Determinants of Maternal Health Outcomes of Lactating Mothers in Meru County, Kenya

Joseph Abuga Orayo
Kisii University, School of Business and Economics, Department of Economics

Type of the Paper: Research Paper.
Type of Review: Peer Reviewed.
Indexed in: worldwide web.
Google Scholar Citation: IJRESS

How to Cite this Paper:

This work is licensed under a Creative Commons Attribution-Non Commercial 4.0 International License subject to proper citation to the publication source of the work.

Disclaimer: The scholarly papers as reviewed and published by the OIRC JOURNALS are the views and opinions of their respective authors and are not the views or opinions of the OIRC JOURNALS. The OIRC JOURNALS disclaims of any harm or loss caused due to the published content to any party.
Determinants of Maternal Health Outcomes of Lactating Mothers in Meru County, Kenya

Abstract
Health care is both a consumer good and investment good. This paper examined the general profiles of lactating mothers in Meru County as well as the demographic, socioeconomic and environmental factors behind nutritional status (BMI) of lactating women in Meru County, Kenya. Kenya Demographic Household Survey (KDHS) data set of 2014 was used. Endogeneity of the socio economic status was examined and its exogeneity established hence use of Ordinary Least Square (OLS) in estimation. From estimation results, both access to clean water and sanitation facilities were found to be positive and negatively significant respectively to the general welfare of lactating mothers. Based on the findings, the study suggests for a need of the county and national governments investing in both environmental and sanitation sensitization campaigns such as behavior change including hand washing practices. They also need to enhance access to clean water and provide proper working human waste disposal solutions in the county.

INTRODUCTION
The attainment of global health success depends on individual nation’s investment in its health sector (Riordan, 2005; WHO, 2014). This is in accordance with recognition that a healthy population promotes economic growth of the nation through productivity, savings and investment. According to WHO (2010) Sub-Saharan Africa is faced by fertility-related health challenges namely, newborn illnesses, pregnancy and childbirth complications, childhood infections, and malnutrition, all of which have a precise effect on the socioeconomic standing of a country’s economy. The death of a woman is said to be a maternal death if it results from the causes related to or aggravated by the pregnancy or its management (Awiti, 2013). Despite some success stories that has been fairly achieved in the eradication of vaccine-preventable diseases still a startling number of women die yearly of causes linked to pregnancy, childbirth and malnourishment. According to the most recent consensus estimates approximately 287,000 women die annually and nearly 85% of these deaths take place in Sub-Saharan Africa and South Asia (World Bank, 2013). In essence, without good health a person cannot achieve anything meaningful in life. For instance, a malnourished person’s ability to participate in economic, social and political activities is curtailed as this is a significant factor in influencing individual's capability to manage the environment of learning. Lactation is defined as an intensified secretion of hormones oxytocin and prolactin and the production of hypothalamic-pituitary gland and hypoinsulinemia (Vernon 1989; Allen, 2001). Lactation needs both an increased nutrients supply and improvement of mechanisms that help the proper usage of nutrients by the breasts. Since sex steroids prevent the lactogenic effects of prolactin, what remains of key importance in lactogenesis is the respective production of estrogen and progesterone. Prolactin not only stimulates synthesis and secretion of milk components in the mammary glands, but also reduces lipogenesis in the liver and adipose tissue and increases delivery of glucose and lactate lipogenic precursors to the mammary gland (McNamara, 1995). During lactation, the hypothalamic-pituitary adrenal axis changes in the case of exercise-induced stress (Altemus et al. 1995). These changes are related to the both the nervous and endocrine systems working together which ensures the preservation of energy and storage of synthesized milk synthesized thereby enabling passage to the breast (Macintosh, 2011). Body changes occurring during this lactation period depend on the actual stage of lactation, the type of species and the nutrition state.
of the woman (Robinson, 1986). Fat metabolism causes weight changes and this situation may vary as affected by the nutritional status and the type of food eaten by the lactating mother. Great metabolism during the period of lactation is seen by the lactating woman’s high appetite and higher body intake of nutrients (Goldberg, 2003). Anthropometric facts propose that women use their body fat and are therefore advised to increase their food intake in order to meet the demand of lactation (Haileslassie, Mulugeta and Girma, 2013). This implies that women need to be healthy such that malnourishment is addressed to meet required lactation.

