Solon *et al* (1979) in the Philippines improved wasting in both rural and urban children after two years of intervention. Data on stunting and underweight was not available.

Public health included immunisations, simple medical treatments and education on hygiene to improve sanitary conditions.

Table 2.8: Impact of the production of crops only on the anthropometric status of children

<table>
<tr><th>Author(s) and country</th><th>Purpose of study</th><th>Type of intervention</th><th>Study subjects</th><th colspan="6">Study findings</th></tr>
<tr><td rowspan="2">Makhotla & Hendriks 2004, Lesotho</td><td rowspan="2">Assess contribution of home gardens to nutritional status</td><td rowspan="2">Home gardening. Experimental/ control No nutrition education</td><td rowspan="2">< 5 years old children</td><td colspan="3">Home gardens (n=2015) below -2SD:
Stunting 49.1%
Underweight 29.6%
Wasting 24.7%</td><td colspan="3">No home gardens (n=673) below -2SD:
Stunting 44.7%
Underweight 23.8%
Wasting 19.7%</td></tr>
<tr><td colspan="6">Quthing district: Association between home gardening and anthropometric indicators: stunting p =0.087; underweight p =0.000 and wasting p = 0.010</td></tr>
<tr><td rowspan="6">Faber *et al* 2001, South Africa</td><td rowspan="6">Determine effects of home gardening of yellow and dark green vegetables on under-nutrition especially vitamin A status</td><td rowspan="6">Home gardening, Nutrition education experimental/control, intervention from 1999, Follow-up at 12 and 20 months. (Reported results at 20 months)</td><td rowspan="6">2 – 5 years old children</td><td colspan="3">Experimental group</td><td colspan="3">Control group</td></tr>
<tr><td>Indicator Mean (SD) % < -2SD</td><td>Baseline n = 107</td><td>Follow-up n = 110</td><td>Indicator Mean (SD) % < -2SD</td><td>Baseline n = 60</td><td>Follow-up n = 111</td></tr>
<tr><td>Stunting</td><td>-1.30 (0.87)
21%</td><td>-1.16(1.08)
16%</td><td>Stunting</td><td>-1.29 (1.27)
20%</td><td>-0.42(1.15)
26%</td></tr>
<tr><td>Under-weight</td><td>-0.55 (1.17)
5%</td><td>-0.23 (0.97)
5%</td><td>Under-weight</td><td>-0.68(1.13)
16%</td><td>-0.46(0.91)
6%</td></tr>
<tr><td>Wasting</td><td>0.31 (1.19)
0%</td><td>0.63 (0.92)
0%</td><td>Wasting</td><td>0.15(0.91)
2%</td><td>0.51(0.72)
0%</td></tr>
<tr><td colspan="6">No significant difference for all anthropometric indicators</td></tr>
</table>

Table 2.8 continued: Impact of the production of crops only on the anthropometric status of children

Author(s) and country	Purpose of study	Type of intervention	Study subjects	Study findings
Solon *et al* 1979 Phillipines (Cebu)	Evaluate effectiveness of three vitamin A intervention strategies	Public health, nutrition education and horticulture; seeds and seedlings; 2 rural and 2 urban barangay areas Lasted for 2 years 1973 to 1975	Children aged 1- 6 years and 7 – 16 years	When weight was compared to Harvard weight standard for height, wasting significantly decreased in children living in both rural and urban areas after public health and horticulture intervention. Weight-for-height figures were not provided t value significant at 0.05

2.9.3 Impact of the production of livestock only on the anthropometric status of children

Low consumption of foods of animal origin is one of the major causes of slow child growth (Ayele & Peacock 2003). However, no study was found to assess the impact of production of livestock only on anthropometric status.

2.9.4 Impact of the production of both crops and livestock on the anthropometric status of children

Two studies were found to combine crops and livestock to determine the impact of agricultural production on anthropometric status. Table 2.9 shows a summary of the two studies. One study was conducted in Ethiopia (Ayalew *et al* 1999) and the other in Vietnam (English & Badcock 1998). Both studies aimed to reduce vitamin A deficiency in rural households with young children. In addition, a multidisciplinary approach was used to develop study interventions in the two countries and nutrition education was part of the intervention. However, the studies produced contrasting results.

In Ethiopia (Ayalew *et al* 1999), production of vitamin A-rich vegetables was integrated into the existing dairy goat development project and the intervention lasted for 13 months before evaluation. There was no significant difference between the anthropometric status of the children in the intervention and those not in the intervention. In Vietnam, English & Badcock (1998) conducted a study to determine the impact of a community nutrition project on vitamin A status, as well as anthropometric status of children. The project combined crop production, fish and small animal husbandry in the same garden. After two years (1991 to 1993) of project implementation, follow-up data was gathered. In the intervention group, stunting significantly reduced from 50.3% to 41.7% but wasting remained constant. In the control group, stunting slightly increased from 45.8% to 47.6%.

Table 2.9: Impact of the production of both crops and livestock on the anthropometric status of children

<table>
<tr><th>Author(s) and country</th><th>Purpose of study</th><th>Type of intervention</th><th>Study subjects</th><th>Study findings</th></tr>
<tr><td>Ayalew et al 1999 Ethiopia</td><td>Improve vitamin A status among women and young children by building on existing dairy goat project</td><td>Complement dairy goat project with health and nutrition information, hands-training for gardening, distribution of seeds to households, multisectorial approach, rural poor Gursum and Kombolcha districts, intervention from December 1996-August 1997 experimental (had goats) and control (had no goats).</td><td>Households with children less than five years old</td><td>After 13 months of intervention, anthropometric indicators of the children in experimental (expt) group were not significantly different from the control group
<table>
<tr><th></th><th>Expt (n = 214)</th><th>Control (n = 106)</th></tr>
<tr><td>Stunting</td><td>43%</td><td>45%</td></tr>
<tr><td>Underweight</td><td>40%</td><td>43%</td></tr>
<tr><td>Wasting</td><td>20%</td><td>16%</td></tr>
</table></td></tr>
<tr><td>English & Badcock 1998, Vietnam</td><td>To reduce vitamin A deficiency</td><td>Home garden combined crops and livestock, Nutrition education, multidiscipline, planting demonstrations, 1991 to 1993 – 2 years, experimental-control; rural households</td><td>Households with children less than 5 years old</td><td><table>
<tr><th></th><th colspan="2">Expt (n = 72)</th><th colspan="2">Control (n = 99)</th></tr>
<tr><td></td><td>Baseline
n = 527</td><td>Follow-up
n = 465</td><td>Baseline
n = 251</td><td>Follow-up
n = 229</td></tr>
<tr><td>Stunting</td><td>50.3%</td><td>41.7%</td><td>45.8%</td><td>47.6%</td></tr>
<tr><td>Wasting</td><td>3.8%</td><td>4.1%</td><td>5.2%</td><td>4.4%</td></tr>
</table>
Stunting significantly decreased in experimental group (p = 0.0007).</td></tr>
</table>

2.10 Background to methodology

The current study used data from the South African NFCS of 1999. The measurement methods used for nutrient intake, hunger perceptions and anthropometric status have been explained in detail in the report of the NFCS of 1999, which is available on the South African Department of Health web site (http://www.sahealthinfo.org/nutrition/foodconsumptio.htm) and a brief summary is given in Chapter 3. The methods for measuring dietary diversity will be explained in detail in this section.

2.10.1 Measuring dietary diversity

Different methods have been used to measure dietary diversity and the methods that have been used to measure dietary diversity of diets of children in developing countries will be discussed. The methods that have been used include food variety score and dietary diversity score (Ruel 2002, p16; Hatloy, Torheim & Oshaug 1998). The food variety score involves a simple count of the number of different food items consumed over a period of time (Ruel 2002, p16; Hatloy *et al* 1998). Hatloy *et al* (1998) used the method in Mali to determine the nutrient adequacy of foods consumed by children below five years of age. A list of 75 foods commonly eaten by the children in Mali was compiled and the foods were treated equally without giving preference to any food item. The food items assessed were obtained through direct weighing of the food items consumed over a period of three days. The results showed that a food variety score of 20.5 had a positive effect on nutrient adequacy.

Dietary diversity score requires that the foods be divided into groups, and a maximum score is set depending on the number of groups, as each group is given one point. In addition to the food variety score, Hatloy *et al* (1998) also used the dietary diversity score to measure the nutrient adequacy of the diets consumed by children over a period of three days. The food groups that were used during the study by Hatloy *et al* (1998) were staples, vegetables, milk, meat, fish, egg, fruits and green leaves. A dietary diversity score of 5.8 had a positive effect on nutrient adequacy. When the food variety score and dietary diversity score methods were compared using Pearson's correlation coefficient, the dietary diversity score (ratio 0.39) was found to be a better predictor of dietary diversity than the food variety score (ratio 0.33) (Hatloy et al 1998). Moreover, the food variety score gives the total number of food items, which may all belong to the same group (Swindale & Ohri-Vachaspati 1999, p11).

The dietary diversity score food groups used by Hatloy *et al* (1998) are different from the groups for children currently recommended by Food and Nutrition Technical Assistance [FANTA] (Swindale & Bilinsky 2005, p9). FANTA and Hatloy *et al* (1998) food group lists are made up of eight food groups with a score of 0 – 8. Swindale & Ohri-Vachaspati (1999, p11) also gave an example of the food groups from the Food and Agricultural Organization food balance sheets. The food list consists of twelve food groups. Swindale & Ohri-Vachaspati (1999) strongly recommends that the food groups used should be adapted to the local setting to reflect the cultural and economic situation of the target population. Sayed (2004, p40) recently used the South African Food Composition Tables food group list of 13 food groups. Table 2.10 shows the different food group lists of FANTA (Swindale & Bilinsky 2005), Hatloy *et al* (1998), FAO (Swindale & Ohri-Vachaspati 1999) and Sayed (2004). Cereals, vegetables, fruits, meat, milk, eggs, fish, legumes and fats and oils are the basis of all the food groups from the different authors.

According to Swindale & Ohri-Vachaspati (1999, p11) and Ruel (2003), the food groups used should each have a nutritional value and the survey objective should also be considered in selecting groups. Therefore, in the development of a dietary diversity food group list specific to the objective of assessing the increase in consumption of animal products, vegetables and fruits, especially from home produced products, it would help to include all products that need to be assessed. Swindale & Ohri-Vachaspati (1999, p11) cautioned that the food group list should not be very large as that might make results interpretation difficult.

Table 2.10: Comparison of food group lists from different authors

Swindale & Bilinsky 2005	**Sayed 2004**	**Swindale & Ohri-Vachaspati 1999**	**Hatloy *et al* 1998**
Grains, roots or tubers	Cereal and cereal products	Cereals	Staples
Vitamin A-rich plant foods	Vegetables	Vegetables	Vegetables
Other fruits and vegetables	Fruit	Fruits	Fruits
Pulses/legumes/nuts	Legumes and legume products	Pulses/legumes	Green leaves
Foods cooked in oil/fat	Fats and oils	Oils/fats	-
Milk and milk products	Milk and milk products	Milk and milk products	Milk
Eggs	Eggs	Eggs	Eggs
Meat, poultry, fish, seafood	Meat and meat products	Meat and offal	Meat
	Fish and seafood	Fish and seafood	Fish
	Sugar, syrups and sweets	Sugar/honey	
	Sauces, seasonings and flavourings	Roots and tubers	
	Nuts and seeds	Miscellaneous	
	Beverages		

Arimond & Ruel (2004) stated that young children of different age groups have different eating patterns. Dietary diversity increases as children grow older and, therefore, the age group of children must be borne in mind when developing food group lists for a dietary diversity score. Children 12 – 23 months of age are expected to have a high dietary diversity of four (4) or more food groups out of seven (7) food groups in a day (Arimond & Ruel 2004). This is supported by the studies reviewed by Ruel (2003), which indicated that a mean of the dietary diversity score of more than five (5) in Kenya and Niger was associated with adequate nutrient intake. However, Ruel (2003) stated that there are no standardized cut-off points and these can be determined by the number of food groups used. The higher the number of food groups used, the higher the cut-off point. Sayed (2004, p40) used 13 food groups and set the cut-off point at half (6) of the food groups. FANTA did not propose a cut-off point. Progress in developing a dietary diversity indicator has been slow because of lack of consistent methods and varying relationships or areas that received attention (Steyn, Nel, Nantel, Kennedy & Labadarios 2006). Given the many approaches currently being used and the lack of agreement on dietary diversity score method, the food group list used by Sayed (2004, p40) was used for this study for uniformity within South Africa.

2.11 Summary

Micronutrient deficiencies affect young children worldwide, especially in developing countries. In South Africa, literature revealed that inadequate nutrient intake in children had been associated with lack of variety of diets. The identified problem nutrients during complementary feeding are vitamin A, vitamin B_6, vitamin B_{12}, vitamin C, calcium, iron, zinc, folate, thiamine, riboflavin and niacin. These problem nutrients, as well as energy and protein, were selected for this study. In South Africa, the NFCS of 1999 24-hour recall nutrient intake findings showed that the majority of children consumed less than 67% of 10 out of 13 of the selected nutrients.

Various methods have been used to combat micronutrient deficiencies and these methods are supplementation, food fortification, dietary diversity and nutrition education. Supplementation and food fortification studies proved that the strategies could adequately improve micronutrient intakes. However, the methods fail to improve the household food security of households, particularly in rural areas. Moreover, supplementation is a short-term measure and it is not sustainable in long-term. Dietary diversification, especially when using crop and small livestock production, is recommended because it addresses multiple micronutrient deficiencies and food insecurity at the same time as a long-term measure.

A review of agricultural intervention studies on the impact of production of crops only showed a positive link between crop production and nutrient intake, and crop production and the consumption of vegetables and fruits. A summary is in Table 2.11. Studies on crop production were limited to focus on promoting vitamin A nutrient intake, and vitamin A intakes were improved. Crop production studies produced mixed results with regard to anthropometric status in the few studies where anthropometry was investigated. Productions of crops and livestock as well as livestock only are not well researched areas and firm conclusions cannot be made. Studies on the relationship between production of crops and/or livestock and food security were not found.

More research is required to determine if crop and/or livestock production improves multiple micronutrient intake, dietary diversity, food security and the anthropometric status of children. The above studies were looking at specific interventions. In contrast, this study is an observational study which aims to determine and compare these parameters in households producing crops only, crops and livestock, livestock only and non-producers.

Table 2.11: Summary of studies on crops and/or livestock production and study variables

Reference, country	Study purpose	Nutrient intake	Dietary diversity	Consumption of eggs, meat and milk	Consumption of vegetables and fruits	Anthropometric status
CROPS ONLY						
Jones *et al* 2005, Nepal	Promote gardening to ↑ vit A & iron	NI	NI	NI	Vegetables & fruits ↑	NI
Makhotla & Hendricks 2004, Lesotho	Assess gardening & nutritional status link	NI	NI	NI	NI	stunting no change; underweight & wasting ↓
Taher *et al* 2004, Bangladesh	Promote gardening to ↑ vit A	Vit A ↑	NI	NI	Vegetables ↑	NI
Faber et al 2002a, South Africa	Promote gardening & GMP to ↑ vit A	NI	NI	NI	Vegetables ↑	NI
Faber et al 2002b, South Africa	Promote gardening & GMP to ↑ vit A	↑ Vit A, B6 & C, riboflavin	NI	NI	NI	NI
Faber et al 2001, South Africa	Effects of gardening on vit A status	N/A	NI	NI	NI	No significant difference for all indicators
Kidala et al 2000, Tanzania	Effects of horticulture & NE on vit A	NI	NI	NI	Vegetables ↑	NI
Talukder et al 2000, Bangladesh	Home gardening national scale-up	NI	NI	NI	Vegetables ↑	NI
Hagenimana *et al* 1999, Kenya	Increase vit A intake	NI	NI	NI	Orange fleshed sweet potatoes ↑	NI
Smitasiri & Dhanamitta 1999, Thailand	Promote gardening to ↑ vit A	↑ Vit A & C, iron	NI	NI	NI	NI
Phillips et al 1996, Guatemala	Effectiveness of vit A interventions	Vit A ↑	NI	NI	NI	NI
Greiner & Mitra 1995, Bangladesh	↑ production & consumption of high carotene foods	NI	NI	NI	Vegetables & fruits ↑	NI
Schmidt & Vorster 1995, South Africa	Veg production, consumption, nutritional status	Energy & protein no significant difference	NI	NI	NI	NI
Attig *et al* 1993, Thailand	Promote gardening to ↑ vit A	Vit A ↑	NI	NI	NI	NI
Solon et al 1979, Phillipines	Effects of horticulture, PH & NE on vit A	Vit A ↑ in rural, but not urban	NI	NI	NI	Wasting ↑

Key: ↑ = increased, ↓= decreased, GM = growth monitoring, NI = not investigated, NE = nutrition education, PH = public health, veg = vegetable production, vit = vitamin

Table 2.11 continued: Summary of studies on crops and/or livestock production and study variables

Reference, country	Study purpose	Nutrient intake	Dietary diversity	Consumption of eggs, meat and milk	Consumption of vegetables and fruits	Anthropometric status
LIVESTOCK ONLY						
Ahmed *et al* 2000, Ethiopia	Link dairy production & human nutrition	↑ energy, protein, retinol & iron	NI	NI	NI	NI
Begum 1994, India	Link dairy production & nutrient intake	↑ energy & protein	NI	NI	NI	NI
Alderman 1987, India	↑ dairy production in rural areas	↑ energy & protein	NI	NI	NI	NI
CROPS & LIVESTOCK						
HKI/Nepal 2004, Nepal	↑ micronutrient intake especially vit A	NI	NI	NI	Vegetables & fruits ↑	NI
Ayalew et al 1999	Gardening & dairy to improve vit A status	NI	NI	↑ milk intake	Vegetables ↑	No significant difference for all indicators
English & Badcock 1998, Vietnam	Effects of gardening on morbidity	↑ energy, protein, vit A & iron	NI	NI	Vegetables ↑	Stunting ↓

Key: ↑ = increased, ↓= decreased, GM = growth monitoring, NI = not investigated, NE = nutrition education, PH = public health, veg = vegetable production, vit = vitamin

CHAPTER 3: METHODOLOGY

3.1 Survey design

A cross-sectional secondary analysis study using the South African NFCS of 1999 data for children aged 1 – 3 years in South Africa was conducted. The purpose of this study was to determine and compare the nutrient intake, dietary diversity, intake of selected food groups, hunger perceptions and anthropometric status of children aged 1 – 3 years from households producing crops and livestock to those without crops and livestock in South Africa.

3.2 Summary of the South African NFCS of 1999

The current study used part of the data from the South African NFCS of 1999. This section will give a brief summary of the NFCS of 1999 as shown in Table 3.1 and section 3.3 will give a summary of the data used for the current study.

Table 3.1: Summary of the South African National Food Consumption Survey of 1999

Attribute	Content
Study aim	To gather data on food consumption patterns of children in South Africa and to inform policy especially for food fortification and nutrition education.
Target population	Children aged 1 – 9 years in South Africa. Selected study households had at least one child aged 1 – 9 years.
Sample size	Initial sample size was 3120. The final response rate was 93% and gave a final sample of 2894.There were 1320 households with children aged 1 – 3 years in the survey (Labadarios, Nel & Huskisson 1999a, p76).
Sampling method	The enumerator areas were randomly selected. Survey had 156 enumerator areas with 82 from urban and 74 from non-urban areas. A snowball sampling method was used to select the households from enumerator areas.
Data collection	Trained field workers collected data using interview questionnaires between February and July 1999.

<u>Table 3.1 continued:</u> Summary of the South African National Food Consumption Survey of 1999

Attribute	Content
Data collection	Socio-demographics questionnaire: gathered data on the household's living environment. Child anthropometry was included in this questionnaire. Measurements taken were height, weight, mid-upper arm circumference for all children and head circumference for children less than 3 years of age.
	24-hour recall questionnaire: collected information on the child's eating patterns in the last 24 hours. Visual aids and food models were used to assist in quantifying the food portion sizes.
	Quantitative food frequency questionnaire (QFFQ): collected data on the child's eating patterns over a period of one month for children aged 12 – 23 months and for the past six months for children aged over two years.
	Food procurement and household inventory questionnaire: collected data on how the food was procured (for example, purchased, produced and donated) and stored. Inventory was done for the households in high risk areas.
	Hunger scale questionnaire: gathered information on the household's and child's levels of perceived hunger.
Validation of questionnaires	Three 24-hour recalls and a QFFQ were compared during the pilot phase. For anthropometric data, measurements by field workers were validated against measurements by survey co-ordinators. Fieldworkers were randomly selected by survey coordinators to repeat measurements on randomly selected households on the same child previously measured.
Quality control	Done for QFFQ and anthropometry. Coordinators randomly chose two households after 20 households included in the survey had been chosen in each enumerator area. Study coordinators completed the selected questionnaires on the same day the first questionnaires were completed.
Data analysis	Was done using the SAS package (version 6.12 for windows). Anthropometric data was analysed using Epi Info (version 6.02) (Labadrios & Nel 1999, p166).
Ethics approval	The Ethics committee of the University of Stellenbosch approved the study and written informed consent for study participants was given by the child's caregiver or mother.

Source: After Labadarios, Kotze & Nel 1999b (for all sections except where cited).

3.3 The NFCS of 1999 data used for the secondary analysis study

Each of the objectives stated in Table 3.2 below addresses the children included in the study from households:

- With crops only;
- With crops and livestock;
- With livestock only ;
- Without crops and livestock (non-producers group).

Table 3.2: Secondary analysis study objectives and the South African National Food Consumption Survey of 1999 data used

Secondary analysis study objective	NFCS of 1999 data used
1.1 To determine and compare the socio-demographic characteristics of children aged 1 – 3 years.	Socio-demographic characteristics questionnaire
1.2 To determine and compare the nutrient intake of children aged 1 – 3 years in the last 24 hours.	24-hour recall data
1.3 To determine and compare the dietary diversity of the foods consumed by children aged 1 – 3 years in the last 24 hours.	24-hour recall data
1.4 To determine and compare the consumption of eggs, meat and milk by children aged 1 – 3 years in the last 24 hours.	24-hour recall data
1.5 To determine and compare the consumption of vegetables and fruits by children aged 1 – 3 years in the last 24 hours.	24-hour recall data
1.6 To determine and compare hunger perceptions of households and/or children aged 1 – 3 years.	Hunger scale questionnaire
1.7 To determine and compare the anthropometric status of children aged 1 – 3 years.	Anthropometric data: socio-demographic characteristics questionnaire

3.3.1 Data weighting of NFCS of 1999 data for secondary analysis study

The South Africa NFCS of 1999 original population sample over sampled high-risk households by 25% (Labadarios *et al* 1999b, p44). Therefore, data weighting was done to account for the differences in sampling rates and allow for the representation of the NFCS of 1999 population sample (Steyn, Labadarios, Maunder, Lombard & Directors of the National Food Consumption Survey 2005). The data weighting procedure has been explained elsewhere (Steyn *et al* 2005).

3.4 Categorization of the study groups

The initial sample of children aged 1 – 3 years was 1320 as indicated in Table 3.1. The study groups were categorized using the Food Procurement and Food Inventory Questionnaire (FPFIP). Sections A and D (Appendix A) of the FPFIP questionnaire were used for categorizing the study groups. Section A had questions about the food items procured in the households, whereas Section D had questions about the types of crops produced and consumed, as well as the types of livestock produced and the purpose of owning the livestock. Figure 3.1 shows graphical presentation of how the study groups were selected.

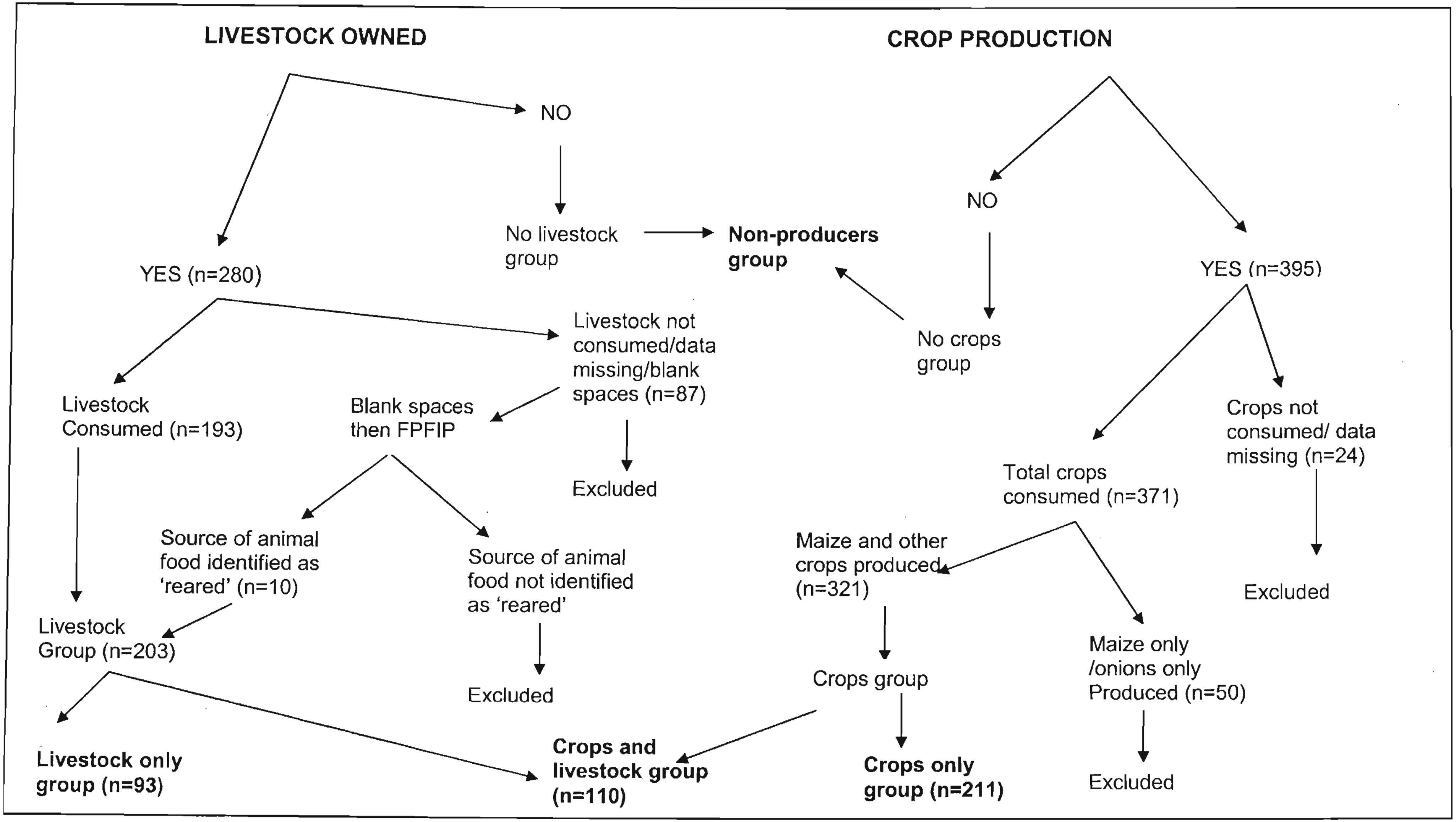

Figure 3.1: Graphical presentation of the categorization of study groups

The crops groups were categorized using section D of the FPFIP questionnaire. The households that produced crops were selected by choosing the households that responded 'yes' to the question 'do you have your own crop production?' A total of 395 households were found to produce crops. Twenty-four households that did not indicate whether the crops produced were consumed or not and households with missing data were excluded from the crops group. All the households that consumed the crops produced were selected, regardless of the amount of crops consumed. The households that produced maize only and onions only were excluded from the crops group. For the purpose of this study, households that produced maize and other crops (or crops only) were considered for the study because the aim was to diversify a maize staple diet with other crops. The South African NFCS of 1999 data was collected before mandatory fortification of maize, as discussed in Chapter 2, Section 2. Onions were excluded because they are often perceived as flavourings and, also, few households produced onions. Forty-seven households produced maize only and three produced onions only. The final study sample of the households that produced and consumed crops was 321. The crops only group was selected by separating the households that produced crops only from the households that produced both crops and livestock. A total of 211 households were found to produce crops only.

