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Toward Improved Understanding of Food Security: A Methodological Examination Based in Rural South Africa

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Abstract

Accurate measurement of household food security is essential to generate adequate information on the proportion of households experiencing food insecurity, especially in areas or regions vulnerable to food shortages and famine. This manuscript offers a methodological examination of three commonly used indicators of household food security – experience of hunger, dietary diversity, and coping strategies. Making use of data from the Agincourt Health and Demographic Surveillance Site in rural South Africa, we examine the association between the indicators themselves to improve understanding of the different insight offered by each food security “lens.” We also examine how the choice of indicator shapes the profile of vulnerable households, with results suggesting that dietary diversity scores may not adequately capture broader food insecurity. Concluding discussion explores programmatic and policy implications as related to methodological choices.

Keywords

Food security; food insecurity; food security measurement; Agincourt; coping strategies; dietary diversity; hunger

Introduction

Food and nutrition security continue to be one of Africa’s most fundamental challenges. The persistence of the challenge is resultant of complex political, social, and economic factors as well as environmental stressors. Food security, as defined by the U.S. Agency for International Development (USAID), is comprised of food availability, access, and utilization. Within the present study, we understand food security as the ability of households to access sufficient, safe, and culturally appropriate food to meet dietary needs in

order to lead a healthy and productive life (USAID 1992; UNFAO 2003; USDA 2009).¹ For years, measures of food security have incorporated both objective (consumption) and subjective (self-reported behaviors) indicators to allow for the evaluation and monitoring of food and nutrition security at national, regional, community, household and individual levels. Here, our unit of analysis is the household since food scarcity is ultimately experienced at the household level (Maxwell 1996). Our analysis provides a methodological examination of three commonly used indicators of household food security – experience of hunger, dietary diversity, and coping strategies. We argue that choice of indicator matters for identifying vulnerable households and that multiple indicators can more accurately determine the levels of household food insecurity. The project's findings should help researchers and food security advocates better identify at-risk households.

Background

Households experience food insecurity when unable to absorb, reduce or mitigate the impact of decline in food availability, access, and/or consumption (Misselhorn 2005; Webb et al. 2006). Some households, clearly, are more vulnerable to food insecurity than others and substantial scholarship has been developed to examine this differential vulnerability (Corbett 1988; Hoddinott & Yohannes 2002; Hatloy & Oshaug 1998; Maxwell 1996; Misselhorn 2005; Webb et al. 2006). Obviously, within this work, precise measurements are necessary to differentiate food-secure from food-insecure households and such measurements are also essential for successful targeted food security interventions and policies. Yet there is not a standard methodology for measuring food security – as aptly noted by the Food and Agriculture Organization (FAO) of the United Nations: no “perfect single measure that captures all aspects of food insecurity” currently exists despite improved theoretical understanding of food security (FAO 2002; Webb et al. 2006).

Standardized measures are complicated by the various components within the concept; For example, Swindale & Bilinsky (2006) point out the difficulty in developing a standard set of indicators to measure the access component of household food security given contextual and cultural variations across space and time. Davies (1996) cautions the use of standardized measures across contexts and even suggests using discretion within the same locality, since the sequence and methods of coping may differ markedly from one household to the next. Moreover, collection of data to evaluate household food access, such as income and expenditures on food, is often expensive, time consuming and technically demanding (Swindale & Bilinsky 2006). In addition, as Maxwell & Frankenberger (1992:48) note “food insecurity can exist on a permanent basis (chronic) or on a temporary basis (transitory) or in cycles.” It is therefore important to consider factors of access, sufficiency, and sustainability within any measure of food security. As such, understanding how the profiles of vulnerable households vary by indicator is critical. By evaluating three commonly used indicators of

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¹Moreover, food security is understood to be less about sufficient global and national production and more about livelihoods that are able to provide enough food at the household level (Misselhorn 2005). Nutrition security is a related, though less commonly used term and refers to adequate nutritional status for all household members at all times. Food security is therefore a necessary precursor to nutrition security, though not a sufficient condition alone (Haddad, Kennedy & Sullivan 1994; Webb et al. 2006). For the purpose of this paper, we focus on measures of food security with the understanding that both secure access to food and proper nutrition are coupled to ensure adequate health outcomes.

household food security—dietary diversity, experience of hunger, and coping strategies—we show how choice of indicator matters for both identifying vulnerable households and developing interventions that target those most in need.

