DETERMINANTS OF NUTRITIONAL OUTCOMES AMONG CHILDREN UNDER FIVE YEARS OF AGE IN UGANDA

BY

HAPPY PROVIDENCE

MAKERERE UNIVERSITY

2013.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS

UFNP	Uganda Food and Nutrition Policy
FAO	Food and Agricultural Organisation
WHO	World Health Organisation
UNAS	Uganda National Academy of Sciences
BMI	Body Mass Index
NDP	National Development Plan

ABSTRACT

Malnutrition rates among children 0-59 months in Uganda are high and vary across rural and urban locations, geographical regions and households of varying socio- economic, demographic and biophysical factors, constituting a significant concern. Using Uganda National Panel Survey 2009/2010 data, it was sought to understand better the determinants and their magnitude of influence on child nutritional outcomes. It was also sought to understand whether these determinants differ significantly in terms of their effects across the domains. A probit regression model was employed while assessing the determinants of the nutritional outcomes in children.

Following the study findings, stunting was found to be at 28.7 %, underweight at 11.8% and wasting at 2.3%.

Vitamin A supplementation reduces the chances of a child being underweight and wasted and this call for the relevant ministries and the government to ensure that both the children and mothers are given these Supplements and other mineral supplements to boost their immunity and ensure proper growth. This recommendation falls in the field of health.

The finding that engagement in agriculture reduces the chances of a child being malnourished, clearly portrays the role agriculture plays in availing food for household consumption and other uses including income. Agricultural products increase dietary diversity and this income may be used to pay for health services. This follows both agricultural and nutrition direction. Therefore agriculture should be encouraged followed by nutrition –consumption of the varieties of the foods produced by the relevant ministries, the government and the households themselves to get down the levels of malnutrition.

The model did not present significant outcome for the Eastern and Northern region implying that there are other determinants of nutritional outcomes in children in the Northern and Eastern regions other than those hypothesized and should thus be analysed.

INTRODUCTION

There has been concern about the high prevalence of hunger and malnutrition in a world that has the capacity to feed its people for over 50years (UFNP, 2003). Even with the reported increase in food production, some families especially those in the developing world continue to have insufficient amounts of food supplying sufficient daily energy and protein. Haddad (2008) puts the estimate of the undernourished at 2-3 billion people worldwide. Populations affected mainly depend on subsistence agriculture and are predominantly rural (UFNP, 2003). Agriculture is the primary source of calories and essential nutrients and is, presently, a major source of income for 80% of the world's poor (IFPRI and ILRI, 2010).

In Uganda, agriculture production is among the major source of food stuffs. Production is high and of a variety (Table 1) and it includes production of cereals such as maize, millet and sorghum; root crops such as cassava, sweet potatoes and Irish potatoes, bananas and pulses like beans and peas.

Table 1: Regional crop production in Uganda for the year 2008

Type of enterprise	Crop production(metric tons)	Region			
		Central	Eastern	Northern	Western
Plantain bananas	Plantain bananas	1,039,837	342,234	31,626	2,883,648
Cereals	Finger millet	13,734	106,838	78,572	77,784
	Maize	449,859	1,108,554	305,798	497,745
	Sorghum	2,678	133,313	177,088	62,716
	Rice	2,173	128,195	43,719	16,649
Root crops	Sweet potatoes	312,402	847,140	292,932	366,295
	Irish potatoes	12,290	4,624	1,311	135,210
	Cassava	409,812	1,061,186	983,124	440,189
Beans	Beans	167,276	98,834	251,221	411,945
Pulses	Field peas	302	3,233	411,945	2,489
	Cowpeas	281	7,086	3,429	261
	Pigeon peas	0	219	11,031	80
Oil crops	ground nuts	32,757	77,247	83,182	51,497
	Soya	208	5,801	15,727	1,887
	Simsim	127	6,774	93,562	565

Source: UCA 2008/2009

With this great agricultural production capacity, we would expect better nutrition status of the citizens although this is not always the case. The country still faces problems of malnutrition and there exists pockets of famine and hunger as well. Some households do experience food shortages always or during some seasons in the year. UCA's 2008/2009 report shows significant numbers of households that experienced food shortage countrywide representing 51.4% of the total number of agricultural households. Putting aside high production that does not translate to expected nutritional outcomes, food shortages may lead to different nutritional outcomes resulting from the responses that households which are victims to this condition take. For example UCA (2009) reports the responses to food shortage as skipping meals, eating less

preferred food and reducing the size of meals which all contribute significantly to inadequate dietary intake and consequently malnutrition.

In addition to dietary intake that may be a result of food shortages as highlighted in the Census of Agriculture (2008/2009), UNFP (2003) puts forward other causes of malnutrition which are multi-factorial and complex. They include among others diseases especially HIV/AIDS, inadequate maternal and child caring practices, inadequate environmental sanitation and health services, illiteracy, family instability, lack of nutrition knowledge, frequent births, poor weaning practices, low family earnings, and social and political instability. Agriculture and these other factors thus need to be well understood as well as their magnitudes of their effect on nutritional status. Countrywide the proportions of the malnourished are high, both under nutrition and obesity (UNAS, 2011) and among children who are the focus in this study, UDHS (2006) reports 38% of children under five years of age stunted, six percent of children wasted and 16% underweight.The high levels of malnutrition among children within the country (UDHS, 2006) qualifies children to form the most vulnerable group of this study, secondly early childhood malnutrition has irreversible consequences in life (Shrimpton *et al.*, 2001) and has an impact on child's health and development physical, mental and social.

