Urbanicity, Poverty and the Double Burden of Malnutrition in Low and Middle Income Countries[1,2,3]

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ABSTRACT

In this paper we focus on overweight and underweight—both major risk factors for non-communicable disease--among adolescents and young adults in 42 countries. We find that among adolescents and young adults, the double burden of malnutrition in LMICs is concentrated among the urban poor. Outside Sub-Saharan Africa, underweight is also concentrated among the urban poor. Overweight is highest among the urban non-poor worldwide. These results suggest that nutrition policy and programming needs to be formulated differently in rural and urban contexts in order to decrease the risk for non-communicable disease in years to come. The findings also call attention to risks associated with urban poverty in LMICs for adolescents and young adults.

INTRODUCTION

The double burden of malnutrition refers to the issue that in many low and middle income countries (LMICs) the prevalence of *both* overweight and underweight have reached the level of a public health problem[1]. Since both types of malnutrition are associated with risk factors for non-communicable disease[2] (NCD), populations that suffer from the double burden of malnutrition are likely to exhibit the highest levels of NDCs in the future.

Urbanization has been associated with the double burden of malnutrition[3,4] although past research reveals that the double burden is not exclusively an urban phenomenon[5]. One reason that the level of urbanization in a society, as well as urban residence itself, may be associated with overweight is that the process of urbanization is often accompanied by an increase in a processed food diet that is low in fiber. Additionally a decline in levels of physical activity may be most pronounced among urban residents[6].

Although there is regional variation in levels of urbanization---the Americas and Europe exceed 70% urban while Africa and Asia are around 40%---people who live in urban areas are now a majority of the world's population and virtually all population growth for the foreseeable future will be in urban areas (UN 2012). The focus of health scholarship and health policy in contemporary LMICs, however, has been on rural people, most particularly rural children. And of course, it remains the case that the majority of infants and children at high risk of poor outcomes reside in rural areas [7].

Some speculate, however, that the dramatic increase in urbanization, which has been accompanied by both the emergence of megacities (i.e. cities with populations of more than 10 million) and the development of urban slum areas, may lead to a re-emergence of an urban health penalty in developing countries [8]. Urban health penalty refers to the worse health and higher mortality that characterized urban populations in contemporary industrialized countries during the 19th century[9]. More specifically, the unprecedented size of modern cities and the consequently large slum areas have given rise to the hypothesis that the urban health penalty in modern cities accrues to the *urban poor only*. The wealthy urban dwellers of Europe and America's cities in the 19th century suffered as much as the poor from the nascent state of preventive and curative care at the time they lived. By contrast, the affluent of the LMICs today profit from modern medical advances---most particularly immunization from communicable diseases, aseptic treatment of injuries and modern methods of addressing obstetric complications. This, together with the benefits of adequate food and sufficient shelter, renders their health risks low. But the affluent are a decreasing percentage of the population in the cities of LMICs.

Most research on the health implications of poverty and urbanicity has had young children as the focus[10]. Studies that focus on urban adolescent health are almost always about sexual and reproductive health only[11,12].

It is critical that consideration of how adolescents and young adults living in urban poverty fare be part of the scholarly and policy discourse. The process of adolescent development as well as the progression of social roles leads adolescents and young adults to interact directly with their environment far more than younger children. Thus, there is reason to believe that to the extent that an urban penalty derives from exposure

to negative environmental influences, poor adolescents and young adults may be more vulnerable to the risks of an urban environment than poor children. Moreover, it is also critical that the study of adolescent health in LMICs be expanded beyond the domain of sexual and reproductive health, as important as that is.

In this paper we explore the double burden of malnutrition among adolescents and young adults in LMICs and the segment of the population—rural, urban poor or urban non-poor—where it is felt most strongly.

METHODS

Data

The Demographic and Health Surveys (DHS) are conducted in many LMICs, approximately every five years with population, health and nutrition as foci [13]. We included DHS data from 42 countries in our analysis of underweight and 38 countries in our analysis of overweight. We only included recent surveys done since 2000.

