Working Paper:

Urbanization and the Nutrition Transition in Cebu, Philippines.

Darren Dahly, MHS

University of North Carolina, Carolina School of Public Health, Department of Nutrition
Carolina Population Center

I would like to acknowledge and thank Drs. Barry Popkin, Linda Adair, and Penny Gordon-Larsen for their comments and assistance in preparing this working paper. I would also like to thank Keri Monda for her helpful comments and edits. I would also like to acknowledge the NSF and the Carolina Population Center for the pre-doctoral traineeship under which I am funded. Last but certainly not least, I would like to thank our collaborators at the Office of Population Studies in Cebu, Philippines. Without their constant hard work the Cebu Longitudinal Health and Nutrition Survey would not be possible.

Abstract –

Given that the nutrition transition is driven by forces such as urbanization, modernization and globalization, one might expect urban environments to be obesigenic. Many comparisons of obesity prevalence in urban and rural areas indicate that urbanites tend to have higher BMIs than their rural counterparts. However, some studies have found differences by gender and age. Furthermore, I might expect that associations between urbanicity and obesity will change as countries develop, as has been the case of socio-economic status (SES) and obesity. Current studies are limited by their cross-sectional nature, and their use of a dichotomous measure of urbanicity. My goal was to use a continuous, scale measure of urbanicity to describe obesity risk in Cebu, Philippines using data from the Cebu Longitudinal Health and Nutrition Survey (CLHNS). I found that in young adult males (mean age 18.72 years; n=1051), both urbanicity and SES were positively associated with risk of over-weight (BMI>25) in 2002 as reflected by multiple logistic regression models that included both urbanicity and SES as independent variables. In a sample of females from the same birth cohort (n=887), there was no apparent relationship between either urbanicity or SES with obesity risk. In a sample of mother's from the CLHNS (n=856) urbanicity and SES were both consistently and positively associated with risk of over-weight in cross-sectional analyses from 1983, 1991, 1994, 1998, and 2002. Furthermore, in 1998 and 2002 a statistical interaction between urbanicity and SES became important. The interaction was inhibitive in that the positive relationship between urbanicity and over-weight risk weakened as SES increased, and vise versa.

Introduction

"Over the last 50 years, the world has witnessed a dramatic growth of its urban population. The speed and the scale of this growth, especially concentrated in the less developed regions, continue to pose formidable challenges to the individual countries as well as to the world community. Monitoring these developments and creating sustainable urban environments remain crucial issues on the international development agenda." -United Nations Department of Economic and Social Affairs/Population Division [1]

As the last century was demographically characterized by rapid population growth, perhaps the new century will be characterized by rapid urbanization. Although urbanization is often associated with improvements in health (through better sanitation infrastructure, for example), rapid urbanization in the developing world is also presenting a variety of health challenges. One such challenge is the nutrition transition. Urbanization and other processes such as globalization and modernization are clearly driving a nutrition transition that has led to a world-wide obesity epidemic [2, 3], even in countries where under-nutrition is still prevalent [4, 5]. Furthermore, the rate of change in dietary and physical activity behaviors in developing societies seems to be much faster than those previously experienced by today's developed societies [2, 3].

Given the dynamics that drive the nutrition transition, one might expect the urban environment to be an obesigenic one. An urban lifestyle is often associated with jobs that require little activity, limited opportunity for recreational activity, and motorized transportation. Furthermore, urbanites around the world are almost constantly exposed to calorie rich, inexpensive foods and the income to afford them. The world's mass media also focus on urban environments, often exposing urbanites in the developing world to western culture and corporate advertising (much of which is for food and drink). The sum of these exposures contrasts with rural areas where people often engage in physically active jobs, have limited resources, and are isolated from mass media influences.

There is a body of literature aimed at capturing the differential obesity risk posed by urban and rural environments (recent examples include [6-12]). While these studies often find that urbanites are more likely to be obese than their rural counterparts, some studies have found important differences between genders and different age groups [7, 10]. Furthermore, other studies have found that the association between obesity and other CHD risk factors can vary by urban-rural residence [9]. Some studies have also found gender differences in urban and rural environments with respect to how the obesity risk associated with urban environments is mediated by education, physical activity, and nutrition [12].

The few examples given above paint a much more complicated picture than one might at first expect. One might also expect that as countries continue to develop, the association between urban environments and obesity risk will also change. This possibility is illustrated by the changing relationship between socio-economic status (SES) and obesity risk. Just 15 years ago it was fairly clear that obesity was a disease of affluence in developing countries [13]. Today, however, there is increasing evidence that obesity risk is shifting to poorer populations and that this shift seems to occur as national economies develop [14]. Thus, one might also predict that as countries develop, any apparent relationship between urbanicity (the urban nature of an environment) and obesity will also change. For instance, as many countries continue to develop, their rural and urban areas could become more and more similar in ways that may affect obesity risk. In western countries, hypothesized obesigenic influences such as modern appliances, fast food, supermarkets, mechanized transportation, and mass media are easily found in both urban and rural areas.

