DEMAND FOR VITAMIN A SUPPLEMENTATION AMONG UNDER-FIVE CHILDREN IN ZAMBIA

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DECLARATION

I, Kabaso Fegus Kabwe hereby declare that this dissertation is my original work and it has not been presented for any other award at the University of Zambia or any other university.

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Date: 31st October 2015

ABSTRACT

Vitamin A deficiency (VAD) continues to be a major public health nutrition concern in Zambia affecting primarily infants and young children below the age of five years and women of child bearing age. It is estimated at 53 per cent and 13 per cent among the under-five children and women of childbearing age respectively. Among the intervention in place to combat VAD in Zambia are food fortification, dietary diversification and vitamin A supplementation (VAS). Of these interventions, bi-annual mass VAS which is given for free mainly during the bi-annual Child Health Weeks is the main government strategy to reduce VAD in Zambia. However, the uptake of VAS remains low and highly varied across regions despite it being free, making the policy goal of reaching 80 per cent of the target population difficult to achieve in order to significantly contribute to mortality reduction amongst the under-five children in Zambia.

This study investigated the demand factors associated with the uptake of VAS among children of 6-59 months old, based on the investment variant of the Grossman's health demand model. In addition, the extent of inequality in the uptake of VAS among different socio-economic groups was examined. The study used the 2010 Living Conditions Monitoring Survey dataset collected by the Central Statistical Office. A mixed (multilevel) effects logit model was used to estimate the reduced form of demand for investment time spent on VAS. Concentration curves were used to examine income-related inequality in the demand for VAS programme.

Out of the 7 382 children sampled, only 3 151 had responses on whether they did or did not receive VAS. Of these, 74 per cent reported having received vitamin A capsule within the last six months. Age of the child ($p<0.001$), education level ($p=0.031$) and employment status ($p=0.013$) of the mother were the key predictors for VAS demand in this study. Conversely, sex, education level and employment status of the household head were not significant predictors of demand for VAS. In addition, household size, residence and region were also insignificant in this study. However, the study showed a significant between-community level effect in demand for VAS while a small income-related inequality in demand for VAS was found with demand slightly greater among households with the highest income.

Improving the education status of women is paramount in increasing the VAS demand. Further, equitable access to VAS should be enhanced through equitable distribution of resources and materials in all regions during each round of Child Health Week. Targeted and strengthened social mobilisation and community sensitisation activities using well-tailored campaign materials vigorously promoting the uptake of VAS among the younger children will be needed for the intervention to achieve its intended goals.

DEDICATION

To my Wife Priscilla,

To my beloved children, Kabwe, Mwape and Chanda

And to my Parents, Mr & Mrs Kabwe

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LIST OF ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
ANC	Antenatal Care
BCG	Bacillus Calmete Guerin
CDHS	Cambodian Demographic and Health Survey
CHDs	Child Health Days
CHWk	Child Health Week
CI	Confidence Interval
CSAs	Census Supervisory Areas
CSO	Central Statistical Office
DALYs	Disability Adjusted Life Years
Df	degrees of freedom
DHS	Demographic and Health Survey
DPT	Diphtheria, Pertussis and Tetanus
EOS	Enhanced Outreach Strategy
exp	Exponential
GDP	Gross Domestic Product
HH	Household
HIV	Human Immunodeficiency Virus
IEC	Information, Education and Communication
IMR	Infant Mortality Rate
LCMS	Living Conditions Monitoring Survey
MDGs	Millennium Development Goals
MMR	Maternal Mortality Ratio
MoH	Ministry of Health
MOST	Micronutrient Operational Strategies and Technologies
NFNC	National Food and Nutrition Commission
NIDs	National Immunisation Days
NMR	Neonatal Mortality Rate
NSP	National Surveillance Project
NSS	Nutritional Surveillance System
NVAC	National Vitamin A Plus Campaign
OPV	Oral Polio Vaccine

OR	Odds Ratio
PPES	Probability Proportion to Estimated Size
PSUs	Primary Sampling Units
SD	Standard Deviations
SE	Standard Error
SEAs	Standard Enumeration Areas
STIs	Sexually Transmitted Infections
TB	Tuberculosis
TDRC	Tropical Diseases Research Centre
U5MR	Under-five Mortality Rate
UNICEF	United Nations Children's Emergency Fund
UNZA	University of Zambia
US	United States
USA	United States of America
VAD	Vitamin A Deficiency
Var	Variance
VAS	Vitamin A Supplementation
VIF	Variance Inflation Factor
WHO	World Health Organisation
ZDHS	Zambia Demographic and Health Survey
ZPAN	Zambia Programme of Action on Nutrition

CHAPTER 1: INTRODUCTION

1.1 Background

Vitamin A deficiency (VAD) is a severe nutritional problem, particularly in the developing world, affecting about 250 million people worldwide, half of whom are children under the age of five years (Bassett and Winter-Nelson, 2010). An estimated four million children under the age of five years are affected by xerophthalmia, a serious eye disorder that is caused by moderate to severe vitamin A deficiency and can lead to blindness (UNICEF, 2007). A study by Aguayo and Baker (2005) showed that an estimated 42 per cent of children of 0-59 months old in sub-Saharan Africa (43.2 million children) are at risk of vitamin A deficiency in the absence of effective and sustained policies and programmes, for the control of vitamin A deficiency. Kapinga *et al*. (2005) also estimated that more than three million children under the age of five years suffer from vitamin A-related blindness in sub-Saharan Africa.

Generally, micronutrient deficiencies especially vitamin A, iron and iodine deficiencies, are a major public health nutrition concern in Zambia affecting mostly infants and young children aged between 6-24 months and pregnant and lactating women (NFNC, 2011). This is attributed to the chronic food insecurity, especially among the low income groups, such as the urban poor and rural small scale farmers. There is ample evidence suggesting that high levels of poor nutrition, especially micronutrient deficiencies, have long term consequences for economic growth by holding back the country's socio-economic development and that those children who suffer from micronutrient deficiencies experience low learning abilities, which hamper their educational attainment and ultimately the future human capital (World Bank, 2006; UNICEF, 2013; FAO, WFP and IFAD, 2012).

Vitamin A deficiency (VAD) continues to be a major micronutrient deficiency problem in Zambia. It was first recognised as a public health nutrition problem in the early 1960s when it was described as the major cause of blindness in Luapula province (MoH/CBoH, 2002). A study carried out by the Tropical Diseases Research Centre (TDRC) and National Food and Nutrition Commission (NFNC) in 1985 in the Luapula valley showed that 1.89 per cent of children of 6-72 months had xerophthalmia and 16.5 per cent had biochemical levels of severe deficiency of less than 10 µg/dl (Sukwa *et al*., 1988; quoted in NFNC, 1997).

A baseline national vitamin A survey conducted in 1997 found that 66 per cent of Zambian children had serum retinol concentrations of ≤ 0.7µmol/L and the night blindness rate was 6.2 per cent (NFNC, 1997), placing Zambia in the severe clinical and sub-clinical VAD category according to the World Health Organisation (WHO) population cut-offs (Tables 1). The survey also found that only about 28.4 per cent of the children younger than five years had received the vitamin A supplements. A follow-up study carried out by the National Food and Nutrition Commission (NFNC, 2003), showed that the prevalence of vitamin A deficiency was estimated at 53 per cent in children below the age of five years and for women of child-bearing age, it is estimated at 13 per cent.

Table 1: WHO Prevalence cut-offs for Vitamin A Deficiency in a population

Prevalence cut-offs to define vitamin A deficiency in a population and its level of public health significance	
Public Health Significance (degree of severity	**Serum or plasma retinol <0.70 µmol/L in preschool age children or pregnant women**
Mild	≥2% - <10%
Moderate	≥10% - < 20%
Severe	≥20%
Prevalence criteria for defining night blindness of public health significance	
Public Health Significance (degree of severity	**Night blindness in children**
Mild	>0% - <1%
Moderate	≥1% - < 5%
Severe	≥5%

(Source: WHO, 2009)

Efforts to combat VAD worldwide were heightened in the early 1990s following the World Summit for Children held in the same year, at which the Heads of States and other high-level policy makers identified and committed themselves to several nutrition goals. The goals included the elimination and control of micronutrient malnutrition by the year 2000. These goals were later endorsed during the Ending Hidden Hunger Conference in Montreal in 1991 and the International Conference on Nutrition in Rome in 1992 (MoH/CBoH, 2002). Zambia adopted the same goals in its Zambia Programme of Action on Nutrition (ZPAN), which mainly focussed on women and children. One of the goals adopted in ZPAN was the virtual elimination of vitamin A deficiency among children and women of childbearing age. The ZPAN had three major interventions for controlling micronutrient malnutrition including VAD, namely micronutrient supplementation, food fortification and dietary diversification.

By 1992, the country through the Ministry of Health began distributing the vitamin A capsules to children of 6-72 months and to lactating mothers in drought-affected areas (NFNC, 2003). The distribution was then extended to health centres throughout the country, targeting the same groups. In addition, the mandatory sugar fortification with vitamin A was launched in 1998. However, amongst all these interventions, the bi-annual mass supplementation with vitamin A remains the main government strategy of reducing the vitamin A deficiencies in the country. The mode of delivery was through the initially designated "Vitamin A supplementation week"; the campaign activity which was designed to occur twice a year. Its key goals were to increase the low vitamin A supplementation (VAS) coverage among children up to six years of age and to raise awareness about the importance of vitamin A through social mobilisation. In February 1998, the first Vitamin A

supplementation week was launched; which was later renamed Child Health Week (CHWk) to make the focus on the child more explicit (MOST, 2004).

Child Health Week is a week of intensified activity during which health workers deliver services through outreach and fixed facilities to promote child health. The service package delivered during that week varies across districts according to available human and financial resources within reach. However, the CHWk service package across the country is driven by a common core service of vitamin A supplementation (VAS) of children up to five-years old. Its long-term objective in Zambia is to extend the coverage VAS of children of 6-59 months old to at least 80 per cent (MOST, 2004). Figure 1 provides the trends of annual averages for VAS from the Child Health Week data from 2000 to 2010.

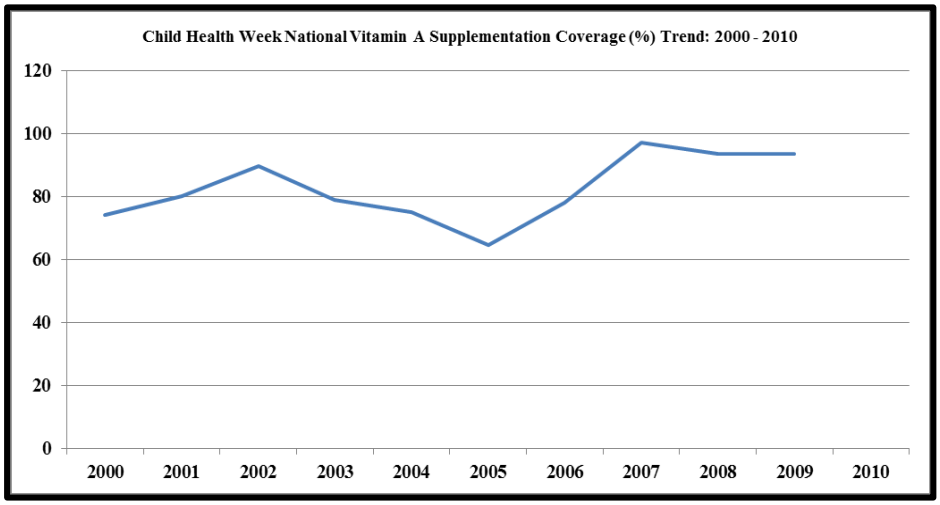

Figure 1: Child Health Week National Vitamin A supplementation coverage trend (2000 - 2010)
(Source: NFNC, 2012)

According to the 2007 Zambia Demographic and Health Survey (ZDHS), only about 60 per cent of children of 6-59 months old had received VAS within the six months preceding the survey, with Northern Province recording the lowest coverage of 48 per cent (CSO/MOH/TDRC, 2009). This picture is presented in Figure 2 below.