Study Samples

To create our study samples we first selected female respondents from each of the countries who were between 15 and 24 years of age. We do not include any countries that sampled only married women.

Outcomes

DHS field staff used SECA 874 digital scales and Shorr height boards to measure respondents to the survey[14]. We used height and weight to calculate Body Mass Index (BMI) and characterized BMI into three mutually exclusive groups: *underweight* (BMI < 18.5) *overweight* (BMI > 25) and *normal weight* (BMI 18.5-24.9). We present the results separately for underweight and overweight groups.

Predictors

We have two predictor variables. The first is *urbanicity* (rural and urban). The second is *poverty*, which is based on the wealth index variable. DHS provides a wealth score for each household, which is estimated from the first factor of the principal component analysis of the family's durable assets. We defined poor households as those in the lower three quintiles of the distribution of wealth in each country. For our analyses, we combine these two variables (urbanicity and poverty) into one that distinguishes among three categories of adolescent and young adult: 1) young rural women (both poor and non-poor combined); 2) poor young urban women; and 3) non-poor young urban women.

Methods

Our analytic strategy has three steps. First, we examined the prevalence of underweight and overweight across the three categories of young people. Second, we compare adolescents across different groups of urbanicity and poverty levels for the odds of underweight and overweight in each country using logistic regression analysis.   All logistic regression results are weighted for disproportionate areal sample section and for differential non-response rates in the DHS.   Our standard-error estimates for 95% confidence level estimation are adjusted for larger design-effect (*deff* > 1) due to the cluster survey design of the DHS. Third, we conducted a meta-analysis on the log-odds ratios and standard errors from these regressions in order to summarize the results across the 42(38) countries. The country specific and pooled meta-analysis results are shown as odds ratios with 95% CI.

RESULTS

Table 1 contains the list of 42 countries in our analysis, the number of female 15 to 24 year olds sampled in each country and their distributions into rural residence, urban residence/poor household and urban residence/non poor household.

In Table 2a we provide the prevalence of underweight by country and by urbanicity/wealth group. We note that in Burundi, Chad, Lesotho, Madagascar, and Uganda the number of young women among the urban poor is fewer than 45, so the prevalence indicators should be viewed with caution. In Niger we do not present the prevalence of underweight since the number young women among the urban poor is less than 25. For each row in Table 2a we shade the group—either rural, urban non-poor or urban poor-- with the highest prevalence of underweight in that country.

In 15 of the 30 Sub-Saharan African countries the highest prevalence of underweight is found in the rural areas, for 14 it is found among the urban poor and for only 2 Sub-Saharan African countries is the highest prevalence found among the urban non-poor. Outside Sub-Saharan Africa underweight appears to be most prevalent among the urban poor.

An analogous tabulation for overweight is found in Table 2b. As before, we highlight the group in each country that has the highest prevalence of overweight and the table shows that in almost three quarters of the countries (33/42) it is the urban non-poor and in only 3 is it the rural areas.

In Table 3 we present the logistic regression coefficients for two models, one of underweight and one of overweight. In both regressions, the urban poor was the omitted category for a variable indicating residence/wealth and therefore the odds ratios presented are as compared to the urban poor for both rural and for the urban non-poor.

The first analytic column of Table 3 presents the odds of being underweight for rural young women compared to the urban poor. At the top of the column we have the overall effect size as estimated by a meta-analysis of the odds ratios. The meta-analysis estimate indicates that young women living in rural areas across the countries we examine have lower odds of being underweight than their poor urban counterparts (OR=0.90). This estimate is significantly less than one. In 24 of the forty-two countries the logistic regression estimate is less than one and three of the four estimates (Benin,

Tanzania and Columbia) that are statistically significant are below one. The estimate for Senegal is statistically higher from one. The I^2 statistic, which is a measure of heterogeneity across the studies in a meta analysis indicates a low to moderate level of heterogeneity[15].

