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DOES URBAN AGRICULTURE HELP PREVENT MALNUTRITION? EVIDENCE FROM KAMPALA

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ABSTRACT

Previous research has suggested that urban agriculture has a positive impact on the household food security and nutritional status of low-socioeconomic status groups in cities in Sub-Saharan Africa, but a formal test of the link between semisubsistence urban food production and nutritional status has not accompanied these claims. This paper seeks to redress this gap in the growing literature on urban agriculture through an analysis of the determinants of the nutritional status of children under five in Kampala, Uganda, where roughly one-third of all households in the sample engage in some form of urban agriculture. When controlling for other individual child, maternal, and household characteristics, these data indicate that urban agriculture has a positive, significant association with higher nutritional status of children, particularly height-for-age. Several pathways by which this relationship is manifested are suggested, and the implications of these results for urban food and nutrition policy and urban management are briefly discussed.

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1. INTRODUCTION

In many African cities, the past decade and a half has been a time of economic hardship. During the 1960s and 1970s, urban populations were favored over rural people with relatively high wages, cheap food policies, better access to health and social services, and stronger safety nets. But from the early 1980s, urban economies across Africa were in a state of stagnation, if not steep decline. One of the factors contributing to this decline was the economic reforms undertaken by many African countries in the 1980s (Demery and Squire 1996; Becker, Jamer, and Morrison 1994). The ways in which economic adjustment programs can have an impact on urban living standards include civil service lay-offs, cutbacks in transfer programs and service provision, and rapid increases in the price of food as subsidies were lifted and exchange rates devalued.

The experience of the population of Kampala, the capital and largest city of Uganda, certainly fits this pattern. However, while the decline of urban economies was a relatively slow-onset crisis in many places, it occurred virtually over night in Kampala with the declaration of the "economic war of liberation" and the expulsion of the Indian merchant class by the Idi Amin regime in 1972. Between 1972 and 1980, real wage income dropped by nearly 80 percent (Jamal and Weeks 1993), and the urban economy rapidly deteriorated into a "*magendo*" or "black market" mode. Smuggling and illegal currency trade made a few individuals rich, but impoverished the majority of the urban population. At the household level, income sources had to be diversified and expanded in order to ensure survival (Bigsten and Kayizzi-Mugerwa 1992). The rapid rural-to-urban migration of the 1960s and early 1970s slowed to a trickle, but then speeded up again with the outbreak of the guerilla war and a scorched earth counterinsurgency response in the Luwero triangle to the immediate northwest of the city from 1981–86. Structural adjustment policies were implemented in the 1981–84 period, and again from 1987 to the present. Daily economic life for the average Kampala resident throughout this period was, in the words of one observer, "a continuous struggle for survival."[1]

Despite the sharp decline in economic fortunes, widespread malnutrition was not observed in Kampala. Urban residents developed various means of access to food in addition to buying increasingly more expensive food in urban markets with declining wage income. Throughout the 1980s, a variety of observers noted increasingly diversified urban food access strategies. The most important of these was urban semisubsistence farming, which was widely believed to have helped mitigate the impact of the economic crisis and structural adjustment (Alnwick 1981; Jamal 1985; Pinstrup-Andersen 1989), and prevented a sharp decline in the nutritional status of the urban population. Similar claims were made about urban agriculture in other African cities (Sanyal 1985; Lee-Smith et al. 1987; Freeman 1991; Sawio 1993). However, no formal test of the link between urban subsistence agriculture and nutrition was carried out in any of these studies. This paper

[1]Banugire (1987, 137).

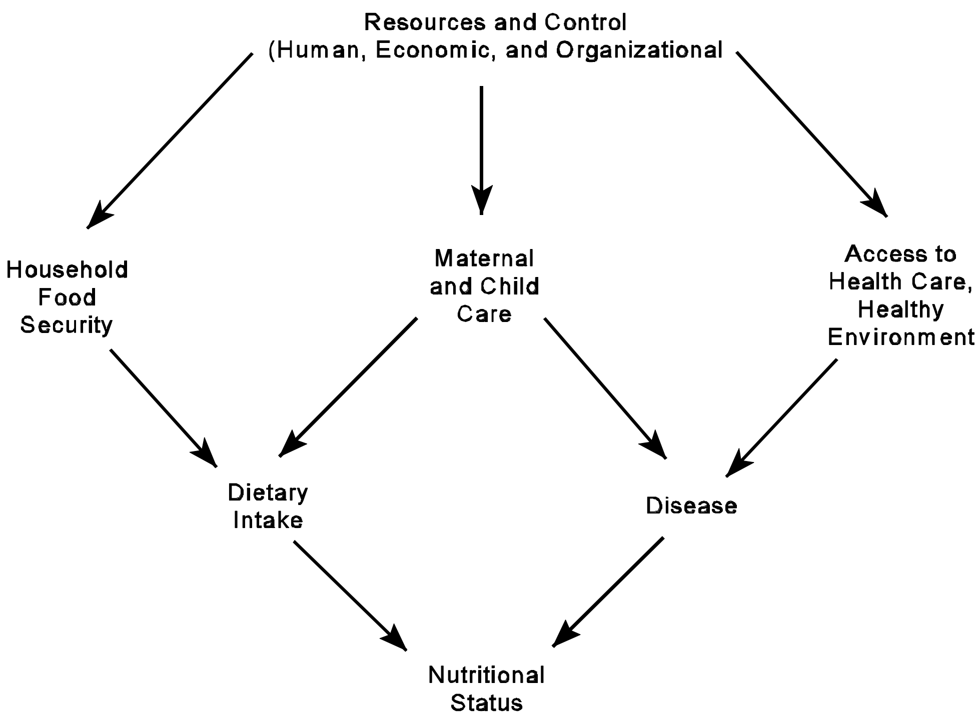
presents data to test the relationship between urban agriculture and nutrition, and results are discussed in terms of policy implications towards urban nutrition and urban planning.

