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Abstract

Background: Policy making in Sub-Saharan Africa commonly assume that food and nutrition security programs that target food insecure households would most likely impact on malnourished individuals. This is despite the compelling evidence from elsewhere in the developing world that show a food distribution pattern that is discriminatory against women and girls in particular. ***Objectives:*** We attempt to examine the extent of the association between measures of women nutritional attainment and household food (in)security, where we determine whether distributional analysis of people's nutrition can reliably predict women's individual nutritional well-being from measures of household level food access. Secondly, we ask whether all malnourished women, or at least a large bulk of them are located within food insecure households, such that they can be reliably targeted through household level food security interventions. ***Results:*** A Spearman Correlation analysis between women's nutritional attainment and household level food (in)security show a positive association at aggregate level; and among households that are considered to be food secure but not among households facing food crisis. We further adopt the use of concentration curves and Indices, as well as joint and conditional probabilities to establish a pattern of distribution on malnourished women across different levels of household food (in)security. Our results show that though a larger proportion of malnourished women are located within food insecure households; there is still considerable evidence of a wide dispersion of incidences of women undernutrition, where an average of 30% of malnourished women were located outside of 40% of the households whose food insecurity status was most severe. Conditional probabilities show more or less equal chances of women being malnourished irrespective of food security level of households within which they are located.

Keywords: Women's Nutritional attainment; Intra-household distribution; household food insufficiency

JEL classification:

1.0 Introduction

Based on assumptions that the household food insecurity status represents the experience of individuals within the household; the standard approach of monitoring food security in most developing countries hinges on the use of household-level food security indicators. Studies, primarily from South Asia, however have shown intra-household patterns of inequality that reflect discrimination against the women and girls (Haddad et.al.,1996; Messer, 1997). While this subject matter has gained momentum within the South Asian context, in the case of sub-Saharan countries on the other hand, there is evidence, albeit scanty and inconsistent; of intra-household inequality in the distribution of nutrition.

Notwithstanding the few and inconsistent results as mentioned above, largely there is a neglect of intra-household processes that determine individual household members' nutritional well-being. This trajectory creates a challenge for food security programming to address nutritional needs of vulnerable members of households. Common among policy makers in Sub-Saharan Africa, is the assumption that food security programmes that target food insecure households would most likely impact on undernourished individuals. This is despite the compelling evidence from elsewhere in the developing world that has cast doubt on this assumption, most of which draws heavily from the critique of the Unitary model of intrahousehold analysis "joint welfare maximisation" assumption. Critics of Becker's (1981) Unitary model have pointed out that holding on to this assumption implies that people within households, experience hunger or malnutrition the same way, given a certain level of household income. The question is do we possess enough evidence to support or reject the notion of a joint welfare among sub-Saharan households, particularly in regards nutritional attainment of women? Effective targeting and monitoring of food and nutritional interventions hinges on the response to the question as posited above.

Using cross-sectional data from the Northern part of Ghana, and within the limits of available data, we attempt to shed light on how household level measures of food sufficiency and hunger perform as a proxy of nutritional status of women of child-bearing age. We further analyse the underlying socio-economic factors that perpetuate the risk of women being malnourished. Presumed to be a vulnerable age-gender cohort among rural households in developing countries; the nutritional attainment of women of ages 15-49 years has caught the attention of researchers and policy makers whose goal is to not only achieve food security for all but to bridge the gendered gap in nutritional attainment as well. In this regard, both the

prevalence and the distribution of incidences women's low nutritional attainment is critical for the achievement of the goal.

Research objectives and question are outlined in detail the next section of the paper, which is then followed by a review that will provide insights into empirical and theoretical evidence and arguments from the available literature on the subject. The rest of the paper is structured as follows: Section 3 outlines a description of the data used in the analysis as well as a definition of key variables of interest of women nutritional attainment and household food (in)sufficiency. Results and a discussion of the findings are presented section 4, followed by Concluding remarks on section 5.

1.1 Research Objectives and Questions

We first ask whether women of child bearing age (15-49) experience food (in)security the same way as other age-group cohorts within the same households, such that there would be a correlation (monotonic) between measures of women's nutritional attainment and those of household food (in)sufficiency. In determining the extent of the association between the two measures, we further ask whether distributional analysis of people's nutrition can reliably predict women's individual nutritional well-being from measures of household level food access. Lastly, we disaggregate households by level of food insufficiency and try to establish whether the association, if any holds for severely food insecure vs those that are classified as food secure.

Secondly, concerning the distribution of incidences of women's undernutrition, we ask whether all malnourished women, or at least a large bulk of them are located within food insecure households, such that they can be reliably targeted through household level food security interventions. We rely on the use of concentration curves and concentration indices (Wagstaff et.al, 1991) to provide an understanding of whether incidences of women undernutrition are concentrated among the food insecure households or whether there is in-fact a wide dispersion of incidences of women undernutrition across consumption groups. Another reliable measure of distribution of incidences of women undernutrition that is central to our study, is that of conditional probability, which essentially measures the likelihood of a woman being located in a food insecure household given their low nutritional attainment. The logistic regression techniques are also helpful determining the risk factors that further perpetuate the likelihood of women being malnourished.