Dietary Diversity

Dietary diversity has traditionally been measured using a simple count of food or food groups consumed over a reference period, typically ranging from 1 to 15 days (Ruel 2003; Drewnowski et al. 1997). Single food counts are referred to as ‘food variety score (FVS)’, whereas food group count is considered the ‘dietary diversity score (DDS)’ (Ruel 2003). Some U.S. studies further analyze dietary diversity by taking account of servings of various food groups in accordance with dietary guidelines (Ruel 2003; Guthrie & Scheer 1981; Kant et al. 1991). In the context of developing countries, however, simple counts of food or food groups are predominantly used to measure dietary diversity, likely because of their relative simplicity (Ruel 2003). Although it is not the purpose of this paper to critically analyze measurements of dietary diversity, which has been done elsewhere (see for example Ruel 2003), we should note that the variety of measures and varying reference periods make comparisons across studies difficult – further complicating ability to generate a holistic understanding of food shortage issues.

Despite the absence of a standardized measurement tool to evaluate dietary diversity across settings, the variety of measures employed have indicated a positive relationship between dietary diversity and nutrient adequacy, both in developed and developing countries (Ruel 2002; Hatloy, Torheim & Oshaug 1998; Hatloy et al. 2000). However, few studies have looked at the relationship between dietary diversity scores and household food security more generally. Hoddinott & Yohannes (2002) evaluated the appropriateness of using household dietary diversity, using both FVS and DDS measures, as an indicator of household food security, measured as household energy availability. They find that as dietary diversity increases so too does per capita consumption and energy availability, and that the increase in energy availability comes more from non-staple foods than staples. From this, they conclude that dietary diversity, and consumption of non-staple foods, is a promising indicator of household food security.

Hatloy et al. (2000) also investigate the association between dietary diversity (both FVS and DDS) and socioeconomic status using data from Mali. Findings indicate that dietary diversity is greater among households with higher socioeconomic status, and that urban households had higher dietary diversity than their rural counterparts. This is consistent with other studies examining the relationship between socioeconomic status and household food security (Leatherman 1994; Ferguson et al. 1993). Still, there have been no studies to-date examining the association between household dietary diversity and subjective measures of household food security, such as experience of hunger and coping strategies.

Experience of Hunger

Early attempts to understand the direct experiences of food security were first undertaken at Cornell University after criticisms regarding the validity of previous approaches that relied upon indirect indicators began to be raised (Frongillo 1999; GAO 1986). The Radimer/

Cornell food security measurements sought to determine the extent of food insecurity and hunger in the United States and found that food insecurity is a complex and managed process, information that indirect indicators, such as food count data is unable to ascertain. The Radimer/Cornell study redefined our understanding of food insecurity and highlighted the fact that food insecurity is experienced differently at the household, adult and child levels and is a managed process with a sequenced level of severity (Frongillo 1999). Moreover, indirect measures, such as consumption, are only able to capture the physiological adequacy element of food security, focusing primarily on quantity and quality of food and not the other two components of certainty and acceptability, which are psychological and social in nature (Maxwell et al. 1999; Frongillo 1999).

Recent research finds that there are universal experiential “core domains” of food insecurity found across most cultures. Specifically, in their meta-analysis of 22 studies representing 15 different countries, Coates et al. (2006) find that insufficient food quantity, inadequate food quality, and uncertainty and worry about food are universal experiences of food insecurity and that there are recognized similarities in how households across contexts manage food insecurity. Furthermore, concerns about eating socially unacceptable food or engaging in socially unacceptable behavior to procure food also emerged from ethnographic data. Coates et al. (2006) found that the “social unacceptability” component of food insecurity emerged differently across cultures and therefore “influences the likelihood of a [coping] strategy being adopted in different cultures” (1445S). However, although context-specific, a general typology of socially unacceptable strategies emerged from Coates et al.’s content analysis. Although their findings point to universal experiential “core domains” of food insecurity at the household level, the ranking of food insecurity measures from least severe to most severe was not consistent across cultural contexts and therefore the process of progression to food insecurity is not universal (Coates et al. 2006). Thus, we argue that a single measure will not adequately locate vulnerable households across geographical and cultural settings and multiple indicators are necessary.