Clearly more research is needed to characterize the relationship between urbanicity and obesity. Furthermore, research efforts should be ongoing. We must continuously re-visit the question of whether urban environments are more obesigenic than rural ones as countries develop. Current studies are somewhat limited in that they typically tend to be cross-sectional in nature. The use of a dichotomous definition of urbanicity, while expedient and often useful, can also be problematic [15-19].

One major problem with the dichotomy is that there is no universally used definition of "urban" or "rural". Vlahov and Galea [17] illustrate this point nicely, noting that "among 228 countries for which the United Nations has data, about half use administrative definitions of urban (e.g., living in the capital city), 51 use [population] size and density, 39 use functional characteristics (e.g., economic activity), 22 have no definition of urban, and 8 define all (e.g., Singapore) or none (e.g., Polynesian countries) of their population as urban" [17]. This makes cross-country comparisons difficult.

That nations define "urban" differently hints at the underlying problem with the dichotomy; urbanicity is too complex to measure so simply. In the past, urban and rural environments were clearly different, but modern "rural" areas are now experiencing factors traditionally associated with the urban environment and the result is "increased blurring of urban-rural distinctions" [18]. Additionally, patterns of urbanization vary between regions [20], resulting in equally varied settlement types and a great deal of heterogeneity among urban areas across the globe and even within countries [18]. The importance of this heterogeneity is not lost on urban health researchers, many of whom have called intra- and inter-urban health research [15-17, 21]. Unfortunately, if using the dichotomy to detect differences between modern urban and rural environments is challenging, then using it to detect differences within and between urban environments is impossible.

Our goal is to describe obesity risk in Cebu, Philippines using a scale measure of urbanicity instead of a dichotomous one. Here I present three separate but related analyses. The first is a brief illustration of how a scale measure of urbanicity can detect heterogeneity among environments (including changes over time) not captured by the urban-rural dichotomy. The second analysis looks at the cross-sectional (2002) relationship between overweight status and the urbanicity scale while controlling for SES in a birth cohort of young adult Filipinos. The third analysis looks at multiple cross-sectional (1983, 1991, 1994, 1998 and 2002) associations between urbanicity and overweight status while controlling for SES in a cohort of adult Filipino women of varying ages.

Study Design

Data are from the Cebu Longitudinal Health and Nutrition Survey (CLHNS; http://www.cpc.unc.edu/projects/cebu/). The study location, Metro Cebu (population 1.9 million) on the east coast of Cebu Island in the central Philippines, comprises three cities (Cebu City, Mandaue, and Lapu-Lapu), seven municipalities in surrounding peri-urban and rural areas, and a total of 270 administrative units (barangays). Barangays are typically villages in rural areas or neighborhoods in urban areas and average approximately two km^2 in size. The study area is ecologically diverse, with densely populated barangays in the cities, less dense peri-urban areas and rural towns, and more isolated mountain and island rural areas.

In 1983, a single stage cluster sampling procedure was used to randomly select 17 urban and 16 rural barangays (as defined by the Philippine census using a combination of population characteristics and administrative function). The selected barangays were surveyed for pregnant women in late 1982 and early 1983. Any woman giving birth in a selected barangay from May 1, 1983 to April 30, 1984 was then recruited for the study sample. A baseline survey was conducted with 3,327 pregnant women. Subsequent interviews took place immediately after birth and then at two month intervals for the next 24 months. A variety of follow up surveys (including those of study mothers, index children, and subsequent children) were conducted in 1991, 1994, 1998, and 2002. Community level data from 1983 and 2002 are used in analysis one, 2002 cross-sectional data on the index children are used in analysis two, and repeated cross-sectional data from the study's mothers are used in analysis three.

Analysis 1 - Measuring urbanicity

Myself and colleagues have previously developed a scale measure of urbanicity based on demographic and modernization characteristics (box 1) for each study barangay, across all applicable survey years. The reliability and validity of the scale have been established using scale development methodology [22]. The scale has been shown to be an improvement over the traditional urban-rural dichotomy in several ways: it is better able to measure differences in urbanicity between barangays; it is better able to detect changes in urbanicity over time; it allows for more refined analyses of the relationship between the urban environment and human health; and it is a more useful measure of urbanicity in statistical modeling.