2.0 Insights into Literature

I place more emphasis on the few studies conducted in Sub-Saharan Africa (SSA), as it seems conclusions of studies done elsewhere in the developing world are contextual by nature, and cannot be readily drawn in other regions. The concern among one cohort of scholars would be that household -level consumption measures do not allow for a proper diagnosis of inequalities within households, as there is mounting evidence of certain undernourished individuals not being located within households that are considered consumption poor (Brown et al. 2018). The results of Brown et al. (2018) study using Demographic and Health Surveys (DHS) and the Living Standards Measurement Study (LSMS) data from a number of countries in sub-Saharan Africa show that roughly half of undernourished women and children were located outside of the poorest 40 percent of households in the sample population. Prior to Brown et.al. (2018) claims, earlier scholars had pointed out that the severity of consumption poverty would differ depending on whether individual or household level data were used. For example, Haddad and Kanbur (1990) study using data from the Philippines found significant variations in energy intake among members within the same households, and concluded that overlooking these differences, may lead to an underestimation of undernourishment by 20 -40 %.

Another cohort of scholars would probe how the discrimination in nutrient allocation against one group relative to the other, occurs. Here the commonly held assumption (informed by literature drawn from South Asia), is that women and girls are consistently discriminated against, and the fundamental question remains; what constitutes discrimination? Behrman and Deolalikar (1990) outline ways in which gender discrimination occurs. This can be in the form of variation in levels of nutrient intake between female and male members of the households, with female members, bearing the brunt, on one hand, or it may occur in the form of relatively higher volatility of female members nutrient intake vis-a-vie that of other household members in response to income and/price shocks.

In light of the conceptualisation of discrimination as highlighted above, Villa et al (2011), study using panel data covering pastoralist communities in Kenya and Ethiopia concludes that there is very little to no evidence that supports the commonly held assumption of an allocation of nutrients that disadvantages women. Firstly, no disparities of nutrient intake between male heads of households and their spouses were detected. However, male heads dietary intake was observed to be more income elastic, which implies that a decrease in household income would result in a decrease in the household head's dietary intake. Though not fully confirmed due to data availability constraints according to Villa e.al (2011), this

pattern of distribution can be referred to as "head-as-buffer" which is contrary to "maternal buffering" explanation, widely cited in the intra-household food distribution discourse[1] (See for example Maxwell, 1995). Secondly, contrary to what is commonly presumed, sons as opposed to daughters; were systematically worse off than other household members in terms of dietary diversity, a pattern of allocation that they attributed to the occupation of livestock herding that kept boys away, as opposed to girls on one hand, and on the other hand the custom of *bride-price,* that attaches 'value' to the girlchild, common among these communities.

Lastly very few studies, par Coates et.al. (2018) and a few others, for example Blaney (2009) and Berti (2012) have sought to quantify inequalities in nutrients intake between male and female members of households. Firstly, why is it important to quantify intra-household inequalities in food distribution? Here we refer to Berti (2012) study, which reviewed 28 studies, and only 4 of which were in conducted in sub-Saharan countries. Central to Berti's (2012) analysis is the concern over whether different age gender groups would benefit equally (according to their specific needs) from food security interventions, given the prevailing intra-household food distribution patterns in terms of who is "favoured" and who is disadvantaged. Intrahousehold inequalities in access to food related resources may be useful in understanding why an increase in people's income, for example may not translate in reduced malnutrition (FAO, 2019). Indeed, inequalities within households, particularly those that are gender based may results in certain economic events, disproportionally benefiting one group and not the other.

Berti (2012) review of the 28 studies conclude that none of the age gender groups in the analysis were consistently favoured nor disadvantaged; in fact, according to Berti (2012) the common assumption of an intra-household food distribution pattern that favours boys over girls was not consistently held in more than half of the studies. Thus, household-level food consumption measures could be used roughly to target vulnerable individuals within households, though for evaluation purposes individual level measures could be used to assess impact of food security interventions (Berti, 2012). Nonetheless, individual level measures are important in selecting specific food and nutrition security measures tailored for specific needs of individuals. Meanwhile Blaney et.al. (2009) study findings on individual household members nutrient adequacy by gender and age, slightly differ from Berti (2012), as they show that adolescent males scored better than their female counterparts.

[1] Maternal buffering is the practice where a mother deliberately limits her own food intake to ameliorate that of young children

Coates et.al. (2018) study in Ethiopia on the other hand, draws our attention to the notion of equity, which they define as "consumption adequacy of one group of household members relative to another." (Coates et.al., 2018: 83). Central to the definition of adequacy here is the distinction between whether one's nutrient intake can be considered nutrient adequate on one hand and whether it meets their nutrition specific needs in relation to their specific physiological needs, on the other hand. The latter is the adapted definition of adequacy in nutrition equity studies for example, Haddad and Kanbur (1990). Coates et.al. (2018) study findings show detrimental inequities in the intake of invisible micronutrients, with adult women, children, more disadvantaged. Interestingly though, the results do not show any inequities against these presumed disadvantaged groups, in the intake of calories and protein.

Lastly, though beyond the scope of this analysis, it is worth probing what factors are responsible for women 's relative deprivation in relation to the other household members, as these have been helpful in shaping our research hypotheses towards searching for the evidence of intrahousehold inequalities in nutritional attainment that are unfavourable to women. Key to understanding these factors lies on the analysis of intrahousehold processes in allocation of food related resources. Empirical and theoretical work on the subject matter, mainly from South Asia, have shown how households would allocate resources according to their concerns for Efficiency on one hand (Rosenzweig and Schultz, 1982) and equity on the other (Pitt, Rosenzweig &Hassan, 1990). Rosenzweig and Schultz (1982) attribute the disparity of female and male nutrient allocation to household's rational response to the gender discrimination in the labour market, where male children face better employment prospects than their female counterparts; a pure investment strategy, according to Behrman (1988). On the other hand, results of Pitt et.al. (1990) 's study in Bangladesh show that the gender differences in calorie consumption between male and female members of households is associated with greater participation of men in energy intensive activities. Thus, the relatively higher consumption of calories by men compensates for their higher energy expenditure in the labour market; essentially showing a food allocation behaviour that exhibits inequality aversion, according to Villa et.al. (2011).