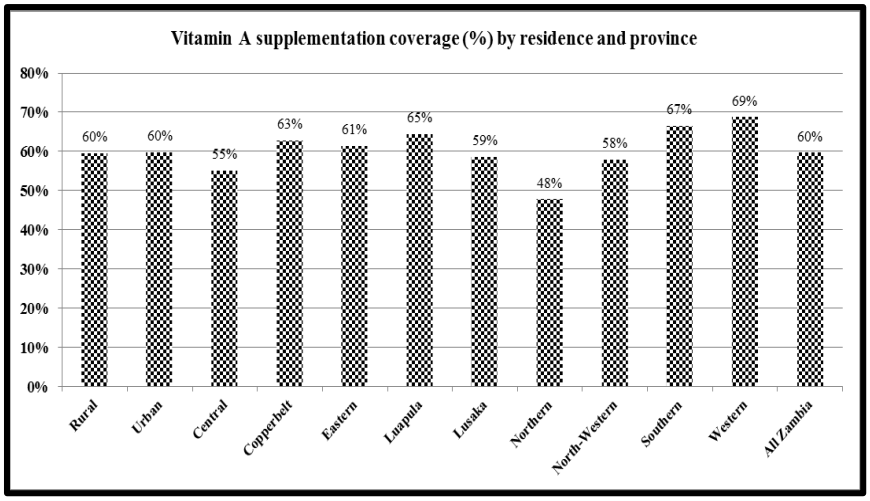

Figure 2: Coverage of vitamin A supplementation by residence and province
(Source: Zambia Demographic and Health Survey 2007)

In comparative terms with other key immunisations, VAS coverage was the least in all the provinces and at national level as shown in Table 2 below.

Table 2: Coverage of different child vaccinations

2010		Completed Vaccinations (%)				
		BCG	**DPT***	**POLIO***	**MEASLES**	**VIT A**
Residence	Rural	91.4	76.1	75.6	83.6	59.6
	Urban	94.7	89.4	80.9	88.5	59.8
Province	Central	93.0	83.6	78.1	91.6	55.1
	Copperbelt	94.8	86.5	81.2	87.0	62.9
	Eastern	98.0	88.4	83.9	89.0	61.4
	Luapula	84.1	68.4	71.4	75.8	64.5
	Lusaka	94.1	91.9	79.7	91.9	58.7
	Northern	81.9	63.0	69.1	71.1	47.8
	North-Western	93.7	60.5	58.5	78.0	57.9
	Southern	97.8	87.9	81.3	92.0	66.6
	Western	97.4	86.3	86.1	93.1	68.8
All Zambia	**All Zambia**	**92.3**	**79.7**	**77.0**	**84.9**	**59.7**

* Refers to children who had received three doses

(Source: Zambia Demographic and Health Survey 2007)

1.2 Statement of the Research Problem

Vitamin A supplementation (VAS) has proved to reduce all-cause mortality by 24 per cent and diarrhoea-related mortality by 28 per cent in children of 6-59 months old globally. Based on this evidence, it continues to be a major nutritional intervention to fight vitamin A deficiency (VAD) among under-five children in Zambia. The Government of the Republic of Zambia has been providing VAS to under-five children and women of childbearing age for free at all public health facilities since the early 1990's as the majority of the Zambian children do not get adequate vitamin A from the locally available foods.

Regrettably, as is the case with many other countries (Nyhus *et al*., 2013) uptake of VAS in Zambia remains relatively low and highly varied across regions making the policy goal of reaching 80 per cent of the target population difficult to achieve, in order to significantly contribute to mortality reduction. Vitamin A deficiency among Zambian children poses a potentially significant challenge to economic growth, as it hampers the productivity of labour in the nation by reducing the available manpower and in the long term, reducing the quality of labour and skills needed for economic productivity.

There is need, therefore, to examine some of the key questions towards understanding the demand factors associated with VAS as a way of increasing the uptake. This study investigates the demand factors and associated inequalities leading to failure to attain and sustain the 80 per cent coverage of vitamin A supplementation in Zambia, when the service is offered for free at all public health facilities.

1.3 Objectives of the study

The overall objective of this study is to investigate the demand factors associated with vitamin A supplementation as well as determine the extent of inequality in the uptake of VAS. The specific objectives are:

1. To determine the demand factors that influences the uptake of VAS among children of 6-59 months old in Zambia.
2. To ascertain the role of the geographical context in influencing the uptake of VAS among children of 6-59 months old in Zambia.
3. To determine the extent of income inequality in the uptake of VAS among children of 6-59 months in Zambia.

1.4 An overview of the health sector in Zambia

The disease burden in Zambia continues to remain high, which is mainly characterised by high prevalence of communicable diseases, particularly, malaria, HIV/AIDS, Sexually Transmitted Illnesses (STIs), and Tuberculosis (TB), while continuing recording high maternal, neonatal and child morbidities and mortalities (MoH, 2011). Since 1992, the Zambian Government, through the Ministry of Health has been implementing significant health sector reforms, aimed at strengthening health service delivery in order to improve the health status of the Zambian people. The reforms have resulted in strengthened health systems, improved access to health care and improved health outcomes. During the period from 2000 to 2010, the health sector recorded significant progress in most of the key areas of health service delivery, and health support systems, leading to major improvements in most of the key health performance indicators.

The key achievements as reported in the 2014 Zambia Demographic and Health Survey (CSO/MoH/TDRC, 2014), include a reduction in Maternal Mortality Ratio (MMR) from 591 deaths per 100 000 live births in 2007, to 398 per 100 000 in 2014, a reduction in the Under-Five Mortality Rate (U5MR) from 119 per 1 000 live births in 2007, to 75 per 1 000 in 2014, and a reduction in the Infant Mortality Rate (IMR) from 70 to 45 per 1 000 live births during the same period. Neonatal Mortality Rate (NMR) also reduced from 34 to 24 per 1 000 live births. Table 3 below provides a graphical presentation of the reductions in the infant mortality and under-five mortality rates over a period of 15 years from 1997 to 2012.

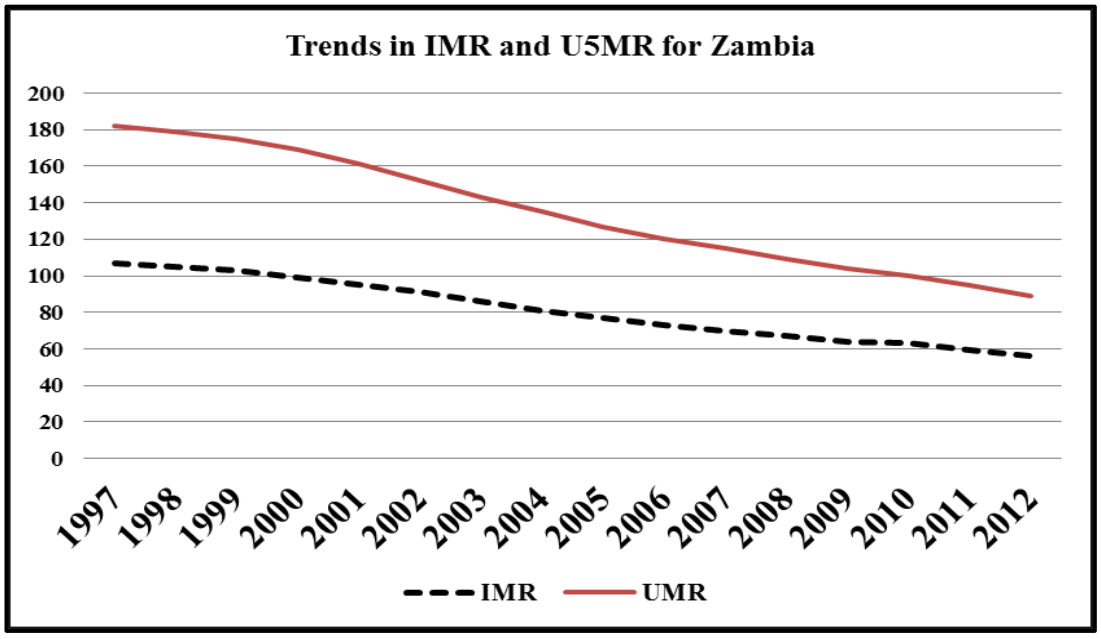

Figure 3: Trends in IMR and U5MR for Zambia
***(Source:** World Bank, 2014)*

1.5 Child Health Days

Child Health Days have been implemented since the early 2000s in a number of sub-Saharan African countries with support from UNICEF and other development partners with the aim of reducing child morbidity and mortality (Oliphant *et al.*, 2010). Child Health Days (CHDs) are twice-annual campaign-style events designed

to increase the coverage of VAS and one or more other child health services. Several studies have shown that Child Health Days are cost effective in varying settings. A study carried out by Fiedler and Chuko (2008) in Ethiopia, revealed that the Child Health Days or the Enhanced Outreach Strategy (EOS) December 2006 round reached more than 10 million beneficiaries at an average cost per beneficiary of US $0.56. When only the mortality impact of vitamin A was considered, the EOS saved 20 200 lives and averted 230 000 Disability-Adjusted Life-Year saved (DALYs) of children of 6–59 months old. According to this study, the average cost per life saved was US $228 and the cost per DALY averted was equivalent to 6 per cent of per capita GDP (US $9), making the EOS cost-effective, according to the WHO criteria.

In Zambia, a similar economic analysis of the June 2010 CHWk[1] round using the activity-based costing, combined with an ingredient approach, estimated the total CHWk costs of about US $5.7 million per round with an average cost of US $0.46 per child (Fiedler *et al*., 2012). The study also showed that with costs of US $1 093 per life saved and US $45 per DALYs, WHO criteria classified Zambia's Child Health Weeks as 'very cost-effective. The study also showed that larger, denser populations are less expensive to serve than smaller, more dispersed populations, reflecting both the relatively high share of total costs that are personnel, and the fact that personnel costs per outreach team and per outreach site are largely fixed. The existence of economies of scale mean that it makes economic sense to spend some additional money on mobilisation to ensure greater coverage is achieved, because most of the costs of the programme in Zambia are in the costs of the CHWk distribution sites, regardless of the number of children served at a site.

[1] Child Health Days are called Child Health Weeks in Zambia

1.6 Rationale and Motivation

Recently, there has been an active debate amongst technocrats, policy makers, funders/donors and several other key stakeholders in Zambia regarding the continued implementation of and support to the bi-annual Child Health Week (CHWk), the main vehicle through which VAS is delivered to the children below the age of five years. Some have argued that this intervention has not been implemented with the desired level of efficiency to achieve its intended goals. On the other hand, some stakeholders have continued to regard the intervention as critical in increasing the coverage of VAS and other related services.

In order to provide further evidence regarding this programme, several empirical studies have been carried in Zambia. The most recent study looked at the cost, efficiency, coverage and reassessment of need for the Child Health Week in Zambia. To the best understanding of this study, this health econometric study on the demand for VAS has not been done before in Zambia. It is hoped therefore, that this study will significantly add to the body of knowledge needed by policy makers, technocrats and programme managers to make informed decisions on the future of the VAS programme in Zambia.

1.7 Conceptual Framework

1.7.1 Grossman's model for health demand

Health economics is a branch of economics which is deeply grounded in welfare economics on which this study was conceptualised, while drawing the strength from the Grossman's model for demand for health capital and health care. Economic literature is dominated by adaptations of the Grossman's model that analyses individual investment and consumption decisions to improve health and utilise health care from the demand perspective (Tim and Stephanie, 2004). The

model leads to a demand for health care of a given quality that is determined by individual and community factors as well as the price of medical care and other similar goods.

In Grossman's human capital framework, individuals demand medical care for the consumption benefits as well as production benefits that good health provides. Thus, the model provides a conceptual framework for the interpretation of the demand for health and medical care in relation to an individual's resource constraints, preferences and consumption needs over the life cycle. Wagstaff (1986) also suggested that Grossman's human capital model of the demand for health provides a framework for analysing issues such as socio-economic inequalities in health, the design of prevention policies and the impact of unemployment on health.