Malnutrition also causes economic loss to the country for example the long-term economic impact of the level of stunting coupled with high levels of iron-deficiency anemia, iodine-deficiency disorders, and low birth weight have been estimated at US$310 million loss annually due to lost productivity, representing a 4.1% reduction in Uganda's Gross Domestic Product (Namugumya, 2011).

However such a situation can be reversed. The overall objective of the Uganda Food and Nutrition Policy is to promote the nutritional status of all the people of Uganda through multi-sectoral and coordinated interventions that focus on food security, improved nutrition and increased income (UFNP, 2003).

Uganda by virtue of its agro-ecological conditions is endowed with high potential for agricultural development and produces sufficient food to meet the needs of the rapidly growing population, but the proportion unable to access adequate calories increased from 59 percent in 1999 to 69 percent in 2006 (Mwadime *et al.*, 2010). As earlier noted UDHS (2006) reports the persistent high rates of malnutrition among children and this condition (malnutrition) or state of health relates to the high rates of infant and child mortality in the country. Much as most of the deaths are attributed to some preventable infectious diseases such as pneumonia, diarrhea, and malaria and to neonatal diseases, malnutrition is the underlying cause of death in nearly 60 percent of cases (MoH, 2009).

The determinants of nutritional outcomes as observed in the forms of stunting, wasting and underweight are diverse. They include among others food availability, levels of health and hygiene, demographic factors such as age and education level of mothers (Godfrey and Younger, 2005). They also include community level factors such as availability of nutrition education programs. Others are socioeconomic including income status of the household, family size and dependency ratio.

In the Ugandan situation, most of these factors are not adequately understood and even for the known factors, the magnitude of their impact and or their relative strengths of their impact on

nutritional outcomes across regions is not well known. Thus it is imperative to study the determinants of nutritional outcomes and the magnitudes of these determinants such that appropriate interventions are designed to prevent malnutrition. With such information availed, together with an integrated approach involving line ministries and other stakeholders such as universities, hospitals, NGOs and CBOs it can contribute to reducing children malnutrition greatly. And with limited resources, policy makers would need to know this information so as to set the correct policy and priorities.
The set hypotheses were that levels of nutritional outcomes are not significantly different in the four regions of the country and household engagement in agriculture positively reduces malnutrition in children.

The study derives its justification from the importance of adequate nutrition which is an essential prerequisite for maintaining health status. Adequate nutrition has internationally been recognized as one of the key factors in human development and economic productivity (NDP, 2010). Investment in nutrition is necessary because nutrition plays a critical role in health and development and such an investment is a necessary prerequisite for further progress towards the Millennium Development Goals (MDGs), particularly that of hunger and health MDGs in Uganda.

The study will increase the understanding of the determinants of nutritional outcomes of children across the regions and households with diverse socioeconomic, demographic and biophysical factors. This research will also contribute to a better understanding of the interaction among agriculture, health, nutrition and demographic factors[1] in determining nutritional outcomes and this forms the academic value of this research.

Nutrition and health are linked to agriculture in many ways. Anything that affects agriculture has the potential to affect health and nutrition, and anything that affects health and nutrition has the potential to affect agriculture (IFPRI, 2011). There is strong empirical evidence that addressing single causal factor of malnutrition is seldom effective, because constraints to good nutritional status are often interrelated. Therefore, strategies to remove constraints on access to food either through income generation, food supplementation or agricultural production may have limited impact on nutritional status if not accompanied by efforts to remove other constraints, such as limited access to health services, vaccination or even lack of knowledge about appropriate feeding thus the need to analyze the determinants of malnutrition along the fields of agriculture, nutrition and health.
This interaction is a new research frontier and this study will add to the limited body of knowledge in this area.
The developmental value of this research is that, the results will serve to inform policy makers and contribute to the design of policies and promoting for improved child nutrition in Uganda. It is hoped that relevant interventions would then be designed with the view of reducing the incidence of malnutrition.

[1] Most of the determinants of malnutrition fall under the fields of agriculture, nutrition and health.

LITERATURE REVIEW

Nutritional outcomes

Nutritional status in children is determined in surveys using measurements of a child's height, weight and age. Three indices of nutritional status are typically constructed from these measurements. These are weight-for-age, height-for-age, and weight-for-height. These measurements are compared against an international reference population to determine whether or not a child is malnourished. Thus malnutrition in children manifests in a number of forms which are the outcomes of the above indices. The forms present themselves as stunting, wasting and underweight. MOH, (2009) refer stunting to mean short stature relative to reference children of the same age, and results from inadequate nutrient intake over a long period of time. Underweight, similar to stunting, is a comparison of a child's weight to that of other children of the same age. Weight-for-age, or underweight, is an indicator used to assess both acute and chronic malnutrition. Underweight children have a weight for age that falls below -2z scores. Severely underweight children have a weight for age below -3z scores.

MOH (2009) further defines other indicators such as wasting that indicates low weight compared with reference children of the same height, and is an indicator of acute malnutrition occurring within a relatively short time period. Wasting often results from recent episodes of illness, and also is common in cases of food shortages resulting from complex emergencies.

Most studies done countrywide have used stunting as a malnutrition indicator for example Bahiigwa and Younger, (2005) while determining children health status in Uganda. Thus stunting is an important predictor of child development; it is associated with reduced school outcome. Compared to children who are not stunted, stunted children often enroll later, complete fewer grades and perform less well in school. In turn, this underperformance leads to reduced productivity and income-earning capacity in adult life (UNICEF, 2009).