Malnutrition is also a maternal health indicator which refers to both under nutrition (inadequate nutrients for growth and maintenance) or over nutrition (consuming too many calories) or in the wrong proportions. Undernourishment as a measurement of maternal health is rarely considered especially in empirical estimations of maternal health status in most studies. According to Smith and Haddad, (2000) the most common form of malnutrition is undernutrition caused by inadequate calories and protein. The anthropometric measure commonly used for adults (also an indicator for maternal health) is the Body Mass Index (BMI). BMI is calculated as individual’s weight in kilograms by the square of the individual’s height in meters (WHO, 2004). The measure is used to classify individual as either underweight, normal, overweight or obese. A woman is underweight if she has a low BMI of less than 18.5. Therefore, a low BMI is associated with malnutrition (Wu, 2009). Between 18.5 and 24.9 for normal BMI and obese if she has BMI above 30, (Hiza, et al., 2000). BMI values of above 25 are unhealthy and have been shown to increase the risk of chronic diseases such as body/heart stroke, high blood pressure, heart diseases (Awiti, 2013). These diseases also include diabetes, and arthritis as well as many others. Hence, the production of nutrition is also partly determined by individual health status and other factors such as age, sex, residence, education attainment among others. This implies that a proper consideration of nutritional status especially among lactating women is urgent. Note that Kenya is among nine countries consisting of India, Pakistan, Sudan, Nigeria, Indonesia, Uganda, Ethiopia and Tanzania contributing to 60% of the world's maternal death based on the world health statistics (WHO, 2014). The maternal mortality ratio as at 2010 was 454 per 100,000 live births while in 2013, the rate changed to 410 (World Bank, 2013). This reduction may be attributed to increase in universal health coverage which includes improved access to hospital services, provision of free maternal care and immunization programs.

Health care is both a consumer good and investment good. From the theoretical expeditions, Grossman (1972) proposed and developed the theory of health production which claims that demographic and socio economic conditions significantly affect the production of health through the demand for health capital stock. Health status indicators classified under infant and child health, maternal health and indicators of general health can be made for individuals or for the whole populations (Saikia and Singh, 2008). Observed health status of a specific individuals, groups or population focuses on the individual’s and population's health statuses (Lopez, et al., 2006; Awiti, 2013). On the other hand, the standard neoclassical consumer model under the demand theory argues that any consumer is deemed to have utility. This same consumer also has a preferable or desirable situation or function which enable him/her to be able to grade different mix of goods and services bought or acquired from the market under an assumption that consumers have a rational behavior, preferences and are faced by a budget constraint as they maximize utility as suggested by Pindyck and Rubinfeld, (2008). Other studies indicate that utility is maximized by households depending on consumption of commodities and leisure (Thomas, 1991; Achieng’, 2014; and Orayo, 2014). However, to attain highest utility, marginal utility should be equal for each good or service a consumer purchases, (Becker, 2007). In this case, respective demand and consumption functions are derived from utility maximization. Note that as this theory provides an acceptable clarification of the commodities demanded. What actually the consumers desire and insist on when buying the medical services, are not these services themselves but more appropriate health (Grossman, 2000). This argument is backed up by Schiff and Valdes (1990) who argued that the process of producing nutrition is determined by inputs of nutrients, inputs of non-nutrient food attributes which affect nutrition. These include cleanliness and storability of food, privately and publicly provided inputs such as potable water and nutritional information. This study builds on utility maximization model to analyze the determinants of lactating nutritional status (malnutrition) among women in Meru County, Kenya.

In Meru County, the population has been growing steadily to 1,486,025 persons in 2017 and is...
projected to increase to 1,517,077 in 2018 and 1,530,043 persons in 2020. The median age is 42 years which constitutes 85% of the lower age groups, with population under 15 years being 40% and the elderly above 60 years comprising 6.2% hence an expansive population pyramid. Specifically, Igembe Central sub county has the highest population 200,110 (13.5%) followed by Imeni South sub county with 196,782 (13.2%) persons and Imenti Central Sub county with the lowest population of 128,101 (8.6%) persons in 2017 (MCHSIP, 2017-2022). Multiple target indicators have been used to determine the level of health status in the county and country at large through surveys and routine reports. Many interventions have been put in place to address the disease burden and other social determinants of health. The SDGs target is to reduce under 5 mortality to 25 per 1000 live births, reduce maternal mortality ratio to fewer than 70/100000 live births and neonatal mortality rate by 12 deaths per 1000 live births by 2030. Currently, the life expectancy for Kenyans stands at 63.5 years (Females – 66 years and Males 61 years) WHO 2015, under 5 Mortality rate is 52 per 1000 live births (KDHS 2014), Maternal Mortality Ratio of 362 per 100,000 live births and annual deaths (crude mortality) of 8 deaths per 1000 persons. In Meru county, the leading causes of morbidity include; respiratory tract infections, arthritis and diseases of the skin while those for mortality are Pneumonia, respiratory tuberculosis and diarrheal and gastroenteritis diseases (MCHSIP, 2017-2022).

On the other hand, the main risk factors for morbidity in the county include pollution, smoking, overcrowding, poor housing, bacterial and viral infections, degenerative disorders, lifestyle, poor hygiene practices, autoimmune disorders and low immunity. Also, the risk factors for mortality include poor health seeking behavior, age, and poor lifestyle, bacterial, viral and/or fungal infections, smoking and Immunosuppression (MCHSIP, 2017-2022). There exists 144 community units at level 1, 419 primary health care facilities and 25 hospitals spread across the whole county offering different types of services. The facilities are owned by different agencies (GOK, FBO, Private and NGOs). Whereas, the county has endeavored to provide essential package for health, the coverage has not been comprehensively attained. Improvement in access and quality of care remains the major focus for the sector for better healthcare outcomes.