2. CONCEPTUAL FRAMEWORK

UNICEF's (1990) conceptual framework of nutritional status shows the immediate determinants of malnutrition in children as inadequate dietary intake and disease. The underlying causes outlined in the framework include (1) insufficient household food security, (2) inadequate maternal and child care, and (3) insufficient health services and an unhealthy environment (Figure 1). UNICEF lists more basic determinants of nutritional status as control over resources, political and ideological superstructure, physical resources, and economic structure. While these more basic causes do not lend themselves to cross-sectional measurement at the household level, multivariate analysis of nutritional status usually includes measures of dietary adequacy and disease, and incorporates household indicators that reflect the underlying causes mentioned.

In this study, urban agriculture was expected to be associated with improved nutritional status through several mechanisms (Figure 1), including improved household food security (through both direct consumption and increased cash income), improved quantity and quality of dietary intake, and through the increased ability of mothers to care for children if they are engaged in farming compared to other forms of nonfarm employment away from the home. Urban agriculture was defined as engaging in the

Figure 1 Relationship of food security, dietary intake, and nutritional status



Source: Adapted from UNICEF (1990).

production of crops or raising livestock within the city limits of Kampala. A cutoff of nine square meters of area under cultivation was used to define the minimum.[2]

3. HYPOTHESES

1. The nutritional status (height-for-age, weight-for-age, weight-for-height) of children under the age of five years from farming households is significantly better than

[2]This minimum definition was derived from women's focus groups, including both farming and nonfarming respondents. In fact, few actual cases in the field had to be determined by this minimum cutoff.

children from nonfarming households when controlling for socioeconomic status, and other child, maternal, and household variables.

2. Among lower socioeconomic status households, there is a significantly higher proportion of moderately to severely undernourished children (Z-score < –2.00) in nonfarming households than in farming households.

3. Compared to other female income-generating activities, farming permits mothers to devote more time to direct child care.

4. There is a positive relationship between maternal time devoted to direct child care and child nutritional status.

4. METHODS

A two-round survey was carried out in Kampala in 1993 with 360 urban households selected into a multistage, random sample.[3] Information was collected during the rainy season (April) and during the immediate postharvest season (July-August) in order to capture any seasonal variation, either through market prices, availability of subsistence food, or incidence of illness. Prior to and during the survey, a series of 40 in-depth case studies were conducted in purposively selected households outside the survey sample, to

[3]The population from which the sample was drawn consisted of seven parishes in the city of Kampala, which had been selected by the Kampala City Council as their long-term planning area, because they represented a cross-section of the city. Three enumeration areas, consisting of the local resistance council areas (local governance units), were selected from among the seven parishes by random selection with likelihood of selection weighted according to the most recent (1991) census data. A census of all households in each selected enumeration area was carried out, and 120 households randomly selected in each enumeration area.

understand the behavior of lower- and middle-socioeconomic status urban households and urban women in terms of employment, food access, time allocation, and child care. Survey data were collected on basic household demographic characteristics, marital and socioeconomic status; income and employment; maternal time-allocation; food frequency, food allocation, and food-related coping strategies; urban farming practices; and child health and anthropometric status. All variables used in the analysis are described in greater detail in Appendix 1.

Socioeconomic status information was determined from a number of sources. This included stated income (where respondents were willing or able to divulge this); numbers of household members engaged in income-generation, including qualitative information about the types of income-generating activities; and ownership and type of housing, land, and a range of consumer-durable assets.[4] Data are presented in terms of four socioeconomic groups (there were five different groups identified, but the numbers were so small in the two upper groups that they were merged for analytical purposes), but it should be noted that these are categorical variables, and should not be interpreted as income quartiles. Socioeconomic variables used in regression equations are dummy variables for these various groups.

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[4]Because of the incorporation of qualitative information about types of work in which respondents engaged, assignment of individual households to socioeconomic status groups had to be done iteratively by coding individual cases by the two main researchers—a process that continued until 100 percent agreement was achieved on the assignment to socioeconomic status groups of all cases.

The dietary adequacy variable was based on the frequency of consumption of categories of food over a four-day recall period, based on the method of Guthrie and Scheer (1981). Other variables measured included basic household demographic information; the age, sex, and education of the head of household;[5] the age and sex of children; maternal age, education, and livelihood; the amount of time women devoted to farming, other livelihood activities, household maintenance tasks, and direct child care. Detailed information was gathered on farming practices, decisionmaking, use of inputs, and land access.

All children under the age of five years in households selected into the sample were weighed and measured, and information was collected for each child on date of birth and recent history of illness. Where documentary evidence was not available during either round of the survey, the stated dates of birth of children given by the mother or other respondent during both rounds were compared, and if they concurred, they were accepted as correct. Where there were inconsistencies in answers, the record was used only in weight-for-height analysis.[6] In the analysis, the illness recall was collapsed to a simple dummy variable for any occurrence of illness in the previous two weeks.

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[5]Households were defined as consumption units and included all the members for which the unit was responsible for feeding, regardless of residence status; head of household was defined as the person with primary responsibility for ensuring that all members of the unit were fed and cared for.

[6]In standard anthropometric measurement, children between the ages of 24 and 60 months are measured for height while standing up, while children under 24 months are measured lying down. All the children in this study were measured lying down, in order to generate data that was comparable to other data sets for Kampala. Epi-Info was used to calculate the average difference in height-for-age Z-scores for a child measured standing up and lying down at 24 months of age, and the difference was subtracted from all children over the age of two years to create an adjusted figure for height-for-age analysis that is comparable to standard measurement procedures. Aside from this, standard measurement procedures were used in this study.

5. RESULTS

BRIEF DESCRIPTION OF URBAN AGRICULTURE IN KAMPALA

About 35 percent of households interviewed engage in some form of agricultural production within the city. The average length of time that these households had been involved in urban farming was 9.5 years, but varies from less than one year to nearly 50 years (S.D. = 10.8). Though farming had always been a part of the urban economy in some parts of Kampala, the practice became widespread in the city during the 1970s and 1980s in response to the collapse of the urban economy. The most common activity is staple crops cultivation, and the most common crops are cassava, plantains, potatoes, cocoyams, and maize. Virtually all farming respondents (95 percent) note that access to food for direct consumption is their primary reason for engaging in agricultural production in the city. Commercial production constitutes a major part of some sectors of urban agriculture—poultry in particular. But by far the most common activity is staple food production for home consumption.