The Feminist critique of the paradigm of thinking as outlined above has been quite profound, and has questioned the justification of what they term "discriminatory allocational outcomes" on the grounds of economic rationality. Unequal power relations within the households are at the core of their arguments; Folbre (1984) for example, argues that the observed gender-based inequalities in nutrition could be looked at through the bargaining lens, as they reflect the father's preference, whose bargaining power within the household is higher than that of the mother. Within the bargaining framework, bargaining

power is defined according to one's fall-back position (Agarwal, 1997), which in turn is determined by a number of factors both quantitative (such as income) and qualitative; for example, access to social capital. Agarwal (1997) further points out that inequalities in access to such resources and the prevailing cultural norms that may influence gender-based biases in distribution of food related resources are the main drivers of the relative deprivation of women vis-vis that of men.

The findings of Coates et.al. (2018) and others point to a grave danger of making assumptions about inequalities (or the lack of) inherent in food distribution patterns in different contexts, as this has implications for the design and implementation of interventions as well as their well-being impacts. Furthermore, the inconsistencies in findings do raise key analytical and policy questions of factors particularly socio-cultural, that are context specific being critical in determining food distribution patterns that may predict a relative deprivation of one age-gender specific group compared to others within the same households. Indeed, targeting poor households without any consideration of the above mentioned factors may overlook undernourished individuals. In this regard, an understanding of intra-household food distribution patterns that are discriminatory against female members is important for policy making and distributional analysis. Here the understanding is that a food distribution pattern that disadvantages women and girls of child bearing age, would most likely result in low nutritional adequacy levels, relative to their physiological needs, with consequences for their own well-being, and that of their children (Haddad e.al, 1996).

3.0 Data and Definition of Variables

The study makes use of the Feed the Future (FtF) Ghana Baseline Survey data. The population-based survey covers four northernmost regions of Ghana and was conducted through a collaboration of 6 institutions; namely the USAID-Ghana Monitoring Evaluation and Technical Support Services (METSS), Kansas State University (KSU), University of Cape Coast (UCC), the Institute of Statistical, Social and Economic Research (ISSER) of the University of Ghana, and the Ghana Statistical Service (GSS). The survey was done over a period of 3 months from June 2012 to August 2012, with the US Department of Agriculture (USDA) and USAID providing technical support (METSS-Ghana, 2012).

The survey adopted a two-stage probability sampling approach, first stage of which is the selection of 230 enumeration areas (2010), done with the help of the sampling frame used in 2010 Ghana census. The enumeration areas were selected by usé of Probability Proportional to Size (PPS). In the second stage, the systematic sampling approach was used to select households from each of the sampled enumeration

areas. With effective sample size estimated at 4600 households, 20 households were selected from each enumeration area. Having accounted for non-response, the final sample size was determined at 4410 households, and the ultimate sample of 4,513 women of ages 15-49. The Key variables of interest, namely measures of household food (in)security and women's nutritional attainment, are discussed in detail in the next sub sections.

3.1 Women's Nutritional Status

We employ two indicators of women's nutritional status; the first being the Body Mass Index (BMI) as a continuous variable used to measure food energy deficiency of women of child bearing age (15-49). The second indicator is a measure of women's undernutrition that is set equal to one if a woman's Body Mass Index is lower than 18.5kg/m2 and zero if it falls within the range >18.5kg/m^2 <26kg/m^2 (considered to be normal). BMI, a measure of people's weight and height is an anthropometric measure of adults' chronic energy deficiency (Shetty and James, 1994), and it reflects not only the current energy expenditure, it is also function of people's health status as well as their access to sanitation and health services. Furthermore, women's BMI is affected by their pregnant and lactating status, nutritional requirements of which impose further demands on women with chronic energy deficiency (Shetty and James, 1994). Research in developing countries has also shown that low maternal BMI is associated with low birthweight of children poor lactation performance, which poses a risk for infant growth (Giay and Khoi, 1992). Given that our analysis is focused on women who are either malnourished or fall within the normal range (not malnourished), our sample is therefore limited to women whose BMI falls below 26kg/m^2. Women who report being pregnant during the survey period are also excluded from the sample.

3.2 Household Food Sufficiency and Hunger

For purposes of comparison and validation of results, we make use of two measures household level nutritional well-being; a consumption (quantity) based and a experiential measure. The food indicator of per capita calorie consumption is a quantitative indicator often used as benchmark as it presents a more accurate and direct measure of household food sufficiency (Maxwell, Coates and Vaitla, 2014). The Hunger Household Score (HHS) on the other hand is an experiential based measure that also captures households' food sufficiency. The idea behind the indicator is that people's experiences with food deprivation- even its most extreme manifestations, can be captured in a survey and summarized into a scale that categorizes households according to their food sufficiency levels (Ballard et.al 2011).

(i) Household Per Capita Calorie Consumption

We first construct the consumption-based approach measure- the daily Per Capita Calorie Consumption, which essentially measures a household energy availability. We adapt two indicators of the consumption-based measure, the first being a continuous variable (cal/capita/day) and the second a dichotomous variable of household food insufficiency set at one for households whose daily calorie consumption per capita falls below the threshold 2300 cal/capita/Per day; and zero for households who consume above the threshold.