Determinants of nutritional outcomes

There have been efforts to examine the extent, nature and determinants of children nutritional status within the country and the whole of East Africa. Biondi *et al.,* (2011), Kabubo-Mariara *et al.,* (2009), Amegah, (2009), Rahman, Mostofa and Nasrin, (2009), Haddad (2008) and Girma and Genebo, (2002) are some of the studies that have attempted to describe these determinants.
Some of these studies have demonstrated that significant differences in nutritional attainment are observed among children of different population groups within and between countries. Often these differences follow a pattern along socio-economic strata. These studies highlight a number of the determinants of children nutritional status and they include maternal education in addition to general parental level of education (Kabubo-Mariara *et al.*, (2009), Turyashemererwa, Kikafunda and Agaba, (2009), Amegah, (2009), Haddad, (2008), Godfrey and Stephen, (2005), Ssewanyana, (2003), Girma and Genebo (2002), Christiaensen and Alderman, (2001) and Haddad, (2000)), access to health services and vaccination (Kasirye, (2010), Kabubo-Mariara *et al.,* (2009) and Amegah (2009), Action Against Hunger, (2006)) and lack of diet diversity (Action Against Hunger, 2006) among others.

Girma and Genebo (2002) found out that, women who receive even a minimal education are generally more aware than those who have no education of how to utilize available resources for the improvement of their own nutritional status and that of their family members. Similar results

were obtained by smith and Haddad, (2000). Education may enable women to make independent decisions, to be accepted by other household members, and to have greater access to household resources. Related to this is that general Parental education has a positive and significant effect on child nutrition. And as earlier noted, parental education is associated with more efficient management of limited household resources, greater utilization of available health care services, better health promoting behaviors, lower fertility and more child-centred caring practices which are all factors related to child health and better nutrition.

In addition, Haddad, (2008) found out that better nutrition status cannot be achieved when women are uneducated. In Kenya, similar results were obtained by Kabubo-Mariara *et al*., (2009) and Amegah, (2009) that maternal education is a significant determinant of child nutrition. And in Ethiopia, both female and male adult education has a large positive and statistically significant effect on the child's nutritional status (Christiaensen and Alderman, 2001) while in among urban poor households in Uganda each of the parents education level has different impacts on the nutritional outcome of either sexes for example maternal education has a strong effect on the long term nutritional status of girls while paternal education has a strong effect on that of boys (Ssewanyana, 2003).

Bahiigwa and Younger, (2005) also found out that the level of education of the mother has a statistically positive effect on children level of stunting. Better educated mothers have taller children. This is probably because education attainment affects children's heights directly through the mother's ability to obtain and process health information, and indirectly through the mother's ability to earn income.

Most studies done in East Africa have showed that access to health facilities is a significant determinant of child nutrition. For example, Kabubo-Mariara *et al*., (2009), using the 1998 and 2003 Demographic and Health Survey data, the use of public health services is a key factor in child nutritional status in Kenya. Similarly, Amegah (2009) found out that fully immunized children had better nutritional status than partially immunized children. Action Against Hunger, (2006) reveal also that improper access to health care, that was translated to poor vaccination coverage caused malnutrition while reporting the results of the nutrition survey in IDP camps, Apac district, Northern Uganda.

Living in rural areas is a risk factor for malnutrition in children in countries such as Vietnam. This could probably due to differences in economic levels and cultural and social security, lack of social security causes poor accessibility to education and health services (Hien and Hoa, 2009).

The agricultural sector has a significant influence on malnutrition for example it is noted that the agricultural sector is very important to the economic development in Uganda and is credited for its contribution to national food self-sufficiency and food security. It accounts for over 40% of GDP and more than 90% of export earnings (Kasirye, 2003).Intervention in agriculture presents one of the approaches to improve household nutrition and these approaches need to be designed to achieve better nutritional outcomes. Most agricultural interventions affect the household's nutritional status through support of production for household consumption and/or improving income-generation (Bonnard, 1999). There are pathways that lead to the main goal or reducing malnutrition for example generating income from sale in markets, subsistence-oriented production for the household's own consumption, the reduction in real food prices associated with increased agricultural production, the empowerment of women as agents instrumental to

household food security and health outcomes and the indirect relationship between increasing agricultural productivity and nutrition outcomes through the agriculture sector's contribution to national income and macroeconomic growth (Mwadime *et al*.,2010).

Methods used in other studies

Turyashemererwa, Kikafunda and Agaba, (2009) employed bivariate analysis to analyse the level of stunting in Kabarole district in south western Uganda. Chi-square tests were conducted to reveal factors significantly related to children levels of stunting in the district. Kikafunda and Namusoke, (2006) also used bivariate analyses to assess the determinants of nutritional status of HIV orphaned children in Rakai District, Uganda but for them, they assessed in addition to stunting, both underweight and wasting. These two studies did look at the influencing factors of nutritional status but the direction of influence and the magnitude to which the assessed factors influenced children nutritional status was not determined.

Kasirye (2010) employed ordered Probit estimation to identify the key determinants of malnutrition over time across the four East African countries and how the various determinants have changed overtime for malnourished and severely stunted children. These two categories of nutritional status were distinguished and the ordered probit model was used because it accounts for any difference in the severity of malnutrition and because the measure of stunting was ordinal. Again the approach used did not assume that various states of stunting were equally spaced, but ranked them from the best nutritional status to the worst. Whereas in this study, both stunting, wasting and underweight which are the categories of children nutritional status used are both nominal and the severity of either status was not considered. It is the magnitude of the factors that is of concern in this study. Again this study is cross sectional in nature.