Among main drivers and indicators of health status in a country, nutritional status is the most prominent factor for policy interventions in improving people’s wellbeing (Asmah, Twerefou and Smith, 2013; Awiti, 2013; Oyakale, 2014). Few studies, however, employ malnutrition indicators with regard to health status in developing countries (Oyakale, 2014). Improved nutritional status of the lactating mother relates to the reduced risk of child mortality and consequent development is boosted. Findings in some developed countries established that malnourished women with BMI below 18.5 display a progressive rise in mortality rates and also increase risk of illness (Girma and Genebo, 2002). Kenya is committed to achieving its set targets in an effort to realize the predetermined vision 2030 through social pillar under which health sector lies. This effort is evident through commitment to embrace the Sustainable Development Goals (SDGs). Indeed, improved health status is an important aspect related to economic growth of a country. Thus, the understanding of the relationship between lactating women nutrition and the respective determinants, exploring more linkage to socio-economic factors is imperative for policy formulation and consequent implementation. However, little attention has been put to address the causes of malnutrition among lactating mothers globally. Few studies have focused on this segment of the population (Chen, et al., 2012; Ogechi, 2014 and Hundera, et al., 2015). Further, these studies have not considered all demographic, socio economic and environmental factors in their estimations. Unfortunately, there are zero studies available on the demographic and socioeconomic determinants of nutritional status among lactating women in Kenya and at county levels. This study is therefore carried out to estimate the impact of the different factors that determine nutritional status of lactating women for policy formulation at county as well as national levels in Kenya. The following are the specific research objectives: First, to establish the demographic and socioeconomic profiles of lactating mothers in Meru County. Secondly, to estimate the effects of demographic, socioeconomic and environmental determinants on nutritional status of the lactating mothers in Meru County. Lastly, to suggest appropriate policies based on the estimated study results. Note that if the health of a lactating mother improves through achieving better nutritional status, then there is high a consequent likelihood of a newborn nourishing up well through to adult life. This study leads to significant contribution to the literature by addressing research gaps on the empirical
investigation into health status of the lactating women in the wake of devolution. The study uses household-based secondary cross sectional data that is the Kenya Demographic Household Survey 2014 (KDHS). This survey is usually conducted after a duration of five years in Kenya. This data provides general and specific information for the health status of the entire population, lactating mothers included at county levels. The survey collects anthropometric measures used in computation of BMI for lactating women. Specifically, mothers who were interviewed provided information on their wealth index, their education levels, the age, environmental/ sanitation information which included their source of their drinking water, type of toilet among other socio-demographic and environmental factors. The rest of the research study is organized as follows; section two reviews relevant theoretical and empirical literature on nutritional status among women globally and local levels, section three presents the research methodology with theoretical framework, estimable models and diagnostic tests employed in estimation while section four presents the analyzed results with their respective interpretation and discussion. Finally section five presents the conclusions and policy recommendations based on the study findings.

LITERATURE REVIEW
The Body Mass Index (BMI) has been widely used in several studies as a reliable indicator of nutritional status of mothers (Conways & Kutinova, 2006; Ajieroh, 2009; Adeoti & Awoniyi, 2012; Kurkalni, Kurkalni & Gahia, 2014 and Ogechi, 2014). Studies from some developed countries established that malnourished women with BMI below 18.5 display a progressive rise in mortality rates and also increase risk of illness (Girma & Genebo, 2002). Other studies have shown that age, residence, education levels, socio economic status, family size and income, timely and adequate prenatal care, accessibility to safe water, hygienic toilet, being literate, access to health information and female autonomy as significantly related to maternal nutritional status, (Conways & Kutinova, 2006; Ajieroh, 2009; Adeoti & Awoniyi, 2012; Koryo-Debrah, et al., 2013; Maisibo, et al., 2013; Kurkalni, Kurkalni & Gahia, 2014; Achieng’, 2014 and Hundera et al, 2015). Also distance to accessing healthcare is highly associated with increased probability of a mother being malnourished.

