The Effect of Food Insecurity on Fertility Preferences in Tanzania

Extended Abstract

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INTRODUCTION

Micro and macro research of family size and fertility preferences have long been linked to economic models of household and community development. As countries and individuals gain wealth, fertility levels and preferences generally decrease to near replacement level. Increasingly, however, scholars are investigating the potential for fertility goals to act more as a "moving target", sensitive to dynamic contextual and individual-level factors, rather than a stagnant variable (Speizer, Calhoun, Hoke, & Sengupta, 2013; Staveteig, 2017; Yeatman, Sennott, & Culpepper, 2013). Dynamic economic and related livelihood factors feature as potentially significant influences on dynamic fertility preferences (Bongaarts & Casterline, 2013). In addition to measurable economic and livelihood factors, scholars also theorize that time-varying *perceptions* of economic instability and insecurity also have the potential to shape family size and fertility preferences.

Measurements of individual- or household-level livelihood and economic stability, as well as perceptions of stability, require highly detailed time series information capturing changes in trends. They must also capture an individual's interpretation and understanding of those changes. In developing countries with primarily subsistence economic systems, these measurements are even more complex, because they reflect household agricultural production, food storage and gender dynamics as components of wealth and resources, as well as *perceptions* of resource stability, and child growth/development (Brown et al., 2015; Carr, 2008; Grace, 2017; Montgomery, Gragnolati, Burke, & Paredes, 2000). A lack of appropriately detailed data limits scientific understanding of fertility decision-making in a context of economic insecurity. However, recently collected survey data from the Demographic and Health Surveys (DHS) in Tanzania contains information on household level perceptions of food insecurity. Because individual perceptions of household food insecurity reflect agricultural and economic stability and perceptions of stability, indicators of food insecurity can be used to capture household economic and livelihood stability (Jazairy, Alamgir, Stanier, & Panuccio, 1992; Sarr, 2008).

Tanzania is a low-income country characterized by widespread dependence on small-scale, household agriculture. Tanzania also has some of the highest fertility rates in the world, with a total fertility rate (TFR) in 2017 of 5.2 (Population Reference Bureau, 2017). The total wanted fertility rate in Tanzania is also much higher than replacement, at 4.5 in 2017 (Ministry of Health, Mainland], & Government Statistician (OCGS), 2016). **The purpose of this study is to examine the relationship between resource stability and fertility preferences in Tanzania. In this research, and reflecting the dynamic resource environment of subsistence production in Tanzania, we use household level perceptions of food insecurity as well as anthropometric health measures to reflect household-level variation in economic and livelihood stability.** The co-occurrence of high total wanted fertility rates with the common experience of periodic food insecurity in Tanzania provides a useful setting to investigate the relationship between fertility preferences and resource constraints.

BACKGROUND

Fertility and food insecurity have a complex relationship. Some evidence suggests that women modify their short-term fertility goals (including birth timing and aspirations) when food is scarce (Clifford,

Falkingham, & Hinde, 2010; Grace, Lerner, Mikal, & Sangli, 2017; Patel & Surkan, 2016). This may be explained by increased stress leading to less sexual activity or a fear of hunger affecting pregnancy (Grace, 2017; Grace et al., 2017). However, there is much conflicting evidence to suggest that fertility does not change, and might even increase, when an individual or household experiences food insecurity. This relationship may be explained by the financial burden of contraceptives, continued breastfeeding through times of food scarcity, a desire to meet one's partner's sexual needs, gratification in a time of uncertainty, a fear that the situation will only worsen, or to strengthen social and economic ties (Grace et al., 2017; Madhavan, 2010; Scheper-Hughes, 1993; Sennott & Yeatman, 2012).

Accounting for this complexity, the birth seasonality framework suggests that there are biological and behavioral mechanisms behind changes in fertility that coincide with seasonal changes in food availability (Grace et al., 2017; Grace & Nagle, 2015). While there are biological and behavioral mechanisms behind changes in *fertility* that coincide with seasonal changes in food availability, this paper builds on qualitative works which underscore the complexity of fertility *preferences* across periods of uncertainty (Agadjanian & Prata, 2002; Grace & Nagle, 2015; Kodzi, Casterline, & Aglobitse, 2010; Sennott & Yeatman, 2012; Yeatman et al., 2013). Here, we specifically concentrate on an individual women's fertility *goals* rather than specific fertility *outcomes*, in order to isolate how behavioral intentions respond to food insecurity.