Sections A and D of the FPFIP questionnaire were both used for categorising the livestock groups. Using section D of the questionnaire, the households that owned livestock were grouped by selecting the households that responded 'yes' when asked if they owned livestock. Households without livestock had a 'no' response. A total of 280 households stated that they owned livestock. The households that owned livestock were further screened to identify households that owned and consumed livestock. A total of 87 households were excluded because they did not use the livestock owned for consumption, had missing data or left blank spaces, which then left 193 households. The households that left blank spaces when asked the purpose of owning livestock were compared with section A of the questionnaire to identify those who responded that they procured foods through 'reared'. There were 10 households that indicated that they procured foods through 'reared' even though they did not state that they consumed the livestock owned in Section D of the questionnaire. These households were included into the livestock group and, that made a total of 203 households that were included in the study. The households that owned livestock only were grouped by excluding the households that owned both livestock and crops and that gave a total of 93 livestock only households. The households that had both crops and livestock were 110.

3.4.1 Categorization of the study groups by rural or urban area and income

The four study groups were further categorised by area of residence and low-income. The cut-off point of low-income was set at a total income of less than R12 000.00[1] per household per year as was used in the South African NFCS of 1999. The low-income cut-off point was based on the Census of 1996 data and, Simkins (2000, p2) reported that the Census household poverty line was R800.00 per month (R9 600.00 per year). During the NFCS of 1999, inflation was considered and low-income cut-off point was set at less than R12 000.00 (Sayed 2004, p39).

3.4.2 Number of children in each study group

Few households in urban areas had crops and livestock and livestock only. The total numbers of the children found in each study group are presented in Table 3.3.

Table 3.3: Number of children found in each study group

Group	National	Rural	Urban[Σ]	<R12 000/ HH/year	≥R12 000/[Σ] HH/year
Crops only	211	115	96	137	36
Crops and livestock	110	98	12	81	12
Livestock only	93	83	10	71	11
Non-producers	Sample size different for each questionnaire used				

[Σ]Crops and livestock groups in urban areas as well as all the groups (except non-producers) in households with a total income of greater than R12 000.00 per household per year were excluded for comparison because of small sample sizes.

[1]*NFCS of 1999 Socio-demographic questionnaire, question 24 ("Household income per month including wages, rent, sales of vegs, etc. State grants"): Options given were "None, R100-R500, R500-R1000, R1000-R3000, R3000-R5000, Over R5000 and Don't know" (Labadarios et al 1999a, p971).*

Households that had income of more than R12 000.00 per household per year also had fewer households that produced crops and livestock and livestock only (Table 3.3). Comparisons of the four study groups could not be made in urban areas or among households with a total income of more than R12 000.00 per household per year because of small sample sizes. Therefore, comparisons of the four study groups for each objective were made at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year. The households in urban areas mostly produced crops only and this gave an opportunity for the comparison of the crops only and non-producers study groups in urban areas.

3.5 Data analysis

Data analysis was done on the weighted South African NFCS of 1999 data for children aged 1 – 3 years. Data analysis for all the study variables was done using the SAS statistical package; SAS 9.1.3 Service Pack 2 XP_Pro platform, Copyright © 2002-2003 by SAS Institute Inc, Cary, NC, USA.

3.5.1 Socio-demographic characteristics

Socio-demographic characteristics were determined for each of the four groups. The selected characteristics were type of dwelling, type of toilet used in each household, source of drinking water, total income earned per month per household and total household income spent on food per week.

3.5.2 Nutrient intake

Secondary analysis of the 24-hour recall data was done for energy, protein, thiamine, riboflavin, vitamin A, vitamin B_6, vitamin C, niacin, folate, calcium, iron and zinc. These nutrients were selected because they were identified by Brown *et al* (1998) & Dewey & Brown (2003) as problem nutrients (except energy, protein and vitamin B_{12}) in which the nutrient densities of the nutrients in the complementary foods were less than the estimated amounts required by infants (section 2.2.1). Vitamin B_{12} was selected because it is only found in animal source foods. Protein was included in this study because over-reliance on plant protein has been associated with slowed child growth (Brown *et al* 1998, pp80-81). In addition, the South African NFCS of 1999 revealed that all the selected nutrients did not meet the RDAs of children aged 1 – 3 years (Steyn & Labadarios 1999, pp260-280). The nutrient intakes of the four study groups were compared at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year. In addition, the crops only and non-producers groups were compared in urban areas.

3.5.3 Dietary diversity

Dietary diversity score was determined using 13 food groups. The food groups used are as presented in Table 3.4. The food groups are as stipulated in the Medical Research Food Composition Tables (Kruger, Sayed, Langenhoven & Holing 1998, pii).

Table 3.4: Food groups and food group number codes used for dietary diversity scoring of the different food groups consumed by children aged 1 – 3 years in South Africa

Food Group List	
1. Cereal and cereal products	8. Meat and meat products
2. Vegetables	9. Fish and sea food
3. Fruit	10. Fats and oils
4. Legumes and legume products	11. Sugar, syrups and sweets
5. Nuts and seeds#	12. Sauces, seasonings and flavourings
6. Milk and milk products	13. Beverages
7. Eggs	

#Group missing for all study children

Source: After Kruger *et al* 1998

Each food group was given one-point and the dietary diversity score cut-off point was set at 6 as Sayed (2004, p40) to compare with available data. The dietary diversity score was determined and compared for all the four study groups at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year. The dietary diversity score was also determined and compared for the crops only and non-producers groups for the children in urban areas. The vegetable and fruit groups were further divided into vitamin A and vitamin C rich food groups and then the percentages of children consuming these food groups were determined. A simple count of different food items within the vegetables and fruits food groups was determined. This was done to determine the contribution of food production on dietary diversity.

3.5.4 Percentages of children consuming eggs, meat and meat products and milk and milk products in the last 24 hours

The percentages of children who consumed any of the eggs, meat and meat products or milk and milk products food groups in the last 24 hours were determined for each of the four study groups. Children who consumed at least one food item in any of the eggs, meat and meat products or milk and milk products food groups were included for determining the percentages of children who consumed any of the food group items.

3.5.5 Percentages of children consuming vegetables and fruits in the last 24 hours

The percentages of children who consumed each of the vegetables or fruits food groups in the last 24 hours were determined for each of the four study groups. Children who consumed at least one food item in any of the vegetables or fruits food group were included for determining the percentages of children consuming any of the food group items.

3.5.6 Hunger perceptions of households with children aged 1 – 3 years

Hunger perceptions were determined at the household level, for individual caregivers or mothers and for the children included in the study. Hunger perceptions were determined for households with children aged 1 – 3 years at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year for the four study groups. In addition, comparisons were made for the crops only and the non-producers groups in urban areas. Hunger perceptions were assessed using the hunger scale questionnaire (Gericke, Labadarios & Nel 1999, pp637-638), Appendix B, and analysis procedure will be explained in the following sections. Sections a) and b) assess hunger perceptions at the household level; section c) individual caregivers' or mothers' hunger perceptions; and sections d) and e) child level hunger perceptions. The same method was used by Gericke *et al* (1999, pp637-638) in the original analysis of this data.

a). The severity of hunger in the households was assessed using the eight (8) main questions of the hunger scale questionnaire to assess the level of food insecurity in the households. Each question was given one-point and the following cut-off points were used for describing the extent of the severity of hunger in the households:

i). Five (5) or more 'yes' responses meant that the households were experiencing hunger.

ii). One (1) to four (4) 'yes' responses meant that the households were at risk of hunger.

iii) No (zero) 'yes' response meant that the households were food secure.

b). The percentages of households that relied on a limited number of foods to feed their children because of a shortage of money for meals was determined.

c). The percentages of individual caregivers or mothers that ever ate less food because there was limited money for food were determined.

d). The percentages of children that ever ate less food because there was not enough money for food were determined.

e). The percentages of children that ever said they were hungry because there was not enough food in the house were determined.

3.5.7 Anthropometric status

The anthropometric indicators used in the study were height-for-age (H/A), weight-for-age (W/A) and weight-for-height (W/H). The cut-off point was set at less than -2 standard deviations (SD) from the median reference growth point for the National Centre for Health Statistics (NCHS) for USA 1977 growth curves as previously used by Labadarios & Nel (1999, pp166-167) in the original analysis of this data from the NFCS of 1999. The percentages of children aged 1 – 3 years with less than -2 SD for H/A (stunting), W/A (underweight) and W/H (wasting) were determined for each of the four study groups. In addition the WHO criteria for defining the severity of under-nutrition was used to categorise the prevalence of stunting and underweight into low, medium, high and very high; wasting is categorised as acceptable, poor, serious and critical (WHO 1995, pp208-212). The cut-off points used are as shown in Table 3.5.

<u>Table 3.5:</u> WHO global cut-off points defining the severity of prevalence of stunting, underweight and wasting expressed as percentage of children below < -2 Z-scores for children under five years of age

Indicator	Percentage of children below < -2 Z-scores							
	Low	Medium	High	Very High	Accep-table	Poor	Serious	Critical
Stunting	<20	20-29	30-39	≥40	Not Applicable			
Underweight	<10	10-19	20-29	≥30				
Wasting	Not applicable				<5	5-9	10-14	≥15

Source: After WHO 1995, pp208-212

The comparisons of the indicators for the four study groups were made at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year. In addition, comparison of the indicators was made for the crops only and non-producers groups in urban areas.

3.5.8 Statistical tests

Statistical data analysis was conducted by the statistician who was involved during the South African NFCS of 1999 study. The statistical significance test used for comparison of nutrient intake and dietary diversity scores for the four study groups was the Kruskal-Wallis test. The nutrient intake and dietary diversity scores comparisons for two study groups (crops only and non-producers) in urban areas were done using the Wilcoxon two sided T-test. The statistical significance tests used for the comparisons of nominal data (socio-demographic characteristics, hunger perceptions and anthropometric indicators) were made using the Chi-Square test. No post-hoc analysis was carried out to determine which groups differed from each other.

3.6 Ethical considerations

The study permission was obtained from the South African NFCS of 1999 study directors. The letter giving permission to use the South African NFCS of 1999 data is attached in Appendix C.

CHAPTER 4: RESULTS

4.1 Socio-demographic characteristics

The socio-demographic characteristics of the households of the children included in this section are the number of children in each study group, type of dwelling, type of toilet used in the household, source of drinking water available in the household, total household income per month, and total household income spent on food per week.

4.1.1 Socio-demographic characteristics of households with children aged 1 – 3 years at the national level in South Africa

Table 4.1 shows that at the national level, higher percentages of households with crops and livestock lived in traditional or mud dwellings (60.7%), used pit latrines (72.8%) and water from rivers or dams (46.1%) when compared to other groups. The households in the non-producers group had more households using flush toilets (58.9%), own tap (70.5%) and earning over R1 000.00 per month (37.9%). Significant differences (p<0.05) for each of these socio-demographic characteristics were found between the four study groups.

Table 4.1: Socio-demographic characteristics of households with children aged 1 – 3 years at the national level in South Africa

	% OF GROUPS AT NATIONAL LEVEL				P-value[Ω]	Total RSA
	Crops only	**Crops and livestock**	**Livestock only**	**Non-producers**		
Type of dwelling	n=148	n=87	n=62	n=509	<0.0001	n=806
Brick	62.1	33.9	58.2	69.0		63.1
Tin/plank	8.5	3.6	3.8	22.7		16.6
Traditional/Mud	29.4	60.7	36.8	7.3		19.4
Other	0.0	1.8	1.2	1.0		0.9
Type of toilet	n=149	n=86	n=61	n=511	<0.0001	n=807
VIP	0.5	0.0	1.8	1.0		0.9
Bucket	7.4	2.7	1.8	5.9		5.5
Flush	29.5	5.9	9.2	58.9		44.0
Pit latrine	51.5	72.8	70.0	28.6		40.7
Other	11.1	18.6	17.2	5.6		8.9
Drinking water source	n=150	n=89	n=61	n=512	<0.0001	n=812
Borehole	6.2	4.3	9.2	1.5		3.3
Community tap	33.5	32.1	33.4	25.2		28.1
Own tap	43.1	14.7	30.2	70.5		56.3
River/dam	15.4	46.1	25.9	2.0		11.1
Other	1.8	2.8	1.3	0.8		1.2
Total income earned/ month/household	n=125	n=75	n=55	n=436	<0.0001	n=691
None	7.3	8.0	6.0	4.9		5.7
R100 – R500	45.0	46.3	51.6	32.1		37.5
R500 – R1000	27.8	33.5	29.6	25.1		26.9
Over R1000	19.9	12.2	12.8	37.9		29.9
Total spent on food/ week/household	n=114	n=70	n=52	n=403	0.0391	n=639
R0 – R50	39.6	34.4	44.5	24.7		30.0
R50 – R100	20.6	28.2	14.5	24.3		23.3
R100 – R200	20.1	14.3	27.1	25.2		23.3
R200 – R300	10.3	12.3	7.4	14.2		12.7
Over R300	9.4	10.8	6.5	11.6		10.7

[Ω] Chi-Square test

4.1.2 Socio-demographic characteristics of households with children aged 1 – 3 years in rural areas in South Africa

Table 4.2 shows that, in rural areas, over 70% of households from all the four study groups used pit latrines. The households in the crops and livestock group had higher percentages of households using traditional or mud dwellings (65.6%), pit latrines

(78.3%) and water from rivers or dams (51.1%). Each of these characteristics had significant differences (p<0.05) between the four study groups.

Table 4.2: Socio-demographic characteristics of households with children aged 1 – 3 years in rural areas in South Africa

	% OF GROUPS WITHIN RURAL AREAS				P-value$^{\Omega}$	Total Rural
	Crops only	Crops and livestock	Livestock only	Non-producers		
Type of dwelling	n=80	n=78	n=54	n=141	<0.0001	n=353
Brick	46.6	31.3	53.8	67.6		52.7
Tin/plank	2.4	1.1	4.3	6.9		4.2
Traditional/Mud	51.0	65.6	41.9	23.1		41.7
Other	0.0	2.0	0.0	2.4		1.4
Type of toilet	n=80	n=77	n=55	n=144	0.0389	n=356
VIP	0.0	0.0	2.0	1.2		0.8
Bucket	0.5	0.0	1.4	2.1		1.2
Flush	3.7	1.0	1.1	12.0		6.0
Pit latrine	76.0	78.3	76.4	71.3		74.7
Other	19.8	20.7	19.1	13.4		17.3
Drinking water source	n=81	n=80	n=54	n=143	<0.0001	n=358
Borehole	11.6	4.7	10.5	5.2		7.3
Community tap	41.1	33.8	36.7	52.0		43.2
Own tap	15.3	7.3	21.8	34.0		22.0
River/dam	28.7	51.1	29.5	7.0		25.1
Other	3.3	3.1	1.5	1.8		2.4
Total income earned/ month/household	n=64	n=68	n=48	n=123	0.3868	n=303
None	7.6	6.6	6.9	4.7		6.1
R100 – R500	55.3	47.5	52.9	41.4		47.5
R500 – R1000	26.3	34.7	28.7	31.5		30.7
Over R1000	10.8	11.2	11.5	22.4		15.7
Total spent on food/ week/household	n=60	n=66	n=45	n=104	0.1189	n=275
R0 – R50	55.1	35.6	46.5	37.9		42.5
R50 – R100	11.5	28.9	15.0	30.7		23.5
R100 – R200	18.3	13.1	24.7	20.1		18.8
R200 – R300	7.7	11.0	7.8	7.3		8.3
Over R300	7.4	11.4	6.0	4.0		6.9

$^{\Omega}$ Chi-Square test

4.1.3 Socio-demographic characteristics of households with children aged 1 – 3 years and a total income of less than R12 000.00/household/year

Table 4.3 indicates that the households in the crops and livestock group had higher percentages of the households using traditional or mud dwellings (60.8%), pit latrines

(72.2%) and water from rivers or dams (50.0%). Significant differences (P<0.05) between the four study groups were observed for these characteristics.

Table 4.3: Socio-demographic characteristics of households with children aged 1 – 3 years and a total income of less than R12 000.00 per household per year in South Africa

	% OF GROUPS AMONG HOUSEHOLDS WITH TOTAL INCOME OF < R12 000.00/HH/YEAR				P-value[Ω]	TOTAL INCOME <R12 000/ HH/ YEAR
	Crops only	**Crops and livestock**	**Livestock only**	**Non-producers**		
Type of dwelling	n=98	n=65	n=47	n=269	<0.0001	n=479
Brick	57.3	35.8	59.0	55.7		53.6
Tin/plank	9.4	2.2	5.0	31.8		20.6
Traditional/Mud	33.3	60.8	36.0	11.4		25.0
Other	0.0	1.2	0.0	1.1		0.8
Type of toilet	n=99	n=64	n=46	n=269	<0.0001	n=478
VIP	0.0	0.0	2.4	1.4		1.1
Bucket	8.2	2.4	2.4	8.8		7.2
Flush	23.5	4.4	8.4	44.7		31.4
Pit latrine	56.6	72.2	67.0	36.5		48.4
Other	11.7	21.0	19.8	8.6		12.0
Drinking water source	n=100	n=66	n=47	n=269	<0.0001	n=482
Borehole	5.8	5.0	12.1	2.4		4.4
Community tap	38.2	32.3	32.0	34.6		34.8
Own tap	40.1	10.1	27.8	59.4		45.6
River/dam	15.3	50.0	26.5	2.6		14.0
Other	0.6	2.6	1.6	1.0		1.2
Total income earned/ month/household	n=100	n=66	n=47	n=271	0.9331	n=484
None	9.1	9.1	6.9	7.9		8.2
R100 – R500	56.3	52.7	59.1	51.6		53.5
R500 – R1000	34.6	38.2	34.0	40.5		38.3
Over R1000	N/A	N/A	N/A	N/A		N/A
Total spent on food/ week/household	n=83	n=57	n=41	n=226	0.1221	n=407
R0 – R50	47.1	34.6	48.3	35.6		39.1
R50 – R100	19.5	23.5	11.0	29.4		24.7
R100 – R200	20.9	16.3	25.1	21.3		20.9
R200 – R300	9.4	12.4	7.4	8.6		9.2
Over R300	3.1	13.2	8.2	5.0		6.1

[Ω] Chi-Square test N/A = Not applicable, households earning < R12 000.00 per household year

4.1.4 Socio-demographic characteristics of households with children aged 1 – 3 years in urban areas in South Africa

Generally, the majority of the dwellings in urban areas were made of bricks and also had flush toilets as shown in Table 4.4. The dwellings had a tendency of significant difference (p=0.0518) between the crops only and non-producers groups. The non-producers group had a higher percentage (28.7%) of households using dwellings made of tins or planks than crops only group. The non-producers group had a significantly (p=0.0110) higher percentage (77.2%) of households using flush toilets than the crops only group.

Table 4.4: Socio-demographic characteristics of households with children aged 1 – 3 years in urban areas in South Africa

	% OF GROUPS WITHIN URBAN AREAS		P-value[Ω]	Total[⋇] Urban
	Crops only	Non-producers		
Type of dwelling	n=68	n=368	0.0518	n=453
Brick	80.2	69.6		71.3
Tin/plank	15.5	28.7		26.2
Traditional/Mud	4.3	1.3		2.0
Other	0.0	0.4		0.5
Type of toilet	n=69	n=367	0.0110	n=451
VIP	1.1	1.0		1.0
Bucket	15.3	7.4		8.9
Flush	59.1	77.2		74.0
Pit latrine	23.5	11.9		13.9
Other	1.0	2.5		2.2
Drinking water source	n=69	n=369	0.1152	n=454
Community tap	24.6	14.9		16.3
Own tap	75.4	84.7		83.4
Other	0.0	0.4		0.3
Total income earned/ month/household	n=61	n=313	0.2040	n=388
None	7.0	5.0		5.5
R100 – R500	34.4	28.4		29.6
R500 – R1000	29.2	22.6		23.9
Over R1000	29.4	44.0		41.0
Total income spent food/ week/household	n=54	n=300	0.6585	n=365
R0 – R50	22.6	20.2		20.7
R50 – R100	30.4	22.1		23.1
R100 – R200	22.1	27.0		26.6
R200 – R300	13.2	16.6		16.0
Over R300	11.7	14.1		13.6

[Ω] Chi-Square test [⋇] Total includes crops and livestock and livestock only

4.2 The 24-hour recall nutrient intakes of children aged 1 – 3 years in South Africa

The results of the nutrient intakes of children are given as median values because data was skewed. Appendix D gives detailed results with mean and median values. The section is divided into three. The first section will present the nutrient intakes of children at the national level. The next section will present the nutrient intakes of children within rural areas and, lastly, the nutrient intakes of children from households with a total income of less than R12 000.00 per household per year.

4.2.1 The 24-hour recall median nutrient intakes of children aged 1 – 3 years at the national level in South Africa

Table 4.5 gives a summary of the results of the 24-hour recall median nutrient intakes of children at the national level. Intakes for five of the thirteen analysed nutrients showed significant differences and one had a tendency of significant difference when the four study groups were compared at the national level. The nutrients that showed significant differences were energy ($p = 0.0052$), folate ($p = 0.0086$), vitamin B_{12} ($p < 0.0001$), thiamine ($p < 0.0001$) and niacin ($p = 0.0102$). Energy, thiamine and folate nutrient intakes were higher in the crops and livestock group while vitamin B_{12} and niacin intakes were higher in the non-producers group than the other groups. Vitamin A had a tendency of higher significant difference ($p = 0.0841$) between the four study groups and the intake was higher in the crops only group.

At the national level, more than 50% of the children from each study group had less than 67% of the RDA for vitamin A, vitamin C, calcium, iron, zinc and folate. The percentages of children consuming less than 67% of the RDA for each nutrient in each group are shown in Figure 4.1.