Based on an identified set of universal core domains (Coates et al 2006; Swindale & Bilinsky 2006; Frongillo 1999) that capture the household food insecurity experience, a set of questions was developed by the USAID funded Food and Nutrition Technical Assistance (FANTA) project to provide a standardized, universally applicable tool to assess the access component of household food security in different cultural contexts (Swindale & Bilinsky 2006). The Household Food Insecurity Access Scale (HFIAS) was designed to be more user-friendly, efficient, cost-effective and sensitive to changes in household food insecurity. Validation studies in Burkina Faso and Bangladesh showed the HFIAS could be applied successfully in different developing country contexts to assess, evaluate, or monitor household food insecurity (Swindale & Bilinsky 2006; Frongillo & Nanama 2004; Coates, Webb & Houser 2003). This measurement, however, focuses exclusively on access and experience of hunger and does not address the two other primary indicators—dietary diversity or coping strategies. While the HFIAS is an important indicator of household food insecurity, we argue that only when used in conjunction with the other two primary indicators—dietary diversity and coping strategies—can a more accurate profile of vulnerable households be made.

Coping Strategies

In areas where households experience recurrent shocks to food security, such as regular periods of drought, household response is not arbitrary. In these cases, households often respond in systematic and predictable ways to “famine signals” through actively and strategically engaging in efforts to minimize risk (Corbett 1988; Frankenberger 1992). Such coping strategies include, but are not limited to: collection of wild foods; migration in search of employment; altering horticulture practices; selling household assets, such as livestock or other possessions; and rationing available food (Corbett 1988; Twine & Hunter 2008; Kirkland, Hunter & Twine 2007). Corbett (1988) also suggests that households that experience chronic food insecurity risk develop “self-insurance strategies.” Such strategies include accumulating assets that can be sold in lean years to help moderate risk to household food security and livelihoods (Corbett 1988). In addition, households may decrease vulnerability through income diversification to ensure food security in times of shortage.

Adding nuance, Davies (1993) makes the useful distinction between coping strategies and adaptive strategies. Coping strategies are considered “fall-back mechanisms” that help a household manage short-term food shortage and can include: eating less desirable foods; collecting wild foods; reducing household and/or individual consumption; borrowing or stealing money; and maternal buffering, in which mothers provide food for their children before feeding themselves (Corbett 1988; de Waal 1989; Maxwell 1996; Maxwell et al. 1999). Longer-term or more permanent changes in a household’s procurement of food are considered adaptive strategies, which may include: selling of productive household assets; leaving school; relocation of some or all household members; and distress migration (Corbett 1988). Importantly, coping strategies do not necessarily imply that households are “getting by” but instead are an indication that household food security is declining, often to a nutritionally unsustainable level (Maxwell 1996). Household coping strategies are also often economically and environmentally unsustainable as well, which threaten longer-term household livelihood strategies and further increase future vulnerability (Maxwell 1996; Twine & Hunter 2008).

Maxwell et al. (1999) found that coping strategy indicators were better able to accurately classify households as either food-secure or food-insecure compared with more traditional measures, such as food recall or caloric adequacy. As such, coping strategy indicators provide both alternative and complimentary measures of household food security and provide insight into the issue of vulnerability.

Most food security research utilizes a single indicator to identify at-risk households, using either dietary diversity, experience of hunger, or coping strategies to classify households as food secure or insecure. We argue that such an approach is unable to capture a more holistic understanding of household food insecurity and that multiple indicators are needed to provide an accurate profile. While each primary measure—dietary diversity, experience of hunger and coping strategies—has been individually evaluated in the literature, there has not been a good comparison of how these measures differentially classify households as food secure/insecure. We show that choice of indicator matters for identifying vulnerable households and that multiple indicators can more accurately determine the levels of

household food insecurity. The project's findings should help researchers and food security advocates better identify at-risk households.

Study Setting, Data and Analytical Approach

Setting

The study was undertaken in the University of the Witwatersrand/Medical Research Council's Rural Public Health and Health Transitions Research Unit (hereafter "the Agincourt Unit"). The study site comprises the Agincourt sub-district of the Bushbuckridge rural municipality, in the extreme northeast of South Africa (see Figure 1).² The site, named after one of the local villages, consists of 24 villages, comprising over 14,000 households and 80,000 residents. Village population size ranges from 480 to 6,834. Approximately a quarter of the population are former Mozambican refugees, most of who fled to South Africa during the civil war in Mozambique in the 1980's. The mean household size in the Agincourt field site ranges from 6.2 in the South African population to 6.5 among former Mozambican refugees.