Despite varied conclusions arrived at, by different studies, some studies are based on small coverage areas (localities) including province(s) or towns and cities leaving other areas (Mbochi, et al., 2012; Gemedo, et al., 2013; Koryo-Debrah, et al., 2013; Ogechi, 2014 and Sholeye et al., 2014) while other studies were facility or institution based (Ndanu, 2013 and Hundera, et al., 2015) making it challenging to generalize to the large population. On the other hand, there are few other that are national based surveys (Conways & Kutinova, 2006; Ajieroh, 2009; Mwende; 2009; Adeoti & Awoniyi, 2012; Maisibo, et al., 2013; Kurkalni, Kurkalni & Gahia, 2014; Achieng’, 2014). These differences as a result of coverage/scoping are likely to contribute to the different results obtained and conclusions arrive at. However, of the most important that cannot be overlooked; many studies are conducted on women (mothers who ever gave birth during their reproductive age) as a whole without considering specifics that is lactating mothers in particular who may be more vulnerable compared to their counterparts. Few studies have focused on this segment of the population (Chen, et al., 2012; Ogechi, 2014 & Hundera, et al., 2015). Exploring these three studies, the first two have not estimated any econometric model and rely only on the descriptive and correlation analysis which does not infer causality. The former is a case of a referral hospital in Ghana and thus may not be generalized to the entire population. Also the studies have not taken demographic, socio economic and environmental factors holistically into consideration. Hundera et al., (2015) never addressed any estimation issues in their works including endogeneity and heterogeneity. This leaves a methodological gap to be filled by this study. Unfortunately, studies available on the determinants of lactating women nutritional status in Kenya as well as at county levels are zero.

METHODOLOGY
Theoretical Framework
The determinants of maternal health status have been explored by various studies such as Rosenzweig & Schultz, (1992; 1993); Wu, (2009); Bategeka et al., (2009); Okurut et al., (2013) and Awiti (2013). Employing modified utility maximization theory which was introduced by Rosenzweig & Schultz, (1992) and utilized in various literatures, this study also adopts this model to address the research objectives. The theoretical fundamentals are based on utility maximization which is subject to the health production function.
and income constraints. Assume a lactating mother maximizes utility \( U_l \) as a result of consumption of goods and services that have no direct effect on health, \( X \), those goods that yield utility directly but also affect individual health, \( Y \) and the individual's health status \( H \). We can write this utility function as follows:

\[
U_l = f (X, Y, H) \quad \text{(1)}
\]

Individual health status in this case is a production function which produces women nutrition (Thomas, 1991; Achieng', 2014). According to Grossman, (1972) and Awiti, (2013) health cannot be purchased from the market, it has to be produced using both marketed and non-marketed inputs, implying that nutritional status is a function of market purchased inputs for example nutrient in food and health services. Therefore, households choose to maximize nutritional status given resources and information constraints they face (Kabubo-Mariara et al. 2008; Achieng', 2014). However, to arrive at this conclusion, we make an assumption that good nutritional status is desirable in its own right as suggested by Rosenzweig and Schultz, (1983).

Following Mwabu, (2009); Awiti, (2013) and Achieng' (2014), we have the nutritional status of the lactating \(^1\) women expressed in a linear form in the following production function:

\[
H = F (Y, Z, \varepsilon) \quad \text{(2)}
\]

Where \( Y \) is the immediate inputs (water and cooking fuel) chosen by household to achieve the desired nutritional status and \( Z \) are other factors and \( \varepsilon \) unobservable biological endowments. According to Pindyck and Rubinfeld (2008) an individual demand curve is related to indifference curves preferences and budget constraints. Similarly, consumers allocate income among various goods and services with a concern of welfare maximization. To maximize utility, the household chooses the optimal consumption bundle, subject to a production function and a budget constraint. This is because gross consumption of goods and services cannot exceed total income given market price and wages (Strauss and Thomas, 1998). The individual is assumed to maximize the utility function subject to the above health production function and a budget constraint indicated in the following representation:

\[
I = XP_X + YP_Y \quad \text{(3)}
\]

I represent the household income

\( P_X \) is the price of the consumption good with no direct effect on nutrition such as clothing

\( P_Y \) is the price of nutrition related good

We ignore \( X \) which is a nutrition-neutral good following Ajakaiye and Mwabu (2007). Following Achieng’ (2014) that prices and income are exogenous to the household, the reduced form household demand function\(^2\) for \( Y \) is substituted in health production function (2) to obtain the following final expression:

\[
H = F (P_Y, Z, I, \varepsilon) \quad \text{(4)}
\]

Therefore, lactating women’s nutrition status is a function of relative price \( P_Y \), household knowledge \( Z \), household income \( I \) and woman’s health endowment \( \varepsilon \). However, the price of \( X \) is allowed to affect demands for \( Y \) through the budget constraint. The next sub-section presents a model leading to establishing the effects of exogenous changes in the socioeconomic, demographic and environmental factors of the household on nutrition outcomes of lactating women in Meru County.