Table 4.5: The 24-hour recall median and interquartile (Q1 – Q3) nutrient intakes of children aged 1 – 3 years at the national level in South Africa

Nutrient (RDA^ϴ)	Median (Q1-Q3)^Ψ	GROUPS AT NATIONAL LEVEL (RSA)				P-Value*	RSA (n = 1210)
		Crops only (n = 209)	Crops and livestock (n = 110)	Livestock only (n = 92)	Non-producers (n = 799)		
Energy (5460 kJ)	Median	4164.1	4214.3	3858.7	3852.7	0.0052	3972.7
	Q1 - Q3	3015.1-6100.0	3090.6 - 5506.9	2881.6-4786.9	2839.0-5149.2		2894.8 - 5350.5
Total Protein (16g)	Median	28.7	27.9	26.2	28.6	0.9258	28.4
	Q1 - Q3	18.1-42.4	18.3-36.5	16.7-39.2	18.9-41.1		18.7-40.8
Vitamin A (400 RE)	Median	215.6	183.7	169.3	176.3	0.0841	181.8
	Q - Q3	81.5-459.0	70.8-403.9	57.0-302.8	77.5-384.3		75.7-393.8
Thiamine (0.5 mg)	Median	0.58	0.58	0.58	0.50	<0.0001	0.54
	Q - Q3	0.37-0.79	0.44-0.78	0.40-0.72	0.36-0.69		0.37-0.73
Riboflavin (0.5 mg)	Median	0.37	0.46	0.37	0.47	0.1632	0.45
	Q1 - Q3	0.20-0.72	0.20-0.72	0.23-0.77	0.25-0.92		0.24-0.85
Niacin (6 NE)	Median	4.4	3.9	3.7	4.6	0.0102	4.4
	Q1 - Q3	2.5-6.8	2.3-6.1	2.1-5.5	2.6-8.4		2.5-7.7
Folate (150 μg)	Median	79.4	85.1	62.3	69.8	0.0086	72.5
	Q1 - Q3	43.3 -138.7	52.1-151.9	37.2-97.2	43.0-122.3		43.3-126.0
Vitamin B_6 (0.5 mg)	Median	0.42	0.43	0.33	0.40	0.2011	0.40
	Q1- Q3	0.24-0.62	0.27-0.62	0.21-0.56	0.22-0.69		0.23-0.65
Vitamin B_{12} (0.9 μg)	Median	0.51	0.50	0.69	1.00	<0.0001	0.87
	Q1- Q3	0.04-1.58	0.00-1.50	0.02-2.12	0.21-2.27		0.12-2.03
Vitamin C (40 mg)	Median	16.5	10.8	12.5	15.0	0.1104	14.4
	Q1 - Q3	5.3-38.7	3.6-28.2	4.2-24.3	3.3-33.2		3.7-33.3
Calcium (500 mg)	Median	245.2	257.2	217.5	242.7	0.2381	242.7
	Q1 - Q3	107.8-490.0	102.0-477.5	114.4-506.9	112.5-418.4		112.0-450.0
Iron (10 mg)	Median	4.3	3.8	4.0	4.0	0.1773	4.0
	Q1 - Q3	2.6-6.5	2.8-6.3	2.2-6.5	2.4-6.2		2.4-6.3
Zinc (10 mg)	Median	4.0	3.6	3.4	3.7	0.6459	3.7
	Q1 - Q3	2.3-6.0	2.6-5.2	2.1-5.3	2.4-5.6		2.4-5.6

*Kruskal-Wallis Test, nutrient intakes are compared between four groups

ϴUSA RDAs of 1989 as used in the analysis of the South Africa NFCS of 1999

ΨQ stands for quartile; Q1 is first quartile and Q3 third quartile

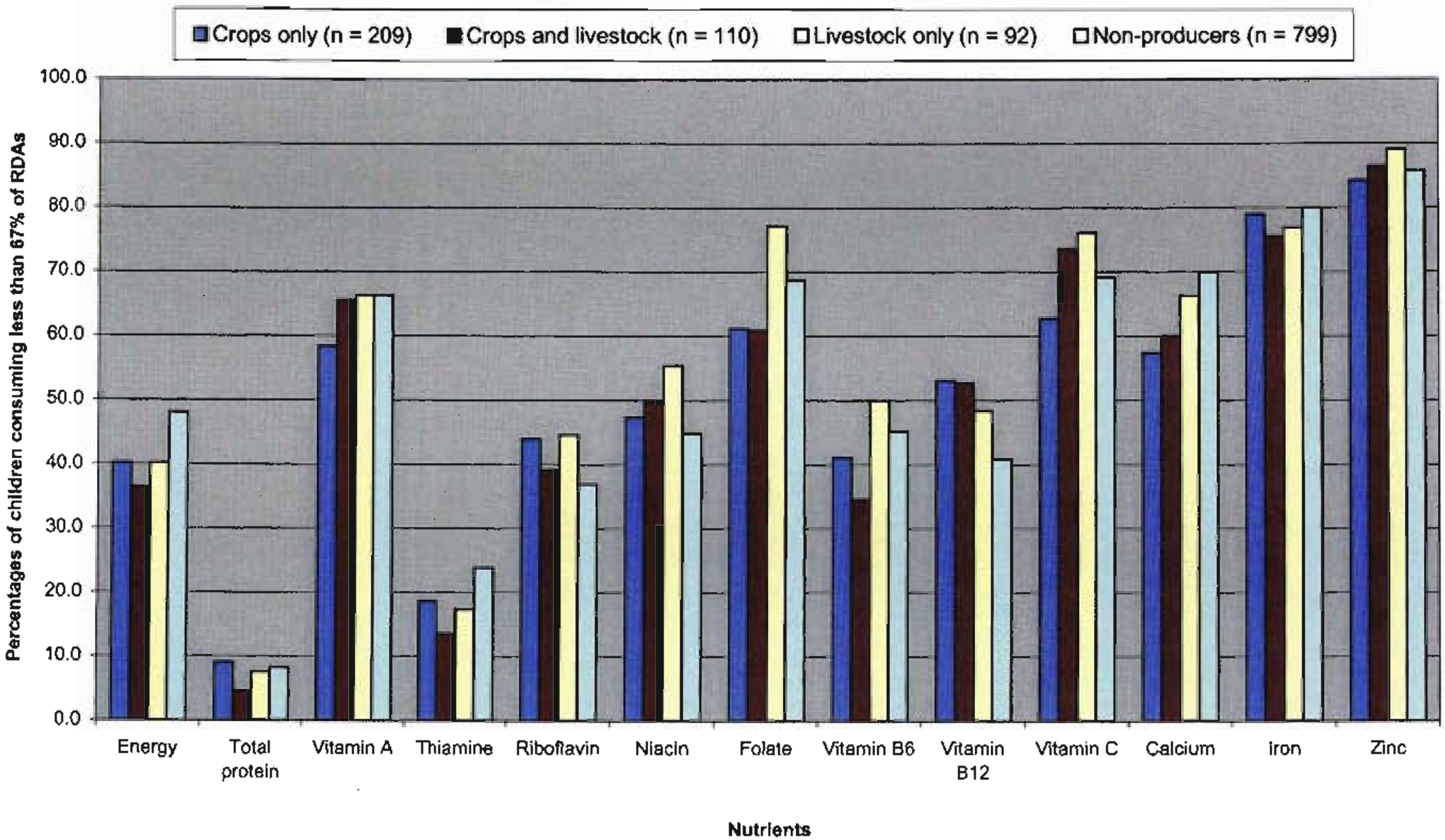

Figure 4.1: Percentages of children aged 1 – 3 years in each study group consuming less than 67% of the RDAs for the selected nutrients at the national level in South Africa

4.2.2 The 24-hour recall median nutrient intakes of children aged 1 – 3 years in rural areas in South Africa

In rural areas, eight nutrients showed significant differences between the four study groups. Table 4.6 illustrates that the nutrients that showed significant differences within rural areas were energy ($p<0.0001$), vitamin A ($p = 0.0056$), vitamin B_6 ($p = 0.0005$), vitamin B_{12} ($p = 0.0372$), vitamin C ($p = 0.0483$), calcium ($p = 0.0320$), iron ($p = 0.0365$) and folate ($p = 0.0009$). Vitamin A, vitamin C and iron intakes were higher in the crops only group. The children in the crops and livestock group had higher nutrient intakes for energy, vitamin B_6, calcium and folate, while vitamin B_{12} intake was higher in the non-producers group. The nutrient intakes of all the nutrients that showed significant differences were lower in the non-producers group, except for vitamin B_{12}.

The graphical presentation of the percentages of children consuming less than 67% of the RDAs for all the selected nutrients in rural areas is shown in Figure 4.2. At least 60% of the children from each study group consumed less than 67% of the RDAs for vitamin A, vitamin C, calcium, iron, zinc and folate.

Table 4.6: The 24-hour recall median and interquartile (Q1 – Q3) nutrient intakes of children aged 1 – 3 years in rural areas in South Africa

Nutrient (RDA[ϴ])	Median (Q1-Q3)[Ψ]	GROUPS WITHIN RURAL AREAS				P-value*	Total Rural (n = 581)
		Crops only (n = 115)	Crops and livestock (n = 98)	Livestock only (n = 82)	Non-producers (n = 286)		
Energy (5460 kJ)	Median	3915.9	4185.8	3703.7	3404.8	<0.0001	3737.2
	Q1 - Q3	2945.0-5437.0	3090.6-5506.9	2881.6-4734.5	2626.9-4504.7		2795.8-4949.8
Total Protein (16 g)	Median	26.7	26.5	25.2	24.6	0.7581	25.7
	Q1 - Q3	18.1-39.6	18.1-35.9	16.7-38.6	17.4-37.1		17.5-37.5
Vitamin A 400 RE	Median	188.1	164.8	156.8	110.0	0.0056	140.0
	Q1 - Q3	61.1-419.0	67.6-400.0	50.8-302.5	49.5-260.2		51.2-322.1
Thiamine (0.5 mg)	Median	0.60	0.58	0.56	0.49	0.2715	0.54
	Q1 - Q3	0.40-0.80	0.44-0.77	0.40-0.71	0.35-0.66		0.38-0.73
Riboflavin (0.5 mg)	Median	0.32	0.43	0.35	0.36	0.3513	0.36
	Q1 - Q3	0.17-0.59	0.19-0.70	0.22-0.68	0.20-0.62		0.19-0.63
Niacin (6 NE)	Median	3.8	3.7	3.1	3.7	0.5772	3.7
	Q1 - Q3	2.5-6.1	2.3-5.9	2.1-5.7	2.2-6.7		2.2-6.1
Folate (150 μg)	Median	70.5	84.9	56.8	58.9	0.0009	63.0
	Q1 - Q3	36.9-123.8	49.3-154.5	35.1-98.5	38.3-92.8		39.3-109.7
Vitamin B_6 (0.5 mg)	Median	0.35	0.43	0.32	0.31	0.0005	0.34
	Q1 - Q3	0.24-0.57	0.26-0.59	0.19-0.53	0.20-0.49		0.23-0.55
Vitamin B_{12} (0.9 μg)	Median	0.27	0.41	0.56	0.64	0.0372	0.50
	Q1 - Q3	0.00-1.17	0.00-1.40	0.00-2.00	0.08-1.50		0.01-1.43
Vitamin C (40 mg)	Median	13.2	9.9	12.5	8.4	0.0483	9.9
	Q1 - Q3	3.0-31.1	3.5-25.5	4.1-23.9	2.0 -21.8		2.5-24.0
Calcium (500 mg)	Median	245.2	249.5	224.4	202.8	0.0320	221.4
	Q1 - Q3	95.8-461.4	96.1-458.6	105.4-426.8	87.2-349.7		93.6-428.8
Iron (10 mg)	Median	4.2	3.8	4.0	3.6	0.0365	3.8
	Q1 - Q3	2.6-6.6	2.7-6.4	2.1-6.6	2.3-5.8		2.4-6.1
Zinc (10 mg)	Median	3.7	3.5	3.3	3.2	0.3206	3.4
	Q1 - Q3	2.5-5.4	2.6-5.1	2.0-5.2	2.3-4.7		2.3-5.0

*Kruskal-Wallis Test, nutrient intakes are compared between four groups

[ϴ]USA RDAs of 1989 as used in the analysis of the South Africa NFCS of 1999

[Ψ] Q stands for quartile; Q1 is first quartile and Q3 third quartile

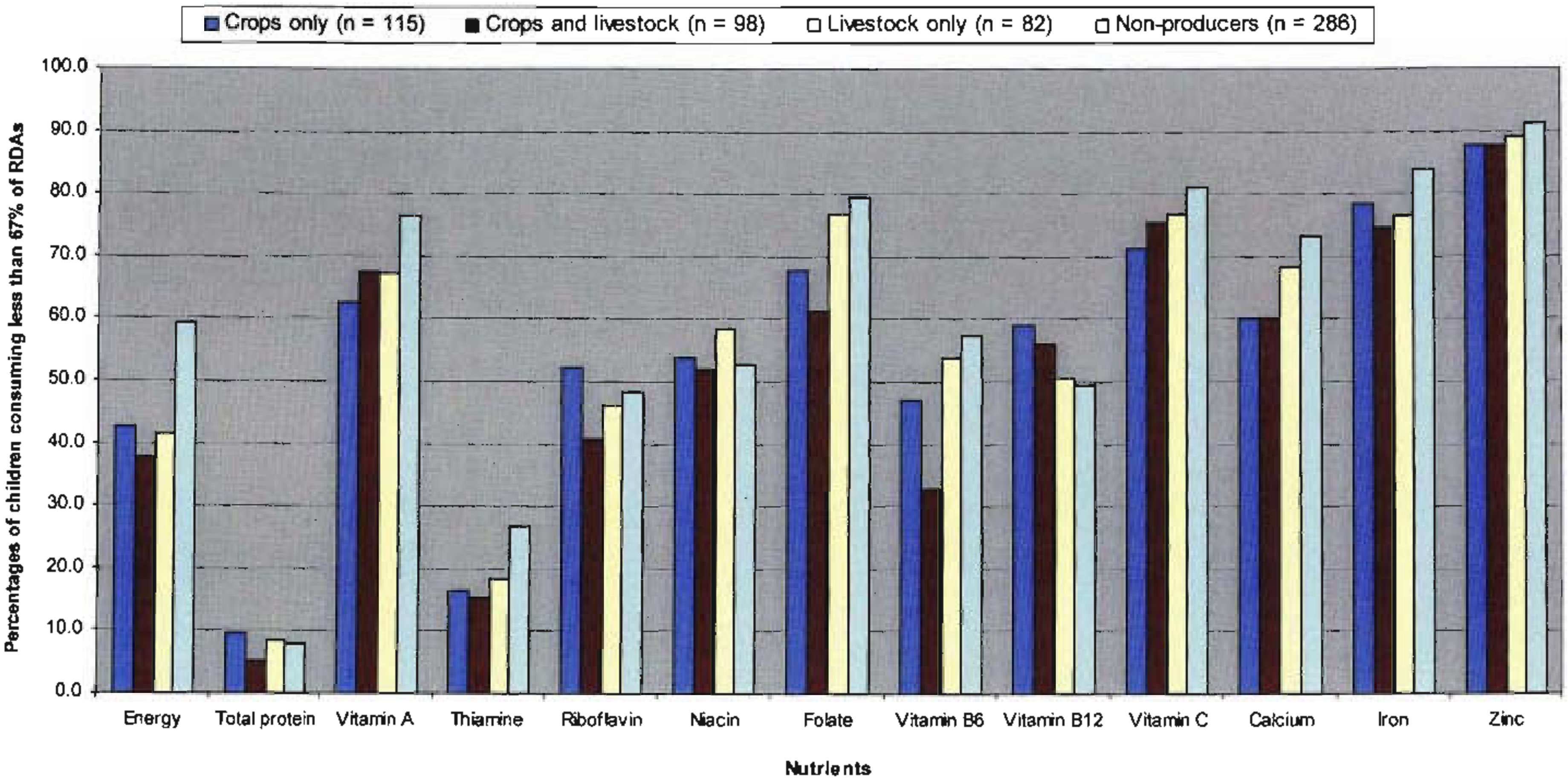

Figure 4.2: Percentages of children aged 1 – 3 years in each study group consuming less than 67% of the RDAs for the selected nutrients in rural areas in South Africa

4.2.3 The 24-hour recall median nutrient intakes of children aged 1 – 3 years from households with a total income of less than R12 000.00 per household per year

The comparison of the four study groups among low income households indicated that there were significant differences in nutrient intakes of the children in the four study groups for energy (p = 0.0022), Vitamin A (p= 0.0119), Vitamin B_{12} (p=0.0215), Vitamin C (p = 0.0134), calcium (p = 0.0364), thiamine (p = 0.0004) and folate (p = 0.0038) (see Table 4.7). Vitamin B_6 and iron had tendencies of significant difference between the four groups (p = 0.0565 and 0.0734 respectively). The crops and livestock group had the highest nutrient intakes for energy, vitamin B_6, calcium, thiamine and folate. Vitamin A and vitamin C nutrient intakes were higher in the crops only group and vitamin B_{12} intake was higher in the non-producers group.

Figure 4.3 indicates that more than 55% of the children in each study group had less than 67% of the RDAs for vitamin A, vitamin C, calcium, iron, zinc and folate. More than 75% of the children in all the study groups were consuming less than 67% of the RDAs for iron and zinc.

Table 4.7: The 24-hour recall median and interquartile (Q1 – Q3) nutrient intakes of children aged 1 – 3 years from households with a total income of less than R12 000.00 per household per year in South Africa

Nutrient (RDA[ϴ])	Median (Q1-Q3)[Ψ]	GROUPS FROM HOUSEHOLDS WITH A TOTAL INCOME < R12 000.00/HH/YEAR				P-Value*	Total income < R12 000/ HH/year (n=721)
		Crops only (n=137)	Crops and livestock (n=81)	Livestock only (n=71)	Non producers (n=432)		
Energy (5460 kJ)	Median	4061.6	4292.2	3703.7	3588.5	0.0022	3845.7
	Q1- Q3	2996.8-5894.4	3090.6-5522.3	2772.6-4671.5	2796.3-5015.1		2839.0-5227.8
Total Protein (16g)	Median	26.8	28.3	25.2	26.8	0.7626	26.7
	Q1- Q3	17.4-40.5	19.4-36.3	16.0-36.9	17.8-37.1		17.7-37.7
Vitamin A (400 RE)	Median	206.6	188.1	184.9	140.9	0.0119	159.5
	Q1- Q3	78.4-460.8	70.6-403.9	57.0-319.2	58.8-309.6		62.0-359.6
Thiamine (0.5 mg)	Median	0.56	0.58	0.54	0.50	0.0004	0.53
	Q1 - Q3	0.36-0.82	0.45-0.78	0.37-0.70	0.35-0.69		0.36-0.72
Riboflavin (0.5 mg)	Median	0.35	0.45	0.37	0.39	0.6896	0.38
	Q1 - Q3	0.19-0.65	0.22-0.65	0.19-0.80	0.21-0.70		0.21-0.68
Niacin (6 NE)	Median	3.8	3.4	3.1	3.7	0.1598	3.7
	Q1 - Q3	2.4-6.5	2.3-5.8	1.9-5.3	2.3-6.8		2.3-6.4
Folate (150 μg)	Median	79.4	85.1	66.4	61.8	0.0038	68.4
	Q1 - Q3	43.5-140.3	52.1-151.1	37.2-95.7	39.4-108.0		41.7-121.2
Vitamin B_6 (0.5 mg)	Median	0.39	0.41	0.30	0.33	0.0565	0.35
	Q1- Q3	0.24-0.62	0.24-0.58	0.19-0.53	0.21-0.56		0.22-0.57
Vitamin B_{12} (0.9 μg)	Median	0.48	0.55	0.56	0.72	0.0215	0.58
	Q1 - Q3	0.01-1.17	0.00-1.50	0.01-2.13	0.08-1.77		0.06-1.60
Vitamin C (40 mg)	Median	16.4	8.4	11.7	10.9	0.0134	11.7
	Q1 - Q3	5.3-39.1	3.1-24.0	2.5-19.25	2.4-26.5		2.7-28.0
Calcium (500 mg)	Median	245.4	249.5	228.2	203.6	0.0364	217.5
	Q1 - Q3	103.1-452.6	102.0-456.2	114.4-561.3	93.3 -381.1		97.9-428.4
Iron (10 mg)	Median	4.0	3.8	4.0	3.4	0.0734	3.6
	Q1 - Q3	2.5-6.5	2.8-6.1	1.9-5.6	2.1-5.7		2.2-5.9
Zinc (10 mg)	Median	3.8	3.6	3.3	3.3	0.2787	3.5
	Q1 - Q3	2.3-5.9	2.6-5.1	2.1-5.0	2.3-5.1		2.3-5.2

*Kruskal-Wallis Test, nutrient intakes are compared between four groups

ϴUSA RDAs of 1989 as used in the analysis of the South Africa NFCS of 1999

Ψ Q stands for quartile; Q1 is first quartile and Q3 third quartile

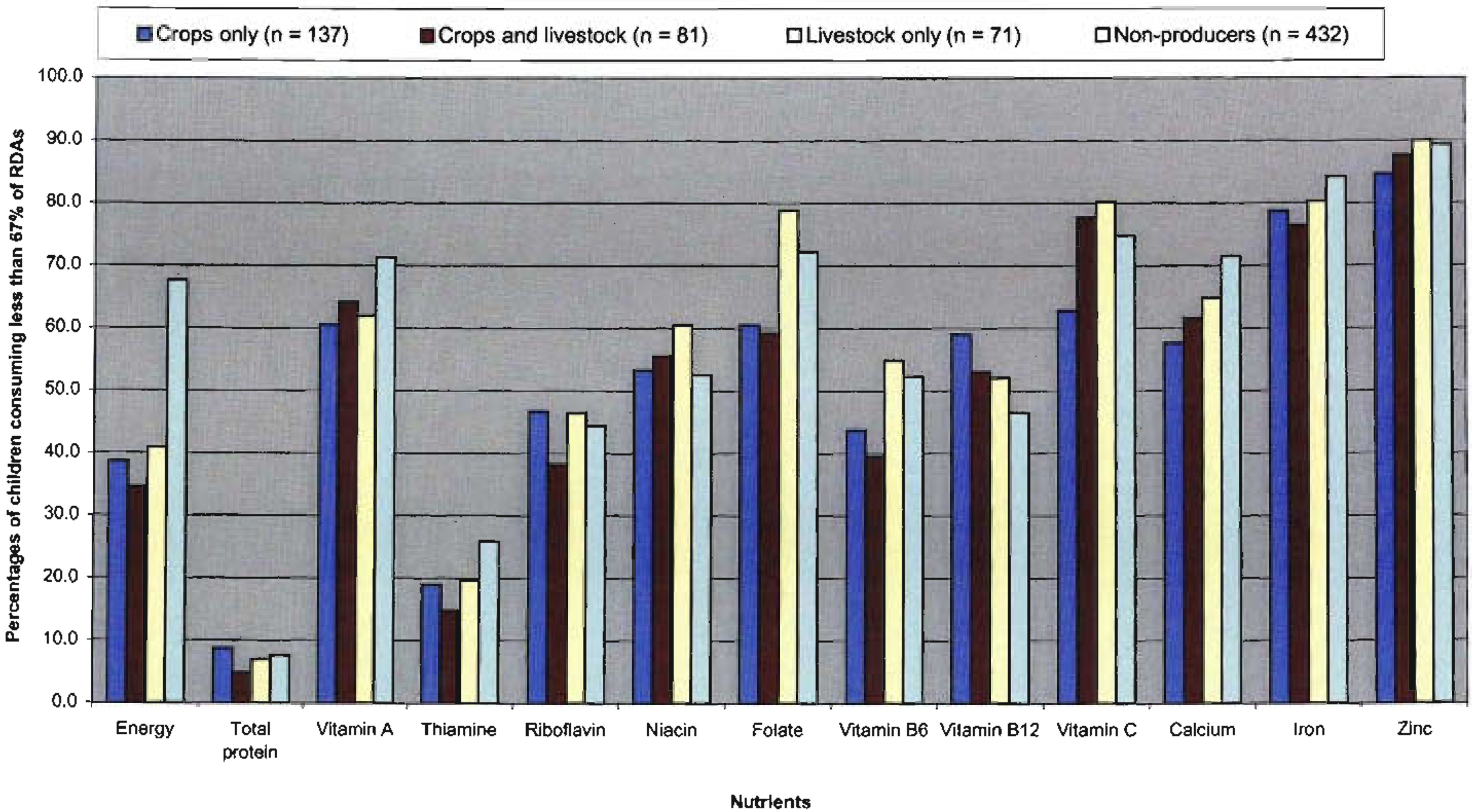

Figure 4.3: Percentages of children aged 1 – 3 years in each study group consuming less than 67% of the RDAs for the selected nutrients among households with a total income of less than R12 000.00 per household per year in South Africa.

4.2.4 The 24-hour recall median nutrient intakes of children aged 1 – 3 years in urban areas in South Africa

The crops only and non-producers groups were compared within urban areas. Table 4.8 shows the results of the 24-hour recall median nutrient intakes for the two groups. Households from the crops only group had significantly higher nutrient intakes for energy (p= 0.0306) and vitamin C (p = 0.0320) than households in the non-producers group. Folate had a tendency of higher significant difference (p = 0.0805) in the crops only group than the non-producers group. Vitamin B_{12} had a tendency of higher significant difference (p=0.0775) in the non-producers group than the crops only group.

Figure 4.4 presents the results of the percentages of children consuming less than 67% of the RDAs for selected nutrients. Overall, more than 50% of the children from each study group consumed less than 67% of the RDAs for vitamin A, vitamin C, calcium, iron, zinc and folate. In each study group, more than 75% of the children consumed less than 67% of the RDAs for zinc and iron.