1.7.2 Health as human capital

Neoclassical economics broadly defines health to include 'longevity and illness-free days in a given year, and that it is both demanded and produced by consumers'. According to Grossman (1972), human beings are nothing but individualistic utility maximisers, therefore, health is desired by human beings because it generates utilities. It enters into the individual utility function directly with a positive influence on the welfare. On the other hand, health is treated as a special form of human capital, and individuals derive both consumption and production benefits from it. Health, therefore, is not only a consumer good, but also it is a human capital, an investment good for the household production function.

Traditional demand theory suggests that individuals maximise their utility function by directly purchasing goods and services in the market. The Grossman's demand for health approach uses household production function model of consumer behaviour (Becker, 1965) to account for the gap between health as an output and

medical care as one of many inputs into its production (Grossman, 1999). According to Grossman (1999), the concept of household production function is perfectly analogous to a firm production function, relating specific output or vector of outputs to a set of inputs.

Efforts taken to maintain health can be considered as inputs in a production process (Zweifel *et al.*, 1999). Health, as is the case with education, may be viewed as an invisible capital stock, which is augmented by investment, providing services and is subject to depreciation. Health is an asset capable of being produced, and health production can be viewed as an investment. Investment in health is achieved by the input of medical services (curative) and one's effort in particular, on prevention. The return on the stock of health capital is spending less time in bad health, which can increase utility directly or indirectly due to higher labour income and thus higher consumption.

1.7.3 Demand for health and health care

The demand for health is one of the most central topics in health economics. Health economics literature distinguishes between the demand for health and the demand for health (medical) care. In Grossman's model, a consumer starts with an initial stock of health and that health depreciates over time. Nonetheless, this stock of health can be increased by investing in health capital. According to this model, the shadow price of health depends not only on the price of health care, but also other factors like education, diet, exercise, recreation etc. Accordingly, the return to health capital investment is the reduction of the time lost to engage into market and non-market activities.

In the neoclassical framework, health care is defined as one of the determinants of health, and it is subjected to the law of diminishing marginal return

in producing health. Therefore, a downward sloping demand curve for health care is derived from the demand for health since individuals demand 'good health' and not the consumption of health care. Grossman (1972), states that health is both demanded and produced by consumers. He further postulates that demand for health is twofold. Firstly, as a consumption commodity, it directly enters the preference functions, and secondly, as an investment commodity, it determines the total amount of time available for market and non-market activities.

1.7.4 Demand for vitamin A supplementation conceptual framework

The conceptual framework for this study is based on the Grossman's model of health demand described above. According to the Grossman's model, individuals derive positive utility from consumption goods (X) and from good health (H). This is given in the following utility function:

$$U = U(H, X) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where U, H and X represent utility, health of the individual and consumption goods, respectively.

Given equation (1), the following assumptions are made that:

$U_H > 0$, $U_X > 0$; and that

$U_{HH} < 0$, $U_{XX} < 0$

According to Grossman's model for demand for health, individuals and households produce their own health through acts of investments and consumption of medical care. Therefore, individuals increases their health capital by investing (I) in health production through the purchase of medical services (M) and spending t^I units of time on preventive efforts as provided for in the following equation:

$$H_1 = H_0(1-\delta) + I(M_0, t^I) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where H_1 is the current stock of health capital, H_0 is the initial stock of health subject to depreciation over time, δ is the rate of depreciation of the initial health stock, M denotes demand for medical services, I represents investment in health while t^I represents time invested in favour of health (preventive).

Given equation (2), the following assumptions are made:

(a) $\frac{\partial I}{\partial M} > 0$; $\quad\quad \frac{\partial^2 I}{\partial M^2} < 0$

(b) $\frac{\partial I}{t^I} > 0$; $\quad\quad \frac{\partial^2 I}{\partial \ (t^I)^{\ 2}} < 0$

The health input demand (M) is endogenously determined within this model while time investment variables (t^I) are exogenously determined as the decision on how much time to spend investing in health care depends largely on people's preference, price of health inputs and non-health inputs. Accordingly, health investment (I) is generated through consumption of medical services (M) and the individual's own input of time (t^I) as shown in the following health investment function:

$$I = I(M, t^I) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Grossman's model assumes that a number of individual characteristics influence health investment decisions by individuals and households. In neo-classical framework, health care, age, income and education, environmental and lifestyle factors, and genetic factors are viewed as the determinants of health (Henderson, 2005). Kelly (1999) further proposes that health care choices for infants are influenced by access and quality, as well as by parental human capital, and

household socio-economic status and composition. Kelly's model provides enormous insight on what influences health care choices for the infants which are primarily made for them by caregivers. This also provided part of the background in developing the models for this study, which looks at what determines the demand for vitamin A supplementation choices in Zambia.

Vitamin A supplementation (VAS) is an act of health investment and it is among the time investment variables (t^I) which is intended to achieve an optimal stock of health for a child. From equation (3), the study was able to come up with the reduced form of the demand function since time investment variables are exogenously determined. VAS being a form of investment (I), the reduced model in this study is given by the following investment function:

$$VAS = \beta V + \Phi Z + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

where VAS is vitamin A supplementation, V is a vector of individual and household characteristics, Z is a vector of community level factors and ε is the error term. β and Φ are coefficient vectors to be estimated.

1.8 Hypotheses

This section highlights the key hypotheses for this study which are deemed to be of significance on the demand for VAS among children of 6-59 months of age in Zambia. The following hypotheses have been tested in this present study:

1. The educational level of the mother of the child does not affect the likelihood of VAS demand among children of 6-59 months of age in Zambia
2. Vitamin A supplementation demand among children of 6-59 months is not affected by geographical factors such as residence (rural and urban)
3. The between-community variance in VAS demand among children of 6-59 months in Zambia is zero
4. The level of household expenditure does not have an effect on the likelihood of demand for VAS among children of 6-59 months of age in Zambia

CHAPTER 2: LITERATURE REVIEW

2.1 Significance of vitamin A

Vitamin A is the name of a group of fat-soluble retinoids involved in immune function, vision, reproduction, and cellular communication. It also supports cell growth and differentiation, playing a critical role in the normal formation and maintenance of the heart, lungs, kidneys, and other organs. Vitamin A deficiency (VAD) is common in many developing countries, often because residents have limited access to foods containing preformed vitamin A from animal-based food sources and they do not commonly consume available foods containing beta-carotene due to poverty. In these countries, low vitamin A intake is most strongly associated with health consequences during periods of high nutritional demand, such as during infancy, childhood, pregnancy, and lactation (National Institute of Health, 2013).

Literature reveals that factors leading to VAD among under-five children include low vitamin A and fact dietary intake, high incidence of diarrhoea diseases and measles, breastfeeding of short duration, and inadequate complementary diet and feeding practices (ACC/SCN, 1994). Empirical studies have shown that improving the vitamin A status of deficient children enhances children's disease resistance capacity and thus reduce their mortality and illness from infectious diseases significantly and at low cost. Therefore, elimination of VAD as a public health problem is a central element of improving the survival, growth, development and wellbeing of children (Vitamin A Global Initiative, 1997).

2.2 The consequences of vitamin A deficiency

According to Schultink (2002), a country with the Under-five Mortality Rate (U5MR) > 50 per 1 000 live births is likely to have a VAD problem that requires immediate or continuing action and that those with U5MR between 20 and 50 per 1

000 live births should assume they have a VAD public health problem until surveys prove otherwise. Although prevalence of clinical symptoms has declined, sub-clinical VAD continues to affect high proportions of children in Africa and south-east Asia (Black *et al*., 2013).

Sufficient evidence exist which shows that consuming a much lower level of vitamin A can lead to night blindness, complete blindness, a compromised immune system, and severe illness. As Gilbert and Foster (2001) have shown, a large percentage of children who go blind, die within a year or two and VAD is a major contributor to this child mortality. Though xerophthalmia remains the most specific and readily recognized clinical manifestation of VAD, it is now recognized that other serious consequences, including increased mortality, result from milder degrees of VAD, before xerophthalmia is apparent or prevalent in the population (Sommer, 1995). There is increasing evidence that VAD also raises significantly the risk of maternal death (Vitamin Global Initiative, 1997). Rice *et al.* (2004) reveal that nearly 800 000 deaths worldwide can be attributed to VAD among women and children. They further approximate that 20% of all-cause maternal mortality can be attributed to VAD. This situation is of great concern requiring specific actions to mitigate the effects of VAD worldwide and Zambia in particular.

2.3 Strategies to combat vitamin A deficiency

Programme activities to reduce VAD are still often limited institutionally to blindness prevention programmes. However, the risk of death increases long before visual impairment occurs in the vitamin A-deficient person. It is therefore, necessary that VAD is understood as a potentially fatal disorder and its reduction as an essential element of child survival programmes.

Considering the remarkable benefits of adequate vitamin A and the savings that accrue from a reduced burden on health services associated with it, several strategies have been developed to improve vitamin A status among the risk populations. According to the Vitamin A Global Initiative (1997), supplementation is a low-cost, highly effective means of improving vitamin A status of children and other population groups and is the quickest intervention to implement on a national scale. There is also enough evidence demonstrating that the effects of vitamin A on reduction of child death and illness are mostly based on supplementation of deficient children. On the other hand, promotion, protection and support of breastfeeding is also an important and essential component of vitamin A deficiency reduction programmes for young children since breast milk continues to be the most important food for children in the first year of life in the developing world.

Fortification is another strategy proving to be effective and sustainable in combating VAD and increasingly feasible in developing countries. The on-going fortification of maize and sugar with vitamin A is proving successful in Zimbabwe and Zambia respectively providing an impetus to move forward in vitamin A fortification in many developing countries. Besides supplementation and fortification, home gardens, particularly those based on dark green leafy vegetables, have been promoted as part of vitamin deficiency control strategies since a very high percentage of vitamin A in the diet comes from horticultural crops. Nonetheless, few of these home garden experiences have been evaluated as to their impact on vitamin A status, and only a few of these have demonstrated a positive impact (Vitamin A Global Initiative, 1997). Notwithstanding, home gardens may be a useful complement to supplementation and fortification as part of a longer-term VAD control strategy.

2.4 The impact of vitamin A supplementation programme

Many health experts, researchers and scholars have empirically demonstrated the role that VAS plays in reducing infant and child mortality, especially in low income and developing countries. It is well documented that VAS coverage of over 80 per cent, among children of six months to six years dramatically increases their chances of survival. Risk of mortality from measles is reduced by about 50 per cent, from diarrhoea by about 40 per cent and overall mortality by 25-35 per cent (Vitamin Global Initiative, 1997).

Empirical studies have also revealed that a reduction in the incidence of diarrhoea and measles in the same group due to improved vitamin A status results in the reduction in the rate of hospital admissions and reduced need for out-patient services lowering the overall cost of health services (Vitamin Global Initiative, 1997). It is therefore, evident that improving the vitamin A status of deficient children enhances their disease resistance capacity and, thus reducing their mortality and illness from infectious diseases significantly. Elimination of VAD as a public health problem must therefore, be a principal element for child survival and maternal survival programmes where the problem exists (Vitamin A Global Initiative, 1997).

Periodic high-dose VAS has been shown to be one of the most cost-effective interventions to reduce child mortality and has prevented an estimated one million child deaths from 1998 to 2001 (Berger *et al*., 2007). As such many countries with high rates of under-five child mortality have opted to implement universal supplementation programmes of children of 6-59 months old. To date, the most effective delivery mechanism of the VAS is a regular twice-yearly Child Health Week event with programmes striving to achieve > 80 per cent coverage of this target group (Robin, 2007).

2.5 Factors associated with low uptake of vitamin A supplementation

Micronutrients such as iodine, iron and vitamin A can have a profound impact on a child's development and a mother's health. Despite their proved benefits and cost-effectiveness, many infants and mothers in sub-Saharan Africa are still missing out on micronutrient supplementation. Rising coverage of VAS in recent years provides a source of hope for scaling up the micronutrient supplementation interventions.

Sub-Saharan Africa, along with other developing areas, has seen a marked rise in coverage of children of 6–59 months, with at least one dose of vitamin A per year. Of all the regions assessed by UNICEF in The State of the World's Children (UNICEF, 2013) publication, East Asia and the Pacific has the highest combined rate of vitamin A coverage (85%) followed by West and Central Africa (83%). South Asia recorded the least vitamin A coverage (73%), followed by sub-Saharan Africa (78%). The expansion of VAS has been achieved through a combination of strategies, encompassing advocacy and the packaging of vitamin A with other high-impact health and nutrition interventions, such as immunisation and national health days, and the child health days have often been the instruments used to deliver the supplementation (UNICEF, 2008).