Tables 1 and 2 illustrate the scale's ability to capture urban heterogeneity between neighborhoods and over time. Table 1 lists the original 33 neighborhoods in the study, sorted by their urbanicity values in 1983. Also listed are the urbanicity scores in 2002 and the urban-rural assignment by the Filipino census in 1980 and 2000. In the middle range of 1983 urbanicity scores, the census defined urban-rural assignment varies, indicating previously undetected heterogeneity with regards to the scale and its components. Table 2 compares the mean change in urbanicity scores in neighborhoods that the census reclassified in 2002 to those that were not reclassified. The greatest changes in urbanicity scores were seen in neighborhoods that were classified as urban in both the 1980 and 2000 censuses. Cleary the urban-rural dichotomy is not able to detect these changes.

Box 1.

Population size

Population Density

Communications The presence of phone service, mail, newspapers, the internet, cable TV, and cellular phones

Transportation The density of paved roads, and the availability of public transportation

Education The presence of educational institutions, including primary and secondary schools, colleges, and vocational schools

Health The presence of health services, including hospitals, medical clinics, maternal health clinics, family planning clinics, and community health centers

Markets The number of Sari-Sari stores (small, retail shops), and the presence of drug stores, grocery stores, and gas stations

Table 1. Barangay Urbanicity Scores and Census Urban-Rural Classification in 1983 and 2002.

	1983		2002		Comparison	
Barangay ID	Urbanicity Score	1980 Census Urban-Rural Classification	Urbanicity Score	2000 Census Urban-Rural Classification	Change in Score	Change in Classification
A	5	Rural	10	Rural	5	No
B	6	Rural	10	Rural	4	No
C	7	Rural	9	Rural	2	No
D	8	Rural	12	Urban	4	Yes
E	9	Rural	20	Rural	11	No
F	9	Rural	16	Urban	7	Yes
G	10	Rural	19	Urban	9	Yes
H	10	Rural	9	Rural	-1	No
I	11	Rural	24	Urban	13	Yes
J	11	Rural	25	Urban	14	Yes
K	11	Rural	16	Urban	5	Yes
L	12	Rural	17	Rural	5	No
M	17	Urban*	52	Urban	35	No
N	19	Urban*	39	Urban	20	No
O	21	Rural	35	Urban	14	Yes
P	22	Urban*	33	Urban	11	No
Q	23	Urban*	50	Urban	27	No
R	24	Rural**	33	Urban	9	Yes
S	25	Urban	33	Urban	8	No
T	25	Urban	40	Urban	15	No
U	25	Rural**	24	Rural	-1	No
V	26	Urban	48	Urban	22	No
W	27	Rural**	32	Urban	5	Yes
X	28	Urban	41	Urban	13	No
Y	34	Urban	41	Urban	7	No
Z	36	Urban	56	Urban	20	No
AA	38	Urban	53	Urban	15	No
BB	41	Urban	40	Urban	-1	No
CC	42	Urban	58	Urban	16	No
DD	42	Urban	59	Urban	17	No
EE	44	Urban	45	Urban	1	No
FF	45	Urban	51	Urban	6	No
GG	49	Urban	50	Urban	1	No

Note: The highlighted section contains neighborhoods in which the urban-rural dichotomous designation oscillates at the urbanicity scores increase
*Urban neighborhoods at or below the median urbanicity score in 1983
**Rural neighborhoods above the median urbanicity score in 1983

Table 2. Average Changes in Urbanicity Score by Census Definition in 1980 and 2000.

	Census Definition		Urbanicity Score		
	1980	2000	1983	2002	Change in Score
I	Urban	Urban	32.71	46.41	13.70
II	Rural	Urban	14.66	23.56	8.89
III	Rural	Rural	10.57	14.14	3.57

Analysis 2 - 2002 cross-sectional analysis of young adult Filipino males and females from a birth cohort

Our second analysis looks at cross-sectional associations between SES, the urbanicity scale, and body mass index (BMI) in a birth cohort of young adult Filipinos in 2002 (the index children from the CLHNS). Males and females are considered separately. The sample includes only study subjects with complete data for BMI, SES, and urbanicity measured in 2002. Pregnant females were also excluded.

Urbanicity was measured using the previously described scale measure. SES is measured by an index reflecting household assets, income, and education. BMI is calculated as kg/m^2. Over-weight/obese (OW) was defined as BMI>25 because of evidence that the metabolic consequences of obesity are associated with lower BMIs in Asian populations compared to Caucasians [3]. Under-weight (UW) is defined as a BMI<18.5. Normal-weight (NW) is defined as a BMI ≥18.5 and ≤25. Sample characteristics are given in table 3. It is important to note that the number of subjects with a BMI>25 is small (<6%).