<u>Table 4.8:</u> The 24-hour recall median and interquartile (Q1 – Q3) nutrient intakes of children aged 1 – 3 years from households in the crops only and the non-producers groups in urban areas in South Africa

Nutrient (RDA[ϴ])	Median (Q1-Q3)[Ψ]	GROUPS WITHIN URBAN AREAS		P-value[+]	Total Urban (n = 629[ж])
		Crops only (n = 94)	Non-producers (n = 513)		
Energy	Median	4599.7	4120.0	0.0306	4204.3
(5460 kJ)	Q1 - Q3	3155.6-6204.9	2925.5-5355.7		2942.5-5506.2
Total Protein	Median	32.6	29.5	0.7647	29.9
(16g)	Q1 - Q3	18.1-45.2	19.9-42.7		19.9-43.1
Vitamin A	Median	247.4	195.5	0.1459	202.9
(400 RE)	Q1 - Q3	107.6-536.1	93.0-419.0		97.9-429.5
Thiamine	Median	0.52	0.53	0.3987	0.53
(0.5 mg)	Q1 - Q3	0.35-0.78	0.36-0.70		0.36-0.72
Riboflavin	Median	0.49	0.51	0.3691	0.51
(0.5 mg)	Q1 - Q3	0.28-0.95	0.29-1.02		0.29-1.00
Niacin	Median	4.9	5.3	0.6034	5.2
(6 NE)	Q1 - Q3	2.8-7.8	2.8-9.3		2.8-8.9
Folate	Median	92.1	76.6	0.0805	79.1
(150 μg)	Q1 - Q3	50.2-183.4	46.3-132.0		47.3-135.8
Vitamin B_6	Median	0.48	0.44	0.9648	0.45
(0.5 mg)	Q1 - Q3	0.23-0.70	0.24-0.76		0.24-0.75
Vitamin B_{12}	Median	0.94	1.15	0.0775	1.07
(0.9 μg)	Q1 - Q3	0.24-2.00	0.29-2.65		0.29-2.54
Vitamin C	Median	23.3	17.3	0.0320	18.0
(40 mg)	Q1 - Q3	7.9-54.5	4.3-39.1		4.6-41.1
Calcium	Median	245.4	252.8	0.2152	253.9
(500 mg)	Q1 - Q3	155.8-530.2	132.0-446.6		136.4-470.9
Iron	Median	4.3	4.2	0.6770	4.2
(10 mg)	Q1 - Q3	2.6-6.5	2.4-6.4		2.4-6.4
Zinc	Median	4.5	3.9	0.3610	3.9
(10 mg)	Q1 - Q3	2.3-6.5	2.4-5.9		2.4-6.1

[+]Wilcoxon two-sided T-approximate Test

[ж] Total includes crops and livestock and livestock only

[ϴ]USA RDAs of 1989 as used in the analysis of the South Africa NFCS of 1999

[Ψ] Q stands for quartile; Q1 is first quartile and Q3 third quartile

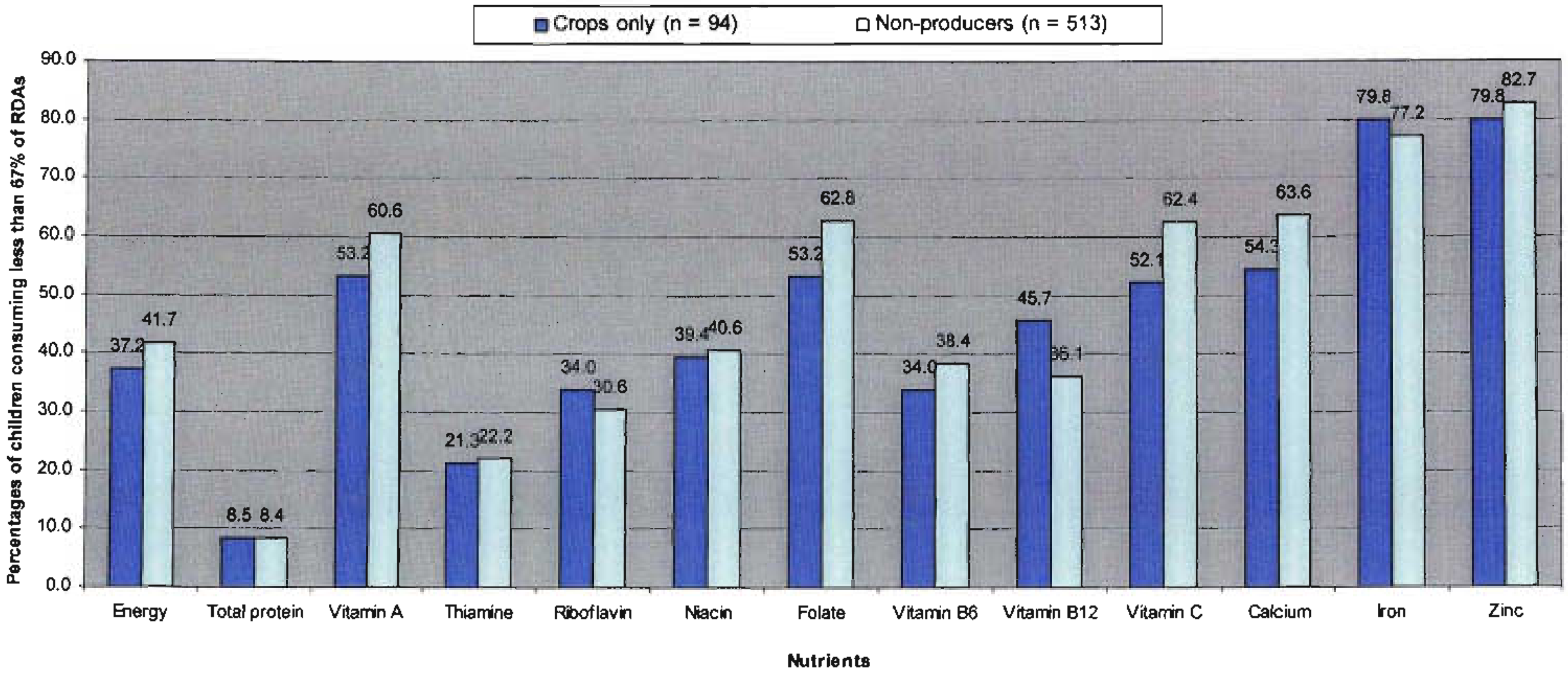

Figure 4.4: Percentages of children aged 1 – 3 years consuming less than 67% of the RDAs for the selected nutrients in the crops only and the non-producers groups in urban areas in South Africa

4.3 Dietary diversity of children aged 1 – 3 years in the last 24 hours

Table 4.9 shows the median and mean dietary diversity scores of children aged 1 – 3 years for all the study groups at the national level, within rural and urban areas and with a total income of less than R12 000.00 per household per year.

At the national level, there was a significant difference between the values for dietary diversity score (p=0.0002). Each of the four study groups had a median DDS of 4.0 which indicates that there was no difference between the values. A DDS of 4.0 was also found for each of the four study groups for children aged 1 – 3 years in rural areas and there was no significant difference (p = 0.9269) between the four study groups. In urban areas, the median DDS was 5.0 for children in the crops only group, as well as in the non-producers group. The DDS was not significantly different (p = 0.7978) between the two groups.

The DDS of children aged 1 – 3 years from households with a total income of less than R12 000.00 per household per year was similar across all the four study groups. The median DDS was 4.0 for all the study groups and the DDS was not significantly different between the four study groups (p = 0.4052).

Table 4.9: Mean and median dietary diversity scores (DDS) for children aged 1 – 3 years at national level, in rural and urban areas and among households with a total income of less than R12 000.00 per household per year in South Africa

Group	**National (RSA) (n = 1211)**			**Rural (n = 580)**			**Urban (n = 631)**			**< R12 000/HH/year (n = 722)**		
	n	**Mean (SD)**	**Median (Q1 – Q3)**	**n**	**Mean (SD)**	**Median (Q1 - Q3)**	**n**	**Mean (SD)**	**Median (Q1 - Q3)**	**n**	**Mean (SD)**	**Median (Q1 - Q3)**
Crops only	210	4.4 (1.7)	4.0 (3.0-5.0)	115	3.9 (1.5)	4.0 (3.0-5.0)	95	5.0 (1.8)	5.0 (4-6)	138	4.3 (1.6)	4.0 (3.0-5.0)
Crops and livestock	110	4.1 (1.4)	4.0 (3.0-5.0)	98	4.0 (1.4)	4.0 (3.0-5.0)	12	Small sample size (excluded)		81	4.0 (1.4)	4.0 (3.0-5.0)
Livestock only	92	4.0 (1.4)	4.0 (3.0-5.0)	82	3.9 (1.4)	4.0 (3.0-5.0)	10	Small sample size (excluded)		71	4.0 (1.5)	4.0 (3.0-5.0)
Non-producers	799	4.7 (1.7)	4.0 (3.0-6.0)	285	4.0 (1.3)	4.0 (3.0-5.0)	514	5.0 (1.8)	5.0 (4-6)	432	4.3 (1.5)	4.0 (3.0-5.0)
Average DDS	**1211**	**4.5 (1.7)**	**4.0 (3.0-6.0)**	**580**	**4.0 (1.4)**	**4.0 (3.0-5.0)**	**631**	**5.0 (1.7)**	**5.0 (4.0-6.0)**	**722**	**4.2 (1.5)**	**4.0 (3.0-5.0)**
P-values	**0.0002***			**0.9269***			**0.7978[+]**			**0.4052[*]**		

* Kruskal-Wallis test

[+]Wilcoxon two-sided T-approximate test

4.4 Percentages of children aged 1 – 3 years consuming selected food groups in the last 24 hours

Table 4.10 gives a summary of the percentages of children consuming the selected food groups at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year. For this section, the significance tests between the groups were not done because the proportions of the food groups were not equal. The recommendation is that each food group should be within a proportion of 0.25. At the national level, a higher percentage of children in the non-producers group consumed meat and meat products (51.2%), as well as milk and milk products (71.5%) than the other groups In rural areas, the percentage of children consuming milk and milk products was higher in the crops and livestock group (65.3%) and lower in the non-producers group (57.9%). The crops only group had a higher percentage (60.0%) of children consuming vegetables than the other groups and, the non-producers group had the lowest percentage (47.7%) of children consuming vegetables. Conversely, the non-producers group (42.5%) had a higher percentage of children consuming meat and meat products than the other groups. In rural areas, all the study groups had few children consuming eggs (range 6.1% - 10.5%) and fruits (range 9.1% - 12.2%).

Table 4.10 also indicates that among households with a total income of less than R12 000.00 per household per year, a higher percentage of children from the households in the non-producers group consumed meat and meat products (45.6%) than other study groups. The crops and livestock group had the lowest percentage (24.7%) of children consuming meat and meat products. The households in the crops and livestock and the non-producers groups had similar percentages of children consuming milk and milk products (67.9% and 67.1% respectively). In addition, the crops and livestock and the non-producers groups had similar percentages of children consuming vegetables (51.9% and 47.7% respectively).

Table 4.10: Percentages of children aged 1 – 3 years in South Africa consuming selected food groups in the last 24-hours at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year

Food group	**% OF CHILDREN IN GROUPS AT NATIONAL LEVEL**				**% OF CHILDREN IN GROUPS IN RURAL AREAS**				**% OF CHILDREN IN HHs WITH TOTAL INCOME <R12000/HH/YEAR**			
	Crops only n=211	Crops and livestock n=110	Livestock only n=93	Non-producers n=799	Crops only n=115	Crops and livestock n=98	Livestock only n=82	Non-producers n=285	Crops only n=138	Crops and livestock n=81	Livestock only n=71	Non-producers n=432
Eggs	10.0	8.2	11.8	15.3	7.0	6.1	9.8	10.5	7.2	7.4	12.7	13.2
Meat and meat products	37.0	26.4	32.3	51.2	29.6	22.4	31.7	42.5	32.6	24.7	25.4	45.6
Milk and milk products	66.8	67.3	62.4	71.5	59.1	65.3	61.0	57.9	60.9	67.9	66.2	67.1
Fruits	16.6	10.0	12.9	20.4	11.3	9.2	12.2	9.1	15.2	9.9	12.7	13.9
Vegetables	62.6	54.5	53.8	52.2	60.0	53.1	54.9	47.7	65.9	51.9	56.3	47.7

4.4.1 Percentages of children aged 1 – 3 years consuming Vitamin A and C rich vegetables and fruits in the last 24 hours

This section only applies to children who consumed vegetables and fruits. The percentage of children consuming vitamin A-rich vegetables ranged from 33.8% to 45.0% for all the groups at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year. The results are in Table 4.11. In rural areas, the non-producers group had the lowest percentage (33.8%) of children consuming vitamin A-rich vegetables and the crops only group had the highest percentage of children with 40.6%. Among households with a total income of less than R12 000.00 per household per year, the crops only group had the lowest percentage of children consuming vitamin A-rich vegetables with 36.3% and the livestock only group was the highest with 45.0%.

A slight difference was observed between the groups for the percentages of children consuming vitamin C-rich vegetables as shown in Table 4.11. In rural areas, the crops and livestock group had the lowest percentage (17.3%) of children consuming vitamin C-rich foods and the livestock only group had the highest percentage (35.6%) of children. Among households with a total income of less than R12 000.00 per household per year, the crops and livestock and crops only groups had the lowest percentage (26.2% and 26.4% respectively) of children consuming vitamin C-rich vegetables and the livestock only group was the highest with 45.0%.

Table 4.11 shows that few children consumed fruits and the crops and livestock group did not have children that consumed vitamin A and C rich fruits at the national level, in rural areas and among low-income households.

A simple count of vegetables eaten in the last 24 hours gave a mean score that ranged from 1.3 – 1.6 at the national level, in rural areas and among households with a total income of less than R12 000.00; and 1.2 – 1.5 for fruits. The results are in Table 4.12.

Table 4.11: Percentages of children aged 1 – 3 years consuming vitamin A and C rich vegetables and fruits in the last 24 hours at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year

Food group	% OF CHILDREN IN GROUPS AT NATIONAL LEVEL				% OF CHILDREN IN GROUPS IN RURAL AREAS				% OF CHILDREN IN HHs WITH TOTAL INCOME <R12000/HH/YEAR			
	Crops only	Crops and livestock	Livestock only	Non-producers	Crops only	Crops and livestock	Livestock only	Non-producers	Crops only	Crops and livestock	Livestock only	Non-producers
VEGETABLES	n=132	n=60	n=50	n=417	n=69	n=52	n=45	n=136	n=91	n=42	n=40	n=206
Vitamin A-rich	42.4	38.3	38.0	38.6	40.6	38.5	35.6	33.8	36.3	40.5	45.0	38.8
Vitamin C Rich	31.1	23.3	38.0	38.6	21.7	17.3	35.6	32.8	26.4	26.2	45.0	40.3
Potato and sweet potato	37.1	45.0	36.0	43.6	33.3	48.1	35.6	36.8	38.5	40.5	30.0	36.9
Other	24.2	21.7	22.0	22.3	18.8	23.1	24.4	19.1	29.7	19.0	17.5	15.0
FRUITS	n=35	n=11	n=12	n=163	n=13	n=9	n=10	n=26	n=21	n=8	n=9	n=60
Vitamin A-rich	2.9	0.0	8.3	2.5	0.0	0.0	10.0	3.8	0.0	0.0	0.0	1.7
Vitamin C Rich	11.4	0.0	8.3	12.9	0.0	0.0	10.0	7.7	14.3	0.0	11.1	15.0
Other	91.4	100.0	83.3	95.1	100.0	100.0	80.0	92.3	85.7	100.0	88.9	95.0

Table 4.12: Mean simple count of the variety of vegetables and fruits consumed by children aged 1 – 3 years in the last 24 hours at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year

Food group	CHILDREN IN GROUPS AT NATIONAL LEVEL				CHILDREN IN GROUPS IN RURAL AREAS				CHILDREN IN HHs WITH TOTAL INCOME <R12000/HH/YEAR			
	Crops only	Crops and livestock	Livestock only	Non-producers	Crops only	Crops and livestock	Livestock only	Non-producers	Crops only	Crops and livestock	Livestock only	Non-producers
VEGETABLES	n=132	n=60	n=50	n=417	n=69	n=52	n=45	n=136	n=91	n=42	n= 40	n=206
(SD)	1.5 (1.0)	1.4 (0.6)	1.5 (0.7)	1.6 (1.0)	1.3 (0.5)	1.3 (0.6)	1.4 (0.8)	1.3 (0.6)	1.5 (1.1)	1.4 (0.6)	1.5 (0.8)	1.4 (0.9)
FRUITS	n=35	n=11	n=12	n=163	n=13	n=9	n=10	n=26	n=21	n=8	n=9	n=60
(SD)	1.4 (0.8)	1.2 (0.4)	1.3 (0.5)	1.5 (1.1)	1.2 (0.4)	1.2 (0.4)	1.3 (0.5)	1.4 (0.6)	1.4 (0.8)	1.3 (0.5)	1.3 (0.5)	1.4 (0.8)

4.4.2 Percentages of children aged 1 – 3 years consuming selected food groups from households in the crops only and the non-producers groups in urban areas

Generally, households in urban areas had higher percentages of children aged 1 – 3 years consuming animal products, vegetables and fruits than in rural areas. The results are shown in Table 4.13. A higher percentage of children in the non-producers group consumed meat and meat products (56.0%) compared to 46.3% in the crops only group. Conversely, a higher percentage of children in the crops only group (66.3%) consumed vegetables than children in the non-producers group (54.7%).

Table 4.13: Percentages of children aged 1 – 3 years consuming selected food groups in the last 24-hours from households in the crops only and the non-producers groups in urban areas in South Africa.

Food Group	% OF CHILDREN IN GROUPS IN URBAN AREAS	
	Crops only (n = 95)	Non producers (n = 514)
Eggs	13.7	17.9
Meat and meat products	46.3	56.0
Milk and milk products	76.8	79.0
Fruits	23.2	26.7
Vegetables	66.3	54.7

4.5 Hunger perceptions in households with children aged 1 – 3 years in South Africa

The section on hunger perceptions is divided into four categories, namely, i) households experiencing hunger; ii) households that rely on a limited number of foods to feed their children; iii) individual caregivers or mothers that ever eat less food because of lack of money to buy food; and iv) children that ever report hunger because of lack of food in the house. The four study groups will be compared at the national level, within rural areas and for households with a total income of less than R12 000.00 per household per year. In addition, the crops only and non-producers groups were compared in urban areas.

4.5.1 Severity of hunger in households with children aged 1 – 3 years in South Africa

At the national level, the crops and livestock group had a higher percentage of households experiencing hunger (65.3%) than the other study groups. The results of the severity of hunger in the households with children included in the study are shown in Table 4.14. The households least affected by hunger were in the non-producers group (46.6%). There was a significant difference ($p < 0.0001$) between the four study groups. Within rural areas, the groups with crops and livestock and livestock only had higher percentages of households experiencing hunger and there was a significant difference ($p=0.0083$) between the four study groups.

Table 4.14: Percentages of households experiencing hunger, at risk of hunger and food secure in households with children aged 1 – 3 years in South Africa

Hunger Severity	% OF HHs AT NATIONAL LEVEL				% OF HHs IN RURAL AREAS				% OF HHs WITH TOTAL INCOME < R12 000/HH/YEAR			
	Crops only n=151	Crops and livestock n = 89	Livestock only n=63	Non - producers n=517	Crops only n=81	Crops and livestock n=80	Livestock only n=55	Non-producers n=146	Crops only n=100	Crops and livestock n=66	Livestock only n=48	Non-producers n=271
Experiencing hunger	56.4	65.3	59.7	46.6	64.6	67.8	67.2	51.3	66.6	72.0	61.5	60.0
At risk of hunger	21.3	25.9	25.0	21.1	22.4	27.8	18.1	25.5	20.7	23.6	24.0	20.3
Food secure	22.3	8.8	15.3	32.3	13.0	4.4	14.7	23.2	12.7	4.4	14.5	19.7
P- value$^{\Omega}$	<0.0001				0.0083				0.1022			

$^{\Omega}$Chi-Square test

4.5.2 Hunger perceptions reported by households with children aged 1 – 3 years in South Africa

Table 4.15 presents the results of households reporting hunger perceptions at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year. The results reported are for households that relied on a limited number of foods, caregivers or mothers that ate less food and children who ate less food, because of lack of money to buy food. In addition, the results of the children that reported hunger because of lack of food in the house are presented in Table 4.15.

At the national level, a higher percentage (82.5%) of households in the crops and livestock group reported that they relied on a limited number of foods to feed their children than the other groups. Households in the non-producers group had the lowest percentage of households (58.0%) that reported relying on a limited number of foods. There was a significant difference (p<0.0001) between the four study groups at the national level. In rural areas, again, households in the crops and livestock group had a higher percentage of households (87.0%) that reported relying on a limited number of foods to feed their children, and there was a significant difference (p=0.0031) among the four study groups. Moreover, among households with a total income of less than R12 000.00 per household per year, households with crops and livestock had a higher percentage than other groups of households (90.1%) that relied on a limited number of foods to feed their children. Other groups each had at least 70% of households relying on a limited number of foods to feed their children. There was a significant difference (p=0.0201) between the four groups among households with a total income of less than R12 000.00 per household per year.

Table 4.15: Percentages of households and children aged 1 – 3 years reporting hunger perceptions at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year in South Africa.

HHs/children reporting hunger perceptions	% OF GROUPS AT THE NATIONAL LEVEL				% OF GROUPS IN RURAL AREAS				% OF GROUPS IN HHs WITH TOTAL INCOME < R12 000/HH/YEAR			
	Crops only n=150	Crops and livestock n=89	Livestock only n=63	Non-producers n=517	Crops only n=81	Crops and livestock n=80	Livestock only n=55	Non-producers n=146	Crops only n=100	Crops and livestock n=66	Livestock only n=48	Non-producers n=271
HHs relying on limited number of foods	69.4	82.5	72.9	58.0	76.2	87.0	75.1	64.6	79.0	90.1	74.2	72.3
P-value	<0.0001				0.0031				0.0201			
Caregivers/mothers that ate less food	62.6	71.1	67.2	55.0	71.7	73.4	74.4	59.3	71.0	78.7	68.4	67.0
P-value	0.0101				0.0551				0.3136			
Children that ate less food	58.7	67.1	58.2	46.7	68.0	69.8	64.2	51.5	67.1	72.9	60.8	59.5
P-value	0.0006				0.0177				0.1694			
Children reporting hunger	54.8	61.6	55.3	41.4	59.7	64.7	62.2	51.1	66.1	64.9	60.8	54.6
P-value$^{\Omega}$	0.0002				0.1847				0.1519			

$^{\Omega}$Chi-Square test

Table 4.15 also indicates that at the national level, a higher percentage of caregivers or mothers from the crops and livestock group (71.1%) reported eating less food because of limited money to buy food. Fewer caregivers or mothers (55.0%) from the non-producers group reported eating less food because of less money and, a significant difference (p=0.0101) was found between the four study groups. Within rural areas, a higher percentage of caregivers or mothers from the livestock only group (74.4%) reported eating less food because of lack of money for food, followed by the crops and livestock group with 73.4%. A tendency of significant difference was found between the four groups (p = 0.0551). Among households with a total income of less than R12 000.00 per household per year, the crops and livestock group had a higher percentage of caregivers (78.7%) that reported eating less food because of lack of money to buy food. However, there was no significant difference between the four study groups (p = 0.3136).

The results of children that ate less food are also presented in Table 4.15. At the national level, a small percentage (46.7%) of households from the non-producers group reported that their children ate less food because of lack of money for food. A higher percentage (67.1%) of households with crops and livestock reported that their children ate less food and there was a significant difference between the four study groups (p = 0.0006). In rural areas, the crops and livestock group, again, had a higher percentage of households (69.8%) that reported that their children ate less food. There was a significant difference (p = 0.0177) between the four groups. There was no significant difference (p=0.1694) between the four groups when compared according to a total income of less than R12 000.00 per household per year.

The results of children reporting hunger are also presented in Table 4.15. Nationally, the households with crops and livestock had the highest percentage (61.6%) of children reporting hunger because of lack of food in the house and there was a significant difference (p = 0.0002) between the four groups. There was no significant difference (p = 0.1847) between the groups when compared within rural areas for children reporting hunger, as well as among households with a total income of less than R12 000.00 per household per year (p = 0.1519).

4.5.3 Severity of hunger in households with children aged 1 – 3 years in the crops only and the non-producers groups in urban areas

About 45% of the children from each of the crops only and the non-producers groups were experiencing hunger. Table 4.16 gives detailed results of the severity of hunger among households with crops only and non-producers in urban areas. There was no significant difference (p=0.8986) between the two study groups.

Table 4.16: Percentages of households with children aged 1 – 3 years experiencing hunger, at risk of hunger and food secure among households in the crops only and non-producers groups in urban areas in South Africa

Hunger Severity	% OF CHILDREN IN GROUPS IN URBAN AREAS		P-value$^{\Omega}$	Total RSA Urban n=457
	Crops only n=70	Non-producers n=371		
Experiencing hunger	46.9	44.7	0.8986	44.3
At risk of hunger	20.0	19.4		20.2
Food Secure	33.1	35.9		35.5

$^{\Omega}$Chi-Square test

4.5.4 Household level, individual level and child level food insecurity in households with children aged 1 – 3 years in the crops only and non-producers groups in urban areas in South Africa

Table 4.17 indicates that in urban areas, households relying on a limited number of foods, caregivers or mothers that ate less food and households that reported that their children ate less foods had no significant difference (p<0.05) between the crops only and non-producers groups. A tendency of significant difference (p=0.0709) was found between the two groups with regard to the children that reported hunger because of shortage of food in the house. The non-producers group had fewer children reporting hunger (37.7%) than the crops only group (49.2%).

Table 4.17: Percentages of households, individual caregivers or mothers and children aged 1 – 3 years affected by food insecurity in the crops only and non-producers groups in urban areas in South Africa

Percentages of households/individuals/ children affected by food insecurity	% OF CHILDREN IN GROUPS IN URBAN AREAS		P-value$^{\Omega}$	Total RSA urban n=457
	Crops only n=70	Non-producers n=371		
Households relying on limited foods to feed children because of not enough money to buy food for a meal	61.7%	55.4%	0.3344	56.1%
Individual caregivers/mothers that eat less food because of not enough money for food	52.1%	53.4%	0.8415	52.5%
Households reporting children that eat less food because of not enough money for food	47.8%	44.8%	0.6434	44.7%
Children saying they are hungry because there is not enough food in the house	49.2%	37.7%	0.0709	38.8%

$^{\Omega}$Chi-Square test

4.6 Anthropometric status of children aged 1 – 3 years in South Africa

Table 4.18 presents the results of the percentage of children with Z-scores less than -2 SD for stunting (H/A), underweight (H/A) and wasting (W/H) for children at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year. There was no significant difference between the four study groups for all the anthropometric status indicators. However, Table 4.19 shows that children in the non-producers group in rural areas had a high prevalence of stunting as well as children in crops and livestock group among low-income households. None of the groups had low levels of stunting and underweight, and there was also evidence of a problem with the prevalence of wasting, particularly with children in rural areas for all the study groups except the crops only group.

Table 4.18: Percentages of children aged 1 – 3 years with Z-score less than -2 SD below the median for height-for-age (stunting, H/A), weight-for-age (underweight, W/A) and weight-for-height (wasting, W/H) at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year in South Africa.

GROUP	% OF CHILDREN AT THE NATIONAL LEVEL				% OF CHILDREN IN RURAL				% OF CHILDREN FROM HHs WITH < R12 000/HH/YEAR			
	n	H/A	W/A	W/H	n	H/A	W/A	W/H	n	H/A	W/A	W/H
Crops only	136	26.0	11.3	1.1	71	27.7	13.2	1.4	91	26.6	11.0	1.1
Crops and livestock	79	26.7	11.2	4.9	72	25.5	11.3	5.4	59	29.0	7.1	3.3
Livestock only	54	20.7	13.4	5.0	47	23.6	13.9	5.7	43	20.1	15.4	4.7
Non-producers	469	23.4	10.9	4.0	125	31.2	14.6	7.2	249	26.9	12.0	3.3
P-values[Ω]		0.7889	0.9556	0.3447		0.7222	0.9332	0.3082		0.7746	0.5936	0.5588

[Ω]Chi-Square Test

Table 4.19: Severity of the prevalence of stunting, underweight and wasting among children aged 1 – 3 years at the national level, in rural areas and among households with a total income of less than R12 000.00 per household per year in South Africa.

INDICATOR	**CHILDREN AT THE NATIONAL LEVEL**				**CHILDREN IN RURAL**				**CHILDREN FROM HHs WITH < R12 000/HH/YEAR**			
	Crops only n=136	Crops and livestock n=79	Livestock only n=54	Non-producers n=469	Crops only n=71	Crops and livestock n=72	Livestock only n=47	Non-producers n=125	Crops only n=91	Crops and livestock n=59	Livestock only n=43	Non-producers n=249
Stunting	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium	Close to high	Medium	Medium
Underweight	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Wasting	Accept	Close to poor	Poor	Accept	Accept	Poor	Poor	Poor	Accept	Accept	Close to poor	Accept

Key: Stunting: low <20, medium 20-29, high 30-39, very high ≥40; Underweight: low <10, medium 10-19, high 20-29, very high ≥30;
Wasting: Accept (acceptable) <5, poor 5-9, serious 10-14, critical ≥15.