The indicator of Calories/Capita/Day is constructed by converting quantities of food consumed into corresponding energy units. Using the 7-day recall methodology, food consumption data covering approximately 300 food items consumed during that period, was collected at the household level. The data captured quantities consumed from market purchases, home production, and from other sources outside the house, e.g., relatives, government/nongovernment aid, or food received in exchange for labour. For more accuracy in reporting, quantities of food were reported in local units of measure for example 'bowl of rice', '2 tubers of yam' etc. Also captured in the data is the expenditure for each food item, and based on the monetary value as reported by the respondent household, the per kilogram price was used to make an estimate of quantities consumed in metric units (kg). The information pertaining to per kilogram price was acquired from the weekly market prices of Food as published by the Ghana Ministry of Food and Agriculture (MoFA) website (MoFA, 2012).

The total amount food consumed in kilograms is converted into dietary energy (kcals), where individual food items are matched with food Composition Tables which consider the percentage of portion of food item that is consumable. FAO *International Network of Food Data Systems* (INFOODS) provides the food composition tables that cover food items from specific regions. The amount of energy acquired (kcal/day) was expressed in per capita units, dividing the total calories acquired by the number of food consumption recording days (seven) and then by the total number of household members.

(ii) Household Hunger Scale

HHS is constructed through the use of three questions that capture people's experiences of food deprivation over a 30day time period, and three frequency responses. In the first instance the respondent, who is a household member that is responsible for food preparation is asked if a given condition of food shortage was experienced, the answer of which is yes, or no. If yes, then the follow up question is about the frequency of the occurrence of the food shortage and/or crisis, and the answer to that is divided into

three- rarely, sometimes, or often. In constructing the Index, firstly the responses to the three "occurrence" questions are coded 1 and 0, for “Yes” and “No” respectively; and the frequency responses are coded 1 for “rarely” and “sometimes” and 2 for “often. The values of the frequency-of-occurrence are then summed to generate the HHS score for each household.

We make use of two indicators generated from the HHS, firstly as a continuous variable that ranges from 0 to 6, with the highest score representing greater food insufficiency; and secondly as a categorical variable that categorise households into three different severities of household hunger: (1) Little to no household hunger for HHS score 0–1; (2) Moderate household hunger for HHS score 2-3; and (3) Severe household hunger for HHS scores 4-6. We adopt the indicator, bearing in mind its limitations, as highlighted by Ballard et al. (2011), who point out that the HHS is more suitable when used within contexts with severe food insecurity, as it does not capture experiences associated with mild to severe food insecurity.

4.0 Results and Discussion

4.1 Correlations; Women’s Undernutrition and Household Food Security

The study explores the relations between household food security status and nutritional status of women of child bearing age (15-49). We hypothesize that there is a monotonic correlation between women’s nutritional attainment and households’ food sufficiency. For monitoring and evaluation purposes, it is crucial to ask whether we can reliably predict women’s nutritional attainment from measures of household level food sufficiency. We conduct a Spearman Correlation Coefficient to establish the relationship, and results are presented in Table 1 below.

Table 1; Spearman’s Correlations between Women’s Nutritional Attainment and Household Food Insecurity

Household Hunger Scale	**BMI**		**Household Consumption (cal/capita/day)**	**BMI**
Aggregate	-0.0466*		Aggregate	0.0580*
0	-0.0654*		0	0.0664*
1	-0.0161		1	0.0520
2	-0.0125			

*Significant at p< 0.05 level

As to be expected, at the aggregate level, BMI has a significant association with both measures of household food (in)sufficiency. The correlation coefficient for Hunger HHS is negative, while that of the Household daily Consumption in calories per capita is positive, which suggests that the level of Women's nutritional attainment decreases with increasing levels of household food insufficiency. The observation seems to corroborate with the assumptions of the unified household economy approach as highlighted in previous sections, that state that individual household members enjoy the same level of food security, and/or experience hunger and malnutrition the same way, given a certain level of household combined income. Consequently, based on this observation, food security assessments that inform policy-making are routinely conducted at household level, and the point made by this study is that without considering the individual nutritional status of vulnerable household members, people's food security levels may be overestimated. To validate this point, further analysis using other approaches are conducted and the results are presented in in the next sub-section; but first it is worthy to show how the strength of association between women's own nutrition and household level food security varies, for households with different food (in)sufficiency levels.

Table 1 shows that when conducting separate analysis using disaggregated data according to food (in)sufficiency level, a different pattern starts to emerge, which shows that with increasing levels of household level food insufficiency the level of correlation between the two measure seems to decrease. For households with little or no food insufficiency (HHS= 0-1)) the association between household level food security and women's nutritional status is still significantly stronger than household with severe food insufficiency, where there seem to be little to no relationship between the two measures. The same pattern is observed on the fourth column, when women's BMI is correlated with household food (in)security measured by (cal/capita/day).

The findings of our analysis show a variation between the food intake of female members and other household members within households facing a crisis. This signals inequalities in intra-household food distribution. However, without data on food intake of their male members of households, nor that of other age-gender groups within households, there is no sufficient evidence of food distribution pattern that favours one group over another, at this point. Furthermore, we draw our conclusions bearing in mind the limitations of correlation coefficients as exploratory tools, whose findings may have to be supplemented by other measures. Nonetheless, there is still enough evidence at this stage to support the claim of a gendered pattern of coping that is characteristic of households that are facing food crises. Agarwal (1992) and others such as Gill (1989) and Kynch (1997) citing experiences with past famines in

India, point out that women often bear the brunt of food crises, either through limiting their own food intake in favour of other household members or through a household asset disposal pattern that is unfavourable to women in relation to men.