The area is typical of rural communities across South Africa, being characterized by poverty and high human densities. Few households are able to support themselves on agriculture alone, primarily due to the shortage of land and declining interest in agriculture as a result of the previous government's forced relocation and separate development policies for black South Africans (Hargreaves & Pronyk 2003). Due to poor local employment opportunities, a large proportion of adults are migrant laborers, working on commercial farms and in towns and cities across the country. Of all males 30–49 years of age, 50% are migrant workers, as are 14% of females of the same age group. A significant proportion of households depend on the state pension of an elderly resident as the only reliable source of household income.

HIV prevalence in the region, estimated from antenatal surveillance data, was 19% in 1998 (DOH 1998), while HIV/AIDS and TB (often associated with HIV) are the leading causes of death among adults between the ages 15–49 in the study site (Kahn et al. 1999). Furthermore, mortality among young adults increased fivefold in the study site over the decade between 1992–1993 and 2002–2003, largely attributed to the emerging HIV/AIDS pandemic (Kahn et al. 2007).

In terms of environmental conditions, the area is characterized by poor soils and highly variable rainfall. The underlying geology is primarily coarse granite and gneiss, giving rise to leached, sandy soils. The region is semi-arid with a mean annual rainfall of 650mm. Rainfall pattern is uni-modal, the summer months from October to April, receiving the most precipitation. The Agincourt field site is characterized by a west-east declining rainfall gradient. The natural vegetation is predominantly broad-leaf savanna woodland.

Data

We surveyed 290 households to develop detailed measures of food security (see Table 1 for sample descriptive information). The survey instrument was developed based upon central

²This border region previously fell under Limpopo Province, but has recently been transferred to Mpumalanga Province.

literature in the relevant fields, as well as the investigators' previous experience in the Agincourt site. The survey instrument focused on 1) food security, 2) livelihood strategies, and 3) use of natural resources, especially in relation to meeting household food requirements. Household food security was assessed using accepted proxy indicators and methodologies (see Hoddinott (1999) and Swindale & Bilinsky (2006) for a useful comparison of most commonly used methods and Hendriks (2005) for an overview within the South African context). Our choice of methods, based on trade-offs between time, cost, accuracy and the expertise required, was as follows (see Table 2 for overview): i) Dietary Diversity Index for 99 food items, including commonly used species of wild foods, recording whether the item was eaten at least once in the last week, month, year, or not at all (see Hoddinott & Yohannes 2002; Swindale & Bilinsky 2005), ii) Household Experience of Hunger and Access to Food, such as number of times in the last 30 days in which the household worried about food or ran out of food (see Household Food Insecurity Scale (FANTA 2004) or the Food Access Survey Tool (Coates et al. 2003)), and iii) Coping Strategies based on frequency of short-term responses to food shortage, such as asking neighbors for food or skipping meals (see Maxwell 1996, Maxwell et al. 1999). All of the above methods were adapted for local conditions through insight gained from three focus groups with local women. The focus group participants assisted in the development of lists of foods eaten locally, as well as coping strategies used when facing food shortages.³

The survey was conducted by experienced local fieldworkers from the Agincourt site. The respondents were typically the female in the household primarily responsible for food acquisition and preparation, and acquisition of natural resources. The survey was conducted in May and June 2006, using the dominant local language of the field site (Shangaan).

Analytical Approach

Our overall analytical goal was to examine how these various indicators related to one another, and what this may tell us about the measurement of food security in our context. Household food security was assessed using these well-developed proxy indicators: dietary diversity index; subjective measures of experience of hunger and access to food; and coping strategies.

We began by creating a dichotomous variable for food insecurity (0 = secure and 1 = insecure) using the dietary diversity data. Our data on dietary habits were collected on two time scales, 7-days and 30-days, and count variables (Dietary Diversity Score) were created for each time scale, in other words we simply added up the number of foods in the survey consumed for each time period. Once summed, we compared the Dietary Diversity Score (DDS) with South African Government dietary guidelines, however this approach classified nearly the entire sample as food insecure and was therefore not instructive. More specifically, the sum total of foods consumed over each time period included a variety of common local foods, and was asked for each of three timelines, 7 days, 30 days, and 12

³Given the objectives of the broader project, the sample was stratified by adult mortality experience. Deaths of prime age adults over the two years prior were classified as either HIV/AIDS-related or non-HIV/AIDS. We do not make use of these sampling strata within the analyses here given our focus on the ways in which the particular measurement of food security shapes identification of vulnerable households.

months. The median number of distinct foods consumed over 7 days was 23, the median number over 30 days was 11, and the median over 12 months was 25. Due to each question being asked independently, each time horizon is independent of one another.