An analogous set of results are in the second analytic column of Table 3, that refer to differences between the urban non-poor and the urban poor (reference group). The estimate of the overall effect size from the meta-analysis is 0.81 and significantly less than one. This indicates that young urban women from non-poor households have lower odds than their poor counterparts to be underweight. Twenty-seven of the individual country estimates are less than one, and all of the individual country estimates that are significantly different from one (13) are less than one. The I^2 statistic suggests a moderate level of heterogeneity across the studies.

Turning to the third analytic column of Table 3, the overall estimate of the effect size for the comparison of rural to urban poor young with respect to overweight indicates that young rural women have lower odds of being overweight than young urban women from poor households (OR=0.84). Twenty-four of the thirty-eight estimates are below 1 and all of the estimates that are statistically significant (8) are less than one. The I^2 estimate indicates a moderate level of heterogeneity across studies.

Finally, the fourth analytic column of Table 3 shows that young women from non-poor households have higher odds than their poor counterparts to be overweight (OR=1.52). Thirty of the thirty-eight estimates are greater than one; all 13 estimates that are statistically significant are over one. There is, however, a moderate to high amount of heterogeneity in the estimate.

DISCUSSION

Overall, we found that young poor urban women are more likely than young rural women to be underweight. In just under half of the LMICs we examined the highest levels of underweight are found among the young urban women from poor households and outside Sub-Saharan Africa this was the dominant pattern. Young urban women from poor households are also more likely than *rural* women to be overweight. It is in this group that a double burden of malnutrition exists and where the urban penalty appears greatest.

Nevertheless, the highest levels of overweight exist among the adolescent and young adult women who are urban and from non-poor households. The concentration of overweight among the poor that is found in high income countries is not yet apparent in LMICs from our analysis. Rather, in the LMICs we studied, overweight remains a disease of affluence, according to our results.

Our study had several limitations worth noting. There are many countries in the world that did not conduct a DHS survey since 2000. In addition, any analysis like ours that is comparative, by necessity is not sufficiently detailed to uncover mechanisms underlying the associations we document. Finally, we use the same indicator of wealth across rural and urban areas which may not be appropriate because some of the items (e.g. livestock) that are indicative of wealth in rural areas may be less indicative in urban areas. Nevertheless our analysis is externally generalizable and, in contrast to other

meta-analyses, uses estimates for input that was based on identical survey and measurement procedures.

Our findings do not support the idea that young women from rural areas are experiencing high levels of overweight, although there are relatively high levels in some countries. Policies and programs designed to combat traditional under nutrition appear to still be appropriate for young rural women. The group most in need of policy and programs regarding the dual burden of malnutrition is the urban poor. The high prevalence of overweight among the urban poor, relative to rural areas suggests that this group might find themselves at the highest risk of NCD in the future and that wide health inequalities in NCD may emerge, with the urban poor suffering most.

The fact that the group we found most likely to experience the double burden of malnutrition is the group that is growing fastest this is especially concerning. Overweight alone, in the countries we looked at, remains a disease of the affluent and it is to this group that policy and programs designed to combat overweight alone should be directed.

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Table 1. Number of Women 15 to 24 and the percent who are rural, urban poor and urban non-poor in 42 DHS countries.