Despite the differences in experiences of food crises, however, food (in)security interventions are mainly focused on reducing households' vulnerability and relying on household level measures for targeting. Here South Asia's experience with famine and food crises monitoring presents a learning opportunity for Sub-Saharan Africa countries, particularly within the context of what some perceive to be a "gender-just"[2] food and nutrition security approach (Rao, Pradan and Rao, 2017). As early as the 1980s there were calls among South Asian scholars, for a gender-sensitive monitoring of food crises that would enable a more effective response that addresses the needs of vulnerable gender-age groups within households (see for example Gill, 1989).

4.2 Distribution of Incidence of Women Undernutrition

The fundamental question is are all malnourished women, or at least a large bulk of them, located in food insecure households, such that they can be reliably targeted through household level food security interventions. In the "Equality" language, we may well ask whether inequalities in the burden of women undernutrition is disproportionally borne by the consumption poor. Firstly, we acknowledge that the fact that household food sufficiency may not be directly translated into women's nutritional well-being (as has been proven elsewhere) does not mean that its enhancement is not critical for people's individual nutritional status. Rather, there are specific challenges inherent in women's individual nutritional attainment that needs to be taken into consideration in policy-making.

Following Brown et.al, (2018), we adapt a simple framework that analyses the extent to which women's nutritional status can be reliably predicted from measures of household food sufficiency. We rely on the measure of conditional probability, which essentially measures the likelihood of a woman being located in a food insecure household ($f<1$) given their low nutritional attainment ($w<1$).

[2] Being enshrined in the Declaration of Human Rights; people's access to adequate food is increasingly being recolonized as a fundamental right and not just a goal of sustainable agriculture development.

Following Brown et.al (2018), the probability takes the following expression, the enumerator of which denotes the joint probability of being undernourished and in a food insecure household Pr(w<1, f<1) ; and the denominator of which is the overall probability of being undernourished Pr(w<0);

$Pr(w<1/f<1) = Pr(w<1, f<1)/ Pr(w<0)$

Values of (w) and (f) are normalised by appropriate cut-off points and nutritional thresholds as stipulated by international standards of the World Health Organisation and FAO, such that a woman is undernourished if they fall below the threshold 18.5kg/m^2 (and only if) shown as (w<1). A household is food insecure if (i) their per capita calorie consumption falls below 2300 kcal/ day and (ii) their Household Hunger Score falls within category 1 and 2, with 2 being the most severe, expressed as (f<1). We rely on the use of Concentration curves and Indices as well as conditional and joint probabilities to establish the distribution of malnourished women across different consumption groups.

4.2.1 Concentration Curves; Women's Nutritional Attainment against Household Food Security

Concentration Curves are commonly used to measure socio-economic inequality in relation to a measure of individual well-being. Introduced into the Equity/Equality discourse by Wagstaff et.al; (1990), concentration curves and indices, have since been popularised by the World Bank in assessing and making cross-country comparisons of poor- nonpoor inequalities in health outcomes (Wagstaff et.al (1991). Wagstaff and Watanabe's (2000) cross-country study extended the use of concentration curves to the Nutrition literature by examining inequality in nutrition outcomes. With some scholars questioning how they differ with Lorenz curves, in a subsequent publication (Wagstaff and Watanabe, 2000) differentiates it from the Lorenz curve by stating that in plotting concentration curves the ranking is done by living standard variable, and not the well-being variable, whose distribution is of interest, as is the case with Lorenz curves. For the plotting of a concentration curve, two variables are of importance; namely an individual level well-being outcome measure, the distribution of which is the subject of interest and (ii) the variable that captures people's living standard, which will then be used to assess the distribution of the individual level variable. Our analysis focuses on the extent to which the incidence of women undernutrition is concentrated among consumption poor households or vise versa. In that regard, the living- standard measure against which we assess the distribution of women undernutrition is that of household food consumption measured by the daily per capita caloric intake.

The concentration curve in figure 1 below plots the cumulative percentage of malnourished women on the y-axis against the cumulative household consumption, ranked by percentiles of household calorie consumption beginning with the lowest, ending with the highest (x-axis).