Hien and Hoa, (2009) used the hierarchical logistic regression to analyze the nutritional Status and the determinants of malnutrition in children under three years of age in Nghean, Vietnam. They analysed the effects of child feeding practice, socioeconomic and demographic factors on nutritional status of children. In the 1st step of the hierarchical logistic regression, age and gender variables and all distal factors were added into the model. In the second step of the analysis all intermediate factors, together with the socioeconomic variables that were significant in the 1st step and child's age and sex, were added. Intermediate variables that were significant in the 2nd step, all distal variables included in the previous model, child's age and sex and all variables of proximal factors (individual variables) were added into the final model. This hierarchy was used because the variables in question were grouped into three as per the conceptual framework but in this study, all the determinant variables are mixed up. The framework that was used to analyse the determinants of malnutrition in children analyses all the variables as being at the same level of influence and that the variables used in this case are not related or they do not influence each other. It is the direction and the magnitude of effect that were important in this study. The same approach of the hierarchical logistic regression model was used by Wamani *et al.,* (2005) while assessing the determinants of poor anthropometric status in Hoima district western Uganda.

Walton *et al.,*(2009) employed the qualitative model of the economic determinants childhood nutrition within a household setting in New Zealand. While Rahman, Mostofa and Nasrin, (2009) employed the multivariate logistic regression methods to analyse the determinants of nutritional status of children 25-59 months in rural Bangladesh.

METHODS USED

The Model

A structural causal web of the determinants of nutritional outcomes has been presented which includes proximal causes such as socio-economic, physical, environmental, political, and social then underlying causes such as income poverty, food insecurity, employment, inadequate care, and household conditions and immediate causes such as inadequate dietary intake and disease (Muller and Krawinkel, 2005). The specific causal paths between these factors and child nutritional outcomes are complex. However deviating from this framework, this study has sought to explain the determinants of child nutritional outcomes from the interaction of agriculture, nutrition and health and thus the factors analyzed fall under these fields.

We aimed to explain the factors affecting nutritional outcomes of children. Given the dichotomous nature of the consumer (household)[2], a qualitative response model is appropriate.

Unordered, categorical dependent variables are modeled with Qualitative response models or a probabilistic choice model that is an extension of a standard linear model, in which each choice is modeled with a separate equation including the predictors and an error. Categorical variables are those variables whose measurement scale consists of a set of categories. For such responses, the use of continuous data analytical methods is inappropriate.

In categorical dependent variable models, the left-hand side variable or dependent variable is neither interval nor ratio, but rather categorical. The level of measurement and data generation process of a dependent variable determine a proper model for data analysis. Binary responses (0 or 1) are modeled with binary logit and probit regressions, ordinal responses (1st, 2nd, 3rd, …) are formulated into or generalized ordinal logit/probit regressions, and nominal responses are analyzed by the multinomial logit (probit), conditional logit, or nested logit model depending on specific circumstances. Independent variables on the right-hand side are interval, ratio, and/or binary (dummy).

Thus in this study, the random variable is not continuous but dichotomous and so econometric modeling that employs linear models to estimate the effect of the explanatory variables on the observed economic phenomena will not apply.

Linear models are of the form;

$Y = \alpha + \sum_{i=1}^{n} \beta_i X_i + e$ ……(1)

Where Y is a continuous random variable, X =$X1…X$n are the variables that explain Y, α is a constant and β=$\beta_1 \dots \dots \beta_n$ are the parameters that ultimately describe the effect a change in X has on Y. i denotes the i-th individual and n is the number of observations.

Qualitative response models relate the probability of an event to various independent variables. In order to provide a detailed analysis of the preference for a nutritional outcome, malnourished or normal children, we applied a discrete choice probit model for binary choice (yes, no) outcome results of the nutritional status of children.

[2] It is assumed that a household is a consumer and will have a choice between a malnourished child and a normal one. Since interest is in getting the determinants of malnutrition, higher utility is attached to malnutrition than a child being normal. Thus malnutrition is coded as 1, while normal 0.

The probit model is a statistical probability model with two categories in the dependent variable (Liao, 1994). Probit analysis is based on the cumulative normal probability distribution. The binary dependent variable, y, takes on the values of zero and one (Adrich &Nelson, 1984).
The probit analysis provides statistically significant findings of which the assessed determinants increase or decrease the probability of malnutrition.

In the binary probit model, preference for malnutrition was taken as 1, while normal as 0. It is assumed that the household obtains maximum utility, when it has preference for malnourished children rather than for normal children (malnutrition is coded 1, and normal 0 because interest is in determining the causes of malnutrition).

There are many specific probabilistic choice models and or variants. They include; linear probability model, Logit model and the probit model.
The general formulation of the probability models is given by

$$\Pr\left(y_i = {}^{1}/_{X_i}\right) = F(X_i\beta) \quad \text{.....(2)}$$

Where F is some function that returns values in the [0, 1] interval. The model is also known as single index model, since the explanatory variables affect the probability through the linear index.

$$I_i = X_i\beta \quad \text{.....(3)}$$

The most common variants of this model choose F to be a cumulative distribution function. If F is the cumulative standard normal, the resulting model is known as the probit model while if F is the cumulative standard logistic distribution it gives the logit model. That is several alternative random utility models of discrete choice can be derived depending on the assumptions about the error terms.

The probability P_i of choosing any alternative over not choosing it can be expressed as in equation (4) where $\emptyset$ represents the cumulative distribution of a standard normal random variable (Greene, 2011).

$$P_i = Prob\left(Y_i = {}^{1}/_{X}\right) = \int_{-\infty}^{x_i'\beta} (2\pi)^{-1/2} \exp\left(-\frac{t^2}{2}\right) dt = \emptyset(x_i'\beta) \quad \text{.....(4)}$$

The relationship between a specific variable and the outcome of the probability is interpreted by means of the marginal effect, which accounts for the partial change in the probability.