	Total N	Rural %	Urban Non-Poor %	Urban Poor %
Sub-Saharan Africa				
Benin	6248	54.8	35.9	9.3
Burkina Faso	5050	73.3	26.2	0.5
Burundi	4191	88.3	11.0	0.8
Cameroon	4936	41.5	44.9	13.5
Chad	2432	76.3	21.8	1.9
Congo (Brazzaville)	3060	42.2	41.4	16.4
Congo Democratic Republic	4304	52.1	38.5	9.4
Ethiopia	6940	73.0	26.3	0.8
Ghana	1902	49.9	38.0	12.1
Guinea	2800	60.9	36.6	2.5
Kenya	3475	75.0	24.2	0.7
Lesotho	3337	69.9	28.0	2.1
Liberia	2675	51.1	40.5	8.4
Madagascar	6776	81.8	17.2	1.0
Malawi	9559	80.4	17.3	2.3
Mali	5781	61.4	35.7	2.9
Morocco	6306	42.0	40.2	17.8
Mozambique	4910	57.3	37.0	5.7
Namibia	4101	55.1	37.0	7.9
Niger	3369	77.0	22.5	0.6
Nigeria	12626	64.1	28.8	7.1
Rwanda	5628	83.9	13.5	2.6
Sao Tome and Principe	1014	45.9	32.2	22.0
Senegal	6648	50.2	36.7	13.2
Sierra Leone	2384	55.5	39.7	4.8
Swaziland	2320	76.6	19.8	3.6
Tanzania	4081	68.8	28.7	2.5
Uganda	3646	80.3	18.5	1.2
Zambia	2944	54.1	43.7	2.2
Zimbabwe	3786	60.1	36.2	3.7
Latin America				
Bolivia	6256	31.9	46.4	21.7
Columbia	20563	22.2	39.2	38.6
Guyana	1783	71.2	19.7	9.1
Haiti	4704	50.2	43.0	6.8
Honduras	8239	46.1	39.9	14.0
Asia				
Cambodia	6889	76.9	21.3	1.8
India	47590	68.6	24.4	7.0
Nepal	5050	86.3	11.9	1.8
Timor-Leste	5487	73.5	22.2	4.3
Other				
Albania	2454	59.0	33.0	8.0
Azerbaijian	2875	44.7	39.0	16.3
Moldova	2541	56.8	37.1	6.2

Table 2. Prevalence of Underweight and Overweight by Wealth and Urbanicity in 42 DHS Countries.						
Country	**Underweight**			**Overweight**		
	Rural	**Urban Non-Poor**	**Urban Poor**	**Rural**	**Urban Non-Poor**	**Urban Poor**
	%	%	%	%	%	%
Sub-Saharan Africa						
Benin	11.6	9.5	20.9	5.2	15.8	3.8
Burkina Faso	22.3	9.5	19.9	2.6	12.6	0.0
Burundi[1]	16.9	11.5	11.2	4.7	17.6	7.3
Cameroon	9.0	6.8	12.6	13.7	26.9	16.9
Chad[1]	28.5	24.1	14.0	2.8	9.6	5.7
Congo (Brazzaville)	16.8	17.9	19.9	9.6	16.7	9.0
Congo Democratic Republic	21.7	21.0	28.5	4.8	9.8	2.2
Ethiopia	32.1	21.3	51.7	1.9	7.5	0.0
Ghana	15.2	8.4	13.6	8.4	20.6	12.0
Guinea	17.4	16.8	15.8	3.6	11.9	0.0
Kenya	16.0	13.2	16.7	9.6	18.9	18.5
Lesotho[1]	10.6	3.2	11.8	25.7	29.9	24.6
Liberia	15.3	12.9	14.6	8.0	12.9	11.2
Madagascar [1]	26.7	23.4	40.1	1.7	4.2	4.7
Malawi	12.6	9.5	12.2	7.8	13.5	7.3
Mali	21.1	14.1	23.2	4.7	14.6	3.7
Morocco	10.9	13.6	13.4	14.1	16.8	14.6
Mozambique	12.8	8.0	7.8	4.5	15.1	6.3
Namibia	26.9	23.1	21.4	6.8	17.8	11.8
Niger[2]	27.1	22.5		2.7	11.8	
Nigeria	17.0	13.7	16.0	8.7	14.7	7.6
Rwanda	8.7	6.3	10.7	13.8	16.4	9.3
Sao Tome and Principe	8.2	17.3	14.2	17.0	15.7	15.0
Senegal	35.6	27.9	27.9	5.2	15.6	9.8
Sierra Leone	15.6	13.6	7.6	14.9	31.9	21.7
Swaziland	5.1	6.4	2.2	29.7	34.9	33.3
Tanzania	14.5	11.4	21.3	8.4	21.6	15.2
Uganda[1]	13.8	8.8	16.5	10.2	20.3	19.7
Zambia	13.4	10.4	11.9	6.1	14.7	8.3
Zimbabwe	12.5	7.9	7.6	11.5	23.2	25.1
Latin America						
Bolivia	2.2	5.9	2.7	29.7	27.1	30.4
Columbia	12.8	13.2	15.8	20.2	20.0	19.4
Guyana	22.0	15.9	27.3	23.7	27.6	25.9
Haiti	21.2	16.1	19.4	7.2	15.3	6.7
Honduras	6.5	7.6	8.3	24.3	31.1	28.1
Asia						
Cambodia	24.3	28.3	17.8	1.7	4.1	6.7
India	46.2	36.4	48.5	2.3	8.9	3.0
Nepal	22.1	22.6	23.5	4.6	9.5	3.7
Timor-Leste	32.4	32.1	32.7	1.4	3.0	0.8
Other						
Albania	6.7	9.7	8.6	11.1	8.9	17.5
Azerbaijian	9.3	11.4	12.9	13.1	14.6	16.3
Moldova	12.1	15.1	14.9	12.8	11.1	12.7