4.6.1 Anthropometric status of children aged 1 – 3 years from households in the crops only and non-producers groups in urban areas in South Africa

The percentages of children in the crops only and non-producers groups with Z-scores less than -2 SD were determined. Table 4.20 shows the results of stunting, underweight and wasting for the crops only and non-producers groups in urban areas. There was no significant difference for all the anthropometric indicators of children when the crops only and non-producers groups were compared within urban areas. Table 4.21 shows that the level of stunting was medium in both groups while underweight was close to medium, but levels of wasting were acceptable.

Table 4.20: Percentages of children aged 1 – 3 years with Z-scores less than -2 SD for height-for-age (stunting), weight-for-age (underweight) and weight-for-height (wasting) from households in the crops only and non-producers groups in urban areas in South Africa

INDICATOR	GROUPS WITHIN URBAN AREAS		P-Value[Ω]
	Crops only n =64	Non-producers n =344	
	%	%	
Stunting	23.4	20.4	0.5142
Underweight	9.4	9.6	0.9349
Wasting	1.5	2.3	0.4832

[Ω]Chi-Square test

Table 4.21: Severity of the prevalence of stunting, underweight and wasting among children aged 1 – 3 years from households in the crops only and non-producers groups in urban areas in South Africa

INDICATOR	GROUPS WITHIN URBAN AREAS	
	Crops only n=64	Non-producers n=344
Stunting	Medium	Medium
Underweight	Close to medium	Close to medium
Wasting	Acceptable	Acceptable

Key: Stunting: low <20, medium 20-29, high 30-39, very high ≥40; Underweight: low <10, medium 10-19, high 20-29, very high ≥30; Wasting: Acceptable <5, poor 5-9, serious 10-14, critical ≥15.

4.7 Summary of the results

4.7.1 Socio-demographic characteristics

The crops and livestock group was the most underprivileged. Households with children aged 1 – 3 years from the crops and livestock group mostly lived in traditional or mud dwellings, used pit latrines and obtained water from rivers or dams. On average, all the four study groups earned a total monthly income of R100.00 to R500.00. However, the non-producers and crops only groups had more households with a monthly income of over R1000.00 per month.

4.7.2 Nutrient intake of children aged 1 – 3 years

Within rural areas, the children from households in the non-producers group had lower nutrient intakes than the other groups. The crops only group had higher vitamin A and vitamin C intakes and the crops and livestock group had higher intakes for energy, calcium and iron. At least 40% of the children in each group had less than 67% of the RDAs for all the selected nutrients except protein and thiamine.

When the four groups were compared according to a total income of less than R12 000.00 per household per year, households in the crops only group had a significantly higher intake of vitamin A and vitamin C. The crops and livestock group had a higher intake for energy, calcium, thiamine and folate. Children in the non-producers group had lower nutrient intakes of most of the nutrients, namely, energy, calcium, thiamine, folate and vitamin A. In addition, all the study groups had the majority of children consuming less than 67% of the RDAs for all the nutrients, except protein.

4.7.3 Dietary diversity of children aged 1 – 3 years

The dietary diversity score was very low for all the four study groups with a median of 4.0 out of a maximum of 13. The score was the same when the groups were compared within rural areas and among the households with a income of less than R12 000.00 per household per year. From the selected food groups, high percentages of children from all the study groups consumed milk and milk products and vegetables. About a third of children in each group consumed vitamin A-rich vegetables in rural areas and among households with a total income of less than R12 000.00 per household per year.

4.7.4 Hunger perceptions in households with children aged 1 – 3 years

The majority of households in the crops and livestock group were experiencing hunger. In addition, households with crops and livestock relied on a limited number of foods to feed their children. The majority of caregivers or mothers from the crops and livestock group reported eating less food due to lack of money for food. Moreover, a higher percentage of children from the crops and livestock group reported hunger. Overall, all the study groups had high levels of food insecurity.

4.7.5 Anthropometric status of children aged 1 – 3 years

There was no significant difference between the four groups for all the anthropometric status indicators. In addition, comparison of urban and non-producers groups in urban areas did not show significant difference between the two groups. Generally, high percentages of children (one in five) in each study group were stunted. According to the WHO global criteria, the prevalence of stunting was high among children in non-producers group in rural areas.

CHAPTER 5: DISCUSSION

5.1 Introduction

The purpose of the study was to determine and compare nutrient intake, dietary diversity, hunger perceptions and anthropometric status of children aged 1 – 3 years in households that produced crops and owned livestock in South Africa. This age group is particularly important because Allen & Gillespie (2001, pvi) stated that it is difficult to meet the nutrient requirements of children during the complementary feeding period, especially in poor rural settings. The current study was a secondary analysis of the South African NFCS of 1999 data among households in rural areas, as well as in urban areas, and households earning a total income of less than R12 000.00 per household per year. This study was an observational study and did not control for differences in the socio-demographic characteristics.

Notable differences in results were observed between the groups (crops only, crops and livestock, livestock only and non-producers) particularly in rural areas and among households with a total income of less than R12 000.00 per household per year. These results are presented in Table 5.1 and the discussion will be on basis of these results.

Table 5.1: Summary of main study findings

Variable	GROUPS IN RURAL AREAS				CHILDREN IN HHs WITH < R12 000.00			
	Crops only	Crops and livestock	Livestock only	Non-producers	Crops only	Crops and livestock	Livestock only	Non-producers
Households socio-demographic Characteristics (highest frequency€)	Brick/ traditional/mud housing; Pit latrine; Community tap; R100-R500 income; R0-R50 spent on food	Traditional/mud housing; Pit latrine; River/dam water; R100-R500 income; R0-R50 spent on food	Brick housing; Pit latrine; Community tap; R100-R500 income; R0-R50 spent on food	Brick housing, Pit latrine; Community tap/own tap, R100-R500 income, R0-R50 spent on food	Brick/ traditional/mud housing; Pit latrine; Own tap; R100-R500 income; R0-R50 spent on food	Traditional/mud housing; Pit latrine; River/dam water; R100-R500 income; R0-R50 spent on food	Brick/ traditional/mud housing; Pit latrine; Community tap; R100-R500 income; R0-R50 spent on food	Brick/tin/ plank housing; Flush/pit latrine; Own tap; R100-R500 income; R0-R50 spent on food
Nutrient intake• (highest nutrient intake for each group)	Vitamin A & C, iron	Energy, folate, vitamin B_6, calcium	No nutrient highest	Vitamin B_{12}	Vitamin A & C, iron	Energy, folate thiamine, vitamin B_6, calcium	iron	Vitamin B_{12}
	At least 60% of children consumed < 67% RDA for vitamin A & C, calcium, iron, zinc, folate				Over 50% of children consumed < 67% RDA for vitamin A & C, calcium, iron, zinc, folate			
Dietary diversity•: DDS (median) and consumption of selected food groups	DDS 4, vegetable intake ↑,	DDS 4	DDS 4	DDS 4, meat ↑ vegetable intake ↓	DDS 4, vegetable intake ↑,	DDS 4	DDS 4	DDS 4, meat ↑ vegetable intake↓
	47.7 – 60% of children consumed vegetables, of these about a ⅓ of children consumed vitamin A-rich vegetables; 9.1% - 12.2% of children consumed fruits; 57.9-65.3% of children consumed milk & milk products; 6.1 – 10.5% of children consumed eggs				47.7-65.9% of children consumed vegetables, of these about a ⅓ of children consumed vitamin A-rich vegetables; 9.9% - 15.2% of children consumed fruits; 60.9-67.9% of children consumed milk & milk products; 7.2% - 13.2% of children consumed eggs			
Hunger scale (highest frequency)	Experiencing hunger; FS 13%	Experiencing hunger; FS 4.4%	Experiencing hunger; FS 14.7%	Experiencing hunger; FS 23.2%	Experiencing hunger; FS 12.7%	Experiencing hunger; FS 4.4%	Experiencing hunger; FS 14.5%	Experiencing hunger; FS 19.7%
	51.3 – 67.8% households experiencing hunger				60.0 – 72.0% households experiencing hunger			
Anthropometry	No significant difference for anthropometric indicators. Prevalence of stunting and underweight medium for all groups except for high levels of stunting in non-producers group; wasting was a problem in crops and livestock, livestock only and non-producers groups.				No significant difference for anthropometric indicators. Prevalence of stunting and underweight medium for all groups except close to high levels in crops and livestock group; wasting was a problem in livestock only group			

Key: € = Where top two characteristics had similar frequencies, both are listed and highest listed first; •From 24 hour recall; DDS = Dietary Diversity Score; FS = Food secure

5.2 Socio-demographic characteristics

When compared to the national values, the proportion of households living in rural areas in each of the four study groups differed considerably. Fifty four percent (54%) of households in the crops only group were in rural areas, while 89% of the crops and livestock group, 87% of the livestock only group and 27% of the non-producers group lived in rural areas. More households in rural areas were engaged in crops and livestock production. At the national level, rural-urban differences are likely to affect study variables and therefore, the results should be interpreted with caution. In rural areas, non-producers were fewer and tended to have better socio-economic status. It would be valuable to find out why non-producers do not produce and the support structure they have. This was an observational study using randomly selected households and differences in the socio-demographic characteristics between the groups were not controlled for. It should be noted that many of the households in all the groups were of poor socio-economic status, that is, they spent low amounts of money on food, used a pit latrine and did not have their own taps, and this was more predominant in the rural areas. In addition, there were differences between the different study groups in this regard. Non-producers group tended to have dwellings made of bricks and had their own tap. These socio-economic differences are potentially important factors which could affect the variables measured in the study groups. The Chi-Square test showed significant difference between the groups in rural areas and low income households. However, Tredoux & Durrheim (2005, p376) stipulate that a frequency of more than five (5) should be achieved in at least 80% of the cells in order to perform Chi-Square test. This was not always achieved in this data set. Therefore, the results should be interpreted with caution.

Generally, the results are comparable to other study findings of rural areas in South Africa. Literature specifically describing the socio-demographic characteristics of crops and/or livestock groups' socio-demographic characteristics could not be identified to support the study findings. The South Africa Demographic Health Survey (SADHS) of 1998 revealed that few households (6.9%) in non-urban areas used flush toilets (Department of Health 1998, p16). Moreover the Department of Health (1998, p16) indicated that 28.5% of households in non-urban areas used water from dams, rivers or streams for drinking. Though not representative of the national population, Mukantwali (2004, p68) recently found that one third of mothers in the Okhahlamba Municipality of KwaZulu-Natal used water from boreholes, rivers or rain water. This shows that children live under unhygienic conditions and are at risk of infectious diseases which is likely to impact on child nutritional status including child growth.

Over 35% of households in all the study groups in rural areas and among households with a total income of less than R12 000.00 per household per year spent R50.00 or less on food per week. These results are supported by Rose & Charlton (2002) who found that in 62.1% of rural households, the amount of money spent on food was not enough to purchase a basic and nutritionally adequate diet. Statistics South Africa (2002, p60) revealed that 35% of poor households spent 35% of their total food expenditure on grain products. Rural and low-income households spent less money on food. Under these circumstances, crop and/or livestock production could augment low-income through direct provision of foods and income generation for other food items or other household activities. A small percentage (6.1%) of households spent R300.00 or more per week on food among households with total income of less than R12 000.00 per household per year. If R300.00 was spent on food per week, a total of R15 600.00 would have been spent in a year, which exceeds their total yearly income of less than R12 000.00. In future, it would be critical to investigate this. There may be a possibility that households over reported income spent on food or under reported total household income. It should be noted that there was an overlap of the ranges of income spent on food as well as income earned per month, for example R100.00 – R200.00 and next category R200.00 to R300.00. This may have also affected how study participants responded to the questions and how the field workers coded the responses.

The two groups that showed notable differences were the crops and livestock groups and the non-producers group. The crops and livestock groups had poor living conditions, while the non-producers groups were better-off. This could lead to confounding effects when analysing the data because due to the socio-economic differences, it could be expected that households in the non-producers group would be more food secure and the children from food secure households would be expected to consume a more diverse diet and have improved micronutrient intakes.

In turn, the children consuming diverse diets that are high in micronutrient intakes would be expected to have better nutritional status including anthropometric status.

5.3 Nutrient intake and dietary diversification

The diets of many children in developing countries have been found to be plant-based with little variety (Ruel 2003; Faber *et al* 2002a; Ruel & Levin 2000, p1), including South Africa (MacIntyre & Labadarios 1999, p352). These less varied diets have been linked to multiple micronutrient deficiencies (Ruel & Levin 2000, p1). Crop and livestock production is recommended to diversify the diets and improve the multiple micronutrient intakes of children (FAO 2002, p3). In this study, children from households producing crops and/or livestock were investigated to determine if their diets had better nutrient intakes and dietary diversity than non-producers.

This study showed that households with crop and/or livestock production in South Africa have been found to have higher intakes of a range of nutrients compared to non- producers, although they were still low compared to the RDAs. In general livestock production on its own was not associated with increased intakes of nutrients which suggests that livestock was used for other purposes other than food.

Three points are of particular interest. Firstly, statistically significant differences were found in the intakes of several nutrients. Secondly, the nutrients for which differences were found varied according to whether the analysis was carried out at national, urban/rural or low income household level. Thirdly there were also some differences between the agricultural production study groups, that is, crops only, both crops and livestock and livestock only. For the latter groups it should be noted that the statistical analysis presented only determines significant differences between the four groups, no post hoc analysis was done to determine which group differed from another group. The overall analysis of the full NFCS data set showed lower nutrient intakes in rural areas (Steyn & Labadarios 1999, p247) and rural households were predominantly of low income (Labadarios *et al* 1999a, p133). It is therefore particularly encouraging to note that despite the socio-economic differences which would have been expected to mitigate against this, there were significant differences in the nutrient intakes for seven of the thirteen nutrients where crop and/or livestock production had a positive impact on nutrient intakes in both the rural and low income household analysis, compared to the national analysis, where this was only found for four nutrients. However for the national, rural and low income analyses, the median intakes in any of the study groups only met the RDAs for protein and thiamine. There were still deficits in the intakes of most of the nutrients.

It is important to speculate as to why even though there were significant differences between the four study groups for some nutrients in rural areas and among low-income households, none of the nutrient intakes in each study group met the RDAs. The study results showed that more than 55% of children in each study group in rural and low-income households had nutrient intakes less than 67% of the RDAs for vitamin A, vitamin C, folate, calcium, iron and zinc. The nutrient intakes that are lower than the RDAs could be linked to a variety of factors such as inadequate food intake, lack of variety of the diet, household food security and study methods.

High percentages of children in all the study groups in rural and low income households consumed vegetables. However, in all the study groups, the nutrient intakes of nutrients that are mostly found in vegetables, that is vitamin A, vitamin C and folate as well as iron and zinc, were less than 67% of the RDAs. This indicates that the intake of vegetables by the children included in the study was not adequate. Also, further analysis of the percentage of children consuming vitamin A and C rich vegetables in all the study groups showed that few children consumed these foods. This could be another factor contributing to low nutrient intakes for vitamin A and C. Therefore, the crop and/or livestock production strategies applied in the literature interventions could be further explored to increase vegetable and fruit production, particularly vitamin A and C rich crops, in an effort to increase the nutrient intakes of children in South Africa. The target population should be rural and poor households. However, increased vegetable and fruit production alone would not be adequate. Attention should be paid to the types of vegetables and fruits and nutrition education should also be part of the strategies to increase the intake of micronutrient rich foods (Ruel & Levin 2000, p11). A similar strategy was used by Faber *et al* (2002b) in KwaZulu-Natal, South Africa, who integrated home gardening, growth monitoring and nutrition education with aim to improve vitamin A intake of children. The strategy improved vitamin A intake as well as other nutrients. The strategy could be expanded to other rural areas in South Africa.

Over 35% of children in each study group in rural areas and among low income households consumed less than 67% of the RDA for energy. Schmidt & Vorster (1995) suggested that in populations where energy intakes are low, it would be better to also promote potatoes and sweet potatoes to improve child nutrition. Ayalew et al (1999, p16) promoted sweet potatoes, along with other vegetables and dairy goats in rural areas of Ethiopia. Hagenimana *et al* (1999) also promoted orange-fleshed sweet potatoes in Kenya to increase vitamin A intake of children aged 1 – 5 years. The children in the intervention group had higher intake of orange fleshed sweet potatoes and vitamin A rich foods than the control group. In South Africa (van Jaarsveld *et al* 2005), orange fleshed sweet potato intervention improved vitamin A status of children aged 5 - 10 years in rural KwaZulu-Natal. The current study showed that, from the sub-group of children consuming vegetables, about a third of children in each group in rural areas and among low income households had potatoes or sweet potatoes. This offers an opportunity for the government to explore the strategy further and facilitate promotion of orange fleshed sweet potato among low income rural households.

Diets of the current study children lacked variety, with a median dietary diversity score of four out of 13 food groups. As indicated previously, there is considerable controversy regarding which food groups and cut-off points should be used. The primary analysis in this study regarding dietary diversity was carried out using the same 13 food groups and a cut-off point of six (6) food groups as Sayed (2005, p40), who also used the same data set of NFCS of 1999 for children aged 1 – 9 years old. Sayed (2005) used the food groups to denote correlation of dietary diversity to food insecurity and found a good correlation with other indicators of food insecurity such as low energy and vitamin A intake. Steyn *et al* (2006) also used the NFCS of 1999 data set for children aged 1 – 9 years and found that a dietary diversity score of four out of nine food groups was the best indicator of nutrient adequacy. The children in the current study had a low dietary diversity score to contribute to adequate nutrient intake. However, Steyn *et al* (2006) used food groups that had fruits and vegetables rich in vitamin A, animal source foods, cereals and nuts and legumes. The current study had three food groups that were low in nutrient density, namely, sugar, syrups, and sweets, sauces, seasonings and flavourings and beverages. These could have influenced nutrient intakes of children. There are different approaches to measuring dietary diversity and there is still lack of agreement on best indicators of dietary diversity (Steyn *et al* 2006). Therefore, the results should be interpreted with caution and this may need further research.

In the current study, a low dietary diversity score in each of the four study groups may be attributed to low percentages of children consuming a variety of the food groups such as eggs, meat and meat products and fruits. In rural areas and among low income households, few children consumed eggs. The households probably owned no or not enough chickens to produce enough eggs. Aliber & Modiselle (2002, p56) found that households in Gauteng and KwaZulu-Natal avoided keeping many chickens because the households could not afford to buy feed for the chickens. None of the children in all the study groups consumed foods in the nuts and seeds food group. This reduced the score even further. One may also assume that the children were too young to consume nuts and seeds, and also, food preferences or taboos, especially for young children, may contribute to the lack of consumption of nuts and seeds. A high percentage of children in each study group in rural and low income households consumed milk and milk products, but calcium intake was low. The South African NFCS of 1999 found that 93% of households with children aged 1 – 9 years purchased milk (Maunder & Labadarios 1999, p499). Therefore, it may be argued that since milk consumed was purchased, the quantities consumed were small because cost is likely to be a limiting factor. Other factors could have also contributed to low nutrient intake of calcium. The portion sizes of milk and milk products were not determined in this secondary analysis study. In addition, other plant food sources which are rich in calcium were not determined for the groups in the current study. These could have caused the differences between the groups.

In rural areas and among low income households, few households in the crops and livestock group (livestock only not excluded) consumed meat and meat products. Kirsten *et al* (1998) reported that the majority of households in rural areas owned few cattle with a range of 1 – 10 head(s) of cattle per household. In addition, Leroy *et al* (2001) found that in the Northern Province in South Africa (Venda), rural households that kept livestock (especially cattle) slaughtered the livestock only for special occasions like weddings and funerals. Aliber & Modiselle (2002, p66) also found that households in Gauteng and KwaZulu-Natal only slaughtered goats and cattle owned for celebrations. The livestock were kept as a source of investment and only sold when in need of income such as for the purchase of food (Aliber & Modiselle 2002, p66). Occasional slaughter of livestock owned might have led to low consumption of meat and meat products amongst the households included in the study. A mini-assessment of the South Africa Heifer International Programme in a rural area of KwaZulu-Natal (Cameron 2003, p27) indicated that 73% of households sold the chickens or goats owned.

Low intake of meat and meat products by children from households in rural areas and among low income households resulted in low nutrient intakes of iron and zinc for each of the study groups. Perlas & Gibson (2005) indicated that plant-based complementary foods are low in readily available iron and zinc. In addition, plant-based complementary foods are high in phytates and polyphenols that inhibit the absorption of iron and zinc (Perlas & Gibson 2005). The current study revealed that over 70% of the children consumed less than 67% of the RDAs for iron and zinc. Lower dietary intake, coupled with the inhibitory properties from the intake of plant-based complementary foods, suggests that the children's iron and zinc intakes available for absorption were lower than the nutrient intake amounts reported in this study.

Methodological issues may have also contributed to nutrient intake and dietary diversity results. It is important to note that the data used for nutrient intake and dietary diversity was a single 24-hour recall method. The method was used because there is a likelihood that the participants would recall foods consumed on the previous day than asking for what they ate a long period of over a month (Hankin 1992, pp175). However, a single 24-hour recall method has its own limitations. The method may not be appropriate because different food items are consumed each day and there may be individual diet variations for each day and this is likely to lead to overestimation of low nutrient intakes (Hankin 1992, pp175-176). The South African NFCS of 1999 (Steyn & Labadarios 1999, p224) indicated that 96% of children had followed their usual eating pattern on the day of the interview. This shows that diet variation was not huge and overestimation would not be a problem. However, the results should be interpreted with caution especially when compared with other studies. The other methodological factor was the use of the RDAs. The South African NFCS of 1999 was conducted and data analysed when the RDAs were still in use. The Food and Nutrition Board, Institute of Medicine, (2002, p11) recommends that the RDAs should not be used to determine the adequacy of nutrient intake for groups because it will lead to overestimation of the proportion of the group at risk of nutrient inadequacy. The Estimated Average Requirements (EAR) method is recommended for assessing nutrient adequacy of a group (Food and Nutrition Board 2000, p102). In the current study, nutrient intakes of children were compared to 67% of the RDAs in which overestimation of the proportion of children at risk would less likely occur.

5.4 Anthropometric status

It should be borne in mind that this was a once-off observational study and conclusive statements could not be made with regard to crop and/or livestock production and anthropometry. Only longitudinal study interventions can give a true picture of the relationship between crop and/or livestock production and anthropometric status. The findings of the prevalence of the anthropometric indicators among children aged 1 – 3 years showed medium levels of stunting (except non-producers group) and underweight in rural areas. The prevalence of wasting was also poor.

In addition, the UNICEF conceptual framework on the causes of malnutrition indicates that various factors contribute to child nutritional status (UNICEF 1998, p24). The nutrient intakes of the children in each study group were not adequate. However, dietary intake alone may not be adequate to improve child growth. Environmental factors could have also contributed to the inadequate growth of children included in the current study. In rural areas and among households with a total income of less than R12 000.00 per household per year, children were from households mainly using pit latrines and water from rivers or dams, particularly the crops and livestock group, followed by the livestock only group. Given this situation, sanitary conditions and hygiene were likely to be poor which increases the chances of infectious diseases. McLachlan & Kuzwayo (1997, pp21-23) indicated that household food security also plays a major role in the anthropometric status of children. In rural areas and among low income households, over 50% of households in the crops and livestock group were experiencing hunger and relied on a limited number of foods to feed their children. Inadequate dietary intake may cause weight loss or growth failure (Allen & Gillespie 2001, p26).

5.5 Hunger perceptions in households with children aged 1 – 3 years in South Africa

Children from households in rural and poor areas often rely on starchy staple diets. The dietary diversification method using crop and livestock production is recommended on the basis that multiple micronutrient intakes and household food security would be addressed simultaneously.

In rural areas, at least half of households in all the four study groups were experiencing hunger and only one in five households in the non-producers group were food secure. In rural areas, households in the non-producers group had better socio-economic status than the other groups and as expected, the group had more food secure households than the other groups. However, for low income households, all the groups were all experiencing. Earlier, Hirschowitz & Orkin (1995, p20) indicated that 88% of South African households with a total monthly income of less than R899.00 (below the minimum living level of that period) reported that they often went hungry. However, Hirschowitz & Orkin (1995, p20) indicated that low income households involved in subsistence agriculture (in some provinces) had few households reporting that their household members occasionally went hungry. This finding was not replicated in the current study. The current study used eight questions to determine perceptions of hunger among households and Hirschowitz & Orkin (1995, p20) used only one question and, therefore, methodological issues may have caused differences in the study results.

Households in each of the four study groups relied greatly on a limited number of foods to feed their children because of lack of money to buy food. This implies that households in the current study were not producing enough foods to meet their households' needs throughout the year. A failing of the NFCS of 1999 was that the survey did not determine if the households produced enough crops and livestock food products to meet their households' needs throughout the year. Kirsten *et al* (1998) found that households in rural KwaZulu-Natal practised subsistence agriculture whereby the majority of households produced a few crops.

McLachlan & Kuzwayo (1997, p23) indicated that food stocks that change with seasons in South Africa have an effect on household food security. These authors reported that agricultural food stocks are depleted during winter and spring, the periods during which lean season is at its peak in South Africa. Mebrahtu *et al* (1995, p237) indicated that when stocks are depleted, households then resort to purchasing basic foods. The South African NFCS of 1999 revealed that over 90% of households purchased the most commonly consumed food items, namely, maize meal, sugar, tea, whole milk and brown bread (Maunder & Labadarios 1999, p497). The South African NFCS of 1999 study data was collected from February 1999 to July 1999 (Labadarios *et al* 1999b, p48). From May to July in 1999 (winter period), some crops may have been scarce or not available during the period of NFCS of 1999 data collection. In that regard, households relied on purchasing foods. One of the main strategies should be to focus on increasing year-round agricultural production for rural and poor households so that agricultural production augments what is purchased. Talukder *et al* (2000) explored this strategy in Bangladesh and found that households that had developed gardens (improved to produce a variety of crops throughout the year) produced more crops throughout the year than households with traditional gardens. However, there are constraints that often discourage households to produce crops. Households in Gauteng and KwaZulu-Natal reported that the main constraints to crop production were purchase of seeds, lack of water, hiring of cultivation equipment and lack of fencing materials (Aliber & Modiselle 2002, pp58-66). In the current study, these factors were not assessed. The socio-demographic characteristics showed that rural and low income households especially crops and livestock producing groups were poor and used dam or river, indication of lack of access to tap water. This means that support with agricultural production resources and services should be provided to poor and rural households. The South Africa Integrated Food Security Strategy (2002, p28) stipulates that food insecurity in rural areas would be reduced by increasing participation of food insecure households in agricultural production and the Department of Agriculture has the mandate to execute this. Provision of resources such as equipment and skills for agricultural production to rural poor is important if food security is to be achieved.