Urban farming is primarily an activity of urban women; nearly 80 percent of the labor is provided by women, and both production and consumption decisions are largely made by women. Men are more likely to be involved in helping to pay for cash inputs and in gaining access to land for cultivation. Aside from the gender differences, farming is not associated strongly with any group: the overall proportion of middle- and upper-socioeconomic status households with someone engaging in urban farming is no different from the proportion of low and very low-socioeconomic status households. In households with small children, there is a greater proportion of the lower socioeconomic status groups engaged in urban agriculture, which supports the logic expressed by many respondents in the case studies that farming is primarily a strategy to provide a stable form of access to food that does not depend on having cash income available, which thus helps to protect the food security of their families and children (Maxwell 1995b). Women interviewed in case studies also noted that farming, compared to other kinds of informal work, permitted them to provide more direct care of their children.

Two major reasons for farming were cited by women during the household case studies. One is simply the rise in the real cost of living throughout the economic crisis in the city; the other is because these economic circumstances have left them responsible for the provision for food for their families, but without, in many cases, access to the means to adequately do so. They may have little real voice in the allocation of their husband's income to household needs and no access to an independent source of cash, and yet still have responsibility for feeding and caring for the household. Farming helps in both ways: first, by providing a source of food for the household that is not dependent on access to cash, and, second, by providing a source of cash through sales for other needs in an emergency. Because of these intrahousehold considerations, women farmers often have good reason to keep their farming activities “secret,” or at least marginal in appearance, because, were its full value known to their husbands, the husbands’ contributions to household upkeep would decline—a point confirmed by a number of focus group discussions.[7] Food from farming is often not the major source of food for the household, but constitutes one important source, and is utilized as a reserve for times when cash for purchase of food is not available. Such a generalization does not cover all cases studied, but it nonetheless constitutes a modal example of noncommercial urban farmers in the city, especially among lower socioeconomic groups where both a man and a woman are present in the household.

Two factors distinguish urban agriculture from rural agriculture in Uganda. The first is the legal status of farming in the city, the second is the constraint on access to land. Technically, at the time of the research, farming in the city was an illegal economic activity, largely because of health concerns, and it is an illegal form of land use. In practice, urban agriculture is often ignored by municipal authorities, but occasional incidents of crop slashing do occur.[8] These were much less frequent in the 1990s than they had been in the 1970s and 1980s. Access to land constitutes a major constraint to urban farming—most of the land farmed in Kampala is not owned by the farmer, and in many cases is not legally occupied.[9]

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[7]For a full discussion of this issue, see Maxwell (1994).

[8]Recent changes in municipal by-laws have recognized urban agriculture as a legitimate activity in the city.

[9]For a much more detailed discussion of the general characteristics of urban agriculture in Kampala, see Maxwell (1995b); for a specific discussion of land access, see Maxwell (1996). For a more general discussion of urban agriculture, see Rogerson (1993), Egziabher et al. (1994), Mougeot (1994), or Smit, Nasr, and Ratta (1996).

STATISTICAL RESULTS: DESCRIPTIVE AND BIVARIATE ANALYSIS

Table 1 presents descriptive statistics for all children for the mean Z-scores for height-for-age, weight-for-age, and weight-for-height, and the prevalence of undernutrition according to the same three measures, by socioeconomic group and round. The cutoff point used in the prevalence measure is a Z-score of –2.00. Mean Z-scores improve with higher socioeconomic status, and the prevalence of malnutrition declines. Little seasonal variation is noted for any of the anthropometric measures. Table 2 presents a bivariate comparison of mean Z-scores for children in farming and nonfarming households, also by socioeconomic group and round. When controlling for socioeconomic status, the nutritional status of children in farming households is significantly higher than children in nonfarming households, as indicated by mean Z-scores for height-for-age. It should also be noted that within the farming group, there is no significant difference between the highest and lowest socioeconomic status group in height-for-age, while the difference among socioeconomic status groups in nonfarming households is significant and large.

With regard to current status, the evidence of an association between urban farming and nutrition is weaker. There are no significant differences between the farming and nonfarming categories for weight-for-height measures, and there is no significant difference among socioeconomic status groups within the farming and nonfarming categories for either round of the survey. With the exception of the very low socioeconomic status, nonfarming group, there is little indication that wasting is a serious

Table 1 Poverty and malnutrition: Mean Z-scores and prevalence of undernutrition by socioeconomic status group

			Mean Z-scores			Prevalence of malnutrition (Z < –2.00)					
						Height-for-age Z-score		Weight-for-age Z-score		Weight-for-height Z-score	
Socioeconomic status group	Survey Round	N	Height-for-age	Weight-for-age	Weight-for-height	N	Percent	N	Percent	N	Percent
Very low	1[a]	55	–1.35	–1.09	–0.44	22	40.0	11	20.0	4	7.2
	2[b]	50	–1.09	–0.89	–0.40	15	30.0	9	18.0	3	6.0
Low	1	171	–0.85	–0.77	–0.33	26	11.6	15	8.7	5	2.9
	2	168	–0.80	–0.79	–0.37	24	14.2	19	11.3	4	2.3
Lower middle	1	44	–0.60	–0.56	–0.30	4	9.1	5	9.0	2	4.5
	2	46	–0.71	–0.61	–0.31	5	10.9	5	10.8	2	4.3
Upper middle/high	1	23	0.72	0.33	–0.04	0	0.0	0	0.0	0	0.0
	2	20	0.79	0.25	–0.22	0	0.0	0	0.0	0	0.0
All socioeconomic status groups	1	293	–0.78	–0.72	–0.32	52	17.7	31	10.6	11	3.8
	2	284	–0.72	–0.71	–0.36	44	15.4	33	11.6	9	3.1

Source: All data from 1993 survey.