Marginal effects are computed because the slope of the probability curve is not constant, but depends on the values of an independent variable of interest and other variables. Coefficients just tell the direction of the impacts and the extent with which the probit curve is stretched. So, marginal changes and discrete changes are necessary in such a model to interpret results effectively. In summary, parameter estimators do not provide readers with any intuitive idea about how individual independent variables affect the probability of an event in which they are most interested.

The marginal effect associated with continuous explanatory variables X_k on the probability $P(Y_i = 1/X)$, holding the other variables constant, can be derived as follows (equation 5) (Greene, 2011).

$$\frac{dp_i}{dx_{ik}} = \emptyset(x_i'\beta)\beta_k \quad \text{.....(5)}$$

where ∅ represents the probability density function of a standard normal variable.
The marginal effect on dummy variables should be estimated differently from continuous variables. Discrete changes in the predicted probabilities constitute an alternative to the marginal effect when evaluating the influence of a dummy variable. Such an effect can be derived from the following (equation 6) (Greene, 2011).

$\Delta = \emptyset(\bar{x}\beta, d = 1) - \emptyset(\bar{x}\beta, d = 0)$ ……..(6)
The marginal effects provide insights on how the explanatory variables shift the probability of a household having a malnourished child.

The Empirical model and specification

The chances that a child is has a specific nutritional outcome is assumed to be the outcome of a complex set of factors related to the household, the child and the environment with which the child lives. The factors may be agricultural, health, nutrition related, socio-economic, demographic and biophysical.

Dependent variable

In the regression model, nutritional outcome was taken as the dependent variable as it conveys the state of nutritional status. The nutritional outcomes that were considered are malnutrition and normal. A child is malnourished if it is stunted, wasted, underweight, any combination of two indicators of malnutrition or both indicators. For purposes of the probit model, only wasting and underweight were considered thus a malnourished child in the model is one that is underweight, wasted or both. The malnourished were compared to normal children. In this analysis, nutritional outcome was measured as a binary variable taking the value 1 or 0 (1 for malnutrition and 0 for normal).

Independent variables

The independent or explanatory variables are employed to identify the contribution of each variable to nutritional outcome. Whether the child had received Vitamin A supplementation , engagement in crop production, rural urban identifier, Age of the child in months, age of first introduction of food, presence of infections including fever and diarrhea, household size, geographical region are some of the variables considered. The guides to the selection of the determinants were consideration of variables based on the relevance to the study's research question, variables known to be of considerable interest of policy making and intervention, the available data in the UNPS 2009/2010 dataset and the conceptual framework for the causes of child malnutrition.

There was no direct variable to measure household food insecurity. The proximal determinant closely associated with household food insecurity such as the number of people in the household was used as a proxy measure.

To measure mothers' education, the variable mother's education level was used in this study.
Women who receive minimal education are generally more aware than those who have no education of how to utilize available resources for the improvement of their own nutritional status and that of their family members (Girma &Genebo).

Children who have received Vitamin A are expected to be well nourished nutritionally. Supplementation with Vitamin A and or other mineral supplements as a preventative measure is

the most cost-effective health intervention for reducing the risk of childhood death and disease. It boosts children's immunity to fight against disease, maintain the right food intake and gain the required weight and height at the respective age. The supplements ensure proper growth and development. Vaccination against measles (measles vaccine); vaccination against measles and other immunisable diseases also reduces chances of infection and ensures proper growth in children.

Household engagement in agriculture is expected to negatively influence malnutrition in children and is thus expected to have negative signs on the coefficients of stunting, underweight and wasting while positive signs expected for Normal nutritional outcome. Agriculture provides products of great diversity in terms of diet to the household and is a source of income. Increase in agricultural income is expected to improve household welfare that includes child nutrition and health among others thus a negative sign.

Location of residence, defined as rural or urban was also included. Although area of residence often tends to be a confounder of other socio-economic factors such as income, in this case the interest is in its effect holding all the other factors constant. The question is whether living in a rural area influences a child's proneness to malnutrition. Urban areas tend to register lower levels of child malnutrition rates because of differences in access to resources and services and educational levels of mothers between urban and rural locations.

Geographical region was employed as an independent variable in the explanatory analyses. There were four regions of residence- Central, Western, Eastern and Central regions.

Data and sources

Data that were used in this study was Uganda National Panel Survey (UNPS) data collected by UBOS as the primary investigators affiliated to Uganda, Ministry of Finance, Planning and Economic Development. The data were collected between September 2009 to August 2010 covering duration of one year and the mode of data collection was by direct face to face interviews.

The units of analysis in the data included; Households, individuals, markets and communities/facilities. Data comprised of Household Identification Particulars and Geographic Identification, Information on Household Members, Education (all persons 5 years and above), Health, Child Nutrition and Health (for all children 0-59 months old), Disability cases, Labor Force Status (for all household members 5 years and above) and Household Consumption expenditure. Data also comprised of information about women including Contraception and Birth Related Issues and Information on Last Child Born in the Last Five Years (whether living or dead). Agricultural data comprised of Current Land Holdings, Livestock Ownership, expenditure, products and income. The community/facility data comprised of Client Satisfaction with Health facilities (with reference to the health facility), report of common diseases and infrastructure.

Market data comprised of consumer goods, key commodities traded and barriers to Market Performance.