**Estimable Model**

The health outcome considered in this study are as a result of anthropometric measures which include weight, height and blood pressure is used in the analyses the nutritional health status (Wu, 2009). From these measures, Body Mass Indicator (BMI) for lactating women is obtainable. Therefore, the study utilized woman nutritional status (BMI) as dependent for lactating women health outcome. Thus the specified ordinary least model (OLS) model is as presented below:

\[
N_i^* = x'\beta' + \varepsilon \quad \text{(5)}
\]

Where \( N_i^* \) is the dependent variable while \( x' \) is a vector of independent variables such as demographic characteristics (current age of the woman, age of the woman at first birth, marital status etc.), socioeconomic characteristics (education, wealth, current residence etc.) and community characteristics and; \( \beta' \) is a vector of parameters and \( \varepsilon \) is the error term. The nature of the variables employed is as follows;

---

\(^1\) Breastfeeding mothers

\(^2\) The demand function is expressed as; \( Y = D_f (P_X, P_Y, K, W, \varepsilon) \)
Table 1: Description and Measurement of Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measurement of variables</th>
<th>Nature of Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactating woman Nutritional</td>
<td>Lactating woman Nutritional health outcome is estimated using: BMI</td>
<td>Dependent Variable</td>
</tr>
<tr>
<td>outcome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-economic Factor</td>
<td>Wealth Index</td>
<td>Endogenous Variable</td>
</tr>
<tr>
<td>Current Age of the woman</td>
<td>Current Age in complete years</td>
<td>Exogenous variable</td>
</tr>
<tr>
<td>Age of the mother at first birth</td>
<td>Age in complete years</td>
<td>Exogenous variable</td>
</tr>
<tr>
<td>Education level of the mother</td>
<td>Education will be created in four categories as: No education (0), Primary education (1), Secondary Education (2) and Higher education (3).</td>
<td>Exogenous variable</td>
</tr>
<tr>
<td>Current residence</td>
<td>Household characteristics: 1 if rural and 0 otherwise.</td>
<td>Exogenous variable</td>
</tr>
<tr>
<td>Age at first birth</td>
<td>Age in complete years</td>
<td>Exogenous variable</td>
</tr>
<tr>
<td>Mothers height</td>
<td>Height in centimeters</td>
<td>Exogenous variable</td>
</tr>
<tr>
<td>Source of drinking water</td>
<td>1 if piped water source, 0 otherwise</td>
<td>Exogenous variable</td>
</tr>
<tr>
<td>Toilet facility</td>
<td>1 if uses flush toilet, 0 otherwise</td>
<td>Exogenous variable</td>
</tr>
<tr>
<td>Employment status</td>
<td>1 if employed, 0 otherwise</td>
<td>Exogenous variable</td>
</tr>
<tr>
<td>Marital status</td>
<td>1 if married, 0 otherwise</td>
<td>Exogenous variable</td>
</tr>
</tbody>
</table>

NB: We used equation 6 to estimate and predict the probabilities.

Diagnostic Tests and Remedies
Test for Endogeneity: Endogeneity is a situation where an independent variable is correlated with the disturbance term of the model. This may arise from three sources; omission of variables, measurement error and reverse causality (Wooldridge, 2003; Kabubo-Mariara et al., 2009). As a remedy, specification and measurement of appropriate instruments is essential. Literature suggests application of IV estimation as appropriate in a health production function. This is based on the fact that health inputs are regarded as chosen by households and consequently there is likely to be a problem of endogeneity especially in the use of OLS (Mwabu, 2007; Achieng’, 2014). Further, studies have pointed out that socioeconomic status of the household is potentially endogenous in the women nutrition status model (Marinda, 2006; Mugo, 2012). However, Achieng’, (2014) revealed socioeconomic status of a woman as exogenous in the women nutrition status model. This may be associated with difficulties of validating some of the instruments suggested in the literature through instrumental variable approach. Nevertheless, this study also employs the number of household members as an instrumenting variable due to the fact that it may be strongly correlated with household socioeconomic status and not with nutrition status of lactating women, Kabubo-Mariara, et al., (2009) however, cautions that at times it is rare to arrive at the instruments that satisfy all of the above properties. Others diagnostics tests done ensures that the values of estimates acquired are not biased and inconsistent. The study tested the distribution of the error term whereby the Shapiro Wilk test was applied. The null hypothesis states that the error terms are normally distributed and alternative hypothesis states that the error terms are non-normally distributed. If the p value is less than the 5% significant level, then we reject the null hypothesis of normality (Mukras, 1993). Test for heteroscedasticity was conducted, that is testing for variation of the error terms across all the observations under study. The Breusch pagan test is used to test for it. If the p value is greater than 5% significance level will imply absence of heteroscedasticity and if found, robust is used to address.

RESULTS AND DISCUSSIONS
Descriptive statistics were used to describe the general characteristics of the KDHS women dataset used in the study as presented in Table 2. The statistics include the mean, standard deviation, the range of the values of the observations and the number of observation. The total population of women surveyed in KDHS 2014 was 31,079. All counties were covered.
On average, lactating mothers in Meru county were aged 28 years with the youngest being 17 years and oldest mother reported to be 49 years. Majority (89.06%) of the lactating mothers were married with age at first birth being 19 years on average while the mother with first birth was reported to have 11 years while the highest age for first birth was reported to be 27 years. The study also established that the average height was about 1.58 meters. Only 6.67% of lactating mothers were employed while the larger portion was composed of unemployed. Similarly, the middle wealth quintile largely described the socio economic status of lactating women with a household reported to having 5 members on average. The household with least members had two (2) people and the largest household number was 12 members. Further details are in table 2 below.