OBJECTIVES

This analysis addresses a gap in the literature to quantitatively investigate the effect of food insecurity on fertility preferences. The gap in the current research is multidimensional, and leads to the two central aims of this study:

1) To quantitatively assess the relationship between household resources, as measured by food insecurity, and fertility preferences, while controlling for relevant demographic covariates; and
2) To examine this question using two different measures of food insecurity - a measure based on perceptions of hunger and a separate measure based on anthropometric measures of health, and to compare the results between the two measures of food insecurity.

DATA AND MEASURES

The data used in this analysis comes from the Tanzania Demographic and Health Survey and Malaria Indicator Survey in 2016. Multiple questionnaires are used to compile all relevant variables, including the Women's Questionnaire, Household Questionnaire, and Biomarker Questionnaire. The survey captured data from 13,266 women in Tanzania. For the purposes of this analysis, we include only women with children under the age of five who are measured in the Biomarker survey (N= 7,050), in order to utilize child anthropomorphic measures as an indicator of food insecurity. We further defined the cohort by only including women who are currently at risk of pregnancy (not declared infecund or sterilized) (N= 6,929).

The outcome of interest is fertility preferences, captured by the desire for more children. Potential responses include: wants no more children, wants more children, or is unsure. We chose this measure of fertility preference, as opposed to desired family size or wantedness of last or current pregnancy, due to its resistance to bias. Any opportunity for bias in this measure is likely to have small net offsetting effects (Bongaarts, 1990).

Two measurements that we use to assess food insecurity are Household Hunger and child stunting. Household Hunger measures food insecurity based on perceptions at a single point in time, while stunting

captures chronic, long-term food insecurity. By using stunting in conjunction with Household Hunger Scores, we convey a robust picture of food insecurity, based on both lived experiences and anthropometric standards. These two measures have the potential to offer different insights into food insecurity and what it means for a woman in a household to be food insecure.

The Household Hunger Score is a cross-culturally validated and simple indicator for household food deprivation in developing areas. It allows us to capture the experience or perception of food insecurity on a household level (Ballard, Coates, Swindale, & Deitchler, 2011). The dimensions of the measure include lack of resources to acquire food, going to sleep hungry, or not eating for an entire day due to insufficient food quantity, all found to be common experiences of food insecurity across diverse households (Coates et al., 2006). The scale ranges from 0-6, from Little to no household hunger to Severe Household hunger, however for the purposes of this analysis, we create a binomial measure of Little to no household hunger and Any household hunger. This is seen in the analysis as Household Hunger No/Yes.

The second measure of food insecurity used is child stunting, or low height-for-age, as an indicator of chronic food insecurity and economic deprivation. For purposes of the analysis, we use measurements taken in the Biomarker Questionnaire to determine whether or not each child under the age of five is stunted, according to World Health Organization z-scores. From this, a categorical scale is developed for each woman, reflecting the number of children she has under the age of five who are stunted. The number of children stunted per woman ranges from 0 to 6, however the population can be most evenly categorized by 0, 1 or 2 or more children under the age of five stunted per woman.

METHODS

Data cleaning and descriptive statistics were done using RStudio. All descriptive statistics reflect the sample population on the individual woman level, including only those with children under the age of five at risk of pregnancy. Differences between women with differing fertility preferences were calculated using Chi-square tests. Demographic variables of interest are broken down by general demographic measures, fertility related variables and food security related variables.

Multinomial generalized logit models were created using SAS 9.4. `PROC SURVEYLOGISTIC` was used to incorporate strata, cluster and weights to model fertility preferences using “No more children” as a reference category. Two models were built, one using Household Hunger and the other using number of young children stunted as the independent variable. Relevant covariates, including urban versus rural setting, number of living children, education, and maternal age, were added and assessed one by one to minimize AIC and maximize R^2. The final model was selected according to these two measures of goodness-of-fit.