Study area, sampling strategy and data analysis

The study area is the whole country Uganda, covering representative samples from all regions of Central, Northern, Eastern and Western.

Sampling strategy

With the 2009/10, the UNPS was set to track and re-interview 3,123 households that were distributed over 322 enumeration areas (EAs), selected out of the 783 EAs that had been visited by the Uganda National Household Survey (UNHS) in 2005/06. The UNPS EAs covered all 34 EAs visited by the UNHS 2005/06 in Kampala District, and 72 EAs (58 rural and 14 urban) in each of the (i) Central Region with the exception of Kampala District, (ii) Eastern Region, (iii) Western region and (iv) Northern region.

Within each stratum, the UNPS EAs were selected from the UNHS 2005/06 EAs with equal probability, and with implicit stratification by urban/rural and district, except for the rural portions of the ten districts that were oversampled by the UNHS 2005/06. In these districts, the probabilities were deflated, to bring them back to the levels originally intended. IDP camps later became unoccupied by 2009/10, the extra EAs in IDP camps were thus not included in UNPS subsample. This allocation strives for reasonably reliable estimates for the rural portion of each region, and for the set of urban areas out of Kampala as a whole, as well as the best possible estimates for Kampala that can be expected from a subsample of the UNHS 2005/06. Therefore, the UNPS strata of representativeness include (i) Kampala City, (ii) Other Urban Areas, (iii) Central Rural, (iv)Eastern Rural, (v) Western Rural, and (vi) Northern Rural.

Prior to the start of the 2009/10 field work, 2 UNPS households were also randomly selected in each EA for the purposes of tracking baseline individuals that moved away from original locations since the UNHS 2005/06. The initial UNPS sample was subjected to three consecutive waves of data collection after which, parts of the sample were replaced by new households extracted from the updated sample frames developed by the UBOS as part of the 2012 Uganda Population and Housing Census.

Data analysis

In this study, height and weight measurements of the children, taking age into consideration, were converted into Z-scores based on the National Center for Health Statistics (NCHS) reference population recommended by the World Health Organization (WHO). Thus, those below -2 standard deviations of the NCHS median reference for height-for-age, weight-for age and weight-for-height are defined as stunted, underweight, and wasted, respectively. In this study three indicators were used to describe child malnutrition-stunting, underweight and wasting. And an analysis was performed focusing on factors and the magnitude of the factors affecting nutritional outcomes.

Both bivariate and multivariate analyses were performed. Bivariate analysis was performed to determine the differentials of fewer than 59 months of age nutritional outcome by explanatory variables. Pearson's chi-square test of independence was performed to test the existence of significant association between nutritional outcomes and selected risk factors. The significant variables observed in bivariate analysis were subsequently included in multivariate analysis to identify the determinants and the magnitude of these determinants on nutritional outcomes of children. These analyses focus on four indicators of nutritional status- normal, stunted, wasted and underweight.

Then a probit regression was run to explain the risk factors.

RESULTS AND DISCUSSION

Determinants of nutritional outcomes

Cross tabulated/ correlation results, shows the relationships between stunting and various factors hypothesized to determine that state of nutritional outcome. The factors known to significantly affect stunting among children include among others Rural/ Urban identifier (0.014), age of the child (0.001), engagement in crop production (0.015), region of residence (0.000) and whether the child had ever received Vitamin A supplementation.

The factors non significantly related to children stunting include number of household members, highest level of mother's education completed, engagement in livestock and poultry, Age of first introduction of food ,whether the child has ever been breastfed in life, Whether the child had received measles vaccination and whether the child had received DPT3 vaccination among others.

The survey results reveal that the factors known to significantly affect underweight among children include among others whether the child had received vitamin A capsule the previous six months, whether the child had received measles vaccine, whether the child had received DPT vaccine, age of first introduction of food/liquid to the child, whether the household had done crop production in the previous six months of the survey and location of residence.

The factors observed to be non significantly related to children underweight include number of household members, highest level of mother's education completed (no formal education, had completed secondary education and had completed university education), engagement in livestock and poultry, whether the child has ever been breastfed in life and among others.

The survey results reveal that the factors known to significantly affect wasting among children include among others number of household members, whether the child had received measles vaccine, whether the child had received DPT vaccine, age of first introduction of food/liquid to the child, geographical region of residence and location of residence.

Whereas age of the child, highest level of mother's education completed (no formal education, had completed secondary education and had completed university education), engagement in livestock and poultry and whether the child has ever been breastfed in life were found to be non significantly related to wasting in children.

The survey results reveal that the education level of the parents is not significantly related to nutritional outcomes and thus not a significant influencing factor to malnutrition. Mother's level of education was found to have effects that are insignificant to both stunting, wasting and underweight of children. Similar results were obtained in Uganda by Bridge *et al.,* (2006) where the educational status of the principal caregiver had a negative association with stunting. The principal care giver is normally the mother of the child across various regions in Uganda as evidenced by the proportions of the relationship of the respondent to the child. However the findings differ from the findings of Turyashemererwa, Kikafunda and Agaba (2009), Amegah (2009), Kabubo-Mariara *et al*., (2009), Haddad (2008), Girma &Genebo (2002), Christiaensen & Alderman (2001) and Haddad (2000) that the education levels of the parents especially the

mothers has a statistically significant effect on the child's nutritional status. This is attributed to the fact that parental education is associated with more efficient management of limited household resources, greater utilization of available health care services, better health promoting behaviors, lower fertility and more child-centred caring practices which are all factors related to child health and better nutrition.