Males and females did not differ with respect to mean BMI, age, SES, or urbanicity. The distributions of BMI categories across genders were similar, although males were slightly less likely to be under-weight (table 3).

Table 3. Characteristics of young adult Filipinos from the CLHNS in 2002.

		Males	Females
n		1051	887
Mean BMI (sd)		20.13 (2.73)	20.00 (2.74)
BMI category*			
% under-weight	BMI<18	25.12	30.44
% normal-weight	BMI 18-25	69.55	63.70
% over-weight	BMI >25	5.33	5.86
Mean age in years (sd)		18.72 (0.33)	18.71 (0.34)
Mean urbanicity score (sd)		41.99 (13.95)	42.00 (13.71)
Mean SES index (sd)		5.53 (2.43)	5.57 (2.31)

chi^2 p-value=0.022

UW and NW males and females were evenly distributed across tertiles of urbanicity (table 4; figures 1 and 2). OW males and females were less likely to live in communities falling within the lowest tertile of urbanicity. OW females were most often found in neighborhoods falling within the middle tertile of urbanicity (54%), while OW males were almost evenly distributed between the middle and highest tertiles of urbanicity (41 and 44% respectively). Scatter plots of continuous measures of BMI and urbanicity in the males and females revealed a linear association, with increasing variance in BMI as urbanicity increased. This relationship was stronger in the males (r=0.079, p=0.01) than in the females (r=0.020, p=0.56). The mean urbanicity score in OW males was 48.02 compared to 41.63 in males with a BMI ≤25 (two sided t-test $p<0.00$). The mean urbanicity score in OW females was 44.87 compared to 41.82 in females with a BMI ≤25 (two sided t-test $p=0.12$).

Table 4. Distribution of BMI category across tertiles of urbanicity.

			Urbanicity – Tertiles of the urbanicity scale (range) %		
			Lowest Tertile (7-36)	**Mid tertile (37-51)**	**Highest Tertile (52-60)**
Males (chi^2 p=0.018)					
264	BMI	<18.5	33.33	35.23	31.44
731	BMI	18.5-25	36.11	31.60	32.28
56	BMI	>25	14.29	41.07	44.64
Females (chi^2 p=0.034)					
270	BMI	<18.5	34.04	32.22	33.70
565	BMI	18.5-25	33.45	35.93	30.62
52	BMI	>25	17.31	53.85	28.85

Figure 1. Distribution of BMI category by tertiles of the urbanicity scale (Males)

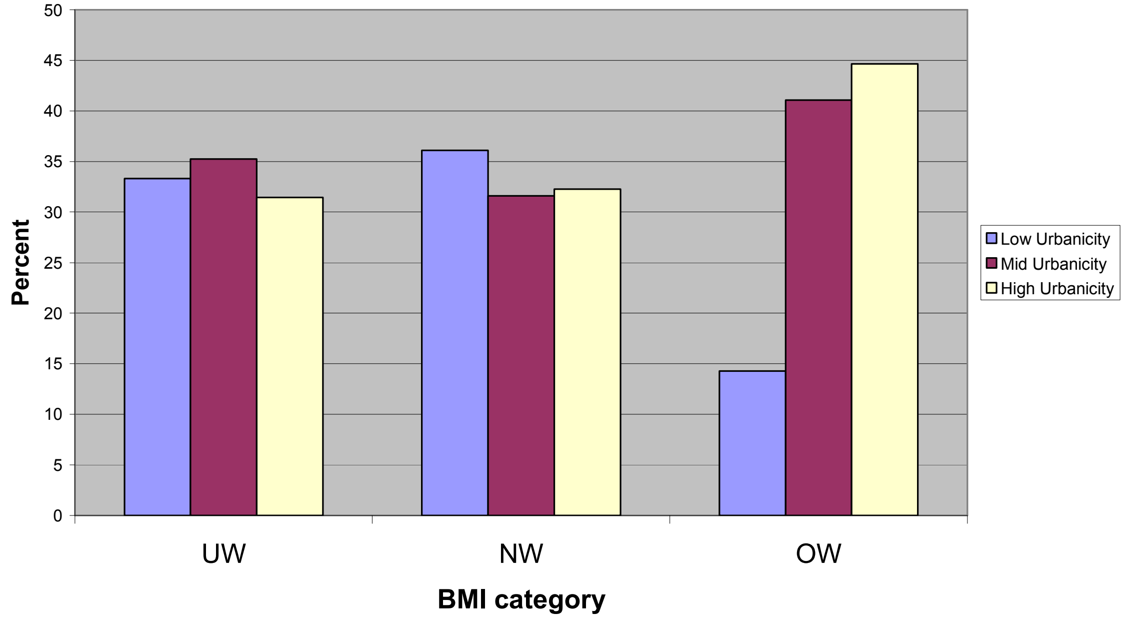


Figure 2. Distribution of BMI category by tertiles of the urbanicity scale (Females)