According to Berger *et al*. (2007), the effectiveness of vitamin A capsule distribution programmes for child survival is related to the extent of programmatic coverage. They also highlight that VAS in developing countries may miss the children who are at highest risk, but little has been done to characterise nutritional status and infectious disease morbidity in children who are missed by VAS. They contend that it is not well known whether this important child survival programme is missing children who may actually be at greater risk of morbidity and mortality.

Davinder *et al.* (2008) claim that effective coverage of periodic high-dose VAS programmes will be critical in reaching the Millennium Development Goal of reducing child mortality by two-thirds between 1990 and 2015.

Recent empirical literature has revealed several factors that are associated with children missed by VAS. A study conducted in Indonesia, based on the data from the Nutritional Surveillance System (NSS), compared nutritional status and other health indicators of children of 12-59 months in rural Indonesia, who did and did not receive a vitamin A capsule within the last six months. The NSS was based upon stratified multi-stage cluster sampling of households in ecological zones of provinces of the country and in slum areas of large cities. The results of this study showed that the missed children were more likely to be younger, male, have mothers who were younger and less educated, and have fathers who were less educated (Berger *et al*., 2007). The study suggests that those living in the more remote areas, deprived of other health services and facing worse health conditions are also more likely to be missed with VAS. According to Berger *et al*. (2007), children who did not receive vitamin A were also less likely to have received childhood immunisations, and belonged to families with higher infant and under-five child mortality than children who received vitamin A. They argued that although a lack of access to other public health interventions and demographic factors may contribute to the rate of malnutrition in children missed by the vitamin A capsule programme, it was likely that increased coverage of VAS would help to maximise the benefits for child survival.

A similar study carried out in Nepal by Thapa (2009) based on data from the 2006 Nepal Demographic and Health Survey, analysed the extent to which the levels and patterns of the programme's coverage continued to be sustained over time,

identifying the children who were still missed by the programme. The sample population was defined as all children of 6-59 months old at the time of the survey, born to the respondents during the five years before the survey. Coverage was defined as the percentage of children of 6-59 months who received VAS (in capsule form) in the last six months preceding the survey. The variables included in the analysis were child's age, child's gender, urban rural residence, mother's education, economic and development sub-region and wealth index, a composite measure of the cumulative living standard of a household. The results of this study revealed that the children missed by the programme were found to disproportionately represent the poorest of the poor families, mothers with no education, and residents of rural areas and certain ecological and development sub-regions.

Davinder *et al.* (2008) carried out a similar study in Cambodia among the pre-school children and their families who participated in the 2005 Cambodian Demographic and Health Survey (CDHS), a nationally representative survey that was part of the worldwide Demographic and Health Surveys (DHS) project. The objective of this study was to characterise the coverage of the Cambodian national vitamin A programme among pre-school children and to identify risk factors for not receiving VAS. The study found out that maternal education was associated with the child receiving a vitamin A capsule in multivariate analyses, adjusting for other potential confounders and argued that greater maternal formal education appeared to be an important determinant for receipt of a vitamin A capsule by pre-school children.

In Bangladesh, Akhter *et al.* (2008) also obtained similar findings when they analysed the National Surveillance Project (NSP) data to assess VAS coverage and to explore which children were less likely to receive a vitamin A capsule in order to

help the Government of Bangladesh identify necessary modifications aimed at higher coverage of VAS among all eligible children. The data was collected in rural Bangladesh to assess VAs coverage among children of 12–59 months. Analyses were performed on six-bimonthly data collection rounds that directly followed each of the six specific National Immunisation Days (NIDs) and National Vitamin A Plus Campaign (NVAC) distribution dates. The study found that VAS coverage was consistently lower among children of 12-23 months compared to older children (24–59 months) in each of the distribution rounds, and that it was lower among children from poorer households compared to those children from wealthiest households, with the extent of this difference varying by round. They also found that coverage was significantly higher if households have had contact with a government health assistant in the last month.

2.6 Equity of access of primary healthcare services

Equity of access to basic primary healthcare services is a fundamental element that the Government of the Republic of Zambia, through the Ministry of Health has recognized as critical to achieving the Millennium Development Goals (MDGs) and its Vision 2030. This is reflected in the health sector mission statement which seeks to provide equitable access to cost-effective, quality health services as close to the family as possible (MOH, 2011). As is the case with other primary healthcare services, Vitamin A Supplementation is a healthcare equity issue and its uptake is mainly related to aspects of access.

O'Donnel *et al.* (2008) looked at equity as an issue which has long been considered an important goal in the health sector yet inequalities between the poor and the better-off persist. They argued that higher morbidity and mortality rates are common among the poor and yet they use health services less even though they have

higher needs than the better-off. According to O'Donnel *et al*. variations in equity of access to health between social groups and individuals are a consequence of mainly the economic, political and social factors. They also contended that health inequalities between groups of people may be defined by their age, gender, geographical location, occupation, ethnicity and education level. Amartya Sen (2002) pointed out that health equity is an issue of fairness and justice in social arrangements and not just about the distribution of health and healthcare. On the other hand, Essink-Bot *et al.* (2012) considered healthcare to be accessible if there is no financial, geographical, time or cultural barriers to healthcare consumption.

A study conducted in the United States of America (USA) by Andersen *et al.* (2002) suggested that access to medical care depends on individual and community characteristics. This study revealed that low-income children and adults and have lower educational attainments were at greater risk of not having access to medical care, the situation which can be improved depending on where people live. The study found that a low-income individual residing in a community with more funded community health centres has better access to medical care. Another study by Jimenez *et al*. (2008) found that income-inequalities in access and use of health care services are mainly driven by variations between provinces favouring the better-off provinces in Canada. In South Africa, Harris *et al.* (2011) also found that poor, uninsured, black Africans and rural groups had inequitable access to healthcare services while in poor households in Vietnam had significant lower average per capita rates of healthcare utilization with delayed and minimized healthcare seeking (Segall *et al*., 2002).

From this literature, it is evident that children from poor households whose mothers are less educated are consistently missed by VAS programme in varying

settings. Studies carried out in other countries show that the age of the child, age of both parents (mothers and fathers), maternal and paternal education level, residence (rural, urban), access to other health services, poverty levels and contact with government health assistants (personnel) are some of the demand factors associated with a child receiving vitamin A capsule in various settings. Therefore, this current study assumes that the age of the child and that of the mother will positively be associated with likelihood of demanding for vitamin A supplementation. Further, this present study assumes that educational attainment of caregivers and that of household heads will be positively associated with the likelihood of demanding for vitamin A supplementation.

This study further suggests that employment status (socio-economic status) of mothers (primary caregivers) and household heads will likely to positively influence the likelihood of receiving vitamin A supplementation while the size of household have negative effect on the demand for vitamin A supplementation in Zambia. Residence is assumed to be associated with the likelihood of vitamin A supplementation demand with household income likely to be positively related to vitamin A supplementation demand and uptake.

CHAPTER 3: METHODOLOGY

3.1 Data

3.1.1 Sampling

This was a descriptive study and quantitative measures were employed to help in exploring the demand factors for vitamin A supplementation. The study used the 2010 Living Conditions Monitoring Survey (LCMS) data. The LCMS is a cross-sectional survey carried out every four years by the Central Statistical Office (CSO), a government institution, mandated to provide the government with statistical data needed for national planning (Central Statistical Office, 2012). This data was collected at household level using a structured household questionnaire.

The 2010 LCMS was designed to cover a representative sample of about 20 000 non-institutionalised private households residing in both rural and urban parts of the country. The sampling frame used for the 2010 LCMS was developed from the 2000 Census of Population and Housing at which time, Zambia had 9 provinces with 72 districts. The districts are further subdivided into 150 constituencies, which are in turn divided into wards. For the purposes of conducting household-based surveys, CSO has further divided the wards into Census Supervisory Areas (CSAs), which are subdivided into Standard Enumeration Areas (SEAs). The SEAs constituted the Primary Sampling Units (PSUs).

The 2010 LCMS employed a two-stage stratified cluster sample design, whereby during the first stage, 1 000 from a total of 16 717 SEAs nationwide were selected with Probability Proportional to Estimated Size (PPES). During the second stage, households were systematically selected from SEAs which formed the primary sampling unit.

Before a sample of households to be interviewed was drawn, all households in the selected SEAs were listed. In the case of rural SEAs, households were listed and stratified according to the scale of their agricultural activity. The urban SEAs were explicitly stratified into low cost, medium cost and high cost areas based on CSO's and local authorities' classification of residential areas. The circular systematic sampling method was used to select households. Using this method, fifteen and twenty-five households were selected from rural and urban SEAs, respectively.

In the 2010 LCMS, all the 1 000 sampled SEAs were enumerated, representing 100 per cent coverage at national level. The household response rate was also generally very high with a national average of 98 per cent of the originally selected households.

3.1.2 Variable Definition

The study population for this study were children of 6–59 months who were eligible to receive vitamin A supplementation (VAS). Therefore, the outcome variable was VAS for children of 6-59 months old within six months preceding the 2010 LCMS. By government policy, every child in Zambia in this age bracket is expected to receive VAS bi-annually. During the 2010 LCMS, the mother was asked if any of the eligible children in the household had received VAS in the last six months preceding the survey. The VAS variable was binary with responses "1" if the child received vitamin A capsule in the last six months, and "0" if otherwise.

Based on the information from existing literature, this study argues that demand for VAS largely depends on a variety of factors. To help investigate the predictors for the demand for VAS, this study examined the role of individual factors including child's age and sex, mother's age, mother's education status, mother's

employment status, household size, household total expenditure and those related to the headship of the household. Household total expenditure was used as a proxy for household income as a more reliable measure since reliability of income data is quite low (Cope *et al.*, 2012). Further, due to data limitations, paternal education was not estimated directly, instead education attainment of the head of household was examined in this study since about three quarters of households are headed by men (CSO/MoH/TDRC, 2014). This study also examined geographical factors including residence (rural or urban) and regions (provinces). Table 3 provides further description of all the variables in this study.

Table 3: Definition of the key study variables

No.	Variable label	Variable definition
1	Vitamin A supplementation – child received vitamin A capsule in the last 6 months (VAS)	1 = yes 0 = otherwise
2	Sex of the child (SXC)	1 = male 2 = female
3	Age of the child (AGC)	Continuous
4	Age of the mother (AGM)	Continuous
5	Mother's highest grade attained (EDM)	0 = never attended school 1 = incomplete grade 12 GCE (O-level) 2 = complete grade 12 GCE (O-level) 3 = tertiary
6	Employment status of the mother (ESM)	1 = self-employed 2 = employee 3 = unemployed
7	Sex of the household head (SXH)	1 = male 2 = female
8	Highest grade attained by head of household (EDH)	0 = never attended school 1 = incomplete grade 12 GCE (O-level) 2 = complete grade 12 GCE (O-level) 3 = tertiary
9	Employment status of the head of household (ESH)	1 = self-employed 2 = employee 3 = unemployed
10	Age of household head (AGH)	Continuous
11	Total household expenditure equivalent (EXP) - proxy for household income	Continuous
12	Household size (HHS)	Continuous
13	Place of residence (RES)	1 = rural 2 = urban
14	Province (PROV)	1 = central 2 = copperbelt 3 = eastern 4 = luapula 5 = lusaka 6 = northern 7 = north-western 8 = southern 9 = western

3.1.3 Data Management and Analysis

The study used Stata software version 11 to analyse the data. Data cleaning was also done using Stata. Several diagnostic tests were performed in order to take into account possible biases during data analysis. These tests included specification, goodness-of-fit, multi-collinearity and linearity diagnostics.