We then used the DDS variable to indicate food insecurity if the household was in the bottom quartile for the overall DDS variable. This decision allowed us to maintain relevancy to our particular context through the use of a scale derived locally since it, by definition, makes the scale relative to the median dietary diversity in the area, not forcing a definition at a national scale. Indeed, classifying food security/insecurity using an outside scale, even if developed at the national level, may ignore important contextual considerations.

Our ‘Experience of Hunger’ indicators were collected using a 30-day time scale, which allowed for comparison to the 30-day time scale of our dietary diversity indicator. We examined six dichotomous indicators of hunger experience (see Table 2): *Still Hungry* indicates food insecurity when the respondent stated the household did not have enough food and someone was left hungry; *Worried* indicated that the respondent had worried the household did not have enough food; *Run Out* indicated whether or not the respondent had actually run out of food; *Adult Hungry* and *Child Hungry* indicated the amount of food served to either adults or children, respectively, in the household had diminished; and finally, *Recurrence* indicated that someone in the household had not had enough to eat for four or more days over the past 30 days.

The ‘Coping Strategies’ indicators were measured at 7-days, and therefore the time scale differed from our ‘Experience of Hunger’ variables but allow for comparison with the 7-day time scale bottom quartile DDS indicator.⁴ The seven dichotomous indicators in the ‘Coping Strategies’ category signify food insecurity if the respondent reported having engaged in the following coping strategy over the past 7-days (see Table 2): asking for food from another household (*Asked for Food*); reduced the amount of food given to men (*Reduce Amt. Men*); had any member of the household skip a meal (*Skip Meal*); reduced the amount of food they served to themselves (*Reduce Amt. Self*); been forced to consume unpleasant food or food they did not like (*Unpleasant Food*); reduce the amount of food served to a child (*Reduce Amt. Child*); or if any member of the household had to skip an entire day of meals (*Skip Whole Day*).

Table 3 presents summary data for each food security measure. Overall, when compared to the ‘Experience of Hunger’ and ‘Coping Strategies’ indicators, the dietary diversity measurement indicates a percentage of food insecurity that falls roughly in the middle of the other two indicators. In addition, between 11% and 54% of study households note food insecurity on at least one of the measures of ‘Experience of Hunger’ with the highest percentage expressing insecurity with regard to ‘worrying about having enough food for the household.’ Reports on a hungry child residing within the household resulted in the lowest percentage of expressed food insecurity, suggesting this particular measurement identifies households in particularly dire situations.

⁴Due to larger project objectives and budgetary constraints, the time scales for each measure do not perfectly match although substantial overlap provides for the methodological comparison offered here.

On ‘Coping Strategies’, between 8% and 33% express food insecurity according to at least one indicator with the lowest percentage indicating insecurity by noting that the main food provider was forced to skip a whole day of food, and the highest percentage indicating that they cope by consuming food found to be unpleasant. In this way, the coping strategy of eating unpleasant foods appears much more prominent and will, therefore, identify a broader array of households as food insecure. In general, given the great variability in food insecurity, these basic results suggest the importance of utilizing several measures to identify this construct.

We took several approaches to comparing measurements with each other at the appropriate time scales (7 & 30-days, respectively). First, we compared indicators of the same time scale by looking at the proportion of households that are classified similarly (food insecure or not). Next, we ran a Chi-Square Test of Independence on each pair of indicators (‘Experience of Hunger’ and DDS at 30-days and ‘Coping Strategies’ and DDS at 7-days) to evaluate their similarity. Finally, we compared the ‘Experience of Hunger’ and ‘Coping Strategies’ indicators to the DDS bottom quartile indicator using standard Student’s T-Test procedures to determine if the percentages classified as hungry or food insecure were statistically distinct. Overall, our analytical strategy allowed for an in-depth look at the various indicators and examination of their interrelationships.

Results

The results are organized in two thematic areas. First, we examine the association between the indicators themselves, and their respective identification of food insecure households, to improve understanding of the different insight offered by each food security “lens.”