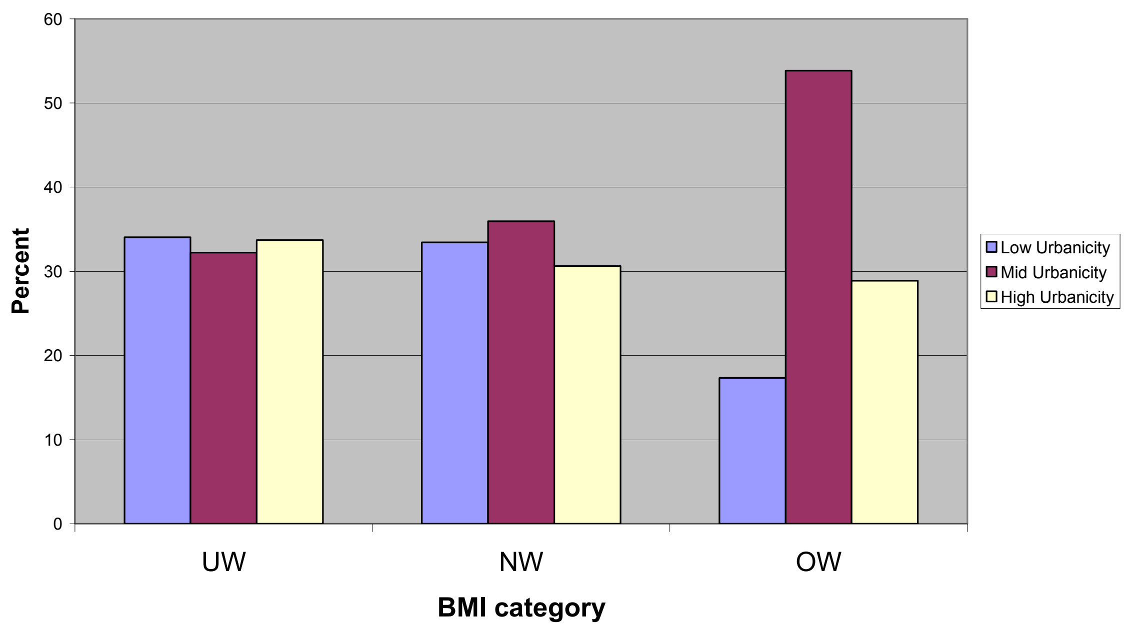
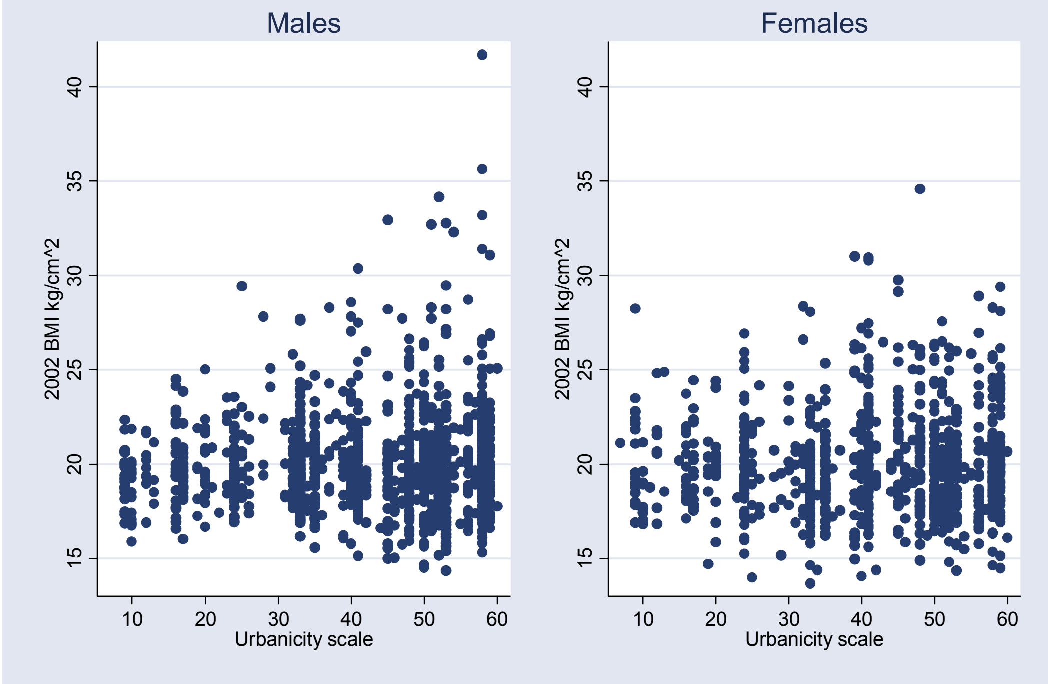