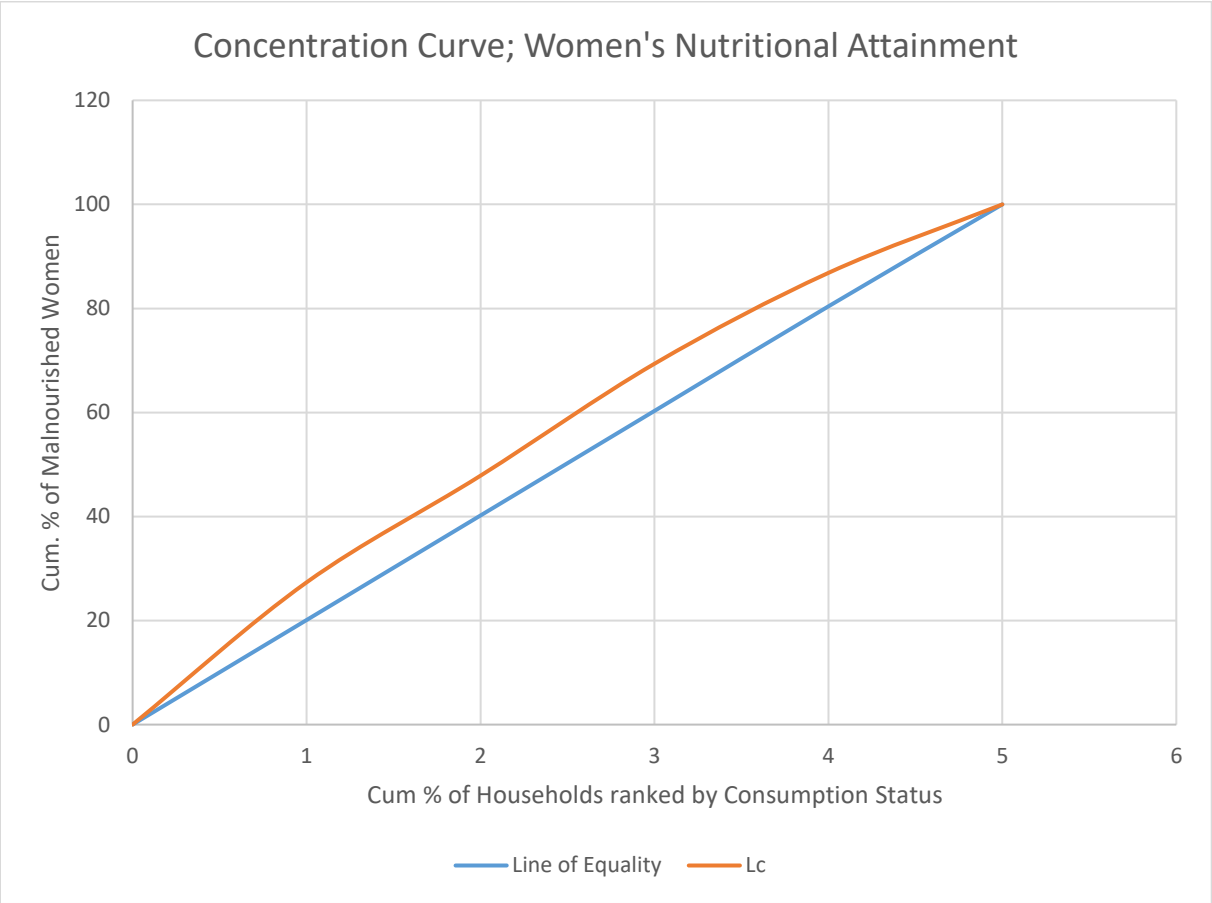

Figure 1; Women's Nutritional Attainment Concentration Curve

Given that concentration curves are often used for cross-country comparisons of the extent of poor-non-poor inequalities in well-being outcomes, their interpretation is based on the extent to which Lc is close or further away from the equality line (concavity), as well as their position in reference to the line of equality- whether above or below (Wagstaff and Watanabe, 2000). With Lc above the line of equality we can deduce that the incidence of women undernutrition is greater among poor consumption households; in contrast a line that is below the diagonal would reflect a pattern of women undernutrition that disadvantages the non-poor consumption households. The concavity of our Lc on the other hand, helps in assessing the level of inequality in the distribution of the incidence of women undernutrition. For our analysis, there is no opportunity for pairwise comparisons due to data limitations, nonetheless with Lc

this close to the diagonal we can deduce that the poor – non-poor gap in the incidence of women undernutrition is quite minimal. This implies that in our sample area women of child bearing age have more or less equal chances of being undernourished, irrespective of whether households they live in are considered food secure or not.

Our findings seem to contradict those of similar studies done elsewhere in developing countries that show that the poor disproportionally bear the burden of malnutrition than the non-poor. For example, Wagstaff and Watanabe (2000), and Bredenkamp et.al. (2014) conclusions were such that incidences of child stunting and wasting in developing countries are skewed towards wealth poor households. Holding on to the assumptions of these findings, it is no wonder that policy making aiming to reach malnourished individuals continues to target households. On the other hand, Brown et.al.'s (2018) cross-country study of the distribution of underweight women ranked according to household consumption show curves that are fairly close to the equality line. Results of this study done in 30 African countries imply low levels of poor-nonpoor inequalities in the incidences of women undernutrition – suggesting a wide dispersion of undernutrition across consumption strata.

To validate this finding however, we rely on another measure, the concentration Index (CI), which is a numerical measure of inequality of distribution of well-being outcome. The CI is defined in relation to Lc, as it reflects twice the area between the concentration curve and the line of equality). Table 2 below presents the proportion of malnourished women who fall within each percentile of household food consumption. The table further presents cumulative values of both the sample households and share of malnourished women that form ordinates of the concentration curve Lc presented in Figure 1. The cumulative values (Pi) and (Li) as indicated are further used to compute the Concentration Index (CI) as shown in the right most column. Following Wagstaff and Watanabe (2000), the concentration index for i=1…,T groups is computed using excel and it follows the formula as indicated below:

$$CI = (p_1L_2 - p_2L_1) + (p_2L_3 - p_3L_2) + ... + (p_{T-1}L_T - p_TL_{T-1})$$

Because there isn't really a reference point that we can use to assess how big the inequality is, we refer to literature on the subject matter (see for example Wagstaff and Watanabe, 2000 and Brown et.al.,2018). The computations on Table show a CI of value -0.14, which not only indicate a concentration of incidences of undernutrition among the consumption poor, because of the negative value; but because it is not more negative than -0.15, it also suggests that there is a wide dispersion of women undernutrition across consumption groups. At this point we can comfortably make a claim that there is a considerable

percentage of malnourished women outside of food insecure households. To further support this claim, we make use of (Pi) and (Li) in Table 2 to generate scores of joint probability of being undernourished and being located in a food insecure household [Pr(w<1, f<1)] . We are particularly interested in the proportion of malnourished women that are located outside the most food insecure households that make 40% of the sample population. The (Li) corresponding to (Pi) of 0.6 is a value of 0.69, which suggest that on average, 30% of undernourished women are located outside the 40% severely food insecure household.