[a] Round 1, April 1993.
[b] Round 2, July/August 1993.

problem in Kampala, an observation confirmed by others (Riley 1987; Uganda/Ministry of Health 1989). While some seasonal variation in weight-for-height might have been expected, particularly among children in farming households, very little evidence of seasonal variation in wasting can be noted from Table 2 for children from either farming or nonfarming households. Children in farming households have significantly higher Z-scores for weight-for-age, but these results are largely explained by differences in stunting, not wasting.

Table 3 is a comparison of the prevalence of undernutrition ($Z < -2.00$) in children under the age of five in farming and nonfarming households across the lower three socioeconomic status groups, and for all three nutrition indicators. Overall, the prevalence of stunting and being underweight is significantly lower among children in farming households, particularly in the lowest socioeconomic status groups. There is little difference between children from farming and nonfarming households with regard to wasting, and few cases of moderate to severe wasting, with the exception of the very low socioeconomic status group.

Table 4 presents a bivariate comparison of the amount of time per day that mothers provide direct child care for preschool children. Farming is associated with increased maternal time allocated to direct child care across socioeconomic status groups, although the paucity of data in the upper socioeconomic status groups makes firm conclusions problematic. There was no significant association of urban farming with the incidence of

Table 2 Urban farming and malnutrition

Socioeconomic status group	Survey Round	Height-for-age Z-score				Weight-for-age Z-score		Weight-for-height Z-score	
		Farming		Nonfarming		Farming	Nonfarming	Farming	Nonfarming
		N		N					
Very low	1	29	–0.71*	26	–2.05*	–0.59*	–1.66*	–0.32	–0.59
	2	26	–0.74*	24	–1.47*	–0.55*	–1.27*	–0.27	–0.55
Low	1	71	–0.61*	100	–1.03*	–0.68	–0.84	–0.38	–0.28
	2	71	–0.51*	97	–1.00*	–0.68	–0.88	–0.36	–0.32
Lower middle	1	21	–0.31	23	–0.86	–0.43	–0.72	–0.37	–0.25
	2	22	–0.53	24	–0.89	–0.36	–0.84	–0.10	–0.50
Upper middle/high	1	7	0.40	16	0.86	0.11	0.43	–0.16	0.00
	2	8	0.53	12	0.97	0.34	0.19	–0.01	–0.37
All socioeconomic status groups	1	128	–0.53*	165	–0.98*	–0.58*	–0.82*	–0.36	–0.30
	2	127	–0.50*	157	–0.91*	–0.53*	–0.85*	–0.33	–0.38
ANOVA	1		F= 1.49		F=21.50*	F= 1.26	F=13.52*	F= 0.14	F= 1.35
	2		F= 2.30		F=11.30*	F= 1.26	F=13.52*	F= 1.32	F= 0.54

Note: * = $p < 0.05$ (for t-test in comparison of means between farming and nonfarming; for F in analysis of variance among socioeconomic status groups).

Table 3 Prevalence of malnutrition, by socioeconomic status groups and farming

Socioeconomic status group	Survey round	Height-for-age Z-score < –2.00				Weight-for-age Z-score < –2.00				Weight-for-height Z-score < –2.00			
		Farming		Nonfarming		Farming		Nonfarming		Farming		Nonfarming	
		n	Percent	n	Percent	n	Percent	n	Percent	n	Percent	n	Percent
Very low	1	6	20.7*	16	61.5*	3	10.3*	8	30.8*	1	3.0	3	11.1
	2	5	19.2*	10	41.5*	2	7.6*	7	29.1*	0	0.0	3	12.0
Low	1	8	11.2	18	18.0	3	4.2	12	12.0	3	3.7	2	1.7
	2	5	7.0*	19	19.5*	5	7.0	16	16.5	2	2.7	3	2.9
Lower middle	1	0	0.0*	4	8.6*	2	9.5	3	13.0	2	7.6	0	0.0
	2	1	4.5	4	8.6	2	9.0	4	16.6	1	4.5	1	3.8
Total	1	14	10.9*	38	23.0*	8	6.2*	23	13.9*	6	4.2	5	2.7
	2	11	8.6*	33	21.0*	9	7.1*	27	17.2*	3	2.2	7	4.2

Note: * = Chi-squared test for difference significant at $p < 0.05$.

Table 4 Maternal employment and time for child care

Socioeconomic status group	Survey round	Maternal time per day for child care: Farming only	Other employment
		(hours per day)	
Very low	1	8.5*	2.7*
	2	5.5*	2.1*
Low	1	5.2*	2.1*
	2	3.7*	2.1*
Lower middle	1	5.1	2.3
	2	3.0	1.6
Upper middle/high	1	--	--
	2	--	--
All socioeconomic status groups	1	5.9*	2.2*
	2	3.7*	2.0*
ANOVA		F = 2.4	F = 0.51
		F = 2.2	F = 0.29

Notes: *$p < 0.05$. $N_1 = 248$; $N_2 = 241$. The sample size is smaller because mothers not reporting either farming or other income-generating work (mostly in the higher socioeconomic status groups who could afford nannies) were dropped from the analysis.

-- = Insufficient data.

any illness measured (including febrile, gastrointestinal, and respiratory illnesses), and, hence, there is no table comparing results.

MULTIVARIATE ANALYSIS

Tables 2 and 3 suggest a positive association between urban farming and nutritional status, particularly in the height-for-age measure. Table 4 suggests a positive association between urban farming and time devoted to direct child care. In order to trace these relationships more precisely, an ordinary least squares regression analysis was carried out to test the relationship of urban farming to nutritional status, while controlling for a series of individual child, maternal, and household-level variables and socioeconomic status. In addition, a two-stage least squares regression analysis was carried out to control for the endogenous determination of several variables in the conceptual framework. All maternal variables (with the exception of time devoted to child care) were treated as exogenous, as were household variables. Endogenous variables clearly included dietary adequacy and morbidity—the two immediate determinants of nutritional status in the conceptual framework—as well as for time devoted to child care, and urban agriculture.