Figure 3. Scatter plots of urbancity and BMI

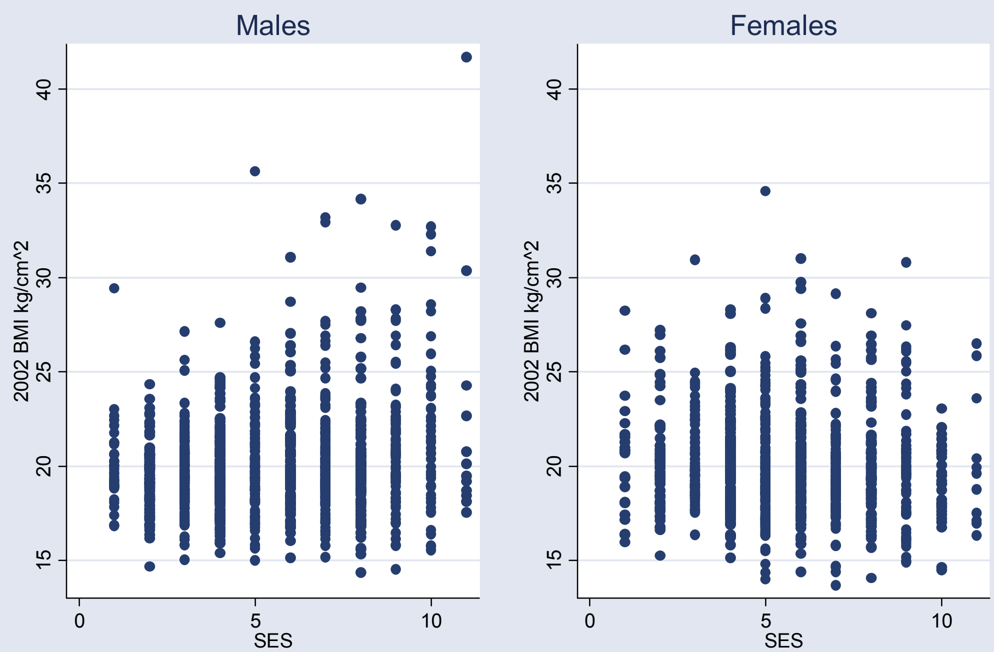


The distribution of BMI categories across tertiles of SES varied considerably between the males and the females (table 5). UW males most often fell within the lowest tertile of SES (43%) and OW males were almost exclusively found in the middle and highest tertiles of SES (41 and 50% respectively). BMI categories among sample females were much more evenly distributed across SES tertiles. Scatter plots of continuous measures of BMI and SES in the males and females (figure 2) further illustrate these differences. There was a linear association between BMI and SES for the males ($r=0.18$, $p<0.01$), and a non-linear distribution of BMI values across SES values in the females.

Table 5. Distribution of BMI category across SES tertiles

			Tertile of the SES index %		
			Lowest Tertile (1-4)	**Mid tertile (5-7)**	**Highest Tertile (8-11)**
Males (chi^2 p=0.000)					
264	BMI	<18.5	42.80	34.85	22.35
731	BMI	18.5-25	38.85	38.99	22.16
56	BMI	>25	9.83	41.07	50.00
Females (chi^2 p=0.370)					
270	BMI	<18.5	31.85	43.33	24.81
565	BMI	18.5-25	36.81	42.28	20.71
52	BMI	>25	28.85	42.31	22.44

Figure 4. Scatter plots of SES and BMI



Next I ran logistic regression models to estimate the relationship between urbanicity, SES and the probability of being OW (compared to a UW+NW referent category). Models were first run using urbanicity and SES in isolation. The results from these models were then compared to a model that included both variables. Product interactions of urbanicity and SES were considered for both males and females, but found to be non-significant and were thus dropped from the models. Including age in the models had no appreciable effect (this is not surprising since this is a birth cohort and variation in age is minimal). Because of the descriptive nature of this analysis I did not include possible mediators (such as physical activity or diet).