3.2 Empirical Model Specification

Based on the conceptual framework, this study proposes that demand for VAS is an act of health investment needed to increase the health capital among children. It is further assumed that variations in VAS are attributable to individual and community (geographical) level factors. In this study, individual level factors were modelled to include child and household characteristics. Child characteristics included only child's age and sex while household characteristics included age, education level and employment status of the mother, household size and household expenditure. Other household characteristics included were sex, educational level and employment status of the head of household. On the other hand, community factors included only place of residence and province (region). Using a multilevel framework, variations at community level were captured as random effects while those at individual level were captured as fixed effects. The study created a variable called vitamin A supplementation (VAS) for purposes of empirical model specification. VAS is a binary variable with responses "1" if the child received vitamin A capsule in the last 6 months, and "0" if otherwise. For all discrete variables listed in Table 2, a set of dummy variables were created. Therefore, the empirical model for this study, specified as a health investment demand function in its reduced form is given as follows:

$$VAS_{ij} = \beta_0 + \beta_1 SXC_{ij} + \beta_2 AGC_{ij} + \beta_3 AGM_{ij} + \beta_4 EDM_{ij} + \beta_5 ESM_{ij} + \beta_6 SXH_{ij} + \beta_7 EDH_{ij} + \beta_8 ESH_{ij} + \beta_9 AGH_{ij} + \beta_{10} log(EXP_{ij}) + \beta_{11} HHS_{ij} + \beta_{12} RES_{ij} + \beta_{13} PROV_{ij} + \varepsilon_{ij} + u_j$$

where;

VAS_{ij}	= uptake of vitamin A supplementation by child *i* living in community *j*
SXC	= child sex
AGC	= age of child
AGM	= age of the mother
EDM	= education level of the mother
ESM	= employment status of the mother
SXH	= sex of the household head
EDH	= education level of household head
ESH	= employment status of household head
AGH	= age of household head
EXP	= household expenditure (log-transformed)
HHS	= household size
RES	= residence
PROV	= province (region)
ε_{ij}	= error term
uj	= error term at community (cluster) level

The decision to use the multilevel analytical procedure was based on the intuition that this procedure allows for the determination of factors at various levels. Further, factors that influence access to primary healthcare in Zambia, vary, some of which could only be captured as random effects in the multilevel model. In this empirical model, household expenditure was log transformed to improve the normal approximation for inference purposes.

3.3 Model Estimation and Analysis

3.3.1 Demand for vitamin A supplementation equation estimation

The VAS empirical model was estimated using logistic regression which relies on maximum likelihood estimation. An xtmelogit technique in Stata was used to measure the likelihood of VAS demand conditional on a number of covariates. This is an iterative approach where various solutions are estimated until the best

solution of having the maximum likelihood is found. The study started the analysis by providing basic descriptive statistics on demographic characteristics of children, such as sex and age, including VAS uptake within six months before the survey. Furthermore, VAS programme coverage by province has been presented.

As is the case in most applications of binary response models such as logit model (Wooldridge, 2002), the primary goal of this study was to explain the effects of the included explanatory variables on the probability of demanding for VAS, i.e. P(VAS=1|**x**). In describing the demand characteristics for VAS, the study computed the partial effects (marginal effects for continuous variables and average effects for discrete or dummy variables) to measure the impact of change in the regressors on the probability of demanding for VAS. These partial effects were converted into log-odds ratios (Jones, 2005) as given below:

$$P(y_j=1)/P(y_i=0) = \exp(\mathbf{x}\boldsymbol{\beta}_j)$$

The univariate odds ratios (OR) were calculated with 95 per cent confidence interval. Thus, statistical significance was considered as $p<0.05$. The study applied the likelihood ratio test to detect interactions between variables. In these calculations, a multivariate model was used to control for individual and geographical characteristics. To investigate the relative importance of the community in the demand for VAS, the study looked at spatial differences in VAS programme demand at the community level in terms of intra (within) and inter (between)-cluster variations in program coverage rates.

In this case, a multilevel data analysis approach was employed to examine variations in the demand for VAS at individual and community levels. This approach was suitable to ensure that the hierarchical structure of the sample was taken into consideration where individuals are nested within households and

households within communities (clusters) with a response variable measured at the lowest level and explanatory variables at all existing levels. Further motivation to use the multilevel approach was its ability to compute fixed effects and random effects for the between cluster variations simultaneously. Consequently, a multivariate multilevel model with two levels was fitted to estimate the influences of measured individual and geographical factors on the demand for VAS programme using the xtmelogit routine in Stata.

In performing the multilevel logistic modelling, three logit models were estimated with a random intercept by community (cluster). The first one was the empty (null) model with no explanatory variables. This model was used to estimate the total variance in demand for the VAS between the communities (clusters). The second model included only the individual characteristics to estimate their effects on VAS demand by observing the between-cluster variability from the empty model. The third estimation was a full model including both individual characteristics and community (geographical) level to reveal the net fixed and random effects. The results of fixed effects (measures of association) are shown as odds ratios (ORs) with 95 per cent confidence intervals (CIs) at 5 per cent significance level.

3.3.2 Logistic regression diagnostics

Under the logistic regression procedure, it is assumed that the true conditional probabilities are a logistic function of the independent variables and that no important variables are omitted in the model. It is also assumed that all the independent variables are measured without error and are not linear combinations of each other. In order for the analysis to be valid, the study carried out key diagnostics on the empirical model to check if these assumptions of logistic regression would be

met to avoid problems such as biased coefficient estimates which could have resulted into invalid statistical inferences.

The study performed the specification test to ascertain if the empirical model comprises all the relevant predictors and determine if the linear combinations of these predictors is sufficient using the linktest Stata command. The result of this test showed that this model was properly specified ($p = 0.646$). The Stata Hosmer and Lemeshows' goodness-of-fit test also suggested that the model fitted the data very well (χ^2 (df=8. N=1,298) = 5.56, $p<0.696$). To rule out multicollinearity among predictor variables, the study performed the collinearity Stata test (collin) based on measures of tolerance (how much collinearity that a regression analysis can tolerate) and variance inflation factor (VIF) to determine how much of the inflation of standard error could be caused by collinearity. The tolerance values for all predictor variables were greater than 0.1 and the VIF values were all less than 10 indicating no serious concerns for multicollinerity. The study also checked for outliers by getting standardised Pearson residuals and plotting them against the predicted probabilities. This test indicated that there were no influential observations that may badly skew our regression estimation.

3.3.3 Inequality analysis

Health equity analysis in this study involved comparing demand for VAS across different income sub-groups. The study constructed the concentration and Lorenz curves of VAS as a method of assessing the degree of income-related inequality in the distribution of the demand for VAS. Concentration curves were chosen to descriptively show whether the demand for VAS varied across different income groups. In the construction of the concentration curves, the cumulative percentage of the VAS (y-axis) was plotted against the cumulative percentage of the

population, ranked by household income (a measure of the living standard), beginning with the poorest and ending with the richest on the x-axis (O'Donnell *et al.,* 2008). To construct the Lorenz curve on the other hand, the cumulative proportions of the household income (y-axis) was plotted against the cumulative proportion of the population (from the poorest to richest) on the x-axis. With this approach, the study was able to examine whether VAS demand was more unequally distributed amongst the poor households. If everyone, irrespective of his living standards has the same value of the health variable, in this case VAS, the concentration curve will be a 45-degree line (line of equality) running from the bottom left-hand corner to the top right-hand corner. If by contrast, VAS takes higher values amongst the poor people, the concentration curve will lie above the line of equality. On the other hand, if the VAS takes lower values amongst the poor people, the concentration curve will lie below the line of equality. The further the concentration curve is above or below the line of equality, the more concentrated the VAS is amongst the poor. In this present study inequality analysis will be carried descriptively by inspecting where the VAS concentration curve lies and how far away it is from the line of equality on the graph.

CHAPTER 4: RESULTS AND FINDINGS

4.1 Descriptive Statistics

Descriptive statistics of this study are reported in Table 4. A total of 7 382 children were included in the analysis of which 3 685 (50%) were males. Nearly half (49%) of the children were from rural areas. Slightly over half (53%) of these children were aged between 24 – 59 months while the mean age was 25 months. Of the 7 382 children, 3 151 had responded whether they did or did not receive a vitamin A capsule in the last six months preceding the 2010 LCMS. Three-quarters (74%) reported to have received vitamin A capsule within the last six months and about a quarter (26%) did not. In comparable terms, VAS uptake was the lowest amongst all other immunisations such as polio (92%), measles (86%), DPT (93%) and BCG (96%).

Table 4: Basic descriptive statistics: Child characteristics

Variable		**N**	**%**
Sex	*Male*	3 685	49.9
	Female	3 697	50.1
Age	*0 - 11 months*	1 812	24.6
	12 - 23 months	1 628	22.1
	24 - 59 months	3 942	53.4
Vitamin A in six months	*Yes*	2 335	74.1
	No	816	25.9
BCG	*Yes*	3 032	95.8
	No	133	4.2
DPT	*Yes*	2 906	93.0
	No	220	7.0
Polio	*Yes*	2 874	91.9
	No	252	8.1
Measles	*Yes*	2 619	86.2
	No	420	13.8

Table 5 below shows the distribution of VAS status by geographic characteristics (residence and province) obtained by cross-tabulation. The results show that the demand for VAS varied by both place of residence and province. There were more children in rural areas (30%) who had not received VAS compared to those found in urban areas (22%). On the other hand, Eastern province had slightly higher proportion of children (34%) who did not receive VAS followed by Luapula province at 30 per cent. Copperbelt (19%) and Western (20%) provinces had the least proportion of children who had not received VAS within six months preceding the survey.

Table 5: Vitamin A supplementation by residence and province

Variable		**Vitamin A received in last six months (*N=3 151*)**				***p-value***
		Yes		**No**		
		N	**%**	**N**	**%**	
Residence	*Rural*	1 070	70.3	452	29.7	*0.001*
	Urban	1 265	77.7	364	22.3	
Province	*Central*	208	76.2	65	23.8	*0.001*
	Copperbelt	391	81.0	92	19.1	
	Eastern	204	66.5	103	33.6	
	Luapula	221	69.9	95	30.1	
	Lusaka	290	75.3	95	24.7	
	Northern	349	72.6	132	27.4	
	North-western	215	73.4	78	26.6	
	Southern	311	72.2	120	27.8	
	Western	146	80.2	36	19.8	

The results presented in Table 6 below reveal that VAS among under-five children did not vary greatly by sex of the child. The proportion of male children who did not receive vitamin A capsule was about 24 per cent and about 26 per cent of female children did not receive vitamin A capsules within six months preceding the survey. Further, the results suggest that the proportion of younger children aged 0-11 months who did not get vitamin A capsule was higher (45%) when compared to those aged 12 months and older.

Table 6: Vitamin A supplementation by child characteristics

Variable		Vitamin A received in last six months (*N=2 543*)				*p-value*
		Yes		No		
		N	%	N	%	
Age	*0 - 11 months*	299	55.0	245	45.0	
	12 - 23 months	427	81.8	95	18.2	*0.001*
	24 - 59 months	1 145	77.5	332	22.5	
Sex	*Male*	896	73.3	327	23.7	*0.731*
	Female	975	73.9	345	26.1	

The mean age for the primary caregivers (mothers) according to this study was 32 years. The results presented in Table 7 below show that the proportion of children who did not receive VAS was higher (36%) among mothers who had never attended any form of schooling compared to those who had completed grade 12 level (16%) or those who attained tertiary education (24%). Additionally, the proportion of children who did not receive VAS was higher among the mothers who were unemployed (34%) compared to the self-employed (23%) and the employed (26%).

Table 7: Vitamin A supplementation by the characteristics of the mothers

Variable		Vitamin A received in last six months				*p-value*
		Yes		No		
		N	%	N	%	
Marital Status	*Never Married*	23	85.2	4	14.8	
	Married	1 907	74.4	657	25.6	*0.312*
	Widowed	2	100.0	-	-	
Educational Attainment	*Never attended school*	160	64.0	90	36.0	
	Incomplete Grade 12 GCE	1 400	74.4	482	25.6	
	Completed Grade 12 GCE	197	84.6	36	15.5	*0.001*
	Tertiary Education	120	76.4	37	23.4	
Employment Status	*Self-employed*	629	76.9	189	23.1	
	Employee	148	74.4	51	25.6	*0.001*
	Unemployed	399	65.6	209	34.4	

Results presented in Table 8 below suggest that the proportion of children who did not receive VAS was higher among household heads who had never

attended school (37%) compared to those who had attained grade 12 level of education (21%) and those who had attained tertiary education (21%). Further, the proportion of children who did not receive VAS was higher among the unemployed household heads (33%) in relation to the self-employed (28%) and the employed (21%) household heads.