PRELIMINARY RESULTS

Descriptive data is presented in Table 1 by the outcome variable, fertility preferences (See next page). Women with different fertility preferences differed significantly by each demographic characteristic ($p<0.001$ for all except Currently pregnant, $p = 0.018$).

Table 1: Demographic characteristics of the women's sample population by fertility preferences, N = 6,929 (p<0.001***, p<0.01**, p<0.05*).

	Fertility Preferences							
	Wants no more children		Wants more children		Undecided			
	N	%	N	%	N	%	Row Total	p-value
Totals	**1,687**	**24.4**	**4,934**	**71.2**	**299**	**4.3**	**6,929**	
Demographic Variables								
Age								p<0.001***
15-19	13	2.4	510	92.7	27	4.9	550	
20-24	91	5.5	1,514	91.3	54	3.3	1,659	
25-29	237	14.5	1,339	82.0	57	3.5	1,633	
30-34	379	28.8	878	66.6	61	4.6	1,318	
35-39	472	46.3	488	47.8	60	5.9	1,020	
40-44	364	63.7	174	30.5	33	5.8	571	
45-49	131	73.6	40	22.5	7	3.9	178	
Marital Status								p<0.001***
Never married	53	11.7	367	80.8	34	7.5	454	
Married	1,021	24.4	3,009	71.9	155	3.7	4,185	
Living together	335	22.9	1,082	74.0	45	3.1	1,462	
Widowed	68	59.1	37	32.2	10	8.7	115	
Divorced	95	26.4	237	65.8	28	7.8	360	
Separated/not living together	115	32.6	211	59.8	27	7.6	353	
Setting								p<0.001***
Urban	417	23.2	1,269	70.5	115	6.4	1,801	
Rural	1,270	24.8	3,674	71.6	184	3.6	5,128	
Education acheivement								p<0.001***
No education	391	29.0	911	67.5	48	3.6	1,350	
Any primary	1,117	26.6	2,880	68.7	197	4.7	4,194	
Any secondary or higher	179	12.9	1,152	83.2	54	3.9	1,385	
Currently working								p<0.001***
No	258	17.0	1,194	78.9	62	4.1	1,514	
Yes	1,429	26.4	3,749	69.2	237	4.4	5,415	
Fertility Related Variables								
Currently pregnant								p=0.018*
No/unsure	1,478	23.8	4,451	71.8	269	4.3	6,198	
Yes	209	28.6	492	67.3	30	4.1	731	
Currently breastfeeding								p<0.001***
No	890	26.3	2,340	69.3	149	4.4	3,379	
Yes	797	22.5	2,603	73.3	150	4.2	3,550	
Children alive (by Quartile)								p<0.001***
0	1	1.4	70	97.2	1	1.4	72	
1	52	3.0	1,593	92.9	69	4.0	1,714	
2-5	897	22.7	2,882	73.1	164	4.2	3,943	
6+	737	61.4	398	33.2	65	5.4	1,200	
Number of births in the last five years								p<0.001***
1	950	22.5	3,075	73.0	189	4.5	4,214	
2	623	26.9	1,594	68.8	99	4.3	2,316	
3+	114	28.6	274	68.7	11	2.8	399	
Food Security Related Variables								
Food problems in the last year								p<0.001***
Never	904	22.4	2,954	73.2	179	4.4	4,037	
Seldom	379	24.5	1,106	71.5	62	4.0	1,547	
Sometimes	175	28.7	402	66.0	32	5.3	609	
Often or Always	229	31.1	481	65.4	26	3.5	736	
Meals per day								p<0.001***
1	23	30.7	45	60.0	7	9.3	75	
2	662	27.1	1,702	69.6	81	3.3	2,445	
3+	1,002	22.7	3,196	72.5	211	4.8	4,409	
Number of children 5 years or younger who are stunted								p<0.001***
0	489	20.7	1,748	74.1	123	5.2	2,360	
1	887	25.1	2,496	70.8	144	4.1	3,527	
2+	311	29.8	699	67.1	32	3.1	1,042	
Household Hunger								p<0.001***
No	1,267	23.1	3,978	72.5	241	4.4	5,486	
Yes	420	29.1	965	66.9	58	4.0	1,443	