Normally, income would be treated in an econometric analysis as an endogenously determined variable. However, in this case, no quantitative, continuous variable for income was available—only a categorical variable for socioeconomic status. As described above, these groups were constructed on the basis of self-reported income, the number of people in the household employed or engaged in self-employment, qualitative information about types of income-generating activities in which people engage, and information about housing and assets. Thus there was an analytical question of whether to treat the socioeconomic status variable as endogenously or exogenously determined. To address this problem, and to note fluctuations in the urban agriculture/nutritional status relationship, depending on the way in which socioeconomic status was controlled for, the variable for socioeconomic status was tested both as an endogenous variable and as an exogenous variable. It was also dropped from the analysis entirely to see if other, income-related variables, such as dietary adequacy or illness would adequately capture the effects of socioeconomic status. There was an insufficient number of instrumental variables available to predict all four of the socioeconomic status groups used in the bivariate analysis, so for this series of regressions, the socioeconomic status was collapsed into two groups—the three lower groups were pooled together, and the two higher groups were pooled, to make one single dummy variable for socioeconomic status. Table 5 presents descriptive statistics for variables used in the multivariate analysis. Table 6 presents results of the OLS and 2SLS regression analyses of height-for-age, while Table 7 presents the results of the regression in which socioeconomic status was a binomial variable, treated as both endogenous and exogenous, and dropped from the analysis entirely. Appendix 1 describes variables used in the multivariate analysis. Appendix 2 presents the systems of equations used to estimate the parameters presented in Tables 6 and 7. Appendix 3 presents the output from SPSS of the models tested.

Several key points emerge from these regression analyses. Urban agriculture has a positive and significant association with height-for-age in both OLS and 2SLS (Table 6). The association of urban agriculture and nutritional status is positive and significant in the different regressions shown in Table 7, although the magnitude of the association varies slightly, and when socioeconomic status is dropped from the analysis, the significance of the association is weaker. When the negative association of low socioeconomic status (the majority of the sample) is not controlled for, it is reasonable that the association between urban agriculture and nutritional status would be somewhat weaker, which was the reason for the first hypothesis noted in Section 3. The association

Table 5 Descriptive statistics: Variables for multivariate analysis

Variable	Mean	Standard deviation
Adjusted height-for-age Z-score	–0.96	1.29
Age of child	29.84	17.73
Sex of child[a]	0.48	0.50
Illness[b]	0.47	0.50
Maternal (caregiver) age	29.18	10.66
Maternal (caregiver) education	7.18	3.92
Hours of time per day devoted to child care	5.88	3.90
Dietary adequacy	6.42	2.25
Household size	6.66	3.14
Education of head of household	9.21	4.23
Sex of head of household[c]	0.82	0.38
Lower-middle socioeconomic status[d]	0.14	0.35
Low socioeconomic status[d]	0.62	0.49
Very low socioeconomic status[d]	0.19	0.40
Urban agriculture[e]	0.45	0.50
Round of survey[f]	0.44	0.50

[a] Reference is female child.

[b] Reference is no illness in past two weeks.

[c] Reference is female head.

[d] Reference is upper middle/high socioeconomic status.

[e] Reference is no farming.

[f] Reference is first round.

Table 6 OLS and 2SLS regression analysis: Height-for-age Z-score (with socioeconomic status as exogenous variable)

	OLS		2SLS	
Variable name	Estimate	t-Ratio	Estimate	t-Ratio
Age of child	–0.017	–2.178*	–0.008	–2.140*
Sex of child	–0.270	–2.469*	–0.221	–1.760**
Illness past two weeks[a]	–0.294	–2.598*	–0.303	0.449
Maternal age	0.017	2.289*	0.006	0.559
Maternal education	–0.047	–2.249*	–0.068	–2.387*
Hours per day of direct care[a]	0.007	0.493	–0.089	–1.548
Dietary adequacy[a]	0.453	1.520	0.133	1.342
Household size	–0.018	–0.833	–0.020	–0.793
Household head education	0.049	2.717*	0.046	1.998*
Household head sex	–0.061	–0.326	–0.004	–0.017
Lower middle socioeconomic status group	–1.314	–4.352*	–1.113	–2.961*
Low socioeconomic status group	–1.357	–4.629*	–1.001	–2.139*
Very low socioeconomic status group	–1.697	–5.110*	–1.187	–1.998**
Urban agriculture[a]	0.530	4.455*	0.551	2.323*
Round of survey	0.124	1.150	0.088	0.753
Constant	–0.222	–0.423*	0.066	0.069
Adjusted R^2	0.15		0.11	

Notes: * $p < 0.05$; ** $p < 0.10$.

[a] Predicted value in 2SLS.

Table 7 2SLS: Height-for-age Z-score (with socioeconomic status excluded, endogenous and exogenous)

Variable	Without socioeconomic status groups Estimate	t-Ratio	Socioeconomic status groups as endogenous variable Estimate	t-Ratio	Socioeconomic status groups as exogenous variable Estimate	t-Ratio
Age of child	–0.006	–1.723**	–0.009	–2.321**	–0.007	–2.040**
Sex of child	–0.232	–1.827**	–0.213	–1.713**	–0.231	–1.860**
Illness past two weeks[a]	–0.043	–0.058	–0.359	–0.532	–0.070	–0.101
Maternal age	0.009	0.800	0.008	0.687	0.009	0.825
Maternal education	–0.072	–2.299*	–0.059	–2.050*	–0.071	–2.405*
Hours per day care[a]	–0.086	–1.552	–0.077	–1.461	–0.078	–1.478
Dietary adequacy[a]	0.235	2.574*	–0.002	–0.017	0.150	1.677**
Household size	–0.027	–1.023	–0.025	–0.993	–0.029	–1.168
Household head education	0.038	1.653**	0.060	2.260*	0.047	2.075*
Household head sex	0.094	0.466	–0.009	–0.047	0.040	0.204
Socioeconomic status group[b]	--	--	–2.459	–1.800**	–1.092	–2.895*
Urban agriculture[a]	0.420	1.722**	0.708	2.386*	0.559	2.355*
Survey round	0.074	0.611	0.116	0.974	0.096	0.827
Constant	–1.850	1.690**	1.848	0.827	–0.372	–0.363
Adjusted R^2	0.08		0.09		0.11	

Notes: * = $p < 0.05$; ** = $p < 0.10$.