Table 8: Vitamin A supplementation by characteristics of the household head

Variable		Vitamin A received in last six months				*p-value*
		Yes		No		
		N	%	N	%	
Sex of Household Head	*Male*	1 956	74.5	670	25.5	*0.263*
	Female	378	72.1	146	27.9	
Educational Attainment	*Never attended school*	138	62.7	82	37.3	*0.001*
	Incomplete Grade 12 GCE	1 443	72.8	538	27.2	
	Completed Grade 12 GCE	365	79.0	97	21.0	
	Tertiary Education	316	79.2	83	20.8	
Employment Status	*Self-employed*	1 390	72.0	542	28.1	*0.001*
	Employee	694	79.3	181	20.7	
	Unemployed	87	67.4	42	32.6	

4.2 Multilevel logistic regression analysis

Multivariate logistic regression procedure was used to determine the VAS demand predictors in Zambia. The dependent variable was whether the child received VAS within the last six months preceding the 2010 LCMS. This variable was binary, coded "1" if the child received VAS and "0" otherwise.

4.2.1 Logit regression models

The study fitted a two-level logistic regression model to measure the influence of individual and community (geographical) characteristics on the demand for VAS. Using the xtmelogit procedure, three logit models were fitted to estimate the reduced form of demand for investment time spent on VAS, with a random

intercept by cluster to obtain estimates of the community effect. Firstly, the null (empty) model was estimated to determine the total variance for VAS demand. The second model included only individual characteristics while the third model was a full model including individual and community (geographical) characteristics.

The study chose the multilevel (mixed effect) model on assumption that the errors within each randomly sampled level two unit are likely to be correlated, necessitating the estimation of a random effects model. With the multilevel modelling, the study was able to estimate the community level random effects accounting for the amount of variations attributed to measured individual and community factors that may influence the demand for VAS among under-five children in Zambia.

4.2.2 Factors associated with Vitamin A supplementation

In addressing the first objective, the study begins by looking at individual and geographical measured demand factors for VAS. The results of this model estimation are presented in Table 9 below as odds ratios. The overall model was significant ($p<0.001$) and the specification test (link test) suggested that the model was properly specified ($p<0.646$). The Hosmer and Lemeshow's goodness-of-fit test further suggested that the model fitted the data well ($p<0.696$).

The multilevel logistic regression results reveal that age of the child, education level and employment status of the mother were significantly associated with the demand for VAS among the under-five children in Zambia agreeing with this study's hypotheses. According to these results, each month increase in the age of the child increases the odds of VAS demand by an estimated 3 per cent [100%(1.03-1)], (odds ratio [OR] 1.03, 95% [CI] 1.02 - 1.04, $p<0.001$) controlling for other variables in the model. Since age of the child was consistently and strongly

linked to VAS, its significance in the specified empirical model was estimated. Firstly, a univariate multilevel logistic regression model was estimated with the age of the child included as the only explanatory variable. This univariate multilevel model was significant (*p<0.001*) and child's age was highly associated with vitamin A supplementation demand (*p<0.001*). Secondly, a full multivariate multilevel logistic regression model omitting child's age from the explanatory variables was estimated. This estimation resulted in an insignificant model (*p<0.1133*). Consequently, a Wald test was performed to determine child's age statistical significance in the specified empirical model (UCLA, 2015). The Wald test suggested that the coefficient for child's age variable was not equal to zero, indicating that including this variable in the model created a statistically significant improvement in the fit of the model (χ^2 (df=1. N=1 298) = 32.91, *p<0.0001*).

With respect to the mother's education level, the odds of VAS demand among under-five children increased by a factor of 2.78 for those whose mothers had completed senior secondary school level of education compared to those whose mothers had never attended any level of education (odds ratio [OR] 2.78, 95% [CI] 1.10 - 7.05, *p=0.031*) controlling for other variables in the model. On the other hand, the odds for the demand for VAS for children whose mothers had completed junior secondary level of school education was likely to increase by a factor of 1.54 more than those whose mothers had never attended any formal education (odds ratio [OR] 1.54, 95% [CI] 0.97 - 2.43, *p=0.066*). Additionally, the odds were more than double for those children whose mothers have attained tertiary level of education compared to those whose mothers had never been to school (odds ratio [OR] 2.59, 95% [CI] 0.79 - 7.80, *p=0.090*). Based on this result, the study reject the null

hypotheses and conclude that educational level of the mother do have an effect on the likelihood of VAS demand among children of 6-59 months in Zambia.

The results further indicate that the odds of VAS demand increased by a factor of 1.56 for children whose mothers were self-employed when compared to the unemployed mothers (odds ratio [OR] 1.56, 95% [CI] 1.10 - 2.23, *p=0.013*). Place of residence (rural and urban) was found to be not significant predictor of the VAS demand (*p=0.231*) even though children in urban areas were 1.29 times more likely to receive VAS compared to those in rural areas. Therefore, this study could not reject the null hypothesis on place of residence as there was insufficient evidence to conclude that it had an effect on the likelihood of VAS demand. Similarly, there was no strong evidence to suggest that household income affected the likelihood of VAS demand (*p=0.877*). Region (province), household income, age of the mother, employment status of household head and household size were equally found to be not significant predictors of VAS demand among the under-five children.

Table 9: Multilevel logistic regression model

Dependent variable: Child received vitamin A supplementation in last six months

Variable	Variable definition	OR	95% (CI)	p-value
Sex of the Child	Male (ref)	1.00		
	Female	0.92	(0.689 - 1.218)	0.547
Child Age	Age of the child in months	1.03	(1.019 - 1.039)	0.001
Age of the Mother	Age of mother in years	1.00	(0.962 - 1.041)	0.970
Mother's Education	Never attended school (ref)	1.00		
	Junior secondary education	1.54	(0.971 - 2.434)	0.066
	Senior secondary education	2.78	(1.096 - 7.052)	0.031
	Tertiary education	2.59	(0.786 - 7.795)	0.090
Mother's Employment Status	Unemployed (ref)	1.00		
	Self-employed	1.56	(1.101 - 2.226)	0.013
	Employee	0.77	(0.362 - 1.619)	0.484
Sex of Household Head	Male (ref)	1.00		
	Female	1.01	(0.152 - 6.717)	0.991
Education Level of Household Head	Never attended school (ref)	1.00		
	Junior secondary education	1.30	(0.737 - 2.278)	0.368
	Senior secondary education	1.66	(0.763 - 3.614)	0.201
	Tertiary education	0.89	(0.330 - 2.401)	0.818
Employment Status of Household Head	Unemployed (ref)	1.00		
	Self-employed	0.92	(0.358 - 2.391)	0.872
	Employee	0.84	(0.301 - 2.369)	0.748
Age of Household Head	Age of the head of household in years	1.16	(0.350 - 3.866)	0.806
Household Income	Household consumption expenditure per capita	1.02	(0.802 - 1.295)	0.877
Household Size	Total number of people living in household	0.88	(0.519 - 1.481)	0.622
Residence	Rural (ref)	1.00		
	Urban	1.29	(0.852 - 1.943)	0.231
Province	Lusaka (ref)	1.00		
	Central	0.85	(0.385 - 1.873)	0.686
	Copperbelt	1.47	(0.657 - 3.266)	0.350
	Eastern	0.85	(0.392 - 1.821)	0.667
	Luapula	1.24	(0.578 - 2.672)	0.578
	Northern	0.94	(0.464 - 1.915)	0.869
	North-western	1.18	(0.533 - 2.606)	0.685
	Southern	0.80	(0.385 - 1.667)	0.552
	Western	0.91	(0.359 - 2.315)	0.847
Random-effects Parameters	Cluster: variance (constant)	Estimate 0.713	Standard Error 0.270	

Table 9: Continued

Tests	χ^2	Df	p-value
Overall model evaluation			
Likelihood ratio test	14.66	1	0.0001
Link test	86.71	2	0.646
Wald test	63.18	26	0.0001
Goodness-of-fit test			
Hosmer and Lemeshow	5.56	8	0.696

4.2.3 Geographical context of the demand for vitamin A supplementation

With respect to the second objective of this study, the summary statistics of the three logit regression models displayed in Table 10 below provides an insight on the extent to which demand for VAS varied across communities by estimating the proportion of total variation related to differences between communities. In this table, parameters and standards errors for the three models are presented. The results of the null (empty) model estimates the intercept as 1.225 as an average demand for VAS. The intercept provides an estimate of the average probability of the demand for VAS across all communities suggesting that the likelihood of a child receiving VAS corresponds to an average probability of about 23 per cent across communities. It further reveals that about 95 per cent of all communities in this study were predicted to have between 10 per cent and 35 per cent of children who had received VAS. The null model further shows that the variance component corresponding to the random intercept at community level was 0.876 (se=0.152). Since this estimate is substantially larger than its standard error, the results suggest a significant variation in community means. In addition, the likelihood ratio test statistic for testing the null hypothesis that the variance of the random effect is equal to zero was 90.91 ($p<0.001$) indicating strong evidence that the between-community variance was non-zero in this two-level model. The intraclass correlation in the null model is 0.29 also suggesting that 29% of the variance of the demand for VAS is at cluster

(community) level. These results therefore show that there were community level factors which had an influence on the demand for VAS.

From the results of the null model, the total variation in demand for VAS attributed to differences between communities was about 88 per cent and only about 12 per cent variation in VAS demand could be explained by the measured individual and geographical level differences as fixed effects. The significant community variation as revealed by the null model requires considerable attention when attempting to understand demand factors associated with VAS in Zambia.

The results further a marked decrease in the variance from 0.876 in the null model to 0.713 in the third model as explanatory variables were being added in each successive model. This variance reduction represents a reduction of 18 per cent from the null model attributed to the individual and geographical factors. This clearly suggests that the set of individual and geographical level variables explained only part of the variation in demand for VAS while the other part was due to community effects. Additionally, the standard deviation (SD) of 0.84 in the third model indicates that children in a community which is one SD above the mean, are more than double odds of receiving VAS compared to those children in an average community [exp (0.84) = 2.24].

Table 10: Logit regression models

Dependent variable: Child received vitamin A supplementation in last six months

Fixed Effects	**Model 1 (Null)**	**Model 2 (Individual Characteristics)**	**Model 3 (Individual and Geographical characteristics)**
Intercept	1.225 (se=0.062) 95% CI=1.103 - 1.347 *p<0.0001*	-1.645 (se=2.188) 95% CI= -5.934 – 2.644 *p=0.452*	-0.830 (se=2.282) 95% CI= -5.303 – 3.644 *p=0.716*
Random Effects	**Model 1**	**Model 2**	**Model 3**
Cluster Variance (constant)	0.876 (se=0.152) *p<0.0001*	0.761 (se=0.274) *p<0.0001*	0.713 (se=0.270) *p=0.0001*
Cluster SD (constant)	0.936 (se=0.081) *p<0.0001*	0.872 (se=0.157) *p<0.0001*	0.844 (se=0.160) *p=0.0001*
Correlation (ρ)	0.29	0.26	**0.25**

[Correlation (ρ) = $SD^{\wedge 2} / (SD^{\wedge 2} + \pi^{\wedge 2/3})$]

4.3 Income inequality analysis in demand for vitamin A supplementation

Regarding the third and final objective of this study, a measure of income related inequality in the demand and utilisation of VAS was constructed. The standard procedure adopted in this study to measure the degree of inequality in the demand for VAS was the concentration curve. The results of equality analysis are shown in Figure 4 below in which the cumulative percentage of households ranked by household expenditure, used as a measure for living standard, is plotted on the x-axis and the cumulative percentage of VAS demand and expenditure is plotted on the y-axis.