5.6 Areas for improvement of the study

- The study used single 24-hour recall data which may not reflect the actual dietary intake patterns of the children surveyed.
- The socio-demographic characteristics of households in the non-producers group were better than those of households in the crops and livestock group. This may have an effect on the extent of the impact produced from the crops and/or livestock group for each study variable.
- The size of the gardens and the amount of crops produced in the gardens of households included in the study were not determined. Therefore, it was not possible to distinguish between households with large home gardens and those with very small home gardens. This could have an effect on the study results because of failure to identify the households that produced very little of large amounts of crops from their gardens.
- The study relied on information that households produced crops and livestock, but the amount consumed was not determined.
- Crops and livestock/livestock products could be used for income generating activities. However, it was not determined whether households used the crops and/or livestock produced for income generation and if income was used to purchase other food products.
- The current study did not identify the types and variety of crops produced by the study households. In addition, the types and number of livestock owned by each household were not identified.
- The crop and livestock production practices of households included in the study, such as training on gardening and nutrition education, were not known.

Therefore, comparison of the study results with other study interventions should be interpreted with caution.

- Literature shows that some of the crop and/or livestock projects that made impact on child nutrition focused on poor-rural households. The current study focused on rural, urban or low-income households. Therefore, the relationship between crop and/or livestock production on the different study variables among poor-rural households may not have been detected.
- Further work is needed to clarify the most appropriate division of groups and cut-off points for dietary diversity score in future similar studies.

5.7 Recommendations for future research

- The current study was an observational study and did not control for socio-demographic differences between households with crops and livestock and non-producers. A controlled longitudinal study is required to monitor changes of the impact of the production of crops and/or livestock on child nutrition in rural and poor households and nutrition education should be part of the intervention.
- Research is required to determine the feasibility of producing year-round variety of crops to avoid depletion of food stocks during the lean season with special focus on rural and poor households.
- Research is required to determine the crop and livestock production practices of rural and low-income households, such as gardening practices, knowledge on micronutrient-rich vegetables and fruits and if variety of produced products are fed to household members in order to map a way forward on how to improve the crop and livestock production practices and knowledge of households.
- The feasibility of scaling-up production of micronutrient rich and energy dense vegetables such as sweet potatoes, especially to vulnerable households, should be established.

- The barriers to crop and livestock production, as well as dietary intake of the crops and livestock products should be established. This could assist in proper targeting of resources and nutrition education.
- The study showed that high percentages of children from each of the study groups consumed vegetables and milk and milk products and, therefore, the main source (purchased or grown) of these food products should be identified.

5.8 Summary

Complementary feeding period, particularly after 12 months of age, is critical because it is difficult to meet the nutrient requirements of children, especially in poor rural settings. This study investigated the relationship between crop and/or livestock production and nutrient intake, dietary diversity, intake of selected food groups, hunger perceptions and anthropometric status of children aged 1 – 3 years in South Africa. The production of crops and livestock, as well as crops only, was positively associated with better nutrient intake of children in rural and low income households. In addition, crops only group had better intake of vegetables than other groups. However, the diets of the children still lacked variety. More than half households in each study groups in rural and low-income households were experiencing hunger. All the relevant stakeholders should support rural and poor households to improve the production of crops and livestock. Nutrition education should also be incorporated to improve consumption of the produced products.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

The purpose of the study was to determine and compare the nutrient intake, dietary diversity, perceptions of hunger and anthropometric status of children aged 1 – 3 years from households with crops and livestock to those without crops and livestock in South Africa. This study was conducted using the South African NFCS of 1999 data. The study variables were further compared within rural areas, within urban areas and among households with a total income of less than R12 000.00 per household per year.

6.1 Conclusions

In rural areas and among households with a total income of less than R12 000.00 per household per year, several nutrient intakes were higher in children in the groups with crops and/or livestock than children of non-producers. The children from households producing both crops and livestock had higher nutrient intakes than the other groups in rural and low income households. Overall, the socio-demographic characteristics of all the groups were poor. Nutrient intake differences were observed despite the fact that the non-producers group had slightly better socio-demographic characteristics than the crops and livestock group. However, the nutrient intakes did not meet the recommended levels of the RDAs. Crop and/or livestock production, particularly crop production, was associated with better intake of vegetables by children in rural and low income households. The diets of children in all the study groups lacked variety. Furthermore, there were no significant differences in the anthropometric status of children between the four study groups. It is important to note that more than half households in all groups were experiencing hunger. Rural and poor households need support to improve crop and/or livestock production practices. Promotion of the consumption of the produced products should also be intensified through nutrition education.

6.2 Recommendations

Households in the crops and livestock groups mainly used pit latrines and water from dams or rivers. It is important to provide piped water and encourage and support the households with education on hygiene to improve sanitary conditions.

Children from households in the crops and livestock and crops only groups had better nutrient intake than children from other groups. Non-producers had the least nutrient intakes compared to other groups. Nutrient intakes were not adequate to meet the RDAs. Over half of households in each group in rural and low-income households were experiencing hunger. The main aim should be to target low-income households, particularly in rural areas, to improve agricultural production because households benefit from agricultural production. This will supplement the purchasing of food. Promotion of the production of a variety of micronutrient-rich vegetables and fruits that could last throughout the year is vital to ensure continuous availability of foods for rural and poor households. This will also help to reduce high levels of food insecurity among households. Crops high in energy and nutrients such as orange-fleshed sweet potatoes should also be promoted because increasing micronutrients intake only would not be sufficient to improve child nutrition. In addition, small animal husbandry such as goats and chickens should be promoted to increase the intake of animal source foods especially meat and meat products, milk, and eggs. Where crops and livestock production are promoted to be produced in same area, assistance with fencing materials should be provided. The process of improving crop and livestock production should also include nutrition education, community participation, women's involvement and behaviour change. Nutrition education should be intensified to increase the consumption of the produced crops and livestock products.

Rural and poor households probably have limited resources to produce enough crops and livestock products to meet their households' needs. The challenge is to support households with inputs such as agricultural materials, skills development, finance and piped water.

REFERENCES

Abrams SA, Mushi A, Hilmers DC, Griffin IJ, Davila P, Allen L (2003). A multinutrient-fortified beverage enhances the nutritional status of children in Botswana. **Journal of Nutrition** 133: 1834-1840.

Administrative Committee on Coordination/Sub-Committee on Nutrition [ACC/SCN] (2000). **4th Report on the World Nutrition Situation: January 2000: Nutrition Throughout the Life Cycle.** Geneva: ACC/SCN.

Administrative Committee on Coordination/Sub-Committee on Nutrition [ACC/SCN] (1997). **Third Report on the World Nutrition Situation.** Geneva: ACC/SCN.

Ahmed MM, Jabbar M, Ehui S (2000). Household-level economic and nutritional impacts of market-oriented dairy production in the Ethiopian highlands. **Food and Nutrition Bulletin** 21(4): 460-465.

Alderman H (1987). **Cooperative Dairy Development in Karnataka, India: An assessment.** Research Report 64. Washington, DC: International Food Policy Research Institute.

Aliber M, Modiselle S (2002). **Pilot Study on Methods to Monitor Household-level Food Security for the National Department of Agriculture.** Pretoria: Human Sciences Research Council, Integrated Rural and Regional Development.

Allen LH, Gillespie S (2001). **What works? A Review of the Efficacy and Effectiveness of Nutrition Interventions.** Manila: ACC/SCN in Collaboration with Asian Development Bank.

Arimond M, Ruel MT (2004). Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health Surveys. **Journal of Nutrition** 134: 2579-2585.

Ash DM, Tatala SR, Frongillo EA, Ndossi GD, Latham MC (2003). Randomized efficacy trial of a micronutrient-fortified beverage in primary school children in Tanzania. **American Journal of Clinical Nutrition** 77: 891-898.

Attig GA, Dhanamitta S, Ittikom K, Smitasiri S (1993). Promoting home gardening to control vitamin A deficiency in northeastern Thailand. **Food, Nutrition and Agriculture** 7: 18-25. http://www.fao.org/es/esn/publications/fna/article.jsp?lang=en&myURI=id1355 (accessed 29 October 2005).

Ayalew W, Gebriel ZW, Kassa H (1999). **Reducing Vitamin A Deficiency in Ethiopia: Linkages with a women-focused dairy goat farming project.** International Centre for Research on Women (ICRW)/Opportunities for Micronutrient Interventions (OMNI) Research Report Series No.4. Washington, DC: ICRW.

Ayele Z, Peacock C (2003). Improving access to and consumption of animal source foods in rural households: The experiences of a women-focused goat development program in the Highlands of Ethiopia. **Journal of Nutrition** 133: 3981S-3986S.

Begum JM (1994). The impact of dairy development on protein and calorie intake of pre-school children. **Indian Journal of Medical Sciences** 48(3): 61-64 (Abstract). http:www.indianjmesci.org/printarticle.asp?issn=00195359;year=1994;volume=48;issue=3;spage=61epage=4;ulast=Begum;type=0 (accessed 29 October 2005).

Berti PR, Krasevec J, FitzGerald S (2004). A review of the effectiveness of agriculture interventions in improving nutrition outcomes. **Public Health Nutrition** 7(5): 599-609.

Brown KH, Dewey KG, Allen LH (1998). **Complementary feeding of young children in developing countries: A review of current scientific knowledge.** Geneva: World Health Organization.

Cameron Y (2003). **The Umzimkulu Heifer Project: An investigation of the use of invested animals level of nutrition knowledge, dietary practices, food taboos, nutritional assessment of under 3-year old children, and available resources**. Unpublished document. University of Natal, Pietermaritzburg.

Campbell CC (1991). Food insecurity: A nutritional outcome or a predictor variable. **Journal of Nutrition** 121: 408-415.

Daelmans B, Saadeh R (2003). Global initiatives to improve complementary feeding. In: **Meeting the Challenge to Improve Complementary Feeding.** Sudbury, Suffolk: Lavenham Press.

Department of Agriculture (2002). **The Integrated Food Security Strategy for South Africa.** Pretoria: Department of Agriculture.

Department of Health (2003). **Statement by Minister of Health Dr Manto Tshabalala-Msimang on the Coming into Effect of Food Fortification Regulations.** http://www.doh.gov.za/search/index.html (accessed 29 October 2005).

Department of Health (1998). **South Africa Demographic and Health Survey 1998.** Full Report. Parow: Medical Research Council.

de Vos AS, Strydom H, Fouché CB, Delport CSL (2002). **Research at Grass Roots: For the social sciences and human service professions,** 2nd ed. Pretoria: Van Schaik Publishers.

de Wagt A (2001). Vitamin A deficiency control programs in Eastern and Southern Africa: A UNICEF perspective. **Food and Nutrition Bulletin** 22(4): 352-356.

Dewey KG, Brown KH (2003). Update on technical issues concerning complementary feeding of young children in developing countries and implications for intervention programs. **Food and Nutrition Bulletin** 24(1): 5-28.

English R, Badcock J (1998). A community nutrition project in Viet Nam: effects on child morbidity. **Food Nutrition and Agriculture** 22: 15-21. http://www.fao.org/docrep/X0051T/X0051t00.HTM (accessed 27 July 2005).

Faber M, Phungula MAS, Venter SL, Dhansay MA, Benadé AJS (2002a). Home gardens focusing on the production of yellow and dark-green leafy vegetables increase the serum retinol concentrations of 2-5-y-old children in South Africa. **American Journal of Clinical Nutrition** 76: 1048-1054.

Faber M, Phungula M, Venter S, Dhansay M, Benadè AJS (2001). **A home-gardening programme focusing on yellow and dark-green leafy vegetables to improve household food security and undernutrition with special reference to vitamin A status of preschool children.** Technical report. Parow: Medical Research Council.

Faber M, Venter SL, Benadè AJS (2002b). Increased vitamin A intake in children aged 2-5 years through targeted home-gardens in a rural South African community. **Public Health Nutrition** 5(1): 11-16.

Food and Agriculture Organization [FAO] (2004). Socio-Economic analysis and policy implications of the roles of agriculture in developing countries. **Research Programme Summary Report 2004, Roles of Agriculture Project.** Rome: Food and Agriculture Organization.

Food and Agriculture Organization [FAO] (2002). **Food Insecurity: When people must live with hunger and fear starvation: The state of food insecurity in the world 2002.** Rome: Food and Agriculture Organization.

Food and Agriculture Organization and International Life Sciences Institute [FAO & ILSI] (1997). **Preventing Micronutrient Malnutrition: A guide to food-based approaches – Why policy makers should give priority to food-based strategies.** Washington, DC: International Life Sciences Institute.

Food and Nutrition Board (2001). **DRI: Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc.** Washington, DC: National Academy Press.

Food and Nutrition Board (2000). **Dietary Reference Intakes: Applications in dietary assessment.** Washington, DC: National Academy Press.

Food and Nutrition Board (1989). **Recommended Dietary Allowances,** 10th ed. Washington, DC: National Academy Press.

Gericke G, Labadarios D, Nel JH (1999). Chapter 8: Hunger Scale questionnaire: A measure of Hunger. In: Labadarios D (ed). **The National Food Consumption Survey (NFCS): Children aged 1 – 9 years, South Africa, 1999.** Department of Health. http://ww.sahealthinfo.org/nutrition/foodconsumption.htm (accessed 07 March 2005).

Gibson RS, Ferguson EL, Lehrfeld (1998). Complementary foods for infant feeding in developing countries: their nutrient adequacy and improvement. **European Journal of Clinical Nutrition** 52: 764-770.

Greiner T, Mitra SN (1995). Evaluation of the impact of a food-based approach to solving vitamin A deficiency in Bangladesh. **Food and Nutrition Bulletin** 16(3): 193-205.

Hagenimana V, Oyunga MA, Low J, Njoroge SM, Gichuki ST, Kabira J (1999). **The Effects of Women Farmer's Adoption of Orange-Fleshed Sweet Potatoes: Raising vitamin A intake in Kenya.** OMNI Research Report Series 3. Washington, DC: International Center for Research on Women.

Hankin JH (1992). Dietary intake methodology. In: Monsen RE. **Research: Sucessful Approaches.** Mexico: The American Dietetic Association.

Hatloy A, Torheim LE, Oshaug A (1998). Food variety- a good indicator of nutritional adequacy of the diet? A case study from an urban area in Mali, West Africa. **European Journal of Clinical Nutrition** 52: 891-898.

Helen Keller International-Nepal [HKI-Nepal] (2004). Homestead Food Production Program in Central and Far-Western Nepal increases food and nutrition security: An overview of program achievements. **The Nepal Nutrition Bulletin** 2(1): 1-7.

Hirschowitz R, Orkin M (1995). **A National Household Survey of Health Inequalities in South Africa.** Menlo Park: The Henry J. Kaiser Family Foundation.

Jones KM, Specio SE, Shrestha P, Brown KH, Allen LH (2005). Nutrition knowledge and practices, and consumption of vitamin A-rich plants by rural Nepali participants and nonparticipants in a kitchen-garden program. **Food and Nutrition Bulletin** 26(2): 198-209.

Kennedy G, Nantel G, Shetty P (2002). **The scourge of "hidden hunger": Global dimensions of micronutrient deficiencies.** Food, Nutrition and Agriculture. http://www.fao.org//DOCREP/005/y83402.htm (accessed 03 May 2005).

Kidala D, Greiner T, Gebre-Medhin M (2000). Five-year follow-up of a food-based vitamin A intervention in Tanzania. **Public Health Nutrition** 3(4): 425-431.

King FS, Burgess A (1996). **Nutrition for Developing Countries.** 2nd ed. New York: Oxford University Press.

Kirsten J, Townsend R, Gibson C (1998). Determining the contribution of agricultural production to household nutritional status in KwaZulu-Natal, South Africa. **Development Southern Africa** 15(4): 573-587.

Krige MU, Senekal M (1997). Factors influencing the nutritional status of pre-school children of farmworkers in the Stellenbosch district. **The South African Journal of Food Science and Nutrition** 9(1): 14-23.

Kruger M, Sayed N, Langenhoven M, Holing F (1998). **Composition of South African Foods: Vegetables and Fruit. Supplement to the MRC Food Composition Tables 1991.** Tygerberg: Medical Research Council.

Labadarios D, Kotze TJvW, Nel JH (1999b). Chapter 2: General Methodology. In: Labadarios D (ed). **The National Food Consumption Survey (NFCS): Children aged 1 – 9 years, South Africa, 1999.** Department of Health. http://ww.sahealthinfo.org/nutrition/foodconsumption.htm (accessed 07 March 2005).

Labadarios D, Nel JH (1999). Chapter 4: Anthropometric Status. In: Labadarios D (ed). **The National Food Consumption Survey (NFCS): Children aged 1 – 9 years, South Africa, 1999.** Department of Health. http://ww.sahealthinfo.org/nutrition/foodconsumption.htm (accessed 07 March 2005).

Labadarios D, Nel JH, Huskisson J (1999a). Chapter 3: General and Socio-demographic Factors Impacting on Dietary Intake, Household Food Security and Nutritional Status. In: Labadarios D (ed). **The National Food Consumption Survey (NFCS): Children aged 1 – 9 years, South Africa, 1999.** Department of Health. http://ww.sahealthinfo.org/nutrition/foodconsumption.htm (accessed 07 March 2005).

Latham M (1997). **Human Nutrition in the Developing World.** Rome: FAO.

Leroy JLJP, van Rooyen J, D'Haese L, de Winter AM (2001). A quantitative determination of food security of rural farming households in the Northern Province of South Africa. **Development Southern Africa** 18(1): 5-17.

MacIntyre U, Labadarios D (1999). Chapter 6: Dietary Intake: Quantitative food frequency method. In: Labadarios D (ed). **The National Food Consumption Survey (NFCS): Children aged 1 – 9 years, South Africa, 1999.** Department of Health. http://ww.sahealthinfo.org/nutrition/foodconsumption.htm (accessed 07 March 2005).

Makhotla L, Hendriks S (2004). Do home gardens improve the nutrition of rural pre-schoolers in Lesotho? **Development Southern Africa** 21(3): 575-581.

Marsh R (1998). **Building on Traditional Gardening to Improve Household Food Security.** Food Nutrition and Agriculture 22: 4-13 http://www.fao.org/documents/show-cdr.asp?url-file=docrep/x0051.htm (accessed 23 June 2005).

Maunder E, Labadarios D (1999). Chapter 7: The food procurement and household inventory method. In: Labadarios D (ed). **The National Food Consumption Survey (NFCS): Children aged 1 – 9 years, South Africa, 1999.** Department of Health. http://ww.sahealthinfo.org/nutrition/foodconsumption.htm (accessed 07 March 2005).

McLachlan M, Kuzwayo P (1997). **Bold Choices: Making the South African nutrition strategy work.** Halfway House: Development Bank of Southern Africa.

Mebrahtu S, Pelletier D, Pinstrup-Andersen P (1995). Agriculture and nutrition. In: Pinstrup-Andersen P, Pelletier D, Alderman H (eds). **Child Growth and Nutrition in Developing Countries: Priorities for action.** Ithaca: Cornell University Press.

Midmore DJ, Niñez V, Venkataraman R (1991). **Household Gardening Projects in Asia: Past experience and future directions.** Taipei: Asian Vegetable Research and Development Centre.

Mukantwali C (2004). **The Impact of the Special Training of Community Health Workers in Breastfeeding Counselling and Support on Exclusive Breastfeeding, Infant Growth and Diarrhoeal Illness in Infants Aged 0 – 6 Months in the Okhahlamba Municipality-KwaZulu-Natal.** Masters Thesis, Discipline of Dietetics and Human Nutrition, University of KwaZulu-Natal, Pietermaritzburg.

Murphy SP, Allen LH (2003). Nutritional importance of animal source foods. **Journal of Nutrition** 133: 3932S-3935S.

Murphy SP, Gewa C, Liang L, Grillenberger M, Bwibo NO, Neumann CG (2003). School snacks containing animal source foods improve dietary quality for children in rural Kenya. **Journal of Nutrition** 133: 3950S-3956S.

Neumann CG (2000). Livestock development and impact on diet quality and the growth and development of children. In: Jabbar MA, Peden DG, Mohamed SMA, Li Pun H (eds). **Agro-ecosystems, Natural Resources Management and Human Health Related Research in East Africa.** Proceedings of an International Development Research Centre – International Livestock Research Institute (ILRI) international workshop held at ILRI Addis Ababa, Ethiopia 11 – 15 May 1998. Nairobi: ILRI.

Perlas LA, Gibson RS (2005). Household dietary strategies to enhance the content and bioavailability of iron, zinc and calcium of selected rice- and maize-based Philippine complementary foods. **Maternal and Child Nutrition** 1: 263-273.

Phillips M, Sanghvi T, Suârez R, McKigney J, Fiedler J (1996). The costs and effectiveness of three vitamin A interventions in Guatemala. **Social Science Medicine** 42(12): 1661-1668.

Rivera JA, Gonzâlez-Cossio T, Flores M, Romero M, Rivera M, Téllez-Rojo MM, Rosado JL, Brown KH (2001). Multiple micronutrient supplementation increases the growth of Mexican infants. **American Journal of Clinical Nutrition** 74: 657-663.

Rose D, Charlton KE (2002). Prevalence of household food poverty in South Africa: results from a large, nationally representative survey. **Public Health Nutrition** 5(3): 383-389.

Ruel MT (2003). Operationalizing dietary diversity: A review of measurement issues and research priorities. **Journal of Nutrition** 133: 3911S-3926S.

Ruel MT (2002). **Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and measurement needs.** Washington, DC: International Food Policy Research Institute.

Ruel MT, Levin CE (2000). **Assessing the Potential for Food-Based Strategies to Reduce Vitamin A and Iron Deficiencies: A review of recent evidence.** Washington, DC: International Food Policy Research Institute.

Sayed N (2004). **Identifying Food Insecure Households in South Africa: Comparison of Different Indicators of Household Food Security (Using data from the 1999. National Food Consumption Survey).** Unpublished Draft Dissertation. Discipline of Dietetics and Human Nutrition, University of KwaZulu-Natal, Pietermaritzburg.

Schmidt MI, Vorster HH (1995). The effect of communal vegetable gardens on nutritional status. **Development Southern Africa** 12(5): 713-724.

Shrimpton R, Schultink W (2002). Can supplements help meet the micronutrient needs of the developing world? **Proceedings of the Nutrition Society** 61: 223-229.

Simkins C (2000). Chapter 1: Introduction. In: Hirschowitz R (ed). **Measuring Poverty in South Africa.** Pretoria: Statistics South Africa.

Smitasiri S, Chotiboriboon S (2003). Experience with programs to increase animal source food intake in Thailand. **Journal of Nutrition** 133: 4000S-4005S.

Smitasiri S, Dhanamitta S (1999). **Sustaining Behaviour Change to Enhance Micronutrient Status: Community- and women-based interventions in Thailand.** OMNI Research Report Series 2. Washington, DC: International Center for Research on Women.

Solon F, Fernandez TL, Latham MC, Popkin BM (1979). An evaluation of strategies to control vitamin A deficiency in the Philippines. **American Journal of Clinical Nutrition** 32: 1445-1453.

South Africa Government Gazette (2003). **Government Gazette: Republic of South Africa.** Regulation No. 7634. Pretoria: Government Printer. http://www.info.gov.za/gazette/regulation/2003/24715.pdf (accessed 29 October 2005)

South African Vitamin A Consultative Group [SAVACG] (1995). **Children aged 6 – 71 months in South Africa, 1994: Their anthropometric, vitamin A, iron and immunization coverage status.** Technical report. http://www.sahealthinfo.org/nutrition/vitamina.htm (accessed 20 April 2005).

Statistics South Africa (2002). **Earning and Spending in South Africa: Selected findings and comparisons from the income and expenditure surveys of October 1995 and October 2000.** Pretoria: Statistics South Africa.

Steyn NP, Labadarios D (1999). Chapter 5: Dietary intake: 24-hour recall method. In: Labadarios D (ed). **The National Food Consumption Survey (NFCS): Children aged 1 – 9 years, South Africa, 1999.** Department of Health. http://ww.sahealthinfo.org/nutrition/foodconsumption.htm (accessed 07 March 2005).

Steyn NP, Labadarios D, Maunder E, Nel J, Lombard C, Directors of the National Food Consumption Survey (2005). Secondary anthropometric data analysis of the national food consumption survey in South Africa: The double burden. **Nutrition** 21: 4-13.

Steyn NP, Nel JH, Kennedy G, Labadarios D (2006). Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy? **Public Health Nutrition:** 9(5): 644-650.

Swindale A, Bilinsky P (2005). **Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator guide.** Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development. http://www.fantaproject.org/downloads/pdfs/HDDS_Mar05.pdf (accessed 9 May 2005).

Swindale A, Ohri-Vachaspati P (1999). **Measuring household Food Consumption: A Technical Guide.** Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development. http://www.foodgrainsbank.ca/proposal-guide/tools/fanta.pdf (accessed 16 May 2005).

Taher A, Talukder A, Sarkar NR, Bushamuka VN, Hall A, De Pee S, Moench-Pfanner R, Kiess L, Bloem MW (2004). Homestead gardening for combating vitamin A deficiency: The Hellen Keller International, Bangladesh, experience. In: Roos N, Bouis HE, Hassan N, Kabir KA (eds). **Proceedings of the Workshop on Alleviating Micronutrient Malnutrition Through Agriculture in Bangladesh: Biofortification and diversification as long-term, sustainable solutions, Gazipur and Dhaka, Bangladesh April 22-24, 2002.** Washington, DC: International Food Policy Research Institute.

Talukder A, Kiess L, Huq N, de Pee S, Darnton-Hill, Bloem MW (2000). Increasing the production and consumption of vitamin A-rich fruits and vegetables: Lessons learned in taking the Bangladesh homestead gardening programme to a national scale. **Food and Nutrition Bulletin** 21(2): 165-172.

Tontisirin K, Nantel G, Bhattacharjee L (2002). Food-based strategies to meet the challenges of micronutrient malnutrition in developing countries. **Proceedings of the Nutrition Society** 61: 243-250.

Tredoux C, Durrheim K (2005). **Numbers, Hypothesis & Conclusions: A course in statistics for the Social Sciences.** Cape Town: Desktop Publishing.