Table 2; Women Undernutrition ranked By Household Consumption Percentiles

Wealth Group Daily Cal/capita	**Freq. Share Population**	**Cum. Share Pop**	**Freq. Share Undernourished Women**	**Cum. Share Undernourished Women**	**Conc. Index**
		Pi		Li	CI
1	0.101	0.101	0.14	0.14	0
2	0.101	0.202	0.14	0.28	-0.00404
3	0.101	0.303	0.12	0.4	-0.01564
4	0.0997	0.4027	0.08	0.48	0.000756
5	0.0991	0.5018	0.12	0.6	-0.01388
6	0.0984	0.6002	0.09	0.69	-0.00898
7	0.1	0.7002	0.1	0.79	-0.02298
8	0.1	0.8002	0.08	0.87	-0.03046
9	0.0994	0.8996	0.07	0.94	-0.0404
10	0.1004	1	0.06	1	
Total	0.1		1.0		-0.13563

4.2.2 Regression Analysis

As per the discussions in Section 1 above the relationship between the variable of nutritional attainment (w<1) and household food sufficiency variable (f<1) is not a clear and unmediated one. In fact, it is dependent on other factors such as intrahousehold inequalities in allocation of food related resources, household access to services like water and sanitation as well as women's individual characteristics. For a better understanding of what drives the relationship, we therefore regress women's nutritional outcomes on household food security, controlling for individual and household characteristics. The augmented regression model is as follows;

$$\ln Y_{ij} = \ln(p/1-p) = \alpha_0 + y_j F_j + \beta_{ij} W_{ij} + \delta_j X_j + \varepsilon_{ij}$$

Assuming that women's nutritional attainment and household food (in)sufficiency are completely independent; let $\ln Y_{ij} = \ln(p/1-p)$ be conditional probability of $Y_{ij,}=1$; where Y_{ij} denotes the incidence of malnourished woman i located in household j (1 = malnourished and 0 = adequately nourished). F_j is a categorical predictor variable that reflects food sufficiency /adequacy status of household j (1 =food insecure and 0 =food secure), and W_{ij} is a vector of the individual characteristics of woman i, such as age, and whether or not they completed primary education. Lastly X_j are household characteristics of household j that include the characteristics of the household head, household food production, type of household (single female headed or dual-headed) and income levels; while γ β and δ are coefficients to be estimated.

The logistic regression model is used to firstly determine the socio-economic factors that put women at risk of being malnourished and to then determine the likelihood of a woman being located in a food insecure household given their low nutritional attainment, i.e the conditional probability. The first step of the analysis entails an estimation of the logit function; the results of which are presented in Table 4. We then compute predicted probabilities of outcome variable Yij =1 among households that are classified as food insecure (Fj= 1). A description of the variables for logistic regression is outlined in Table 3 below.

Table 3. Description of Variables for Logistic Regression

Variable	Description	Mean (n=3129)
Outcome Variable		
Women's Undernutrition	Women nutritional status in BMI (1 if <=18,5kg/m2)	13%
	Women's Individual Characteristics	
Age	Age of female, years	28.43 (9.13)
Woman's literacy	Women's literacy, 1 if completed 1^0 school	37%
	Household Characteristics	
Household headship	household head is female = 1	10%
Household Size	Total no. of members of household	7.9 (4.10)
Access to safe drinking water	Access to clean drinking water (1 if yes)	59%
Access to Sanitation	Availability of Private latrine (1 if yes)	15%

Rural household	1=rural, 0=urban	78%
Landownership	household ownership of land (1 if yes; 0 if otherwise)	87%
Access to Electricity	household access to electricity (1 if yes)	25%
Household Income	Household Per Capita Expenditure (GHc /week	13.23 (15.59)
Household Food Insufficiency	Household calorie intake (1 if less than 2300cal/capita)	52%
Household Food Hunger	Household food inadequacy (1 if HHS category >=1)	36%

Source; Own Calculations

Of the 3129 women that make our sample, 13 percent of them are malnourished with BMI value falling below 18.5kg/m^2. Other individual level variables included are indicators of human capital; being, women's literacy, 37% of whom reportedly completing primary school; women's age in years (mean=28.4), as well as the age squared. The square of women's age accounts for the diminishing and eventually reversing role of age as a human capital ta enhances women's ability to access food related livelihood resources. Household income and wealth, expected to reduce the risk of women being malnourished, are proxied by household per Capita expenditure, Land ownership and electricity connectivity. Lastly, sanitation and safe and clean drinking water are factors that influence people's nutritional status outside of economic factors. Proper sanitation is measured by whether households have a private latrine, only 15% of which were reported. Access to safe and clean drinking water on the other hand is measured by whether households accessed their water from a private or public tap; as well as a closed or protected source, such as boreholes.

Table 4 below present coefficients of the logistic regression analysis starting with our factor variables: measures of household food (in) sufficiency and hunger. Model 1 estimates show the amount of increase in the incidence of women undernutrition that would be predicted by one unit increase in household hunger measured by HHS, while model 2 factor variable is household food sufficiency measured by daily calorie consumption per capita (cal/ca/day). Model 1 coefficients show that the incidence of women undernutrition increases by 0.22 for each unit increase in household hunger. Model 2 estimates also show a positive and significant coefficient for household food insufficiency measured by cal/ca/day), suggesting that for every unit of change in households food insufficiency the odds of women being malnourished increases by 0.29.

Other factors that perpetuate the risk of women being acutely malnourished include women's age in years; with younger women more likely to be malnourished than older women (maximum 49 in our case). Contrary to our expectations, women's literacy, presumed to be a critical human resource that enables one's access to other livelihood options, is not associated with women's undernutrition and neither is access to sanitation and clean water, and this may be due to the fact that access to these services is at a very low level, and therefore presents low variability.