Descriptive statistics are further explored in Tables 2-4. Table 2 shows the two measures of food insecurity by education achievement. Women with different levels of education differed significantly from each other with respect to Household Hunger ($p<0.001$) and child stunting ($p<0.001$). Table 3 shows the two measures of food insecurity by urban and rural settings. There are significant differences in stunting across urban and rural settings ($p<0.001$); however, interestingly, Household Hunger does not significantly differ across women in urban and rural settings ($p=0.146$). Lastly, Table 4 tests the association of stunting and Household Hunger (see next page). Women in households experiencing hunger differ significantly from women in households not experiencing hunger with respect to how many stunted children they have; this association, however, is only significant on a level of alpha = 0.05 ($p=0.036$).

Table 2: Food security measures of the women's sample population by education achievement, N = 6,929 (p<0.001***, p<0.01**, p<0.05*).

	Education Acheivement							
	No education		Any primary		Any secondary or higher			
	N	%	N	%	N	%	Row Total	p-value
Totals	**1,350**	**19.5**	**4,194**	**60.5**	**1,385**	**20.0**	**6,929**	
Number of children 5 years or younger who are stunted								p<0.001***
0	364	15.4	1,353	57.3	643	27.2	2,360	
1	690	19.6	2,206	62.5	631	17.9	3,527	
2+	296	28.4	635	60.9	111	10.7	1,042	
Household Hunger								p<0.001***
No	1,008	18.4	3,294	60.0	1,184	21.6	5,486	
Yes	342	23.7	900	62.4	201	13.9	1,443	

Table 3: Food security measures of the women's sample population by setting, N = 6,929 (p<0.001***, p<0.01**, p<0.05*).

	Setting					
	Urban		Rural			
	N	%	N	%	Row Total	p-value
Totals	**1,801**	**26.0**	**5,128**	**74.0**	**6,929**	
Number of children 5 years or younger who are stunted						p<0.001***
0	809	34.3	1,551	65.7	2,360	
1	886	24.6	2,659	74.5	3,257	
2+	124	11.9	918	88.1	1,042	
Household Hunger						p=0.146
No	1,448	26.4	4,038	0.773.6	5,486	
Yes	353	24.5	1,090	75.5	1,443	

Table 4: Number of children under the age of five who are stunted per women by household hunger, N = 6,929 (p<0.001***, p<0.01**, p<0.05*).

	Household Hunger					
	No		Yes			
	N	%	N	%	Row Total	p-value
Totals	**5,486**	**79.2**	**1,443**	**20.8**	**6,929**	
Number of children 5 years or younger who are stunted						p=0.036*
0	1,906	80.8	454	19.2	2,360	
1	2,776	78.7	751	21.3	3,527	
2+	804	77.2	238	22.8	1,042	

The first set of models assess fertility preferences as a function of Household Hunger (Table 5). Women experiencing any Household Hunger are less likely to either want more children or to be unsure about having more children compared to women not experiencing Household Hunger. For women who want more children, these effects remain significant when controlling for setting, number of living children, education and maternal age. For women who are unsure about having more children, these effects remain significant only when controlling for setting; upon controlling for number of living children, education, and maternal age, the association between Household Hunger and being unsure about more children compared to wanting no more children became non-significant.

We are concerned mostly with the comparison of women who want more children to women who do not want more children, as we expect these two groups to differ the most. While the effect of household hunger remains significant as each successive covariate enters the model, the significance lessens from p<0.001 in Models 1 and 2 to p<0.05 in Models 3, 4 and 5. In addition, women experiencing Any Household Hunger are 31.5% less likely to want more children before adjusting for any covariates (Model 1). Once we consider the confounding effects of setting, number of living children, education and maternal age, this effect is reduced to 21.6% (Model 5). The results indicate that while other factors may help to explain variation in fertility desires, any perception of household hunger in the last year significantly lessens one's desire for more children.