United Nations Children's Fund [UNICEF] (1998). **The State of the World's Children 1998.** New York: Oxford University Press.

van Jaarsveld PJ, Faber M, Tanumihardjo SA, Nestel P, Lombard CJ, Benadé (2005). β-carotene-rich orange-fleshed sweet potato improves the vitamin A status of primary school children assessed with the modified-relative-dose-response test. **American Journal of Clinical Nutrition** 81: 1080-1087.

van Staden E, Langenhoven ML, Donald PR, Laubscher JA (1994). Dietary intake of children with failure to thrive. **The South African Journal of Food Science and Nutrition** 6(3): 90-93.

Winichagoon P, McKenzie JE, Chavasit V, Pongcharoen T, Gowachirapant S, Boonpraderm, Manger MS, Bailey KB, Wasantwisut M, Gibson RS (2006). A multimicronutrient-fortified seasoning powder enhances the haemoglobin, zinc and iodine status of primary school children in North East Thailand: A randomized controlled trial of efficacy. **Journal of Nutrition** 136: 1617-1623.

World Health Organization [WHO] (1995). **Physical Status: The use and Interpretation of Anthropometry: Report of a WHO expert committee.** Geneva: WHO.

Appendix A: Sections of Food Procurement and Food Inventory Questionnaire with questions used for categorization of the study groups (Source: After Maunder & Labadarios 1999, pp1014-1046).

SECTION A: I WILL NOW ASK ABOUT THE FOOD ITEMS IN THE HOUSE:

CODES FOR COLUMNS BELOW							
SOURCE OF FOOD		**FREQUENCY OF FOOD PURCHASE**		**PLACE OF FOOD PURCHASE**		**PLACE OF FOOD STORAGE**	
Purchased	*1*	*Daily / 2X p week*	*1*	*Supermarket*	*1*	*Cupboard*	*1*
Reared	*2*	*Weekly*	*2*	*Small Shop*	*2*	*Fridge*	*2*
Grown	*3*	*Fortnightly /*	*3*	*Market*	*3*	*Freezer*	*3*
Grown and milled	*4*	*Monthly*	*4*	*Vendor*	*4*	*Vegel. Rack*	*4*
Picked – wild	*5*	*Spec. Occ*	*5*	*Butchery*	*5*	*Garden*	*5*
Hunted / Fished	*6*	*Infrequently*		*Picked/Field*	*6*	*Bag*	*6*
Prt – pay – emplr	*7*			*Self*	*7*	*Bucket/trunk*	*7*
Barter	*8*			*Take away*	*8*	*Pantry*	*8*
Homemade	*9*			*Other*	*9*	*Pot*	*9*
Clinic / NGO / Inst.	*10*					*Tupper*	*10*
Dons / Present	*11*					*In a Container*	*11*
Other	*12*					*Coolbox*	*12*
						Other	*13*

SECTION D

Please answer the following additional questions:

1. What form of transport do you use to go and buy your food?

1	2	3	4	5	6	7
Foot	Bicycle/ Motorbike	Taxi	Public Transport	Car of Friend	Own Car	Other (Please Specify)

2. Do you have your own crop production Yes ☐ No ☐

If yes, complete the following table:

Which crops are grown?	What proportion is consumed in your own household each year? (Please Circle)				
	None	¼	½	¾	All
	None	¼	½	¾	All
	None	¼	½	¾	All
	None	¼	½	¾	All

3. Do you own any livestock? Yes ☐ No ☐

If yes, complete the following table:

Kind of animal	No. of animals	Purpose

4. Do you use any other methods to keep food? Yes ☐ No ☐

If yes, please explain which foods and how you preserve them:

Food	Methods of Preservation

APPENDIX B : Hunger Scale questionnaire used for assessing hunger perceptions (Source : Gericke et al 1999, p1046).

NATIONAL FOOD CONSUMPTION SURVEY: SA CHILDREN 1-9 YEARS OLD

Subject number: [ ][ ][ ][ ][ ][ ] Birth Date: DD MM YY [ ][ ][ ][ ][ ][ ] Interview Date: DD MM YY [ ][ ][ ][ ][ ][ ]

Province:_______ EA.:_______ Interviewer: _______ Interviewer Code: _______

HUNGER SCALE

I AM NOW GOING TO ASK YOU EIGHT QUESTIONS ON FOOD THAT IS AVAILABLE IN YOUR HOUSEHOLD. ALL YOU HAVE TO DO IS TO ANSWER AYES@ OR ANO@ TO EACH OF THESE QUESTIONS.

		YES	NO
1.	Does your household ever run out of money to buy food?		
1a	Has it happened in the past 30 days?		
1b	Has it happened 5 or more days in the past 30 days?		
2.	Do you ever rely on a limited number of foods to feed your children because you are running out of money to buy food for a meal?		
2a	Has it happened in the past 30 days?		
2b	Has it happened 5 or more days in the past 30 days?		
3.	Do you ever cut the size of meals or skip any because there is not enough food in the house?		
3a	Has it happened in the past 30 days?		
3b.	Has it happened 5 or more days in the past 30 days?		
4.	Do you ever eat less than you should because there is not enough money for food?		
4a.	Has it happened in the past 30 days?		
4b.	Has it happened 5 or more days in the past 30 days?		
5.	Do your children ever eat less than you feel they should because there is not enough money for food?		
5a.	Has it happened in the past 30 days?		
5b.	Has it happened 5 or more days in the past 30 days?		
6.	Do your children ever say they are hungry because there is not enough food in the house?		
6a.	Has it happened in the past 30 days?		
6b.	5 or more days in the past 30 days?		
7.	Do you ever cut the size of your children's meals or do they ever skip meals because there is not enough money to buy food?		
7a.	Has it happened in the past 30 days?		
7b.	Has it happened 5 or more days in the past 30 days?		
8.	Do any of your children ever go to bed hungry because there is not enough money to buy food?		
8a.	Has it happened in the past 30 days?		
8b.	Has it happened 5 or more days in the past 30 days?		

THANK YOU FOR YOUR COOPERATION

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Appendix C: Letter of permission to use the South African NFCS of 1999 data

UNIVERSITY OF STELLENBOSCH

Faculty of Health Sciences

3 May 2006

Prof E Maunder
KwaZulu-Natal University
Department of Nutrition and Dietetics
Pietermritzberg

Dear Prof Maunder

MS LENKWETSE GABAITSEWE: MSC HUMAN NUTRITION

Further to the request received from the said student on the said matter, I hereby confirm that it is in order for Ms Lenkwetse Gablatsewe to carry out a secondary analysis on the database of the 1999 National Food Consumption Survey (NFCS). The purpose of the analysis will be to determine the relationship between crop and livestock production on the dietary and nutrient intake in children aged 1-3 years as well as the perception of hunger in their households.

Yours Sincerely

PROF D LABADARIOS
CHAIRPERSON: NFCS

Department of Human Nutrition, Tygerberg Campus; PO Box 19063; Tygerberg 7505, South Africa
Email: demetre@sun.ac.za; www.sun.ac.za/nutrition; www.sun.ac.za/nicus
Tel: 27 21 938 9259; Fax: 27 21 933 2991

APPENDIX D: Detailed 24-hour recall nutrient intake results for children aged 1 – 3 years in South Africa

<u>**Table 1:**</u> National energy intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL				RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
		Crops only	Crops and livestock	Livestock only	Non-producers					
Energy (Kj) RDA = 5460 Kj	Number	209	110	92	799	1210	581	629	721	303
	Mean	4500.1	4533.5	4173.1	4155.2	4257.9	4094.0	4380.4	4212.2	4491.7
	SD	1605.9	1633.6	1420.5	1464.3	1505.7	1356.4	1625.3	1536.6	1479.7
	Lower 95% CI	4227.4	4159.4	3793.2	4023.1	4149.2	3944.1	4225.1	4067.9	4278.8
	Upper 95% CI	4772.7	4907.6	4552.9	4287.3	4366.6	4243.9	4535.6	4356.4	4704.6
	Median	4164.1	4214.3	3858.7	3852.7	3972.7	3737.2	4204.3	3845.7	4422.5
	Lower Quartile	3015.1	3090.6	2881.6	2839.0	2894.8	2795.8	2942.5	2839.0	3133.5
	Upper Quartile	6100.0	5506.9	4786.9	5149.2	5350.5	4949.8	5506.2	5227.8	5694.9
	P-value	0.0052*					<0.0001+		0.0013+	
	<67% RDA	40.2	36.4	40.2	48.1	45.0	49.9	40.5	47.0	37.6
	<100% RDA	69.4	71.8	83.7	80.4	77.9	82.1	74.1	79.6	72.6

*Kruskal-Wallis Test   +Wilcoxon two-sided T-approximate Test

Table 2: Energy intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Energy (Kj) RDA = 5460 Kj	Number	115	98	82	286	581	94	513	629
	Mean	4273.0	4514.5	4087.5	3782.6	4094.0	4751.6	4296.0	4380.4
	SD	1495.0	1674.5	1410.0	1112.5	1356.4	1716.2	1613.9	1625.3
	Lower 95% CI	3921.1	4107.7	3684.2	3590.5	3944.1	4325.4	4125.0	4225.1
	Upper 95% CI	4624.8	4921.3	4490.8	3974.8	4243.9	5177.7	4467.0	4535.6
	Median	3915.9	4185.8	3703.7	3404.8	3737.2	4599.7	4120.0	4204.3
	Lower Quartile	2945.0	3090.6	2881.6	2626.9	2795.8	3155.6	2925.5	2942.5
	Upper Quartile	5437.0	5506.9	4734.5	4504.7	4949.8	6204.9	5355.7	5506.2
	P-value	< 0.0001*					0.0306[+]		
	<67% RDA	42.6	37.8	41.5	59.4	49.9	37.2	41.7	40.5
	<100% RDA	76.5	72.5	85.4	86.7	82.1	60.6	76.8	74.1

*Kruskal-Wallis test [+]Wilcoxon two-sided T-approximate Test

Table 3: National total protein intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL				RSA	Rural	Urban	<R12000/ HH per year	>=R12000/HH per year
		Crops only	Crops and livestock	Livestock only	Non-producers					
Total protein (g) RDA = 16g	Number	209	110	92	799	1210	581	629	721	303
	Mean	31.3	30.3	29.8	31.4	31.1	29.1	32.7	29.9	35.0
	SD	14.7	13.5	12.8	13.3	13.5	12.3	14.5	13.7	13.1
	Lower 95% CI	28.8	27.3	26.4	30.2	30.2	27.7	31.3	28.6	33.2
	Upper 95% CI	33.8	33.4	33.2	32.6	32.1	30.5	34.0	31.2	36.9
	Median	28.7	27.9	26.2	28.6	28.4	25.7	29.9	26.7	34.1
	Lower Quartile	18.1	18.3	16.7	18.9	18.7	17.5	19.9	17.7	21.8
	Upper Quartile	42.4	36.5	39.2	41.1	40.8	37.5	43.1	37.7	46.1
	P- value	0.9258*					<0.0001+		<0.0001+	
	<67% RDA	9.1	4.6	7.6	8.3	8.0	7.9	8.1	7.5	6.9
	<100% RDA	19.6	16.4	22.8	18.9	19.1	21.2	17.2	20.9	12.9

*Kruskal-Wallis Test   +Wilcoxon two-sided T-approximate Test

Table 4: National plant protein intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL: Crops only	Crops and livestock	Livestock only	Non-producers	RSA	Rural	Urban	<R12000/ HH per year	>=R12000/ HH per year
Plant protein (g) RDA = 16g	Number	209	110	92	799	1210	581	629	721	303
	Mean	18.1	19.3	16.8	14.4	15.8	17.1	14.8	16.6	13.8
	SD	7.8	8.4	7.3	6.2	7.0	6.9	6.9	7.1	6.4
	Lower 95% CI	16.7	17.4	14.8	13.9	15.2	16.3	14.1	16.0	12.8
	Upper 95% CI	19.4	21.2	18.8	15.0	16.3	17.8	15.5	17.3	14.7
	Median	17.3	16.8	14.6	13.1	14.2	15.5	13.5	14.9	12.0
	Lower Quartile	10.1	13.3	10.5	8.9	9.5	10.7	8.8	10.2	8.0
	Upper Quartile	24.2	23.8	19.4	18.2	19.7	21.1	18.5	20.6	17.5
	P-value	<0.0001*					<0.0001+		<0.0001+	

*Kruskal-Wallis Test

+Wilcoxon two-sided T-approximate Test

Table 5: National animal protein intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL: Crops only	Crops and livestock	Livestock only	Non-producers	RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
animal protein (g) RDA = 16g	Number	209	110	92	799	1210	581	629	721	303
	Mean	12.6	10.9	12.8	16.5	15.0	11.7	17.4	13.0	20.0
	SD	12.2	10.7	10.7	11.3	11.5	10.3	12.1	11.5	11.1
	Lower 95% CI	10.5	8.4	10.0	15.5	14.13	10.5	16.2	12.0	18.8
	Upper 95% CI	14.7	163.3	15.7	17.6	15.8	12.8	18.6	14.1	22.0
	Median	9.1	8.0	8.4	13.5	11.7	8.3	14.4	9.2	18.3
	Lower Quartile	1.6	0.2	0.6	5.5	4.0	0.8	6.1	1.7	8.8
	Upper Quartile	18.4	15.6	18.6	24.7	22.5	16.9	26.2	18.5	29.4
	P-value	<0.0001*					<0.0001+		<0.0001+	

*Kruskal-Wallis Test

+Wilcoxon two-sided T-approximate Test

Table 6: Total protein intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Total protein (g) RDA = 16g	Number	115	98	82	286	581	94	513	629
	Mean	30.4	29.6	28.9	28.2	29.1	32.2	32.6	32.7
	SD	15.9	13.7	12.5	9.9	12.3	13.2	14.8	14.5
	Lower 95% CI	26.7	26.3	25.3	26.5	27.7	28.9	31.0	31.3
	Upper 95% CI	34.1	33.0	32.5	29.9	30.5	35.6	34.2	34.0
	Median	26.7	26.5	25.2	24.6	25.7	32.6	29.5	29.9
	Lower Quartile	18.1	18.1	16.7	17.4	17.5	18.1	19.9	19.9
	Upper Quartile	39.6	35.9	38.6	37.1	37.5	45.2	42.7	43.1
	P-value	0.7581*					0.7647+		
	<67% RDA	9.6	5.1	8.5	8.0	7.9	8.5	8.4	8.1
	<100% RDA	20.9	17.4	22.0	22.4	21.2	18.1	17.0	17.2

*Kruskal-Wallis Test   +Wilcoxon two-sided T-approximate Test

Table 7: National vitamin A intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL				RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
		Crops only	Crops and livestock	Livestock only	Non-producers					
Vitamin A (RE) RDA = 400 RE	Number	209	110	92	799	1210	581	629	721	303
	Mean	363.7	284.2	264.5	399.5	371.2	253.9	458.8	345.0	426.2
	SD	358.9	253.2	318.0	682.2	586.6	250.7	769.6	600.0	493.9
	Lower 95% CI	302.8	226.2	179.5	337.9	328.8	226.2	385.3	288.7	355.1
	Upper 95% CI	424.6	342.2	349.6	461.0	413.5	281.6	532.3	401.3	497.2
	Median	215.6	183.7	169.3	176.3	181.8	140.0	202.9	159.5	244.4
	Lower Quartile	81.5	70.8	57.0	77.5	75.7	51.2	97.9	62.0	117.5
	Upper Quartile	459.0	403.9	302.8	384.3	393.8	322.1	429.5	359.6	500.4
	P-value	0.0841[*]					<0.0001[+]		<0.0001[+]	
	<67% RDA	58.4	65.5	66.3	66.3	64.9	70.9	59.3	67.6	57.4
	<100% RDA	70.8	73.6	79.3	76.6	75.5	79.0	72.3	77.7	70.0

[*]Kruskal-Wallis Test [+]Wilcoxon two-sided T-approximate Test

Table 8: Vitamin A intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Vitamin A (RE) RDA = 400 RE	Number	115	98	82	286	581	94	513	629
	Mean	324.7	268.0	260.1	205.7	253.9	406.8	472.7	458.8
	SD	335.0	247.0	333.0	168.5	250.7	384.9	834.5	769.6
	Lower 95% CI	245.9	208.0	164.9	176.6	226.2	311.3	384.2	385.3
	Upper 95% CI	403.6	328.0	355.3	234.8	281.6	502.4	561.1	532.3
	Median	188.1	164.8	156.8	110.0	140.0	247.4	195.5	202.9
	Lower Quartile	61.1	67.6	50.8	49.5	51.2	107.6	93.0	97.9
	Upper Quartile	419.0	400.0	302.5	260.2	322.1	536.1	419.0	429.5
	P-value	0.0056*					0.1459+		
	<67% RDA	62.6	67.4	67.1	76.6	70.9	53.2	60.6	59.3
	<100% RDA	72.2	74.5	79.3	79.0	79.0	69.2	72.9	72.3

*Kruskal-Wallis test +Wilcoxon two-sided T-approximate Test

Table 9: National thiamine intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL: Crops only	Crops and livestock	Livestock only	Non-producers	RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
Thiamine (mg) RDA = 0.5 mg	Number	209	110	92	799	1210	581	629	721	303
	Mean	0.63	0.66	0.60	0.57	0.59	0.60	0.59	0.59	0.61
	SD	0.28	0.30	0.24	0.25	0.26	0.24	0.27	0.26	0.26
	Lower 95% CI	0.59	0.59	0.54	0.55	0.58	0.57	0.56	0.57	0.57
	Upper 95% CI	0.68	0.73	0.67	0.59	0.61	0.63	0.61	0.61	0.64
	Median	0.58	0.58	0.58	0.50	0.54	0.54	0.53	0.53	0.55
	Lower Quartile	0.37	0.44	0.40	0.36	0.37	0.38	0.36	0.36	0.40
	Upper Quartile	0.79	0.78	0.72	0.69	0.73	0.73	0.72	0.72	0.75
	P-value	<0.0001*					0.7883^{+}		0.1289^{+}	
	<67% RDA	18.7	13.6	17.4	23.9	21.6	21.7	21.5	22.8	18.2
	<100% RDA	40.2	33.6	40.2	51.3	46.9	47.5	46.4	48.0	42.2

*Kruskal-Wallis Test

$^{+}$Wilcoxon two-sided T-approximate Test

Table 10: Thiamine intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Thiamine (mg) RDA = 0.5 mg	Number	115	98	82	286	581	94	513	629
	Mean	0.64	0.67	0.60	0.54	0.60	0.62	0.58	0.59
	SD	0.26	0.32	0.24	0.19	0.24	0.30	0.27	0.27
	Lower 95% CI	0.58	0.60	0.53	0.51	0.57	0.55	0.55	0.56
	Upper 95% CI	0.70	0.74	0.67	0.58	0.63	0.70	0.61	0.61
	Median	0.60	0.58	0.56	0.49	0.54	0.52	0.53	0.53
	Lower Quartile	0.40	0.44	0.40	0.35	0.38	0.35	0.36	0.36
	Upper Quartile	0.80	0.77	0.71	0.66	0.73	0.78	0.70	0.72
	P-value	0.2715*					0.3987+		
	<67% RDA	16.5	15.3	18.3	26.9	21.7	21.3	22.2	21.5
	<100% RDA	35.7	34.7	40.2	58.7	47.5	45.7	47.2	46.4

*Kruskal-Wallis test

+Wilcoxon two-sided T-approximate Test

Table 11: National riboflavin intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL: Crops only	Crops and livestock	Livestock only	Non-producers	RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
Riboflavin (mg) RDA = 0.5 mg	Number	209	110	92	799	1210	581	629	721	303
	Mean	0.58	0.64	0.62	0.74	0.69	0.56	0.80	0.61	0.95
	SD	0.45	0.55	0.55	0.62	0.58	0.44	0.68	0.54	0.68
	Lower 95% CI	0.50	0.52	0.48	0.69	0.65	0.51	0.73	0.56	0.85
	Upper 95% CI	0.65	0.77	0.77	0.80	0.73	0.60	0.86	0.66	1.05
	Median	0.37	0.46	0.37	0.47	0.45	0.36	0.51	0.38	0.70
	Lower Quartile	0.20	0.20	0.23	0.25	0.24	0.19	0.29	0.21	0.38
	Upper Quartile	0.72	0.72	0.77	0.92	0.85	0.63	1.00	0.68	1.16
	P-value	0.1632*					<0.0001+		<0.0001+	
	<67% RDA	44.0	39.1	44.6	36.9	38.9	47.5	31.0	44.5	23.1
	<100% RDA	61.2	55.5	59.8	54.9	56.5	64.4	49.1	63.0	38.6

*Kruskal-Wallis Test

+Wilcoxon two-sided T-approximate Test

Table 12: Riboflavin intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Riboflavin (mg) RDA = 0.5 mg	Number	115	98	82	286	581	94	513	629
	Mean	0.47	0.62	0.62	0.55	0.56	0.70	0.82	0.80
	SD	0.34	0.53	0.57	0.40	0.44	0.54	0.70	0.68
	Lower 95% CI	0.39	0.49	0.45	0.48	0.51	0.56	0.74	0.73
	Upper 95% CI	0.55	0.75	0.78	0.62	0.60	0.83	0.89	0.86
	Median	0.32	0.43	0.35	0.36	0.36	0.49	0.51	0.51
	Lower Quartile	0.17	0.19	0.22	0.20	0.19	0.28	0.29	0.29
	Upper Quartile	0.59	0.70	0.68	0.62	0.63	0.95	1.02	1.00
	P-value	0.3513*					0.3691+		
	<67% RDA	52.2	40.8	46.3	48.3	47.5	34.0	30.6	31.0
	<100% RDA	68.7	58.2	61.0	65.7	64.4	52.1	48.9	49.1

*Kruskal-Wallis test　　+Wilcoxon two-sided T-approximate Test

Table 13: National niacin intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL Crops only	Crops and livestock	Livestock only	Non-producers	RSA	Rural	Urban	<R12000/HH/ per year	>=R12000/HH per year
Niacin (NE) RDA = 6 NE	Number	209	110	92	799	1210	581	629	721	303
	Mean	5.6	4.6	4.5	6.0	5.7	4.8	6.4	5.0	7.5
	SD	3.9	2.3	2.7	3.5	3.4	2.8	3.8	3.2	3.9
	Lower 95% CI	4.9	4.0	3.8	5.7	5.4	4.5	6.0	4.7	6.9
	Upper 95% CI	6.3	5.1	5.3	6.3	5.9	5.1	6.7	5.3	8.0
	Median	4.4	3.9	3.7	4.6	4.4	3.7	5.2	3.7	6.6
	Lower Quartile	2.5	2.3	2.1	2.6	2.5	2.2	2.8	2.3	3.5
	Upper Quartile	6.8	6.1	5.5	8.4	7.7	6.1	8.9	6.4	10.6
	P-value	0.0102*					<0.0001+		<0.0001+	
	<67% RDA	47.4	50.0	55.4	44.9	46.6	53.7	40.1	53.8	30.0
	<100% RDA	64.5	73.6	79.4	60.2	63.6	71.6	56.3	70.6	46.2

*Kruskal-Wallis Test

+Wilcoxon two-sided T-approximate Test

Table 14: Niacin intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Niacin (NE) RDA = 6 NE	Number	115	98	82	286	581	94	513	629
	Mean	5.0	4.4	4.4	4.9	4.8	6.3	6.4	6.4
	SD	3.6	2.3	2.8	2.5	2.8	4.2	3.8	3.8
	Lower 95% CI	4.1	3.9	3.6	4.5	4.5	5.3	6.0	6.0
	Upper 95% CI	5.8	5.0	5.2	5.4	5.1	7.3	6.8	6.7
	Median	3.8	3.7	3.1	3.7	3.7	4.9	5.3	5.2
	Lower Quartile	2.5	2.3	2.1	2.2	2.2	2.8	2.8	2.8
	Upper Quartile	6.1	5.9	5.7	6.7	6.1	7.8	9.3	8.9
	P-value	0.5772*					0.6034+		
	<67% RDA	53.9	52.0	58.5	52.8	53.7	39.4	40.6	40.1
	<100% RDA	70.4	75.5	78.1	68.9	71.6	57.5	55.4	56.3

*Kruskal-Wallis test +Wilcoxon two-sided T-approximate Test

Table 15: National folate intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL				RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
		Crops only	Crops and livestock	Livestock only	Non-producers					
Folate (µg) RDA = 150 µg	Number	209	110	92	799	1210	581	629	721	303
	Mean	109.9	119.1	84.7	92.8	98.0	92.1	102.4	94.8	111.4
	SD	85.3	86.1	62.7	57.8	67.0	67.7	66.2	66.2	71.6
	Lower 95% CI	95.4	99.4	68.0	87.6	93.2	84.7	96.1	88.6	101.1
	Upper 95% CI	124.4	138.9	101.5	98.1	102.9	99.6	108.7	101.0	121.7
	Median	79.4	85.1	62.3	69.8	72.5	63.0	79.1	68.4	90.3
	Lower Quartile	43.3	52.1	37.2	43.0	43.3	39.3	47.3	41.7	50.9
	Upper Quartile	138.7	151.9	97.2	122.3	126.0	109.7	135.8	121.2	143.5
	P-value	0.0086*					<0.0001+		0.0004+	
	<67% RDA	61.2	60.9	77.2	68.7	67.4	73.7	61.5	69.2	59.4
	<100% RDA	79.0	73.6	89.1	83.6	82.3	85.5	79.3	83.6	78.2

*Kruskal-Wallis test

+Wilcoxon two-sided T-approximate Test

Table 16: Folate intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Folate (µg) RDA = 150 µg	Number	115	98	82	286	581	94	513	629
	Mean	101.5	119.1	81.4	77.2	92.1	119.1	98.8	102.4
	SD	91.7	87.9	60.4	44.4	67.7	76.4	63.5	66.2
	Lower 95% CI	80.0	97.7	64.1	69.5	84.7	100.1	92.0	96.1
	Upper 95% CI	123.1	140.4	98.6	84.8	99.6	138.1	105.5	108.7
	Median	70.5	84.9	56.8	58.9	63.0	92.1	76.6	79.1
	Lower Quartile	36.9	49.3	35.1	38.3	39.3	50.2	46.3	47.3
	Upper Quartile	123.8	154.5	98.5	92.8	109.7	183.4	132.0	135.8
	P-value	0.0009*					0.0805+		
	<67% RDA	67.8	61.2	76.8	79.4	73.7	53.2	62.8	61.5
	<100% RDA	86.1	73.5	89.0	88.5	85.5	70.2	80.9	79.3