Consistent with other studies on the determinants of food security, household wealth indicators of ownership of house and household Income (proxied by per Capita expenditure) show negative and significant coefficients, implying a positive effect on women's nutrition. The result should however be interpreted with caution, as it may lead to assumptions that household level wealth indicators can serve as reliable predictors of people's individual nutritional attainment– an assumption that has been proven to be false by past scholars such as Haddad and Kanbur (1990) and more recently Brown et.al, (2018), for example.

Table 4. Parameter Estimates of Logit Models for Women Undernutrition

	Model 1	**Model 2**
VARIABLES	Women Undernutrition	Women Undernutrition
HHS category 1 (moderate food insecurity)	0.218*	
	(0.123)	
HHS category 2 (severe food insecurity)	0.185	
	(0.162)	
Household cons <2300 kcal/capita/day		0.294**
	(0.134)	(0.134)
Household headship (1 if female)	0.236	0.239
	(0.173)	(0.173)
Hh head literacy (1 if completed 1^0 school)	0.142	0.119
	(0.132)	(0.132)
Household Size	-0.0199	-0.0243
	(0.0148)	(0.0149)
Access to clean and safe drinking water (1 if yes)	-0.126	-0.132
	(0.117)	(0.116)
Access to sanitation (1 if yes)	-0.126	-0.125
	(0.169)	(0.169)
Rural (1 if rural and 0 if urban)	0.0695	0.104
	(0.178)	(0.178)
Landownership (1 if yes, 0 if otherwise)	-0.157	-0.125
	(0.163)	(0.164)
Access to electricity (1 if yes, 0 if otherwise)	0.0356	0.0179

	(0.161)	(0.160)
Per Capita total expenditure	-0.0184***	-0.0138**
	(0.00590)	(0.00611)
		(0.137)
Constant	1.361**	1.219*
	(0.625)	(0.633)

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

We estimate predicted probability of women undernutrition at different levels of household food (in)security; proxied by household hunger and food insufficiency, and the results are presented in Table 5 below. Holding all the predictor variables at their mean values, the predicted probability of a woman being malnourished, 11% and 10% among those within households with satisfactory food sufficiency level i.e. HHS category 0 and Household daily consumption of more than 2300 kcal/capita. This implies that given the socio-demographical factors as described in Table 3, women in households that are not hungry and/or whose food sufficiency is satisfactory do have a likelihood, albeit small, of being malnourished. Meanwhile, with equal predicted probability of 13 % predicted probability of incidence of women undernutrition in moderately food secure and severely food insecure; largely there seems to be an equal chance of women being undernourished irrespective of the food security level of households they are located in.

Table 5: Predicted Probabilities for Women Undernutrition

VARIABLES	**Predicted Probabilities**
HHS category 0 (little to no food insecurity)	0.108***
	(0.00786)
HHS category 1 (moderate food insecurity)	0.130***
	(0.0105)
HHS category 2 (severe food insecurity)	0.127***
	(0.0156)
Household cons >=2300 kcal/capita/day	0.0993***
	(0.00979)
Household cons <2300 kcal/capita/day	0.129***
	(0.00814)
Observations	3,129

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The findings of a dispersion of malnourished women across different levels of household consumption; though unexpected are consistent with those of Brown et.al (2018), whose study covered a total of 30 countries in Sub-Saharan Africa. The scholars attribute the finding to a high overall rate of undernutrition among those countries whose distribution exhibit the phenomenon. Rightfully so, overall, food insecurity

is prevalent in the northern parts of Ghana, the figure of which according to reports are four times that of national average (METTS-Ghana, 2012). This, according to the report, is due the low population density and vast land mass, as well as relatively poor road infrastructure that also create a sense of isolation and hence vulnerability among people in the area.

5.0 Conclusion

In the Introduction section of this paper, we pose a fundamental question on whether there is enough evidence to support or even reject Becker's (1981) notion of a joint welfare among sub-Saharan (SSA) households. From the review of the existing literature, the results of the few studies conducted within the context of SSA on the subject show inconsistent findings. Our study attempts to bridge this gap, as it has proven to be a constraint for policy making and programming to reach the most vulnerable people. Our primary focus is the nutritional attainment of women of child-bearing age, who are presumed to be vulnerable; due to their physiological needs on one hand and on the other hand, other socio-cultural factors that place them at a lower status than other household members. We conduct an analysis that allow a comparison between women's nutritional attainment and household level food (in)sufficiency; which show a positive association, at aggregate level; and among households that are considered to be food secure but not among households facing crisis. Data availability limits our ability to fully explain our findings, nonetheless, there is consistency with claims of previous scholars that monitoring frameworks that rely on household level measures are likely to lead to an underestimation of the prevalence of food deprivation. In light of these claims, individual level measures of nutritional attainment alongside those at household level are critical in giving a more realistic picture of food deprivation in different contexts.

We further adopt the use of concentration curves and Indices, as well as joint and conditional probabilities to establish a pattern of distribution on malnourished women across different levels of household food (in)sufficiency. Our results show that though a larger proportion of malnourished women are located within food insecure households; there is still considerable evidence of a wide dispersion of incidences of women undernutrition, where an average of 30% of malnourished women were located outside of 40% of the households whose food insecurity status was most severe. Furthermore, conditional probabilities show more or less equal chances of women being malnourished irrespective of food security level of households within which they are located. The findings provide evidence that food and nutrition security interventions that target households, may not reach a considerable number of women who are most in need.

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