Table 5: Multinomial logistic regression modeling fertility preferences among women at risk of pregnancy with children 5 years of age or younger, N = 6,929. Household hunger is the independent variable of interest (p<0.001***, p<0.01**, p<0.05*).

		Fertility Preferences							
		Wants more children vs. No more			Unsure vs. No more				
		Estimate	95% CI		Estimate	95% CI		AIC	R^2
Model 1	Any Household Hunger	**0.685*** **	0.592	0.793	**0.659***	0.461	0.943	10363	0.0048
Model 2	Any Household Hunger	**0.685*** **	0.592	0.793	**0.666***	0.465	0.954	10344	0.008
	Rural vs. Urban	1.021	0.878	1.188	**0.589** **	0.428	0.810		
Model 3	Any Household Hunger	**0.816***	0.680	0.980	0.736	0.515	1.052	8368	0.2539
	Rural vs. Urban	**2.420*** **	1.978	2.961	1.016	0.743	1.390		
	Number of Living Children	**0.509*** **	0.486	0.533	**0.707*** **	0.653	0.765		
Model 4	Any Household Hunger	**0.797***	0.663	0.957	0.728	0.508	1.044	8340	0.2578
	Rural vs. Urban	**2.272*** **	1.855	2.783	0.989	0.720	1.357		
	Number of Living Children	**0.497*** **	0.473	0.521	**0.702*** **	0.647	0.761		
	Any primary vs. No education	**0.622*** **	0.493	0.786	0.939	0.616	1.433		
	Any secondary + vs. No education	**0.567*** **	0.406	0.791	0.812	0.466	1.415		
Model 5	Any Household Hunger	**0.784***	0.652	0.944	0.729	0.506	1.049	8163	0.2769
	Rural vs. Urban	**1.942*** **	1.584	2.381	0.900	0.647	1.250		
	Number of Living Children	**0.624*** **	0.583	0.667	**0.809*** **	0.734	0..892		
	Any primary vs. No education	**0.651*** **	0.510	0.830	0.966	0.631	1.479		
	Any secondary + vs. No education	**0.639***	0.455	0.898	0.878	0.501	1.536		
	Maternal age	**0.913*** **	0.897	0.930	**0.939*** **	0.911	0.968		

The second set of models assess fertility desires as a function of child stunting (Table 6). When comparing women with one child stunted to no children stunted, there was no significant difference in fertility preference. This association remained non-significant when controlling for each successive covariate in Models 2-5. When comparing women with two or more children stunted to no children stunted, however, there were significant differences in fertility preferences. Women with two or more children stunted were significantly less likely to want more children compared to women with no children stunted; this effect remained significant while controlling for setting, number of living children and education. The effect, however, is non-significant once maternal age is controlled for. Women with two or more children stunted were significantly less likely to be unsure about wanting more children compared to wanting no more children; this effect remained significant when controlling for setting, only. Once number of living children, education, and maternal age were controlled for, the effect of stunting became non-significant.

Again, we are most concerned with the comparison between women who want more children and those who do not. The results indicate that having one child stunted compared to no children stunted is not significant enough to affect wanting more children. On the other hand, having two or more children under the age of five who are stunted *does* have an affect on a woman wanting more children. Even when controlling for number of living children, there is *still* no significant effect of one child stunted but a significant effect of two or more children stunted. These results beg further investigation into the mechanisms behind these effects.

Interestingly, however, having two or more children stunted is associated with a decreased likelihood to want more children in Models 1 and 2, but the direction of effect changes once we consider more covariates. Upon controlling for number of living children (Models 3-5), having two or more children stunted is associated with an *increased* likelihood to want more children. This suggests that for women with the same number of living children, having two or more children stunted is associated with wanting more children; the relationship between stunting and fertility preferences is dependent on how many living children a woman has.

Table 6: Multinomial logistic regression modeling fertility preferences among women at risk of pregnancy with children 5 years of age or younger, N = 6,929. Number of children stunted under the age of five per woman is the independent variable of interest (p<0.001***, p<0.01**, p<0.05*).