[a] Predicted value in 2SLS.

[b] Socioeconomic status group as binomial dummy variable (not included in first model, exogenous in second model, and endogenous in third model).

of urban agriculture with height-for-age does not vary significantly at different times of the year.

The lower three socioeconomic status groups have a negative and significant association with height-for-age in both OLS and 2SLS, and the magnitudes of the estimates increase with each lower socioeconomic status category in OLS. Collapsing the five groups into a single dummy variable did not significantly alter the relationship of socioeconomic status to nutritional status, although when treating socioeconomic status as a predicted variable, the negative association increases (but is only weakly significant), and the positive association of urban agriculture to nutritional status is increased. When dropped altogether, some of the effects of socioeconomic status are picked up by the dietary adequacy variable, but not by the illness variable, as might have been expected. Given the construction of the socioeconomic status groups, the models treating the variable as exogenous probably provide the most accurate results. Assets, especially land and housing, may be endogenous in the long term, but not in a cross-sectional analysis such as this. Clearly, a better result would have been obtained from data that included a continuous, quantitative variable for income, as well as information on assets. However, the relationship of urban agriculture to nutritional status is relatively stable across all the models tested here—roughly a difference of 0.5 Z-scores between children in farming and nonfarming households. And it was the relationship of urban agriculture to nutritional status that was in question in this study, not the relationship of income to nutritional status. This magnitude and significance of the urban agriculture/nutritional status relationship is only slightly weaker when socioeconomic status is dropped from the analysis altogether.

The occurrence of illness has a significant negative association with height-for-age in OLS, but the relationship is insignificant in 2SLS. This may be the result of poor instrumental variables with which to predict the occurrence of illness, rather than the actual lack of an association when controlling for endogeneity. Variables capturing child and maternal characteristics, including the age and sex of the child, the age and education of the mother,[10] and the education of the head of household, were significant in OLS, but sex of child and age of mother were not significant in some of the 2SLS models (Table 6). Maternal time spent on child care does not have a significant association with height-for-age in any of the models tested. This measure was intended as a proxy for other care variables, but recent research indicates that maternal time allocation is not always a reliable indicator of care (Engle, Menon, and Haddad 1996). The dietary adequacy measure was also not significant, except when socioeconomic status was dropped from the analysis (Table 7). While this may be because the dietary adequacy measure is a poor proxy for caloric intake, the lack of a robust impact of other food consumption proxies on nutritional status has been problematic in similar, previous cross-sectional analyses (Alderman 1990).

[10]Maternal education had a negative association with height-for-age. While small in magnitude, this is nevertheless the opposite of what might be expected. Two possible explanations emerged from further investigation: One is that there was a large group of mothers with no formal education who were quite a lot older, suggesting a life-cycle effect—that is, their skills as mothers outweighed their lack of formal education. The second is that a large proportion of uneducated women were farming, since there were no educational barriers to farming. However, this negative association holds even when controlling for age and farming.

6. DISCUSSION

Both bivariate and regression (both OLS and the various 2SLS models tested) results support the first hypothesis that child nutritional status (height-for-age) is significantly higher among households that farm, when socioeconomic status and other variables are controlled for. Bivariate analysis supports the second hypothesis that among lower-socioeconomic status households, there is a significantly higher prevalence of moderate to severe malnutrition among children from nonfarming households than among farming households. Bivariate analysis results tentatively support the third hypothesis, that, compared to other forms of income generation, farming mothers devote more time to direct child care. However, multivariate results do not support the fourth hypothesis of a positive relationship between maternal time devoted to direct child care and nutritional status.

While the statistical relationship between urban farming and nutritional status is fairly strong, these results do not confirm the particular pathway by which the relationship is manifested.[11] Two pathways were suggested by the conceptual framework (Figure 1) and by qualitative case studies—namely through improved quality and quantity of food consumption, and through increased time for direct child care. Urban agriculture is associated with improved quantity and quality of food consumption (the dietary adequacy

[11]We note, however, that due to the cross-sectional nature of our data, we cannot control for any biases that may be introduced by unobserved factors that might influence both the adoption of urban agriculture and the height-for-age of children (e.g., mother's dynamism).

variable) and with increased time for child care in the first-stage regressions. Time for child care is negatively associated with the occurrence of illness, and urban agriculture has no association with illness in first-stage regressions. However, in the second-stage (results depicted in Tables 6 and 7), the relationship of all three of these endogenous variables (hours per day of direct child care, dietary adequacy, and illness) to nutritional status is not statistically significant. As noted earlier, this may be at least in part because of poor instrumental variables—especially in the case of illness. And this may be in part because variables measured are imperfect proxies for the concepts in the conceptual framework—time devoted to child care is not the best proxy for caring practices more generally, and the dietary adequacy variable used here is a measure of food frequency, not caloric intake. Perhaps most important, height-for-age is cumulatively affected by all these variables over a long period of time, but cross-sectional surveys permit only a short recall period.

As a result, even though the relationship of urban agriculture to nutritional status is significant and positive, it is not possible to specify which of the two pathways suggested above account for the relationship. However, given the known theoretical relationship of food consumption, care, and health to nutritional status, and the relationship of urban agriculture to these three determinants of nutritional status demonstrated in this analysis, it is likely the relationship of urban agriculture and nutritional status is mediated to some extent by both pathways. Qualitative results support this conclusion.