As depicted by the Lorenz curve in Figure 4, it is evident that poor people in this study commanded a very small proportion of income. The results suggest that income inequality was quite high with about 80 per cent of the total population having a share of only about 40 per cent of the wealth. This implies that about 60 per cent of the total wealth was concentrated among the richest few (20%) while the

poorest (20%) accounted for less than 5 per cent of the total wealth. The pictorial display of the Lorenz curve which lies far away from the line of equality (the 45-degree line or equi-distribution line) confirms the high income inequality in this study.

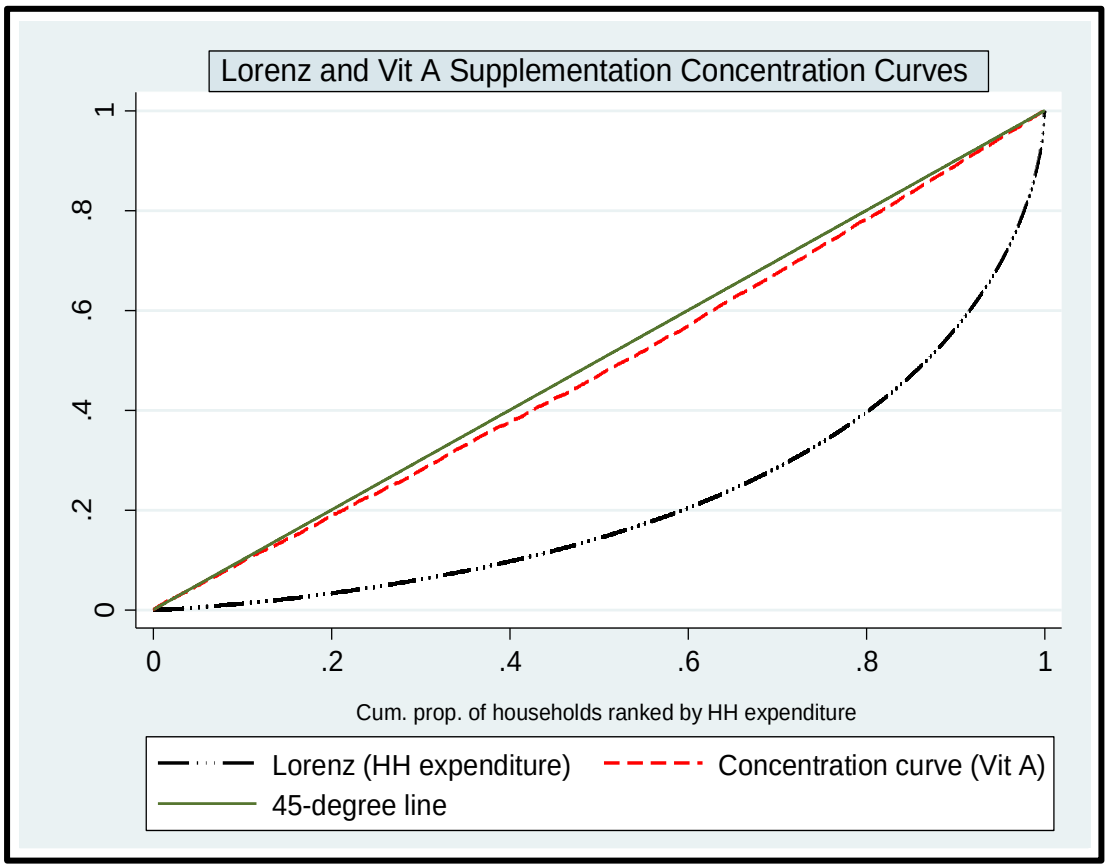

Figure 4: **Lorenz and Vitamin A supplementation concentration curves**

With regard to demand for VAS, the concentration curve lies below and close to the equi-distribution line indicating less inequality in VAS demand for the under-five children in Zambia. However, a close inspection of the graph (Figure 4) above suggests that demand for VAS was slightly greater among households with the highest income. The richest (20%) accounted for about 22 per cent of the total VAS demand. On the other hand, the poorest (20%) had a share of about 18 per cent of the overall demand for VAS for the under-five children in Zambia.

CHAPTER 5: DISCUSSION

In this Chapter, this study provides a detailed empirical discussion of the key findings of the multilevel mixed logistic regression models and income inequality analysis for vitamin A supplementation demand presented in Chapter 4 of this report.

5.1 Summary of Major findings

This study has demonstrated that demand for VAS is influenced by a number of socio-economic factors. In this present study, it was found that the age of the child, education and employment status of the mother were the significant predictors of the demand for VAS for under-five children in Zambia. Sex of the child and age of the mother were not significant predictors of VAS demand. Other variables that were statistically insignificant are household income, household size, sex and age of the household head. Education level of household head, employment status of the head of household, residence (urban or rural) and region (province) were the other variables which were statistically insignificant in the study's multivariate logistic regression. These findings have profound implications on how the VAS programme is implemented and presents new potential areas for future research.

The results of this study have revealed that age of the child was significantly associated with the likelihood of demand for VAS among the under-five children in Zambia. The results suggested that older children had increased odds of receiving VAS compared to the younger children. This result is in agreement with similar studies carried out elsewhere (Berger *et al.,* 2007; Akhter *et al*., 2008). These findings suggest that emphasis has been placed on other forms of immunizations in the younger children such as measles, OPV, BCG from both the supply and demand sides and little on VAS. This makes VAS secondary in the younger age group and not considered as among the key child survival interventions. As it has been

demonstrated in various empirical settings, low coverage of VAS is a missed opportunity to reduce all-cause and diarrhoeal related child mortality in Zambia. To change this picture, a re-assessment of the need of this critical intervention is required. It also calls for a re-design of the social mobilisation strategies emphasising the need to target and capture younger children with VAS during the bi-annual child health weeks.

This present study further revealed that the education of the mother was an important demand predictor of VAS for children in Zambia. The results suggest that children whose mothers had never attended school had decreased odds of demand for VAS. These findings are in line with what Berger *et al*. (2007) found in their study in rural Indonesia regarding the factors associated with children who are missed with VAS. Similar studies by Thapa (2009) and Davinder *et al.* (2008) in Nepal and Cambodia respectively also found that maternal education was associated with a child receiving VAS. These findings underscore the role of education in human life development and are consistent with literature which suggests a significant association between formal educational attainment and individual health outcomes (Baker *et al*., 2011). It is widely accepted that low education attainment results in low ability to assimilate health choices for improved health outcomes, and in this case the choice to demand for vitamin A supplementation.

A similar study by Ikeako *et al*. (2006) in Nigeria on the influence of formal maternal education on the use of maternity services pointed out that maternal educational level was the main predictor variable. In addition there is enough evidence which suggests that women's schooling is associated with much of the world's improvement in child survival and maternal and child health since the 1960s (Rowe *et al*., 2005). Higgins *et al.* (2008) in their review paper on health impacts of

education, pointed out to the fact that education is an important social determinant of health. At individual level, the knowledge, personal and social skills provided through education can better equip individuals to access and use information and services to maintain and improve their own and families' health.

According to the multivariate logistic regression results, children whose mothers were unemployed were less likely to have received VAS compared to the employed. Similar results were obtained by Akhter *et al.* (2008). A study by Choi *et al.* (2005) found that the socio-economically disadvantaged children were less likely to benefit from the national programme efforts than their better-off counterparts. They point to various studies that have suggested that high programme coverage does not necessarily imply equal use of the programme across different socioeconomic levels. Simkhada *et al.* (2008) in their systematic review of literature on factors affecting the utilisation of antenatal care (ANC) in developing countries also showed that women with high economic status were more likely to receive adequate and early ANC than those with low economic status. Equally, women who were working utilised the primary health care services more than housewives and the unemployed. This clearly underscores that access to primary health care services including VAS is influenced by a family's socio-economic status.

This study has equally demonstrated significant effect of community level factors on the demand for VAS. The results of this study revealed that about 88 per cent of the demand for VAS was attributed to community level factors. In this study, community level factors were not estimated directly due to data limitations. However, these were captured indirectly through the random effect parameter. The study asserts that there are factors that operate at community level which influence demand for VAS. There is enough evidence showing that utilisation of primary

health care services is affected by factors such as access – affected mainly by distance to the health delivery facilities, cultural factors or barriers, access to health promotional messages or information and economic activities. This study further argue that though the VAS is delivered mainly through CHWk whose primary objective is to increase the uptake by bringing this service as close to the family as possible by increased service delivery points (outreach sites), the number of these service delivery outreach points are not enough to ensure a greater target population is reached primarily due to human, material and financial constraints.

Oliver and Mossialos (2004) also contended that geographical proximity to the service delivery point, information, cultural beliefs, indirect financial costs, opportunity costs and preferences affect demand and access of primary healthcare services. Additionally, a study by Halwindi *et al.* (2013) in Mazabuka, Zambia suggested that low awareness levels on the importance of taking children for Child Health Week, long distances, poor communication and poor scheduling of health programmes were among the factors that were perceived to be barriers to accessing healthcare. It is therefore highly likely that VAS demand in this study was influenced by similar factors which were not estimated in our regression model.

This study finds a small income-related inequality in demand for VAS among children of 6-59 months with demand slightly greater among households with higher income. With support from cooperating partners, the Ministry of Health in collaboration with the National Food and Nutrition Commission in Zambia has continued providing vitamin A capsules for free in all health institutions routinely and during the bi-annual Child Health Week event undertaken to provide comprehensive primary health care services. Since these vitamin A capsules are

offered for free, it is thus highly likely that income-related inequality in the demand for VAS will be small as demonstrated in this present study.

There is enough evidence suggesting that VAS is a sustainable strategy that can be provided for free to target populations at low-cost (WHO, 2011). This can further be enhanced using an integrated approach with existing routine and campaign style programmes. It is further anticipated that as the VAS programme matures while gaining operational efficiency, sustainability will be achieved. However, heavy reliance on donor funding threatens the long-term sustainability of the free provision of this service to the community.

At its inception, Child Health Weeks, the main vehicle through which VAS is delivered, were mainly driven by huge donor funding with a focus on intensified community sensitization and social mobilization, supply and distribution of all the required logistics and supplies including monitoring and supervision during implementation. The government contribution was mainly the supply of human resources. However, the funding structure has changed in recent years. The government through Ministry of Health has increasingly taken up the ownership of the intervention by incorporating specific Child Health Week activities such as community sensitization, social mobilization, monitoring and supervision in the health sector specific action plans at all levels of healthcare system. Nonetheless, cooperating partners especially UNICEF, WHO and USAID have continued to support the acquisition and distribution of the vitamin A capsules in the country.

An assessment of the national vitamin A supplementation and deworming programme conducted in Tanzania by Mullins and Ehrlich (2011) pointed at various factors that can affect sustained increases in the uptake of VAS and ultimately having an impact on deficiency reduction. It is important to note that short supply of IEC

materials, a weak monitoring and evaluation and reporting system, shortages of vitamin A capsules compounded by delays in delivery and limited access to services especially in rural and remotes areas are some of the challenges which impact negatively on the VAS programme in various countries including Zambia. If not checked, these factors have the potential to limit and reverse the gains achieved so far towards virtual elimination of vitamin A deficiency in Zambia through VAS.

5.2 Limitations

This study has limitations just like any other research work. In this study, the 2010 LCMS data was used which is based on the self-reported information of respondents and there was no means of validating the provided information. Further, the 2010 LCMS dataset is from a cross sectional survey, therefore, the study could only examine the association between explanatory variables and the outcome variable. This study could not draw any conclusions about causality. Possibilities do exist that those associations found could be due to other factors not included in this study's models.

CHAPTER 6: CONCLUSIONS AND POLICY RECOMMENDATIONS

This study has demonstrated that individual and community (geographical) factors play a key role in the demand for vitamin A supplementation for under-five children in Zambia. Child's age was consistently associated with increased likelihood of the demand for VAS. Maternal education and employment status were also consistent strong demand factors for VAS among under-five children in Zambia. This present study concludes that younger children and those whose mothers are poor and less educated are consistently being missed by this very important child survival intervention.

The multilevel framework used in this study has demonstrated significant between-community variations in the demand for VAS among children of 6-59 months old. The role of community level factors as revealed by this study should not be understated as they have proved to be significant in the uptake of VAS. Therefore, it is necessary that programme managers, technocrats, policy makers, donors and other key stakeholders look beyond individual and geographical factors when examining health care seeking behaviours to raise the demand for this important life-saving strategy.