[1] The number of the urban poor in these countries is < 45

[2] The number of the urban poor in these countries is < 25.

Table 3. Odds Ratios for Underweight and Overweight on Urbanicity and Wealth Interaction, 42 DHS Countries				
	Underweight		Overweight	
	Rural vs. Urban Poor	Urban Non-poor vs. Urban Poor	Rural vs. Urban Poor	Urban Non-poor vs. Urban Poor
	odds ratio	odds ratio	odds ratio	odds ratio
Overall Effect Size from Meta Analysis	0.90 *	0.81 *	0.84 *	1.52 *
I² (measure of heterogeneity)	39.6%	63.2%	42.1%	79.9%
Country				
Sub-Saharan Africa				
Benin	0.50 *	0.39 *	1.38	4.77 *
Burkina Faso [1]	1.15	0.42 *		
Burundi	1.61	1.02	0.62	2.72
Cameroon	0.68	0.51 *	0.78	1.81 *
Chad	2.44	1.95	0.48	1.77
Congo (Brazzaville)	0.81	0.88	1.07	2.04 *
Congo Democratic Republic	0.70	0.67	2.22	4.77 *
Ethiopia [1]	0.44	0.25		
Ghana	1.14	0.58 *	0.67	1.90 *
Guinea [1]	1.13	1.08		
Kenya	0.96	0.76	0.47	1.03
Lesotho	0.88	0.25 *	1.06	1.31
Liberia	1.06	0.86	0.69	1.16
Madagascar	0.55	0.46 *	0.34 *	0.90
Malawi	1.03	0.76	1.08	1.98
Mali	0.88	0.54 *	1.28	4.43 *
Morocco	0.79	1.02	0.95	1.18
Mozambique	1.75	1.03	0.70	2.65 *
Namibia	1.35	1.10	0.55 *	1.62 *
Niger [1]	1.09	0.85		
Nigeria	1.07	0.84	1.17	2.09 *
Rwanda	0.79	0.56	1.57	1.92
Sao Tome and Principe	0.54	1.27	1.16	1.06
Senegal	1.43 *	1.00	0.51 *	1.71 *
Sierra Leone	2.24	1.90	0.63	1.69
Swaziland	2.43	3.04	0.85	1.08
Tanzania	0.63 *	0.47 *	0.51	1.54
Uganda	0.81	0.49	0.47	1.04
Zambia	1.15	0.85	0.72	1.90 *
Zimbabwe	1.73	1.05	0.39 *	0.90
Latin America				
Bolivia	0.80	2.23 *	0.97	0.85
Columbia	0.78 *	0.81 *	1.05	1.04
Guyana	0.75	0.50 *	0.89	1.09
Haiti	1.12	0.80	1.07	2.50 *
Honduras	0.77	0.92	0.82 *	1.16
Asia				
Cambodia	1.49	1.82 *	0.24 *	0.59 *
India	0.91	0.61 *	0.74 *	3.11 *
Nepal	0.92	0.95	1.28	2.78
Timor-Leste	0.99	0.98	1.84	3.87
Other				
Albania	0.76	1.13	0.59 *	0.46 *
Azerbaijian	0.69	0.86	0.77	0.88
Moldova	0.78	1.02	1.01	0.86