7. IMPLICATIONS FOR POLICY

Several implications for food and nutrition policy can be inferred from these results. The cutbacks in urban subsidies and formal social safety nets that can occur under economic adjustment have resulted in poor people relying more on their own informal "safety nets." Urban agriculture is one such component of an informal safety net and for our Kampala sample, the positive association with child nutritional status indicates that it can be a successful strategy. Governments and nongovernmental organizations (NGOs) could do more to support such informal safety nets. But in many cases, informal strategies such as urban agriculture are overlooked or even actively discouraged by local and national governments that fail to understand their importance.

Nevertheless, urban agriculture faces two major constraints. First, it has often been either suppressed or ignored by municipal governments—not only in Kampala, but across Sub-Saharan Africa (Egziabher et al. 1994; Mougeot 1994; Freeman 1991; Lee-Smith et al. 1987; Sanyal 1985). This attitude is changing, but one of the principal reasons cited by municipal governments for suppressing urban agriculture has been that it is a threat to public health—by providing places for mosquitoes and rodents to inhabit and breed, through possible food contamination, and a variety of other reasons. These cited reasons should be subject to investigation, but are not the topic of this paper. The conclusion of this paper is that urban agriculture can have a positive impact on public health, through improved nutritional status of children, particularly among the lower-socioeconomic status groups. As such, the public health basis for the legal status of urban agriculture ought to be revisited by municipal authorities, in Kampala and elsewhere.[12]

Second, the strategy depends on access to land, which in many cases is an insurmountable constraint, and those constraints may be growing (Maxwell 1996). But idle land in cities is neither a new nor disappearing feature of urban life. It is difficult to suggest ways by which such land could be rationally allocated to low socioeconomic status groups as a formal means of providing support to households' own attempts to safeguard food security and nutritional status, but such informal agricultural production practices as already exist could be supported, not just through a more conducive legal framework, but also through direct extension support. NGOs interviewed in Kampala in 1993 suggested that they would be ready to provide such support were it not for its legal status. However, caution should be exercised about urban agriculture as a panacea for urban food insecurity and malnutrition. Clearly, not everyone—certainly not all the poor or vulnerable—is going to be able to get access to land in cities for farming. Thus, there is a need for local authorities, the research establishment and development agencies, to work with the urban poor to understand and develop other urban food and livelihood security strategies.

[12]In 1995, the Kampala City Council took steps towards changing the legal status of urban agriculture by altering some of the by-laws regulating the practice.

APPENDIX 1

VARIABLES KEY

A. Variables in Main Models

Name	**Variable**	**Definition**
SEX1	Sex of child	Dummy
AGE	Age of child	Months
ILLNESS	Illness of child	Occurrence of illness in past two weeks
SWAGE	Maternal age	Years
SWEDUC1	Maternal education	Years of formal schooling
HRSCHILD	Hours per day of direct maternal care of child	Hours per day
ADEQDIET	Dietary adequacy	Frequency of consumption of foods, aggregated by food group, and combined into index. (For complete explanation, see Guthrie and Scheer 1981).
HOUSENUM	Household size	Total number of people in household
HHHEDUC	Education of household head	Years of formal schooling
HHHSEX	Sex of household head	Dummy
LMINC	Lower middle socioeconomic status	Socioeconomic status groups were constructed from stated income, information on number of people employed and type of work, type of housing, and ownership of productive assets and consumer durables. Used for Regression 1
LOWINC	Low socioeconomic status	
VLINC	Very low socioeconomic status	
URBAG	Urban agriculture	Dummy for someone in household engaged in urban agriculture (keeping livestock or at least nine square meters of land)
ROUND	Round of survey	Dummy. Round 1 was rainy season (April); Round 2 was postharvest (July).
INGGRP1	Socioeconomic status dummy	Dummy. 0 = LM,L,VL SES groups 1 = UM, H SES groups Used for Regressions 3 and 4

B. Instrumental Variables for First-Stage Regressions

Name	**Variable**	**Definition**
FOODPP	Food expenditure per adult equivalent per day	Uganda Shillings (roughly Ushs 1,200 to US$1.00 during survey)
FOODAPOR	Food apportioning	Dummy for apportioning of food by principal homemaker or unlimited access by individual. Proxy for food allocation
HLTHCARD	Presence of health card	Dummy
WATER	Presence of piped water in household	Dummy
OWNSLAND	Land ownership	Dummy
YRSKLA	Years in Kampala	Number of years since arrival in Kampala
POPDENS	Population density in enumeration area	Number of people per hectare
OUTHOURS	Hours of maternal employment in trade or wage labor	Number of hours per day
NUMKIDS	Number of children in household	Total number of children.
HHHAGE	Age of head of household	Years
DEPRATIO	Dependency ratio	Ratio of household size to number employed
EMPLOYED	Number of working persons in the household	Any person who is generating an income, either in cash or in kind, whether through employment or self-employment

APPENDIX 2

REGRESSION EQUATIONS

Equation 1: 2SLS With Four Socioeconomic Status Groups as Exogenous					
	Basic Equation	Instrumenting Equations for other Endogenous Variables			
Variables	HAZ	Illness	Hrschild	Adeqdiet	Urbag
Age	x	x	x	x	x
Sex	x	x	x	x	x
Illness	x				
Swage	x	x	x	x	x
Sweduc	x	x	x	x	x
Hrschild	x				
Adeqdiet	x				
Urbag	x				
LMinc	x	x	x	x	x
Lowinc	x	x	x	x	x
VLinc	x	x	x	x	x
Housenum	x	x	x	x	x
HHHeduc	x	x	x	x	x
HHHsex	x	x	x	x	x
Round	x	x	x	x	x
Other variables that affect:					
Illness but not HAZ: Hlthcard Water		x			
Hrschild but not HAZ: Outhours Numkids			x		
Adeqdiet but not HAZ: FoodPP Foodapor				x	
Urbag but not HAZ: Ownsland Popdens YrsKla					x