### Table 2: Summary of Statistics for lactating mothers in Meru County

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>MEAN</th>
<th>STD. DEV.</th>
<th>MIN</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index</td>
<td>24.01</td>
<td>4.03</td>
<td>16.56</td>
<td>35.54</td>
</tr>
<tr>
<td>Underweight</td>
<td>0.0469</td>
<td>0.213042</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Normal</td>
<td>0.6406</td>
<td>0.4836103</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Overweight</td>
<td>0.2188</td>
<td>0.4166667</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Obese</td>
<td>0.0938</td>
<td>0.2937848</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Current Age of the woman</td>
<td>28.13</td>
<td>6.533188</td>
<td>17</td>
<td>45</td>
</tr>
<tr>
<td>Age of the mother at first birth</td>
<td>19.13</td>
<td>3.570159</td>
<td>11</td>
<td>27</td>
</tr>
<tr>
<td>Marital status</td>
<td>0.8906</td>
<td>0.31464</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>No education</td>
<td>0.0781</td>
<td>0.2705</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Primary education</td>
<td>0.625</td>
<td>0.4880</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Secondary education</td>
<td>0.1875</td>
<td>0.3934</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>High education</td>
<td>0.1094</td>
<td>0.3146</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Mothers height</td>
<td>1.5756</td>
<td>0.0650</td>
<td>1.423</td>
<td>1.734</td>
</tr>
<tr>
<td>Source of drinking water (piped)</td>
<td>0.5469</td>
<td>0.5017</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Toilet facility (flush)</td>
<td>0.0469</td>
<td>0.2130</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Current residence</td>
<td>0.2188</td>
<td>0.4167</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Employment status</td>
<td>0.0667</td>
<td>0.2515</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Wealth index</td>
<td>3.0313</td>
<td>1.2844</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Household size</td>
<td>4.9844</td>
<td>1.9231</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

Total Observations: 64

*Source: Author’s computation based on KDHS (2014)*
In terms of education levels, 7.81 percent of women had no formal education; slightly more than half of women interviewed had at least primary education (62.5 percent) and those with secondary and higher education were 18.75 percent and 10.94 percent respectively. It was shown that mothers whose source of drinking water was piped water were slightly above 50 percent and only 4.69 percent of the sampled lactating mothers had access to flush toilet. Further, about 21.88 percent of the surveyed women resided in urban areas whereas the rest resided in rural areas.

Determinants of Maternal health outcomes of lactating mothers in Meru County

The second objective specifically was to find out the effects of these socio-economic and demographic determinants on the nutritional status of lactating mothers in Meru County. As described in the methodology section, this was expected to be accomplished by using instrumental variable approach.

Validation of the Study Instruments and Endogeneity of socioeconomic status

Before proceeding to estimation, the study tested the validity and relevance of the suggested instrument. Socioeconomic status, in the form of wealth index was suggested as the potential endogenous variable to lactating mother’s nutrition status implying employment of an instrument that is not only relevant but also valid. The number of household members was adopted as the instrument for socioeconomic status in this study. From the test results, the p-value and the magnitude of the first stage F statistic on the instrument show that the number of household members is not a valid and strong instrument as suggested by the literature. The p-value = 0.475 is an indication that the suggested instrument is not relevant to instrument wealth index in the maternal nutritional status model. The F-value of 0.517669 is way below a threshold of 10 suggesting that the instrument is very weak. Following the reviewed literature, socioeconomic status of the household is potentially endogenous to women nutritional status. This study carried the endogeneity test. The null hypothesis states that the socioeconomic status is exogenous. From the IVRegress results, the Durbin (score) chi2 (1) of 0.038657 has a p value of 0.8441 which is more than 5% level of significance implying that we fail to reject the null hypothesis. This was similar to confirmatory test of Wu-Hausman. Following this finding, the study concludes that the use of either IVRegress or IVProbit may not be appropriate. Therefore in either analysis, the OLS model was employed to examine the net effect of each independent variable on BMI.

Determinants of Nutritional Status: BMI as the Dependent Variable

The BMI was computed by dividing the weight of the mother in kilogram over height in meters square. To validate the estimates, both heteroscedasticity test for constant variance and normality test were performed. As indicated in table, the Breusch Pagan test show that the variance was constant but Shapiro Wilk test indicated a p value of 0.01602 which is less than 5% level of significance implying non normality of data thus use of nonlinear model as indicated in Table 3. The study employed nonlinear model as a result. Natural logarithm was done on the dependent variable (LN BMI).