The results of the survey from bivariate analysis also reveal that households engaged in agriculture present mixed results on the levels of stunting, wasting and underweight in children. For example survey results show that engagement in crop production has a significant relationship with childhood stunting and underweight but engagement in livestock and poultry production had insignificant results. Wasting in children also shows quite different results for child bearing households engaged in agriculture. Engagement in agriculture whether crop or livestock and poultry production was not found to be significantly related to children wasting at all.

Nevertheless, agriculture presents pathways that lead to the main goal of reducing malnutrition for example generating income from sale in markets, subsistence-oriented production for the household's own consumption, the reduction in real food prices associated with increased agricultural production, the empowerment of women as agents instrumental to household food security and health outcomes and the indirect relationship between increasing agricultural productivity and nutrition outcomes through the agriculture sector's contribution to national income and macroeconomic growth (Mwadime *et al.*, 2010). Agriculture still forms the backbone of the Uganda's economy and is the major employer of rural households.

The results of the probit regression model are shown in table 2. The significant variables in the model include age of the child, supplementation with vitamin A during the previous six months of the survey, the dummy of a child coming from the central region of the country, the dummy of a child coming from the Northern region of the country and the age at which foods and other fluids were introduced to the child.

The sign of the coefficients of variables including urban rural identifier, whether the child has received Vitamin A supplement, Age of introduction of food to the child, household size, household engagement in crop and livestock production and whether the child had been immunized against measles is negative. The implication is that being in the urban area reduces the probability of the child getting malnourished due to differences in economic levels and cultural and social security, lack of social security causes poor accessibility to education and health services in rural and urban areas (Hien and Hoa, 2009).

As age of introduction of food to the child as well as household size increases, the probability of a child being malnourished reduces. The model results further show that household engaged in both livestock, crop and poultry production have lower chances of having malnourished children. This probability of getting malnourished is 24% lower for crop production and 18%for livestock and poultry production. This finding portrays the role that agriculture plays in availing food for household consumption and other uses including income. Agricultural products increase dietary diversity and agricultural income may be used to pay for health services.

Immunization boosts immunity in children and it is still observed that immunized children have lower chances of suffering from malnutrition. For example the results of the probit model reveal that for an immunized child, the probability of a child getting malnourished is 17% less compared to children who are not immunized holding all the other. Most studies reveal similar results because immunization increases the child's immunity to fight disease. For example

Amegah (2009) found out that fully immunized children had better nutritional status than partially immunized children.

Similarly, Vitamin A supplementation reduces the probability of a child being malnourished holding all the other factors constant. The probability of malnutrition is 9% less for children who have received Vitamin A capsule. Mangusho, (2010) found out that children supplemented with vitamin A had a higher Body Mass Index while analyzing the effect of supplementation among 6-10 year old children in Wakiso District much as the study was done on older children compared to the ages of the children in question and that supplementation reduces prevalence of underweight but not stunting in children.

The sign of the coefficients of variables including age and region variables is positive implying that as age of the child increases the chances of it getting malnourished increases as well. While looking at the region variable, there is increased chance of getting malnourished children in the Central, Eastern and northern regions holding all the other variables at the given values. Western region was dropped from the model because of multicollinearity.

For a one month increase in the age of the child, the probability of the child getting malnourished increases by 0.6% holding all the other factors constant.

Table 11: Estimates of the binary probit model

Variable	Coefficient	Standard error	P>|z|	Marginal effects
Constant	-0.7338	0.4859	0.131	-
Urban	-0.2303	0.1963	0.241	-0.0378
Age2	0.0392	0.0106	0.000	0.0069
Vit a	-0.4569	0.1485	0.002	-0.0906
h_6q_{16}	-0.0013	0.1444	0.993	-0.0002
h_6q_{22}	-0.1678	0.1394	0.229	-0.0297
Central	0.4959	0.2197	0.024	0.0995
Eastern	0.2965	0.2255	0.189	0.0576
Northern	0.5950	0.2087	0.004	0.1276
h_6q_{12}	-0.0857	0.0340	0.012	-0.0151
Hhdsize	-0.0195	0.0219	0.374	-0.0034
$H_{19}q_1$	-0.1151	0.2427	0.635	-0.0213
$H_{19}q_2$	-0.1499	0.1824	0.411	-0.0275
Measlesvaccine	-0.1727	0.1541	0.262	-0.0318
Log likelihood	-222.267			
Pseudo R2	0.0882			
N	662			
Prob > chi2	0.0000			

When the model was run for each of the regions, age of the child and Supplementation with vitamin A were found to be significant influencing factors to malnutrition in both the Central and Western regions but insignificant in both the north and Eastern regions. The model did not present significant outcome for the Eastern and Northern region implying that there are other determinants of nutritional outcomes in children in the Northern and Eastern regions other than those hypothesized.

CONCLUSION AND RECOMMENDATIONS

The results of the probit regression model show that significant variables in the model include age of the child, supplementation with vitamin A during the previous six months of the survey, the dummy of a child coming from the central region of the country, the dummy of a child coming from the Northern region of the country and the age at which foods and other fluids were introduced to the child.

Being in the urban area reduces the probability of the child getting malnourished. As age of introduction of food to the child as well as household size increases, the probability of a child being malnourished reduces. The model results further show that household engaged in both livestock, crop and poultry production have lower chances of having malnourished children. This probability of getting malnourished is 24% lower for crop production and 18%for livestock and poultry production. This is because agriculture avails food for household consumption and other uses including income.