		Fertility Preferences							
		Wants more children vs. No more			Unsure vs. No more				
		Estimate	95% CI		Estimate	95% CI		AIC	R^2
Model 1	1 Stunted vs. None	0.902	0.77	1.057	0.775	0.578	1.039	10365	0.005
	2+ Stunted vs. None	**0.642*** **	0.511	0.805	**0.434*** **	0.267	0.706		
Model 2	1 Stunted vs. None	0.893	0.762	1.046	0.825	0.615	1.108	10349	0.0079
	2+ Stunted vs. None	**0.629*** **	0.5	0.791	**0.497** **	0.304	0.81		
	Rural vs. Urban	1.08	0.926	1.26	**0.64** **	0.463	0.885		
Model 3	1 Stunted vs. None	1.069	0.891	1.283	0.905	0.673	1.217	8352	0.256
	2+ Stunted vs. None	**1.565** **	1.195	2.048	0.763	0.47	1.24		
	Rural vs. Urban	**2.326*** **	1.899	2.848	1.038	0.756	1.426		
	Number of Living Children	**0.499*** **	0.477	0.523	**0.711*** **	0.657	0.769		
Model 4	1 Stunted vs. None	1.056	0.882	1.265	0.896	0.667	1.203	8327	0.2596
	2+ Stunted vs. None	**1.538** **	1.176	2.011	0.756	0.466	1.227		
	Rural vs. Urban	**2.201*** **	1.793	2.702	1.014	0.737	1.397		
	Number of Living Children	**0.488*** **	0.465	0.513	**0.707*** **	0.652	0.765		
	Any primary vs. No education	**0.631** **	0.499	0.798	0.946	0.621	1.441		
	Any secondary + vs. No education	**0.591** **	0.426	0.821	0.83	0.48	1.435		
Model 5	1 Stunted vs. None	1.03	0.853	1.243	0.883	0.656	1.19	8167	0.2769
	2+ Stunted vs. None	1.147	0.866	1.52	0.61	0.369	1.009		
	Rural vs. Urban	**1.938*** **	1.581	2.376	0.934	0.672	1.298		
	Number of Living Children	**0.616*** **	0.574	0.661	**0.83*** **	0.751	0.918		
	Any primary vs. No education	**0.657*** **	0.515	0.837	0.971	0.635	1.483		
	Any secondary + vs. No education	**0.662***	0.474	0.924	0.899	0.517	1.563		
	Maternal age	**0.915*** **	0.898	0.932	**0.934*** **	0.905	0.964		

While the two sets of models alone carry significance, together they illuminate a fascinating difference between how we perceive of and measure food insecurity, and how women experience it. As stated previously, Household Hunger captures perceptions of food insecurity and resource scarcity, while stunting captures chronic resource deprivation. Any Household Hunger is associated with a decreased likelihood of wanting more children, while stunting, once we consider how many living children a woman has, has the opposite effect. These results suggest that perceived food insecurity has different effects on wanting more children than the measured anthropomorphic consequences of chronic resource deprivation.

FUTURE STEPS

The preliminary results suggest an interesting relationship between stunting, number of living children, and fertility preferences. In subsequent analyses we will further interrogate these associations through tests of effect modification. Also, the preliminary results reflect associations between food insecurity and fertility preferences *per woman*. In the next stages of the research we will investigate these findings on a household level to see what role household might play in these associations.

CONTRIBUTION

Beyond informing the demographic discourse on fertility preferences, this study contributes a deeper understanding of how we conceptualize, measure and research food insecurity. By comparing two measures used to assess the same general concept, we can uncover whether or not these measures, in actuality, are capturing the same phenomenon.

Lastly, Tanzania provides an ideal setting for the beginnings of the quantitative analysis of the link between fertility preferences and food insecurity. The methods of this analysis contribute an example that can be replicated in other settings, with potential different nuanced effects relating fertility preferences and food insecurity. After working out the analysis of these important research questions in Tanzania, we plan to take advantage of the Demographic Health and Surveys Program's ability to streamline cross-country analysis to replicate the analysis on a multi-national scale. The cross-cultural comparability of the Household Hunger Scale, stunting and fertility preferences lends themselves to be strong points of country-to-country comparisons of the effects of food insecurity on fertility presences.

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