Using concentration curves, this study has shown a small income-related inequality for VAS demand as the service continues to be offered for free in public health facilities. Donors continue to be the major financiers of the intervention as the acquisition and distribution of the vitamin A capsules forms a greater expenditure component of VAS programme. The findings of this study offer an opportunity for follow-up researches including detailed investigation of community level factors that are associated with VAS demand which this study did not capture due to data limitations.

From the policy point of view, these results clearly show that children from households with poor access to resources and information do not get vitamin A supplementation. This study provides insights on the demand factors for VAS thereby providing a firm foundation for evidence-based programming for the VAS programme. Zambia has great potential of reaching the World Summit for children goal of elimination of vitamin A deficiency as a public health nutrition problem having put in place strategies such as VAS and food fortification which are anchored in the National Food and Nutrition Strategic Plan (2011-15). However, a well-coordinated resource mobilization and allocation plan to support these actions are required with a strong coordination mechanism by strengthening the legal and institutional frameworks of NFNC to influence decisions at all levels.

A strong monitoring and evaluation system is required which will provide data on process and impact indicators corresponding to key programme activities. Zambia continues to face resource constraints in carrying out regular nationally representative surveys on vitamin A and other micronutrients of public health significance. However, the need for a functional monitoring and evaluation system cannot be overemphasized which can be enhanced through population based surveys, post-distribution community level surveys and strengthened HMIS system for reporting routine VAS.

In terms of service provision, efforts should be made to ensure that all regions are equitably serviced with vitamin A supplementation during each round of Child Health Week through equitable distribution of resources and materials according to population size and local inputs. Strengthened IEC promotional campaign through targeted healthcare information and health promotion messages about Child Health Week and vitamin A supplementation should be employed which should commence

early enough for each round of Child Health Week. This calls for a design of campaign materials for VAS with a focus on the illiterate poor disadvantaged households in order to significantly raise the demand for VAS among the under-five children in Zambia. These campaign materials should equally endeavour to vigorously promote VAS among younger children raising its significance just as other immunisations such as polio and measles. These demand raising activities have proven to increase the uptake of vitamin A supplementation in various settings.

Supportive supervision and training to programme managers and services providers at all levels should be an integral part of VAS. There is also need to review the current financing arrangements for the VAS supported by a positive policy environment to assure its sustainability in the long-run.

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ANNEXES

Annex 1. Multivariate conditional logistic regression results

Dependent variable = vitamin A in last six months

Variable		OR	95% (CI)	p-value
Sex of the Child	Male (*ref*)	1.00		
	Female	1.01	(0.719 - 1.415)	0.961
Child Age	0 - 11 months (*ref*)	1.00		
	12 - 23 months	2.73	(1.633 - 4.573)	0.001
	24 - 59 months	2.34	(1.566 - 3.490)	0.001
Age of the Mother		1.00	(0.959 - 1.052)	0.861
Mother Education	Never attended school (*ref*)	1.00		
	Junior secondary education	2.04	(1.161 - 3.581)	0.013
	Senior secondary education	3.23	(0.941 - 11.100)	0.062
	Tertiary education	5.06	(1.145 - 22.381)	0.032
Mother's Employment status	Unemployed (*ref*)	1.00		
	Self-employed	1.43	(0.958 - 2.122)	0.080
	Employee	0.67	(0.272 - 1.630)	0.372
Sex of Household head	Male (*ref*)	1.00		
	Female	0.47	(0.103 - 2.172)	0.336
Education level of Household head	Never attended school (*ref*)	1.00		
	Junior secondary education	1.43	(0.734 - 2.787)	0.293
	Senior secondary education	1.97	(0.761 - 5.081)	0.163
	Tertiary education	0.91	(0.244 - 3.405)	0.891
Employment status of Household head	Unemployed (*ref*)	1.00		
	Self-employed	2.33	(0.824 - 6.587)	0.111
	Employee	1.36	(0.439 - 4.228)	0.591
Age of Household head		1.99	(0.462 - 8.574)	0.356
Household Income		1.07	(0.803 - 1.429)	0.641
Household Size		0.74	(0.381 - 1.421)	0.360
Residence	Rural (*ref*)	1.00		
	Urban	1.56	(0.974 - 2.502)	0.064
Province	Lusaka (*ref*)	1.00		
	Central	0.77	(0.348 - 1.713)	0.527
	Copperbelt	2.11	(0.722 - 6.181)	0.172
	Eastern	0.91	(0.428 - 1.930)	0.804
	Luapula	1.23	(0.583 - 2.591)	0.588
	Northern	1.07	(0.530 - 2.162)	0.849
	North-western	0.89	(0.372 - 2.142)	0.798
	Southern	0.89	(0.413 - 1.920)	0.767
	Western	1.23	(0.453 - 3.357)	0.681

Annex 2. Results of the Fixed Effects Model

Dependent variable = Child received vitamin A supplementation in last six months

Variable		OR	95% (CI)	p-value
Sex of the Child	Male (ref)	1.00		
	Female	0.94	(0.724 - 1.218)	0.636
Child Age	0 - 11 months (ref)	1.00		
	12 - 23 months	3.76	(2.551 - 5.550)	0.001
	24 - 59 months	3.03	(2.202 - 4.171)	0.001
Age of the Mother		1.00	(0.969 - 1.041)	0.813
Mother Education	Never attended school (ref)	1.00		
	Junior secondary education	1.74	(1.154 - 2.611)	0.008
	Senior secondary education	3.00	(1.283 - 7.016)	0.011
	Tertiary education	2.88	(1.061 - 7.808)	0.038
Mother's Employment status	Unemployed (*ref*)	1.00		
	Self-employed	1.54	(1.136 - 2.085)	0.005
	Employee	0.81	(0.416 - 1.575)	0.533
Sex of Household head	Male (ref)	1.00		
	Female	1.06	(0.191 - 5.832)	0.950
Education level of Household head	Never attended school (ref)	1.00		
	Junior secondary education	1.30	(0.787 - 2.163)	0.302
	Senior secondary education	1.63	(0.803 - 3.309)	0.176
	Tertiary education	0.96	(0.388 - 2.365)	0.926
Employment status of Household head	Unemployed (*ref*)	1.00		
	Self-employed	0.80	(0.342 - 1.889)	0.617
	Employee	0.73	(0.286 - 1.850)	0.504
Age of Household head		1.05	(0.351 - 3.149)	0.928
Household Income		1.02	(0.826 - 1.262)	0.849
Household Size		0.58	(0.262 - 1.286)	0.180
Residence	Rural (*ref*)	1.00		
	Urban	1.35	(0.961 - 1.906)	0.083
Province	Lusaka (*ref*)	1.00		
	Central	0.87	(0.445 - 1.710)	0.691
	Copperbelt	1.47	(0.728 - 2.967)	0.282
	Eastern	0.87	(0.455 - 1.675)	0.684
	Luapula	1.22	(0.641 - 2.336)	0.541
	Northern	0.99	(0.538 - 1.816)	0.971
	North-western	1.22	(0.614 - 2.416)	0.573
	Southern	0.82	(0.437 - 1.533)	0.532
	Western	0.95	(0.421 - 2.149)	0.903

Annex 3. Results of the Random Effects Model

Dependent variable = Child received vitamin A supplementation in last six months

Variable		OR	95% (CI)	p-value
Sex of the Child	Male (ref)	1.00		
	Female	0.94	(0.725 - 1.213)	0.623
Child Age	0 - 11 months (ref)	1.00		
	12 - 23 months	3.80	(2.579 - 5.597)	0.001
	24 - 59 months	2.89	(2.131 - 3.913)	0.001
Age of the Mother		1.01	(0.971 - 1.042)	0.755
Mother Education	Never attended school (ref)	1.00		
	Junior secondary education	1.72	(1.147 - 2.577)	0.009
	Senior secondary education	2.81	(1.211 - 6.500)	0.016
	Tertiary education	2.65	(0.983 - 7.123)	0.054
Mother's Employment status	Unemployed (*ref*)	1.00		
	Self-employed	1.53	(1.131 - 2.066)	0.006
	Employee	0.80	(0.413 - 1.565)	0.521
Sex of Household head	Male (ref)	1.00		
	Female	1.17	(0.213 - 6.400)	0.857
Education level of Household head	Never attended school (ref)	1.00		
	Junior secondary education	1.31	(0.795 - 2.160)	0.289
	Senior secondary education	1.64	(0.818 - 3.306)	0.163
	Tertiary education	0.99	(0.404 - 2.421)	0.981
Employment status of Household head	Unemployed (*ref*)	1.00		
	Self-employed	0.85	(0.363 - 1.990)	0.707
	Employee	0.77	(0.306 - 1.956)	0.587
Age of Household head		1.16	(0.388 - 3.440)	0.796
Household Income		1.01	(0.816 - 1.243)	0.949
Household Size		0.84	(0.550 - 1.346)	0.462
Residence	Rural (*ref*)	1.00		
	Urban	1.35	(0.959 - 1.899)	0.085
Province	Lusaka (*ref*)	1.00		
	Central	0.88	(0.449 - 1.718)	0.704
	Copperbelt	1.46	(0.724 - 2.948)	0.290
	Eastern	0.87	(0.451 - 1.663)	0.665
	Luapula	1.22	(0.642 - 2.333)	0.540
	Northern	1.00	(0.545 - 1.826)	0.994
	North-western	1.28	(0.650 - 2.538)	0.472
	Southern	0.81	(0.435 - 1.518)	0.516
	Western	0.96	(0.428 - 2.174)	0.930

Annex 4: Comparison between three different models

COMPARISON BETWEEN CONDITIONAL LOGISTIC, FIXED AND RANDOM EFFECTS MODELS							
Variables		**LOGISTIC**		**FIXED**		**RANDOM**	
		Estimates	**OR**	**Estimates**	**OR**	**Estimates**	**OR**
Sex of the Child	Female	0.008	1.01	-0.063	0.94	-0.065	0.94
Child Age	12 - 23 months	1.005	2.73	1.325	3.76	1.333	3.80
	24 - 59 months	0.849	2.34	1.109	3.03	1.060	2.89
Age of the Mother		0.004	1.00	0.004	1.00	0.006	1.01
Mother Education	Junior secondary education	0.713	2.04	0.552	1.74	0.542	1.72
	Senior secondary education	1.173	3.23	1.099	3.00	1.031	2.81
	Tertiary education	1.622	5.06	1.057	2.88	0.973	2.65
Mother's Employment status	Self-employed	0.355	1.43	0.431	1.54	0.424	1.53
	Employee	-0.408	0.67	-0.212	0.81	-0.218	0.80
Sex of Household head	Female	-0.748	0.47	0.054	1.06	0.156	1.17
Education level of Household head	Junior secondary education	0.358	1.43	0.266	1.30	0.270	1.31
	Senior secondary education	0.676	1.97	0.489	1.63	0.497	1.64
	Tertiary education	-0.092	0.91	-0.043	0.96	-0.011	0.99
Employment status of Household head	Self-employed	0.846	2.33	-0.218	0.80	-0.163	0.85
	Employee	0.310	1.36	-0.318	0.73	-0.258	0.77
Age of Household head		0.688	1.99	0.051	1.05	0.144	1.16
Household Income		0.069	1.07	0.021	1.02	0.007	1.01
Household Size		-0.307	0.74	-0.543	0.58	-0.178	0.84
Residence	Urban	0.445	1.56	0.303	1.35	0.300	1.35
Province	Central	-0.259	0.77	-0.136	0.87	-0.130	0.88
	Copperbelt	0.748	2.11	0.385	1.47	0.379	1.46
	Eastern	-0.095	0.91	-0.135	0.87	-0.144	0.87
	Luapula	0.206	1.23	0.202	1.22	0.202	1.22
	Northern	0.068	1.07	-0.011	0.99	-0.002	1.00
	North-western	-0.114	0.89	0.197	1.22	0.250	1.28
	Southern	-0.116	0.89	-0.200	0.82	-0.207	0.81
	Western	0.210	1.23	-0.050	0.95	-0.036	0.96
Intercept		-4.568				-1.112	
$lnsigma^2$						-14.624	