Table 6 reports estimated odds ratios from the logistic regression models. In the females, neither SES nor urbanicity were significant predictors of overweight, whether considered individually or in combination. In the males, both urbanicity and SES were predictive of the risk of over-weight compared to normal-weight. These relationships persisted in the combined model which included both SES and urbanicity. In the combined model, a one point increase in the SES index (range 1-11) was associated with a 37% increase in the risk of overweight, while a 10 point increase in urbanicity (range 7-60) was associated with a 36% increase in the risk of being over-weight. It is worth noting again however, that the proportion of over weight individuals in this population was small (<6%).

Table 6. Logistic regression models of the estimated odds ratios (BMI <25 referent) of OW (BMI>25) in young adult (mean age 18.7 years) Filipino males and females associated with a 10 point change in the urbanicity scale and/or a 1 point change in the SES index.

	Urban model	**SES model**	**Combined Model**	
	OR	OR	OR_{urb}	OR_{ses}
	[95% CI]	[95% CI]	[95% CI]	[95% CI]
Males (n=1051)				
OW (BMI>25)	1.504*	1.409*	1.357*	1.374*
	[1.175,1.925]	[1.246, 1.594]	[1.048, 1.756]	[1.211, 1.558]
Females (n=887)				
OW (BMI>25)	1.19	1.068	1.170	1.043
	[0.953, 1.492]	[0.946, 1.205]	[0.928, 1.476]	[0.920, 1.183]

* 95% CI excludes 1.0

Analysis 3 – Repeated cross-sectional analyses of adult Filipino females

While the young adults investigated in analysis two were rarely OW (<6%) the mothers from the study (the subjects of analysis three) have been characterized by rapid increases in obesity prevalences since the study began in 1983 [23]. Furthermore, because this is a sample of mother's from the CLHNS, they are obviously much older than the index children studied in analysis two. This means that one might expect a different relationship between these women and the index children, because they are both older and were experiencing a different stage of their lives while the study area was urbanizing.

Here I focus on a sub-set of women with complete data for age, SES, urbanicity, and BMI for each of the survey years 1983, 1991, 1994, 1998, and 2002. While this restricts our sample size considerably (and increases the importance of taking losses to follow-up into consideration) it allows us to make comparisons across time in the same women. As in analysis two, I ran logistic regression models for each survey year, using OW as an outcome. The women's age was also included in every model. Models were first run using urbanicity and SES in isolation (controlling for age). The results from these models were then compared to a full model that included both urbanicity and SES. I also tested for interactions between age, SES, and urbanicity and included any interactions terms for a given year when the likelihood ratio test had a p value of <0.10. The results from these models are summarized in table 7.

Table 7. Logistic regression models of the estimated odds ratios (BMI <25 referent) of overweight (BMI>25) in adult Filipino females (n=856) associated with a 10 point change in the urbanicity scale and/or a 1 point change in the SES index while controlling for age.

Year	Urban model	SES model	Combined Model		
	OR	OR	OR_{urb}	OR_{ses}	$OR_{interaction}$
(mean age in years)	[95% CI]	[95% CI]	[95% CI]	[95% CI]	[LRT** P-value]
1983	1.829*	1.294*	1.787*	1.219	ns
(26.78)	[1.367, 2.446]	[1.050, 1.593]	[1.329, 2.402]	[0.984, 1.511]	
1991	1.283*	1.262*	1.208*	1.219*	ns
(35.58)	[1.151, 1.431]	[1.161, 1.371]	[1.078, 1.353]	[1.118, 1.328]	
1994	1.291*	1.273*	1.201*	1.229*	ns
(38.54)	[1.149, 1.450]	[1.168, 1.388]	[1.063, 1.358]	[1.123, 1.344]	
1998	1.337*	1.232*	1.568*	1.488*	0.946
(41.95)	[1.197, 1.492]	[1.137, 1.336]	[1.199, 2.051]	[1.127, 1.965]	[0.092]
2002	1.288*	1.257*	1.634*	1.713*	0.923
(45.76)	[1.164, 1.425]	[1.162, 1.360]	[1.270, 2.102]	[1.295, 2.267]	[0.011]

* 95% CI excludes 1.0

Similar to the analysis of young men described earlier, both urbanicity and SES were consistently associated with risk of OW regardless of the cross-sectional year considered. These associations persisted even when both variables were included in the model. The magnitudes of the estimated ORs from the models described in table 7 are also similar to those seen in the young adult males (table 6).

Perhaps the most interesting result from this analysis is the emergence of a statistical interaction between SES and urbanicity in 1998 and 2002. That this interaction term is less than one indicates that higher SES inhibits the positive association between urbanicity and obesity, and vise versa. To further explore this interaction I looked at the 2002 mean, age-adjusted BMI (represented by studentized residuals from a linear regression of BMI on age) across nine groups defined by tertiles of urbanicity and SES (table 8)

Table 8. 2002 mean age-adjusted BMI (represented by studentized residuals from a regression of BMI on age) by tertiles of urbanicity and SES.