Table 5 presents the overlap in households identified as food insecure across the different measures with statistical significance suggesting substantial association across measures. As evident, 86% of the ‘Coping Strategies’ and 67% of the ‘Experience of Hunger’ measures resulted in statistically significant Chi-Square associations of $p < 0.01$, suggesting many measures are similarly identifying food insecure households. As an example, 91% of households that indicated that the respondent skipped an entire day of food (*Skipped Whole Day*) also reported reducing the amount of food served to men (*Reduce Amt. Men*). Another example, 83% of households that reported running out of food (*Run Out*) also worried about having enough food (*Worried*) in the last 30 days. Practically, these associations (and the others noted in Table 4 as statistically significant) indicate that many of the measures have significant overlap in identifying food insecure households.

Yet, *lack of overlap* is also instructive as this points to indicators that are potentially tapping into distinct dimensions of household food experience. The data suggest the indicator with the least significant Chi-Square tests, and seemingly the lowest proportion similarly classified as food insecure, is the bottom quartile DDS indicator. Indeed, food insecure households identified by the dietary diversity measure exhibit a significant association only with the *Reduce Amt. Self*, *Reduce Amt. Child* and *Unpleasant Food* variables on the 7-day time scale. This is a particularly important finding in its suggestion that dietary diversity

measures may not adequately capture the multi-dimensionality of food insecurity as experienced at the household level.

Table 4 provides further information on household size and SES, providing a profile of households separately by food security status for each indicator. We find that while most food secure households are large, they also have higher SES. To further clarify the associations between food security indicators, Figure 2 displays the relationship of ‘Coping Strategies’ (bars) to the bottom quartile of the ‘Dietary Diversity Score’ (line) in terms of percent classified as hungry or food insecure for each measure. To add nuance, the graph also includes information on the mean socio-economic status (SES) for each indicator. The results reveal less distinction between measures than suggested by Table 3. Specifically, despite the impression that the DDS may be over-identifying food insecure households over the 7-day time scale, there is important overlap with food insecure households as indicated by ‘Coping Strategies.’ In only three instances do these measures identify different households to a degree that reaches statistical significance— *Reduce Amt Men*, *Unpleasant Food*, and *Reduce Amt Child*. Indeed, when compared to the bottom quartile DDS, ‘Coping Strategies’ over identify food insecure households on one measure (*Unpleasant Foods*) and under identifies on two measures (*Reduce Amt. Men & Reduce Amt. Child*). In most cases, bottom quartile DDS identifies a greater number of food insecure households than does ‘Coping Strategies’. The consideration of SES reveals that food insecure households rank consistently below mean socio-economic status.

The information displayed in Figure 3 parallels that presented in Figure 2, though for the 30-day time scale bottom quartile DDS indicator and ‘Experience of Hunger’ measures. Figure 2 suggests that dietary diversity appears a reasonable, middle ground indicator at this temporal scale since three of the ‘Experience of Hunger’ measures classify more households as food insecure (*Still Hungry*, *Worried*, *Run Out*), while three measures classify fewer (*Adult Hungry*, *Child Hungry*, *Recurrence*). Additionally, the indicators *Still Hungry*, *Worried*, *Run Out* and *Child Hungry* are all significantly different from the bottom quartile DDS indicator. In other words, when compared to the DDS, the ‘Experience of Hunger’ indicator over-classifies food insecure households on three measures (*Still Hungry*, *Worried*, *Run Out*) and under classifies on one (*Child Hungry*). This is a marked difference from Figure 2 (‘Coping Strategies’), which shows a lower overall percentage of food insecure households compared to the bottom quartile DDS indicator. We do, however, see a similar SES difference as in Figure 2, although less marked. Importantly, contrasting the figures suggests an important temporal dimension to measurement of food security, since the 30-day time scale tends to show less food insecurity as compared to the much shorter 7-day time scale. Again, this finding has important methodological implications, discussed further below.

Overall, our comparison across measures reveals differences in identification of food insecure households based on measurement choice, including the referent time scale (7 days or 30 days). On measurement choice, the results also suggest that measures of dietary diversity, given their time horizon sensitivity, are insufficient on their own to accurately measure household food security. On referent time scale, the greater levels of food insecurity comparison of the 30-day ‘Experience of Hunger’ indicators to the shorter, 7-day

time scale ‘Coping Strategies’, suggests that longer time horizons offer greater chance of observing experiences of household food insecurity. Finally, it is interesting to note that, while SES did not significantly vary from the sample mean, it was uniformly lower among households classified as food insecure by all indicators examined.

Conclusions

While each of the primary measures evaluated here -- dietary diversity, experience of hunger and coping strategies -- has been individually evaluated in the literature, there has been no comparison of how these measures differentially classify households as food secure/insecure. We show that choice of indicator matters for identifying vulnerable households. In this way, the results suggest that multiple indicators can more accurately determine the levels of household food insecurity and identify the most vulnerable households.