Equation 2: 2SLS Without Socioeconomic Status Groups					
	Basic Equation	Instrumenting Equations for other Endogenous Variables			
Variables	HAZ	Illness	Hrschild	Adeqdiet	Urbag
Age	x	x	x	x	x
Sex	x	x	x	x	x
Illness	x				
Swage	x	x	x	x	x
Sweduc	x	x	x	x	x
Hrschild	x				
Adeqdiet	x				
Urbag	x				
Housenum	x	x	x	x	x
HHHeduc	x	x	x	x	x
HHHsex	x	x	x	x	x
Round	x	x	x	x	x
Other variables that affect:					
Illness but not HAZ: Hlthcard Water		x			
Hrschild but not HAZ: Outhours Numkids			x		
Adeqdiet but not HAZ: FoodPP Foodapor				x	
Urbag but not HAZ: Ownsland Popdens YrsKla					x

Equation 3: 2SLS With Two-Group Socioeconomic Status Dummy as Endogenous						
	Basic Equation	Instrumenting Equations for other Endogenous Variables				
Variables	HAZ	Illness	Hrschild	Adeqdiet	Urbag	SES
Age	x	x	x	x	x	x
Sex	x	x	x	x	x	x
Illness	x					
Swage	x	x	x	x	x	x
Sweduc	x	x	x	x	x	x
Hrschild	x					
Adeqdiet	x					
Urbag	x					
Incgrp1	x					
Housenum	x	x	x	x	x	x
HHeduc	x	x	x	x	x	x
HHHsex	x	x	x	x	x	x
Round	x	x	x	x	x	x
Other variables that affect:						
Illness but not HAZ: Hlthcard Water		x				
Hrschild but not HAZ: Outhours Numkids			x			
Adeqdiet but not HAZ: FoodPP Foodapor				x		
Urbag but not HAZ: Ownsland Popdens YrsKla					x	
SES but not HAZ: Depratio HHHage						x

Equation 4: 2SLS With Two-Group Socioeconomic Status Dummy as Exogenous					
	Basic Equation	Instrumenting Equations for other Endogenous Variables			
Variables	HAZ	Illness	Hrschild	Adeqdiet	Urbag
Age	x	x	x	x	x
Sex	x	x	x	x	x
Illness	x				
Swage	x	x	x	x	x
Sweduc	x	x	x	x	x
Hrschild	x				
Adeqdiet	x				
Urbag	x				
Incgrp1	x	x	x	x	x
Housenum	x	x	x	x	x
HHHeduc	x	x	x	x	x
HHHsex	x	x	x	x	x
Round	x	x	x	x	x
Other variables that affect:					
Illness but not HAZ: Hlthcard Water		x			
Hrschild but not HAZ: Outhours Numkids			x		
Adeqdiet but not HAZ: FoodPP Foodapor				x	
Urbag but not HAZ: Ownsland Popdens YrsKla					x

APPENDIX 3

REGRESSION RESULTS

Appendix Table 8 Two-stage least squares (2SLS) regressions on standardized height-for-age: Model 1

Variable	β	t
ADEQDIET	.1327	1.342
HRSCHILD	–.0886	–1.548
ILLNESS	–.3028	–.449
URBAG	.5513	2.323
LMINC	–1.1134	–2.961
LOWINC	–1.0077	–2.139
VLINC	–1.1872	–1.998
AGE	–.0076	–2.140
HHHEDUC	.0461	1.998
HHHSEX	–.0036	–.017
HOUSENUM	–.0207	–.793
ROUND	.0878	.753
SEX1	–.2211	–1.760
SWAGE	.0063	.559
SWEDUC1	–.0681	–2.387
(Constant)	–.0662	–.069
R square = .1411		
Adj. R square = .1139		
F = 5.1893		
N = 490		

Appendix Table 9 Two-stage least squares (2SLS) regressions on standardized height-for-age: Model 2

Variable	β	t
ADEQDIET	.2345	2.574
HRSCHILD	–.0860	–1.552
ILLNESS	–.0429	–.058
URBAG	.4288	1.772
AGE	–.0065	–1.723
HHHEDUC	.0382	1.653
HHHSEX	.0940	.466
HOUSENUM	–.0272	–1.023
ROUND	.0742	.611
SEX1	–.2370	–1.827
SWAGE	.0093	.800
SWEDUC1	–.0718	–2.299
(Constant)	–1.8549	–1.690

R square = .0998
Adjusted R square = .0771
F = 4.4057
N = 490

Appendix Table 10 Two-stage least squares (2SLS) regressions on standardized height-for-age: Model 3 (INCGRP1 as endogenous)

Variable	β	t
ADEQDIET	–.0025	–.017
HRSCHILD	–.0774	–1.461
ILLNESS	–.3599	–.532
URBAG	.7081	2.386
INCGRP1	–2.4593	–1.800
AGE	–.0089	–2.321
HHHEDUC	.0604	2.266
HHHSEX	–.0095	–.047
HOUSENUM	–.0251	–.993
ROUND	.1163	.974
SEX1	–.2132	–1.713
SWAGE	.0077	.687
SWEDUC1	–.0589	–2.050
(Constant)	1.8486	.827

R square = .1150
Adjusted R square = .0908
F = 4.7573
N = 490

Appendix Table 11 Two-stage least squares (2SLS) regressions on standardized height-for-age: Model 4 (INCGRP1 as exogenous)

Variable	β	t
ADEQDIET	.1503	1.677
HRSCHILD	–.0785	–1.478
ILLNESS	–.0701	–.101
URBAG	.5586	2.355
INCGRP1	–1.0926	–2.895
AGE	–.0074	–2.040
HHHEDUC	.0480	2.075
HHHSEX	.0399	.204
HOUSENUM	–.0299	–1.168
ROUND	.0969	.827
SEX1	–.2312	–1.860
SWAGE	.0091	.825
SWEDUC1	–.0719	–2.405
(Constant)	–.3726	–.363

R square = .1365
Adjusted R square = .1129
F = 5.7876
N = 490

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