Immunization boosts immunity in children and it is still observed that immunized children have lower chances of suffering from malnutrition. For example the results of the probit model reveal that for an immunized child, the probability of a child getting malnourished is 17% less compared to children who are not immunized holding all the other variables at given values.

Similarly, Vitamin A supplementation reduces the probability of a child being malnourished holding all the other factors constant. The probability of malnutrition is 9% less for children who have received Vitamin A capsule.

As age of the child increases the chances of it getting malnourished increases as well. While looking at the region variable, there is increased chance of getting malnourished children in the Central, Eastern and northern regions holding all the other variables at the given values.

The model did not present significant outcome for the Eastern and Northern region implying that there are other determinants of nutritional outcomes in children in the Northern and Eastern regions other than those hypothesized.

Recommendations

The following recommendations are forwarded following the findings of the study.

The negative coefficient on Vitamin A supplement that imply that vitamin A supplementation reduces the chances of a child being underweight and wasted calls for the relevant ministries and the government to ensure that both the children and mothers are given these Supplements and other mineral supplements to boost their immunity and ensure proper growth. This recommendation falls in the field of health.

The finding that engagement in agriculture reduces the chances of a child being malnourished stunted although results show the opposite for engagement in crop production for underweight and stunting, clearly portrays the role that agriculture plays in availing food for household consumption and other uses including income. Agricultural products increase dietary diversity

and this income may be used to pay for health services. This follows both agricultural and nutrition direction. Therefore agriculture should be encouraged followed by nutrition – consumption of the varieties of the foods produced by the relevant ministries, the government and the households themselves to get down the levels of malnutrition.

The model did not present significant outcome for the Eastern and Northern region implying that there are other determinants of nutritional outcomes in children in the Northern and Eastern regions other than those hypothesized and should thus be analysed.

REFERENCES

Action Against Hunger, (2006). Nutrition Survey report IDP camps, Apac district, Northern Uganda.

Amegah.T. A, (2009). The influence of socio-economic and nutritional characteristics on child growth in Kwale district of Kenya. African Journal of Agriculture, Nutrition and Development, Volume 6. ISSN. 1684-5374.

Bahiigwa.G andYounger. S.D, (2005). Children's Health Status in Uganda.

Biondi .D, Kipp.W, Jhangi.G.S, Alibhai.A, Rubaale.T and Saunders.L.D, (2011). Risk Factors and Trends in Childhood Stunting in a District in Western Uganda. Journal of Tropical Pediatrics, vol. 57, no. 1.

Bridge. A, Kipp. W, Jhangri.G.S, Laing.L and Konde-Lule.J, (2006). Nutritional status of young children in AIDS-affected households and controls in Uganda. American Journal of Tropical Medicine and Hygiene. 74(5), pp. 926–931.

Christiaensen.L and Alderman.H, (2001). Child Malnutrition in Ethiopia: Can Maternal Knowledge Augment The Role of Income? Africa Region Working Paper Series No. 22.

Drewnowski, A., & Specter, S. (2004). Poverty and Obesity: the role of energy density an energy costs. American Journal of Clinical Nutrition 79: 6-16.

Girma, W and Genebo, T., (2002). Determinants of Nutritional Status of Women and Children in Ethiopia. Ethiopia Health and Nutrition Research Institute, Addis Ababa, Ethiopia.

Haddad, L., (2008). Improving the nutrition status of children and women. Institute of Development Studies, University of Sussex, Falmer BN1 9RE, UK

Hien.N.N and Hoa.N.N, (2009). Nutritional status and Determinants of Malnutrition of under three years of Age in Nghea Vietnam. Pakstan Journal of Nutrition 8(7): 958-964. ISSN 1680-5194.

Reference: IFPRI (2011). Leveraging agriculture for nutrition and health.

Kabubo-Mariara. J. *et al.,* (2009). Determinants of Children's Nutritional Status in Kenya: Evidence from Demographics and Health Surveys. Journal of African Economies. Volume 18. No. 3: 363-387.

Kasirye.I, (2010). What are the successful strategies for reducing malnutrition among young children in East Africa? Human Development Research Paper 2010/15.

Kurtz and Johnson, (2000). Enhancing Nutrition Results: The Case for a Women's ResourcesApproach. International Center for Research on Women.

MoAAF, (2011). Statistical Abstract.

MoH, (2009). The operational framework for nutrition in the national child survival strategy.

Namugumya, B.S (2011). Advocacy to Reduce Malnutrition in Uganda: Some Lessons for Sub-Saharan Africa. Leveraging agriculture for improving nutrition and health 2020. Conference Brief 11.

Shrimpton R, Victora C, de Onis M, Costa Lima R, Blössner M, Clugston G. 2001. Worldwide Timing of Growth Faltering: Implications for Nutritional Interventions. *Pediatrics*. 107; 75-81.

Smith. L. C. and Haddad. L. (2000). Explaining Child Malnutrition in Developing Countries: A Cross-Country Analysis. International Food Policy Research Institute.

Turyashemererwa. F.M, Kikafunda. J.K and Agaba. E. , (2009). Prevalence of early childhood malnutrition and influencing factors in peri urban areas of Kabarole District western Uganda

UNAS (2011). Uganda National Academy of Sciences. Workshop report. Main streaming Nutrition with Agriculture in Uganda.

UNFP (2003). Uganda food and nutrition policy.

UNICEF,(2 009). Tracking progress on child and maternal nutrition. A survival and development priority

Walton.M, Signal.L and Thomson.L, (2009). Household Economic Resources as a Determinant of Childhood Nutrition: policy responses for New Zealand. Social Policy Journal of New Zealand. Issue 36.