Accurate measurement of household food security is essential for high quality research and well-targeted policies and programs. Our findings illustrate the importance of considering a suite of issues when addressing food security, namely the time horizon for data collection and which particular aspects (e.g. dietary diversity, ‘experience of hunger’ or ‘coping strategies’) are most important. In our analysis DDS appears to provide a good overlap with the measures of the two other indicators examined here—‘Coping Strategies’ and ‘Experience of Hunger’. Importantly, the DDS indicator can help identify vulnerable households that might otherwise be overlooked using a single measure, such as *Child Hungry*. Conversely, the DDS indicator may also help show when a measure has over-identified vulnerable households, as is the case with *Worried*. These are significant differences that could possibly have important policy impacts.

Our results further highlight the importance of time horizon when evaluating household food security. In exploring variation in food insecurity, across time units, as measured by the Dietary Diversity Score, fewer households were categorized as food insecure at the longer time horizon. A shorter methodological “window” would result in higher levels of perceived food insecurity. Indeed, this sensitivity may be logically related to food seasonality, another important consideration when measuring hunger.

The time horizon is also important to consider for the other indicators, for example ‘Coping Strategies’, which are meant to be short-term. While they were collected at the 7-day time scale, chances of observing a short term coping strategy might increase if the time scale were longer. The ‘Experience of Hunger’ indicators are also subject to this risk, and the greater the time scale the more likely that observing households experiencing hunger. These are important considerations for research design and for programs that target food insecure households, and have important implications for policies aimed at improving household food security.

The results of any research are subject to time sensitivity, and thus the selection of indicators is crucial. It would be prudent to include a variety of indicators and time scales to ensure robust findings, as well as considering the comparability of indicators in research design. It

is also important to consider problems with recall after a certain period of time, which may also impact results if the time horizon chosen exceeds the memory of some respondents.

Our study indicates the importance of using multiple indicators across various, but comparable time horizons. We show that there are important time differences by type of indicator, and that many indicators are similar, but somewhat unique in what they are measuring. These results show that it would be inappropriate to classify households as food insecure without the use of multiple indicators measuring different aspect of food security and that the profile of vulnerable households change depending on such indicators.

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Figure 1. Study Area, Agincourt Health and Demographic Surveillance Site, South Africa

Figure 2. 'Coping Strategies' and Bottom Quartile DDS (7 Days)

Note: Numbers above bars are PCA SES means by category.

Socio-economic status is measured through an asset index derived from a count of key possessions for households in the region. These include presence of a tap and toilet in the homestead, as well as ownership of appliances (e.g. radio) and equipment (e.g. wheelbarrow).

*=Difference in Proportion Food Insecure Significant at .05

Figure 3. 'Experience of Hunger' and Bottom Quartile DDS (30 Days)

Note: Numbers above bars are PCA SES means by category.

Socio-economic status is measured through an asset index derived from a count of key possessions for households in the region. These include presence of a tap and toilet in the homestead, as well as ownership of appliances (e.g. radio) and equipment (e.g. wheelbarrow).

*=Difference in Proportion Food Insecure Significant at .05

Table 1

Sample Description

Respondent Sex	% of Sample		
Males	8.60		
Females	91.40		
	Mean	Median	Standard Deviation
Socio-Ecomonic Status	3.13	N/A	1.36
Household Size	4.95	N/A	2.87

Table 2

Indicator Description

Dietary Diversity	
<i>Bottom Quartile 30 Days</i>	Indicates food insecurity if the household food variety score is in the bottom 25% of scores.
<i>Bottom Quartile 7 days</i>	Indicates food insecurity if the household food variety score is in the bottom 25% of scores.
Experience of Hunger	
<i>Still Hungry</i>	Indicates food insecurity if the household has still been hungry after a meal in the last 30 days
<i>Worried</i>	Indicates food insecurity if the household has worried about having enough food in the last 30 days
<i>Run Out</i>	Indicates food insecurity if the household has run out of food in the last 30 days
<i>Adult Hungry</i>	Indicates food insecurity if an adult in the household has gone without enough food in the last 30 days
<i>Child Hungry</i>	Indicates food insecurity if a child in the household has gone without enough food in the last 30 days
<i>Recurrence</i>	Indicates food insecurity if the household has gone hungry more than once in the last 30 days
Coping Strategies	
<i>Asked for Food</i>	Indicates food insecurity if the household has asked for food in the last 7 days
<i>Reduce Amt. Men</i>	
<i>Skip Meal</i>	Indicates food insecurity if someone in the household has skipped a meal in the last 7 days
<i>Reduce Amt. Self</i>	Indicates food insecurity if the main food distributor has reduced the amount they gave themselves in the last 7 days
<i>Unpleasant Food</i>	Indicates food insecurity if the household has eaten food they found unpleasant in the last 7 days
<i>Reduce Amt. Child</i>	Indicates food insecurity if the household has reduced the amount of food for a child in the last 7 days
<i>Skip Whole Day</i>	Indicates food insecurity if someone in the household has skipped a whole day of food in the last 7 days