Table 3 shows the R squared of 45.77% implying that the dependent variable (BMI) was explained by independent variables at that percentage while the rest proportion was attributed either to omitted variables or measurement error. Similarly, the explanatory variables jointly explained BMI significantly since the overall p value was 0.0031 against the selected significance levels. From the regression results, only primary education, secondary education, piped water source and flush toilet were found to be statistically significant determinants of nutritional status of lactating mothers in Meru County at different selected levels of significance. Among the significant variables only piped water source was found to increase the BMI of lactating mothers. Further discussion is done only of the significant determinants in the following sub-section.

3 An instrument is considered relevant if its effect on a potentially endogenous explanatory variable is statistically significant and strong if the size of its effect is large.
Ethiopia, Nigeria and Kenya. who both found inverse relationship between factors constant. 15 had no education secondary education levels compared to those who lactating significant at levels were found to be factor in determining Body Mass Index. The Maternal education was found to be important Model Discussions of the Study Results from OLS

<table>
<thead>
<tr>
<th>LNBMI</th>
<th>Coefficients</th>
<th>Std. Err.</th>
<th>t</th>
<th>P&gt;t</th>
<th>Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-Economic Status</td>
<td>0.0140</td>
<td>0.0209</td>
<td>0.67</td>
<td>0.507</td>
<td>-0.0282 0.0563</td>
</tr>
<tr>
<td>Current Age of the woman</td>
<td>0.0024</td>
<td>0.0046</td>
<td>0.53</td>
<td>0.600</td>
<td>-0.0068 0.0117</td>
</tr>
<tr>
<td>Age of the mother at first birth</td>
<td>0.0069</td>
<td>0.0085</td>
<td>0.81</td>
<td>0.421</td>
<td>-0.0102 0.0241</td>
</tr>
<tr>
<td>Marital status</td>
<td>0.0970</td>
<td>0.0755</td>
<td>1.28</td>
<td>0.205</td>
<td>-0.0550 0.2489</td>
</tr>
<tr>
<td>Education (No Education =Reference)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary education</td>
<td>-0.1580*</td>
<td>0.0930</td>
<td>-1.70</td>
<td>0.096</td>
<td>-0.3453 0.2922</td>
</tr>
<tr>
<td>Secondary education</td>
<td>-0.2520**</td>
<td>0.1090</td>
<td>-2.31</td>
<td>0.025</td>
<td>-0.4713 -0.0327</td>
</tr>
<tr>
<td>High education</td>
<td>-0.0499</td>
<td>0.1520</td>
<td>-0.33</td>
<td>0.744</td>
<td>-0.3558 0.2560</td>
</tr>
<tr>
<td>Mothers height</td>
<td>-0.2239</td>
<td>0.3182</td>
<td>-0.70</td>
<td>0.485</td>
<td>-0.8644 0.4167</td>
</tr>
<tr>
<td>Source of drinking water (piped)</td>
<td>0.1200***</td>
<td>0.0440</td>
<td>2.73</td>
<td>0.009</td>
<td>0.0314 0.2086</td>
</tr>
<tr>
<td>Toilet facility (flush)</td>
<td>-0.2153*</td>
<td>0.1181</td>
<td>-1.82</td>
<td>0.075</td>
<td>-0.4530 0.0223</td>
</tr>
<tr>
<td>Household size</td>
<td>0.0022</td>
<td>0.0131</td>
<td>0.17</td>
<td>0.864</td>
<td>-0.0240 0.0285</td>
</tr>
<tr>
<td>Current residence</td>
<td>-0.0322</td>
<td>0.0613</td>
<td>-0.52</td>
<td>0.602</td>
<td>-0.1555 0.0912</td>
</tr>
<tr>
<td>Employment status</td>
<td>0.0754</td>
<td>0.0923</td>
<td>0.82</td>
<td>0.418</td>
<td>-0.1103 0.2611</td>
</tr>
<tr>
<td>Constant</td>
<td>3.2876</td>
<td>0.4677</td>
<td>7.03</td>
<td>0.000</td>
<td>2.3461 4.2290</td>
</tr>
</tbody>
</table>

Number of observations = 60  
F(13, 46) = 2.99  
Prob > F = 0.0031  
R-squared = 0.4577  
Adj R-squared = 0.3044  
Root MSE = 0.13769

Cook-Weisberg test for heteroscedasticity: Prob > chi2 = 0.9073  
Shapiro-Wilk W test for normal data: Prob > chi2 = 0.01602  
Instrument (Household size)=P value is 0.475  
Durbin (score) chi2(1) = 0.038657 (p =0.8441)  
Wu-Hausman F(1,46) = 0.029656 (p =0.8640)  
F(1,47)=0.517669

*** ** * Significant at 1% 5% and 10% respectively

Discussions of the Study Results from OLS Model

Maternal education was found to be important factor in determining Body Mass Index. The coefficients of primary, and secondary education levels were found to be negative and statistically significant at 10% and 5% of levels respectively. A lactating mother who had either primary or secondary education levels compared to those who had no education lowered the woman’s BMI by 15.8 and 25.2 percent respectively holding other factors constant. This implies that lactating mothers with primary, and secondary education levels had a higher risk of being malnourished. This finding differs with the findings obtained by Girma (2007), Adeoti and Awoyini (2012) and Achieng’ (2014) who both found inverse relationship between probability of being underweight and education in Ethiopia, Nigeria and Kenya.