*Kruskal-Wallis test
+Wilcoxon two-sided T-approximate Test

Table 17: National vitamin B_6 intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL: Crops only	Crops and livestock	Livestock only	Non-producers	RSA	Rural	Urban	<R12000/HH/ per year	>=R12000/HH per year
Vitamin B_6 (μg) RDA =	Number	209	110	92	799	1210	581	629	721	303
	Mean	0.49	0.47	0.41	0.52	0.50	0.42	0.56	0.45	0.65
	SD	0.28	0.22	0.22	0.32	0.30	0.21	0.36	0.27	0.36
	Lower 95% CI	0.44	0.42	0.35	0.49	0.48	0.39	0.53	0.42	0.60
	Upper 95% CI	0.53	0.52	0.47	0.55	0.52	0.44	0.60	0.47	0.70
	Median	0.42	0.43	0.33	0.40	0.40	0.34	0.45	0.35	0.55
	Lower Quartile	0.24	0.27	0.21	0.22	0.23	0.23	0.24	0.22	0.32
	Upper Quartile	0.62	0.62	0.56	0.69	0.65	0.55	0.75	0.57	0.89
	P-value	0.2011*					<0.0001+		<0.0001+	
	<67% RDA	41.2	34.6	50.0	45.2	43.9	50.6	37.7	49.5	29.0
	<100% RDA	60.3	63.6	69.6	62.5	62.7	72.3	53.9	69.1	46.5

*Kruskal-Wallis Test

+Wilcoxon two-sided T-approximate Test

Table 18: Vitamin B_6 intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total Rural	Crops only	Non-producers	Total urban
Vitamin B_6 (mg) RDA = 0.5 mg	Number	115	98	82	286	581	94	513	629
	Mean	0.43	0.47	0.40	0.39	0.42	0.55	0.57	0.56
	SD	0.21	0.22	0.23	0.19	0.21	0.34	0.37	0.36
	Lower 95% CI	0.38	0.41	0.33	0.35	0.39	0.47	0.53	0.53
	Upper 95% CI	0.48	0.52	0.46	0.42	0.44	0.63	0.61	0.60
	Median	0.35	0.43	0.32	0.31	0.34	0.48	0.44	0.45
	Lower Quartile	0.24	0.26	0.19	0.20	0.23	0.23	0.24	0.24
	Upper Quartile	0.57	0.59	0.53	0.49	0.55	0.70	0.76	0.75
	P-value	0.0005*					0.9648+		
	<67% RDA	47.0	32.7	53.7	57.3	50.6	34.0	38.4	37.7
	<100% RDA	67.8	65.3	70.7	76.9	72.3	51.1	54.4	53.9

*Kruskal-Wallis test +Wilcoxon two-sided T-approximate Test

Table 19: National vitamin B_{12} intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL: Crops only	Crops and livestock	Livestock only	Non-producers	RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
Vitamin B_{12} (μg) RDA = 0.9 μg	Number	209	110	92	799	1210	581	629	721	302
	Mean	1.56	1.23	1.41	2.54	2.14	1.41	2.69	1.94	2.55
	SD	4.97	1.54	1.62	6.16	5.47	3.30	6.85	5.65	4.42
	Lower 95% CI	0.71	0.88	0.96	1.97	1.75	1.05	2.03	1.41	1.91
	Upper 95% CI	2.40	1.59	1.84	3.09	2.54	1.78	3.34	2.47	3.18
	Median	0.51	0.50	0.69	1.00	0.87	0.50	1.07	0.58	1.53
	Lower Quartile	0.04	0.00	0.02	0.21	0.12	0.01	0.29	0.06	0.63
	Upper Quartile	1.58	1.50	2.12	2.27	2.03	1.43	2.54	1.60	2.93
	P-value	<0.0001*					<0.0001+		<0.0001+	
	<67% RDA	53.1	52.7	48.4	40.9	44.6	52.7	37.2	50.2	26.5
	<100% RDA	56.5	59.1	53.9	48.6	51.3	58.9	44.4	57.4	32.8

*Kruskal-Wallis Test

+Wilcoxon two-sided T-approximate Test

Table 20: Vitamin B_{12} intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total Urban
Vitamin B_{12} (μg) RDA = 0.9 μg	Number	115	98	82	286	581	94	513	629
	Mean	1.56	1.13	1.34	1.50	1.41	1.56	2.93	2.69
	SD	6.41	1.54	1.64	2.01	3.30	2.17	7.51	6.85
	Lower 95% CI	0.05	0.75	0.87	1.15	1.05	1.02	2.13	2.03
	Upper 95% CI	3.07	1.50	1.81	1.85	1.78	2.09	3.72	3.34
	Median	0.27	0.41	0.56	0.64	0.50	0.94	1.15	1.07
	Lower Quartile	0.00	0.00	0.00	0.08	0.01	0.24	0.29	0.29
	Upper Quartile	1.17	1.40	2.00	1.50	1.43	2.00	2.65	2.54
	P-value	0.0372*					0.0775+		
	<67% RDA	59.1	56.1	50.6	49.5	52.7	45.7	36.1	37.2
	<100% RDA	62.6	62.2	55.7	57.2	58.9	48.9	43.9	44.4

*Kruskal-Wallis test
+Wilcoxon two-sided T-approximate Test

Table 21: National vitamin C intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL: Crops only	Crops and livestock	Livestock only	Non-producers	RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
Vitamin C (mg) RDA = 40 mg	Number	209	110	92	799	1210	581	629	721	303
	Mean	51.1	21.7	22.9	29.1	31.9	19.1	41.5	28.4	44.5
	SD	119.0	34.8	33.2	37.7	60.2	24.3	79.3	66.3	56.1
	Lower 95% CI	30.8	13.7	14.0	25.7	27.6	16.4	34.0	22.1	36.4
	Upper 95% CI	71.3	29.7	31.8	32.5	36.3	21.7	49.1	34.6	52.5
	Median	16.5	10.8	12.5	15.0	14.4	9.9	18.0	11.7	20.3
	Lower Quartile	5.3	3.6	4.2	3.3	3.7	2.5	4.6	2.7	7.9
	Upper Quartile	38.7	28.2	24.3	33.2	33.3	24.0	41.1	28.0	46.5
	P-value	0.1104*					<0.0001+		<0.0001+	
	<67% RDA	62.7	73.6	76.1	69.1	68.9	77.6	60.9	73.4	58.1
	<100% RDA	75.1	82.7	84.8	80.7	80.3	86.9	74.1	84.2	71.3

*Kruskal-Wallis Test

+Wilcoxon two-sided T-approximate Test

Table 22: Vitamin C intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Vitamin C (mg)	Number	115	98	82	286	581	94	513	629
	Mean	20.4	21.2	19.4	17.1	19.1	85.0	33.7	41.5
RDA = 40 mg	SD	18.7	36.5	23.4	21.1	24.3	172.5	43.8	79.3
	Lower 95% CI	16.0	12.3	12.7	13.5	16.4	42.2	29.0	34.0
	Upper 95% CI	24.8	30.0	26.1	20.8	21.7	127.9	38.3	49.1
	Median	13.2	9.9	12.5	8.4	9.9	23.3	17.3	18.0
	Lower Quartile	3.0	3.5	4.1	2.0	2.5	7.9	4.3	4.6
	Upper Quartile	31.1	25.5	23.9	21.8	24.0	54.5	39.1	41.1
	P-value	0.0483*					0.0320+		
	<67% RDA	71.3	75.5	76.8	81.1	77.6	52.1	62.4	60.9
	<100% RDA	80.0	85.7	86.6	90.2	86.9	69.2	75.4	74.1

*Kruskal-Wallis test

+Wilcoxon two-sided T-approximate Test

Table 23: National calcium intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL				RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
		Crops only	**Crops and livestock**	**Livestock only**	**Non-producers**					
Calcium (mg) RDA = 500 mg	Number	209	110	92	799	1210	581	629	721	303
	Mean	367.5	379.5	344.6	316.8	334.5	319.6	345.6	317.8	383.5
	SD	282.8	390.8	270.0	232.5	262.8	261.1	264.2	264.2	249.1
	Lower 95% CI	319.5	290.0	272.4	295.9	315.5	290.8	320.4	293.0	347.7
	Upper 95% CI	415.5	469.0	416.8	337.8	353.5	348.5	370.9	342.6	419.4
	Median	245.2	257.2	217.5	242.7	242.7	221.4	253.9	217.5	307.2
	Lower Quartile	107.8	102.0	114.4	112.5	112.0	93.6	136.4	97.9	180.1
	Upper Quartile	490.0	477.5	506.9	418.4	450.0	428.8	470.9	428.4	491.0
	P-value	0.2381*					0.0005+		<0.0001+	
	<67% RDA	57.4	60.0	66.3	70.0	64.6	67.6	61.8	67.1	55.1
	<100% RDA	76.6	80.9	75.0	83.0	81.1	84.0	78.4	82.1	75.6

*Kruskal-Wallis Test

+Wilcoxon two-sided T-approximate Test

Table 24: Calcium intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Calcium (mg) RDA = 500 mg	Number	115	98	82	286	581	94	513	629
	Mean	364.2	363.1	331.5	268.6	319.6	371.2	335.1	345.6
	SD	311.2	364.1	268.4	179.7	261.1	245.3	255.8	264.2
	Lower 95% CI	291.0	274.7	254.7	237.5	290.8	310.3	308.0	320.4
	Upper 95% CI	437.4	451.6	408.3	299.6	348.5	432.1	362.2	370.9
	Median	245.2	249.5	224.4	202.8	221.4	245.4	252.8	253.9
	Lower Quartile	95.8	96.1	105.4	87.2	93.6	155.8	132.0	136.4
	Upper Quartile	461.4	458.6	426.8	349.7	428.8	530.2	446.6	470.9
	P-value	0.0320*					0.2152+		
	<67% RDA	60.0	60.2	68.3	73.1	67.6	54.3	63.6	61.8
	<100% RDA	80.9	81.6	78.1	87.8	84.0	71.3	80.3	78.4

*Kruskal-Wallis test

+Wilcoxon two-sided T-approximate Test

Table 25: National iron intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL				RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
		Crops only	Crops and livestock	Livestock only	Non-producers					
Iron (mg) RDA = 10 mg	Number	209	110	91	798	1208	579	629	721	302
	Mean	5.3	5.0	4.9	4.8	4.9	4.8	4.9	4.6	5.6
	SD	3.5	2.8	3.3	2.8	3.0	2.9	3.0	2.8	2.8
	Lower 95% CI	4.7	4.3	4.0	4.5	4.7	4.5	4.6	4.3	5.2
	Upper 95% CI	5.9	5.6	5.8	5.0	5.1	5.2	5.2	4.8	6.0
	Median	4.3	3.8	4.0	4.0	4.0	3.8	4.2	3.6	5.1
	Lower Quartile	2.6	2.8	2.2	2.4	2.4	2.4	2.4	2.2	3.0
	Upper Quartile	6.5	6.3	6.5	6.2	6.3	6.1	6.4	5.9	7.3
	P-value	0.1773[*]					0.1195[+]		<0.0001[+]	
	<67% RDA	79.0	75.5	76.9	80.0	78.9	80.1	77.7	82.0	70.2
	<100% RDA	90.4	90.9	93.4	92.6	92.1	92.6	91.7	92.3	90.1

[*]Kruskal-Wallis Test [+]Wilcoxon two-sided T-approximate Test

Table 26: Iron intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Iron (mg)	Number	115	98	81	285	579	94	513	629
RDA = 10 mg	Mean	5.7	5.0	4.7	4.4	4.8	4.8	4.9	4.9
	SD	4.1	2.9	3.0	2.1	2.9	2.6	3.1	3.0
	Lower 95% CI	4.7	4.3	3.9	4.0	4.5	4.2	4.6	4.6
	Upper 95% CI	6.6	5.7	5.6	4.7	5.2	5.4	5.3	5.2
	Median	4.2	3.8	4.0	3.6	3.8	4.3	4.2	4.2
	Lower Quartile	2.6	2.7	2.1	2.3	2.4	2.6	2.4	2.4
	Upper Quartile	6.6	6.4	6.6	5.8	6.1	6.5	6.4	6.4
	P-value	0.0365*					0.6770+		
	<67% RDA	78.3	74.5	76.5	83.9	80.1	79.8	77.2	77.7
	<100% RDA	87.8	89.8	93.8	95.1	92.6	93.6	91.2	91.7

*Kruskal-Wallis test   +Wilcoxon two-sided T-approximate Test

Table 27: National zinc intake of children aged 1 – 3 years in South Africa

Nutrient		GROUPS AT THE NATIONAL LEVEL: Crops only	Crops and livestock	Livestock only	Non-producers	RSA	Rural	Urban	<R12000/HH per year	>=R12000/HH per year
Zinc (mg) RDA = 10 mg	Number	209	110	92	799	1210	581	629	721	303
	Mean	4.3	4.3	4.1	4.3	4.3	4.0	4.5	4.0	4.9
	SD	1.9	2.3	2.0	2.0	2.0	1.8	2.1	2.0	2.1
	Lower 95% CI	4.0	3.8	3.5	4.1	4.1	3.8	4.3	3.9	4.6
	Upper 95% CI	4.6	4.9	4.6	4.4	4.4	4.2	4.7	4.2	5.2
	Median	4.0	3.6	3.4	3.7	3.7	3.4	3.9	3.5	4.4
	Lower Quartile	2.3	2.6	2.1	2.4	2.4	2.3	2.4	2.3	2.9
	Upper Quartile	6.0	5.2	5.3	5.6	5.6	5.0	6.1	5.2	6.5
	P-value	0.6459[*]					<0.0001[+]		<0.0001[+]	
	<67% RDA	84.2	86.4	89.1	85.7	85.8	89.7	82.2	88.4	79.5
	<100% RDA	98.1	92.7	94.6	96.3	96.1	96.2	96.0	96.0	95.7

[*]Kruskal-Wallis Test [+]Wilcoxon two-sided T-approximate Test

Table 28: Zinc intake of children aged 1 – 3 years in rural and urban areas in South Africa

Nutrient		GROUPS IN RURAL AREAS					GROUPS IN URBAN AREAS		
		Crops only	Crops and livestock	Livestock only	Non-producers	Total rural	Crops only	Non-producers	Total urban
Zinc (mg) RDA = 10 mg	Number	115	98	82	286	581	94	513	629
	Mean	4.1	4.2	3.9	3.8	4.0	4.5	4.5	4.5
	SD	1.9	2.3	2.0	1.5	1.8	1.9	2.2	2.1
	Lower 95% CI	3.6	3.7	3.4	3.5	3.8	4.1	4.2	4.3
	Upper 95% CI	4.5	4.8	4.5	4.0	4.2	5.0	4.7	4.7
	Median	3.7	3.5	3.3	3.2	3.4	4.5	3.9	3.9
	Lower Quartile	2.5	2.6	2.0	2.3	2.3	2.3	2.4	2.4
	Upper Quartile	5.4	5.1	5.2	4.7	5.0	6.5	5.9	6.1
	P-value	0.3206*					0.3610		
	<67% RDA	87.8	87.8	89.0	91.3	89.7	79.8	82.7	82.2
	<100% RDA	97.4	92.9	95.1	97.2	96.2	98.9	95.7	96.0

*Kruskal-Wallis test

+Wilcoxon two-sided T-approximate Test

Table 29: Nutrient intake of children aged 1 – 3 years from households with a total income of less than R12 000.00 per household per year in South Africa

Nutrient		GROUPS WITH <R12 000.00/HH/YEAR				P-value	RSA
		Crops only	Crops and livestock	Livestock only	Non-producers		
Energy (Kj) RDA = 5460 Kj	Number	137	81	71	432		721
	Mean	4526.5	4497.2	4092.3	4057.8	0.0022	4212.2
	SD	1655.2	1551.1	1448.4	1498.9		1536.6
	Lower 95% CI	4179.6	4082.3	3648.0	3871.8		4067.9
	Upper 95% CI	4873.3	4912.1	4536.6	4243.9		4356.4
	Median	4061.6	4292.2	3703.7	3588.5		3845.7
	Lower Quartile	2996.8	3090.6	2772.6	2796.3		2839.0
	Upper Quartile	5894.4	5522.3	4671.5	5015.1		5227.8
	<67% RDA	38.7	34.6	40.9	67.6		47.0
	<100% RDA	72.3	70.4	87.3	82.4		79.6
Total Protein (g) RDA = 16g	Number	137	81	71	432		721
	Mean	30.9	29.8	28.4	29.9	0.7626	29.9
	SD	15.8	12.5	12.4	13.5		13.7
	Lower 95% CI	27.5	26.4	24.6	28.2		28.6
	Upper 95% CI	34.1	33.1	32.2	31.5		31.2
	Median	26.8	28.3	25.2	26.8		26.7
	Lower Quartile	17.4	19.4	16.0	17.8		17.7
	Upper Quartile	40.5	36.3	36.9	37.1		37.7
	<67% RDA	8.8	4.9	7.0	7.6		7.5
	<100% RDA	21.2	17.3	23.9	21.1		20.9

<u>Table 29 continued</u>: nutrient intake of children aged 1 – 3 years from households with a total income of less than R12 000.00 per household per year in South Africa

Nutrient		GROUPS WITH <R12 000/HH/YEAR				P-value	RSA
		Crops only	Crops and livestock	Livestock only	Non-producers		
Vitamin A (RE) RDA = 400 RE	Number	137	81	71	432	0.0119	721
	Mean	368.3	289.3	287.8	358.7		345.0
	SD	381.9	262.4	352.4	722.1		600.0
	Lower 95% CI	288.3	219.1	179.7	269.0		288.7
	Upper 95% CI	448.3	359.5	395.9	448.3		401.3
	Median	206.6	188.1	184.9	140.9		159.5
	Lower Quartile	78.4	70.6	57.0	58.8		62.0
	Upper Quartile	460.8	403.9	319.2	309.6		359.6
	<67% RDA	60.6	64.2	62.0	71.3		67.6
	<100% RDA	71.5	74.0	77.5	80.3		77.7
Thiami-ne (mg) RDA = 0.5mg	Number	137	81	71	432	0.0004	721
	Mean	0.64	0.67	0.57	0.56		0.59
	SD	0.29	0.30	0.23	0.24		0.26
	Lower 95% CI	0.58	0.59	0.50	0.53		0.57
	Upper 95% CI	0.70	0.75	0.64	0.59		0.61
	Median	0.56	0.58	0.54	0.50		0.53
	Lower Quartile	0.36	0.45	0.37	0.35		0.36
	Upper Quartile	0.82	0.78	0.70	0.69		0.72
	<67% RDA	19.0	14.8	19.7	25.9		22.8
	<100% RDA	43.1	29.6	45.1	53.5		48.0

Table 29 continued: nutrient intake of the children aged 1 – 3 years from the households with total income less than R12 000/HH/year in South Africa

Nutrient		GROUPS WITH <R12 000/HH/YEAR				P-value	RSA
		Crops only	Crops and livestock	Livestock only	Non-producers		
Riboflavin (mg) RDA = 0.5mg	Number	137	81	71	432	0.6896	721
	Mean	0.54	0.61	0.63	0.63		0.61
	SD	0.45	0.52	0.55	0.57		0.54
	Lower 95% CI	0.45	0.47	0.46	0.56		0.56
	Upper 95% CI	0.64	0.75	0.80	0.70		0.66
	Median	0.35	0.45	0.37	0.39		0.38
	Lower Quartile	0.19	0.22	0.19	0.21		0.21
	Upper Quartile	0.65	0:65	0.80	0.70		0.68
	<67% RDA	46.7	38.3	46.5	44.4		44.5
	<100% RDA	66.4	56.8	60.6	60.4		63.0
Niacin (RE) RDA = 6 NE	Number	137	81	71	432	0.1598	721
	Mean	5.4	4.3	4.3	5.1		5.0
	SD	4.0	2.3	2.8	3.1		3.2
	Lower 95% CI	4.5	3.7	3.4	4.8		4.7
	Upper 95% CI	6.2	4.9	5.1	5.5		5.3
	Median	3.8	3.4	3.1	3.7		3.7
	Lower Quartile	2.4	2.3	1.9	2.3		2.3
	Upper Quartile	6.5	5.8	5.3	6.8		6.4
	<67% RDA	53.3	55.6	60.6	52.6		53.8
	<100% RDA	67.9	77.8	83.1	68.1		70.6

Table 29 continued: nutrient intake of children aged 1 – 3 years from households with a total income of less than R12 000.00 per household per year in South Africa

Nutrient		GROUPS WITH <R12 000/HH/YEAR				P-value	RSA
		Crops only	Crops and livestock	Livestock only	Non-producers		
Folate (µg) RDA = 150 µg	Number	137	81	71	432	0.0038	721
	Mean	114.6	116.1	79.1	85.7		94.8
	SD	92.9	81.6	51.6	52.2		66.2
	Lower 95% CI	95.2	94.2	63.2	79.2		88.6
	Upper 95% CI	134.1	137.9	94.9	92.2		101.0
	Median	79.4	85.1	66.4	61.8		68.4
	Lower Quartile	43.5	52.1	37.2	39.4		41.7
	Upper Quartile	140.3	151.1	95.7	108.0		121.2
	<67% RDA	60.6	59.3	78.9	72.2		69.2
	<100% RDA	78.1	74.1	91.6	85.9		83.6
Vitamin B_6 (mg) RDA = 0.5 mg	Number	137	81	71	432	0.0565	721
	Mean	0.49	0.44	0.38	0.44		0.45
	SD	0.29	0.21	0.21	0.28		0.27
	Lower 95% CI	0.43	0.38	0.31	0.41		0.42
	Upper 95% CI	0.55	0.50	0.44	0.48		0.47
	Median	0.39	0.41	0.30	0.33		0.35
	Lower Quartile	0.24	0.24	0.19	0.21		0.22
	Upper Quartile	0.62	0.58	0.53	0.56		0.57
	<67% RDA	43.8	39.5	54.9	52.3		49.5
	<100% RDA	62.8	65.4	73.2	71.1		69.1

Table 29 continued: nutrient intake of children aged 1 – 3 years from households with a total income of less than R12 000.00 per household per year in South Africa

Nutrient		GROUPS WITH <R12 000/HH/YEAR				P-value	RSA
		Crops only	Crops and livestock	Livestock only	Non-producers		
Vitamin B_{12} (μg) RDA = 0.9 μg	Number	137	81	71	432	0.0215	721
	Mean	1.48	1.22	1.51	2.33		1.94
	SD	5.92	1.61	1.79	6.41		5.65
	Lower 95% CI	0.24	0.80	0.96	1.54		1.41
	Upper 95% CI	2.72	1.65	2.06	3.13		2.47
	Median	0.48	0.55	0.56	0.72		0.58
	Lower Quartile	0.01	0.00	0.01	0.08		0.06
	Upper Quartile	1.17	1.50	2.13	1.77		1.60
	<67% RDA	59.1	53.1	52.1	46.5		50.2
	<100% RDA	62.0	60.5	56.3	55.6		57.4
Vitamin C (mg) RDA = 40mg	Number	137	81	71	432	0.0134	721
	Mean	54.6	17.0	20.8	22.8		28.4
	SD	137.6	16.1	32.0	31.1		66.3
	Lower 95% CI	25.8	12.7	10.9	19.0		22.1
	Upper 95% CI	83.4	21.3	30.6	26.7		34.6
	Median	16.4	8.4	11.7	10.9		11.7
	Lower Quartile	5.3	3.1	2.5	2.4		2.7
	Upper Quartile	39.1	24.0	19.25	26.5		28.0
	<67% RDA	62.8	77.8	80.3	74.8		73.4
	<100% RDA	75.2	84.0	90.1	86.1		84.2

Table 29 continued: nutrient intake of children aged 1 – 3 years from households with a total income of less than R12 000.00 per household per year in South Africa

Nutrient		GROUPS WITH <R12 000/HH/YEAR				P-value	RSA
		Crops only	Crops and livestock	Livestock only	Non-producers		
Calcium (g) RDA = 500g	Number	137	81	71	432	0.0364	721
	Mean	357.0	364.9	370.1	284.6		317.8
	SD	299.1	369.0	290.3	218.8		264.2
	Lower 95% CI	294.3	266.2	281.1	257.4		293.0
	Upper 95% CI	419.7	463.7	459.2	311.7		342.6
	Median	245.4	249.5	228.2	203.6		217.5
	Lower Quartile	103.1	102.0	114.4	93.3		97.9
	Upper Quartile	452.6	456.2	561.3	381.1		428.4
	<67% RDA	57.7	61.7	64.8	71.5		67.1
	<100% RDA	81.8	79.0	71.8	84.5		82.1
Iron (mg) RDA = 10mg	Number	137	81	71	432	0.0734	721
	Mean	5.2	4.9	4.6	4.3		4.6
	SD	3.7	2.9	2.9	2.3		2.8
	Lower 95% CI	4.4	4.1	3.7	4.0		4.3
	Upper 95% CI	6.0	5.7	5.5	4.6		4.8
	Median	4.0	3.8	4.0	3.4		3.6
	Lower Quartile	2.5	2.8	1.9	2.1		2.2
	Upper Quartile	6.5	6.1	5.6	5.7		5.9
	<67% RDA	78.8	76.5	80.3	84.3		82.0
	<100% RDA	90.5	90.1	94.4	94.0		92.3

Table 29 continued: nutrient intake of children aged 1 – 3 years from households with a total income of less than R12 000.00 per household per year

Nutrient		GROUPS WITH <R12000/HH/YEAR				P-value	RSA
		Crops only	Crops and livestock	Livestock only	Non-producers		
Zinc (g) RDA = 10g	Number	137	81	71	432	0.2787	721
	Mean	4.2	4.3	3.8	4.0		4.0
	SD	2.0	2.3	1.8	1.9		2.0
	Lower 95% CI	3.8	3.7	3.2	3.7		3.9
	Upper 95% CI	4.6	4.9	4.3	4.2		4.2
	Median	3.8	3.6	3.3	3.3		3.5
	Lower Quartile	2.3	2.6	2.1	2.3		2.3
	Upper Quartile	5.9	5.1	5.0	5.1		5.2
	<67% RDA	84.7	87.7	90.1	89.4		88.4
	<100% RDA	97.8	92.6	97.2	95.8		96.0