Table 3**Food Security Measures**

	% Food Insecure	
	7 Days	30 Days
Dietary Diversity Score		
Bottom Quartile ^a	24%	21%
Experience of Hunger		
Still Hungry	N/A	31%
Worried	N/A	54%
Run Out	N/A	42%
Adult Hungry	N/A	16%
Child Hungry	N/A	11%
Recurrence	N/A	17%
Coping Strategies		
Asked for Food	21%	N/A
Reduce Amt. Men	9%	N/A
Skip Meal	22%	N/A
Reduce Amt. Self	21%	N/A
Unpleasant Food	33%	N/A
Reduce Amt. Child	26%	N/A
Skip Whole Day	8%	N/A

^a Indicator variable if household is in the bottom 25% of the dietary diversity scores for each time period.

Table 4

Mean Values Comparing Food Secure and Insecure Households by Indicator

	<u>Food Insecure</u>		<u>Food Secure</u>	
	<u>HH Size</u>	<u>SES</u>	<u>HH Size</u>	<u>SES</u>
Dietary Diversity Score				
7-Day Bottom Quartile ^a	4.6	2.7*	5.1	3.3
30-Day Bottom Quartile ^a	4.7	2.9	5.0	3.2
Experience of Hunger				
Still Hungry	5.1	2.8*	4.9	3.3
Worried	5.1	3.0	4.8	3.3
Run Out	4.9	2.9*	5.0	3.3
Adult Hungry	5.5	2.7*	4.9	3.2
Child Hungry	6.1	2.8	5.2	3.2
Recurrence	5.1	2.9	4.9	3.2
Coping Strategies				
Asked for Food	5.5	2.9	4.8	3.2
Reduce Amt. Men	5.6	2.9	4.9	3.2
Skip Meal	5.3	2.6*	4.9	3.3
Reduce Amt. Self	5.5	2.8*	4.8	3.2
Unpleasant Food	5.1	3.0	4.9	3.2
Reduce Amt. Child	3.8*	2.8*	5.3	3.3
Skip Whole Day	5.5	3.0	4.9	3.1

^a Indicator variable if household is in the bottom 25% of the dietary diversity scores for each time period.

* if $p < .05$ that mean is different from food secure households

Table 5

Indicator Classification Patterns of Households

<i>7 Days</i>	Bottom Quartile	Asked for Food	Reduce Amt. Men	Skip Meal	Reduce Amt. Self	Unpleasant Food	Reduce Amt. Child	Skip Whole Day
Bottom Quartile	.							
Asked for Food	0.69	.						
Reduce Amt. Men	0.75	0.85*	.					
Skip Meal	0.71	0.85*	0.84*	.				
Reduce Amt. Self	0.73*	0.87*	0.85*	0.90*	.			
Unpleasant Food	0.69*	0.81*	0.74*	0.79*	0.82*	.		
Reduce Amt. Child	0.7*	0.76*	0.77*	0.77*	0.79*	0.71*	.	
Skip Whole Day	0.74	0.83*	0.91*	0.83*	0.84*	0.74*	0.76*	.
<i>30 Days</i>								
Bottom Quartile								
Still Hungry	0.68	.						
Worried	0.52	0.72*	.					
Run Out	0.61	0.82*	0.83*	.				
Adult Hungry	0.74	0.8*	0.58*	0.69*	.			
Child Hungry	0.69	0.7*	0.46	0.57*	0.83*	.		
Recurrence	0.73	0.84*	0.58*	0.7*	0.8*	0.73*	.	

Note: Cells are the proportion of households that are similarly classified as either food insecure or secure for each pair of indicators

* Indicates a significant Chi-Square test at the .001 level