The study further considered both flush toilet and piped water source as environmental factors affecting maternal health status. The coefficient the piped water source was positive and statistically significant whereas the coefficient of flush toilet had a negative and statistically significance in the BMI model. Mothers with access to piped water source increased their BMI by 12 percent holding other factors constant. The study results on the other hand, fails to concur with the finding of Achieng’ (2014) who found insignificance of piped water source to maternal health status in Kenya. Lactating who access to flush toilet lowered BMI by 21.53 percent holding other factors constant. Women who use clean toilet are expected to become unsusceptible to infections but in this case may have been associated to other hygiene practices not embraced. The study result on access to clean sanitation facilities (flush toilet) differs with the finding of Ajieroh (2009).
CONCLUSIONS AND POLICY RECOMMENDATIONS

The ultimate goal for Sustainable Development Goals is to improve the socio economic status of a nation through sustainable development. For this to be achieved, however, it is clear that there is need for improved health status of the population which is an important aspect which is directly related to economic growth of a country. There is no doubt that among main drivers and indicators of health status in a country, nutritional status is the most prominent factor for policy interventions in improving people’s wellbeing. However, little has been done with regard to mothers’ malnutrition status of especially lactating women in developing countries in particular Kenya.

Conclusions

This study was carried out with the knowledge that the nutritional status of a mother has major effects for her health and the health of her children. Mainly, this study explored factors behind nutritional status of lactating women in Meru County. The measurement indicators for nutritional status of lactating mother were BMI. Upon conducting endogeneity tests, it was found that the socioeconomic status of lactating mother was exogenous and the suggested instrument (household size) was weak and invalid. Thus implied that instrumentation was not appropriate thus OLS was employed as estimating technique. Further, the study results from the model reveal welfare increasing and reducing factors with regard to nutritional status of lactating mothers. Only piped water source was found to be welfare increasing while primary education, secondary education, and flush toilet was found to lower welfare of mothers in Meru County. The study concludes that despite the inverse relationship by education and sanitation variables, contributing to lower maternal health outcome, source of drinking water (piped) among lactating women therefore should be of priority in policy formulation.

Policy Implications

Kenya is one of the countries in East Africa struggling with improving nutritional status of mother. Therefore as a developing country with prospects of economic growth and attainment of sustainable development goals, Kenya has to deal with mothers’ health outcomes. First, investing in education especially female education need to be promoted based on the study findings which indicated a negative and significant influence of education on BMI. Women with either primary or secondary education levels were found to be associated with significant rise of undernourishment. Nevertheless, the current government need therefore to introduce subjects focusing on nutritional habits in the existing free primary and secondary education by releasing the resources (educational funds) in time and ensuring proper utilization of the same funds in provision of learning materials and personnel. This is based on the higher magnitude associated with increased undernourishment among lactating women with primary and secondary education levels. To promote this policy, the national and county government need to increase educational infrastructures that are equipped with better home science equipment of learning to encourage female education in nutritional uptake in Meru County to reverse the trends.

Secondly, the government and other stakeholders need to pursue sanitation and hygiene programmes which ultimately end infection among lactating women in Kenya. Therefore, there is need for development of programmes targeting at providing clean toilet facilities to the population. For instance, the Kenya government should fund creation of better sewerage lines both at the source and at the end points in regions coupled with infected or dirty water and poor sewerage lines which are the likely cause of infection. Further, the government need to educate the general population or women while attending antenatal and postnatal clinic on other associative practices (for example hand washing practices and better waste disposal mechanism) so as to avoid infections which are likely to contribute to undernourishment. This is based on the study results whereby access to clean sanitation or toilet facilities significantly influenced BMI of the lactating mothers.

Areas for further study

This paper mainly concentrated in analyzing nutritional status of lactating mothers in Meru county using data collected from the Kenya Demographic and Household Survey (KDHS). The study used the BMI of lactating mothers as the dependent variable for nutritional status. For comparison, the study recommends more studies using dichotomous variables (such as underweight, overweight, obese and normal) as indicators for nutritional status of lactating mothers in Kenya. Further, there is need to have studies focusing on comparison with other counties with more other tests like heterogeneity. Finally, other studies need
to consider intra-household food distribution and physical activities on assessing lactating mother’s nutritional status both at regional and national levels.

REFERENCES