	Low Urban (7-35)	Mid-Urban (36-51)	High-Urban (52-60)
Low SES (1-3)	-0.535	0.058	-0.025
Mid-SES (4-5)	-0.399	0.330	0.080
High-SES (6-8)	0.282	0.460	0.268

.

Looking at table 8, higher SES is always associated with higher age-adjusted z-score of BMI within levels of urbanicity. However, higher urbanicity is not always associated with higher BMI within levels of SES, indicating that higher urbanicity, while positively associated with BMI on its own, inhibits the direct association between SES and BMI which results in a net decrease in BMI.

The interaction can also been seen by looking at the OR for increasing urbanicity across levels of SES and vise versa. The 2002 OR for OW associated with a 10 point increase in urbanicity (controlling for age) is: 1.375 (n=425, p<0.001) in the lowest tertile of SES; 1.910 (n=247, p=0.071) in the middle tertile of SES; and 0.907 (n=184, p=0.472) in the highest tertile of SES. The 2002 OR for OW associated with a 1 point increase in SES (controlling for age) is: 1.421 (n=304, p<0.001) in the lowest tertile of urbanicity; 1.153 (n=296, p=0.035) in the middle tertile of urbanicity; and 1.161 (n=256, p=0.041) in the highest tertile of urbanicity.

Conclusions

I have briefly illustrated that a scale measure of urbanicity is able to capture environmental heterogeneity within both urban and rural areas as well as over time. I then used the scale measure of urbanicity to describe obesity risk in three populations from the CLHNS. In 2002, both urbanicity and SES were associated with OW risk in young adult males from a selected sample from of index children from the CLHNS. These associations were not apparent in young females selected from the same birth cohort. In a similar analysis of the selected mother's from the study I found that, like the young adult males, both urbanicity and SES were associated with obesity risk.

In the mothers I also found evidence of a statistical interaction that was absent in the young adults, and that emerged in 1998 and had strengthened by 2002. The nature of the interaction suggests that the positive association between urbanicity and obesity is inhibited by high levels of SES, and vise versa. Thus residents of highly urban areas with high SES had lower age-adjusted BMIs than one would predict given the independent, positive relationships between urbanicity and SES with obesity risk. One explanation for the emergence of this interaction is that as the Philippines has developed economically, the burden of obesity has begun to shift towards to poor. This certainly fits with recent evidence that the obesity burden tend to shift towards the poor as countries develop [14].

1. UN, *World Urbanization Prospects: The 2003 Revision*, in *World Urbanization Prospects*, M.J. Chamie, Editor. 2004, United Nations Department of Economic and Social Affairs/Population Division: New York. p. 1-3.
2. Popkin, B.M. and P. Gordon-Larsen, *The nutrition transition: worldwide obesity dynamics and their determinants.* Int J Obes Relat Metab Disord, 2004. **28 Suppl 3**: p. S2-9.
3. Popkin, B.M., *The nutrition transition: an overview of world patterns of change.* Nutr Rev, 2004. **62**(7 Pt 2): p. S140-3.
4. Prentice, A.M., *The emerging epidemic of obesity in developing countries.* Int J Epidemiol, 2006. **35**(1): p. 93-9.
5. Mendez, M.A., C.A. Monteiro, and B.M. Popkin, *Overweight exceeds underweight among women in most developing countries.* Am J Clin Nutr, 2005. **81**(3): p. 714-21.
6. Belahsen, R., M. Mziwira, and F. Fertat, *Anthropometry of women of childbearing age in Morocco: body composition and prevalence of overweight and obesity.* Public Health Nutr, 2004. **7**(4): p. 523-30.
7. Chung, S.J., et al., *Urban and rural differences in the prevalence of gender and age specific obesity and related health behaviors in Korea.* J Korean Med Sci, 2005. **20**(5): p. 713-20.
8. Sobngwi, E., et al., *Physical activity and its relationship with obesity, hypertension and diabetes in urban and rural Cameroon.* Int J Obes Relat Metab Disord, 2002. **26**(7): p. 1009-16.
9. Venkatramana, P. and P.C. Reddy, *Association of overall and abdominal obesity with coronary heart disease risk factors: comparison between urban and rural Indian men.* Asia Pac J Clin Nutr, 2002. **11**(1): p. 66-71.
10. van der Sande, M.A., et al., *Obesity and undernutrition and cardiovascular risk factors in rural and urban Gambian communities.* Am J Public Health, 2001. **91**(10): p. 1641-4.
11. Abdul-Rahim, H.F., et al., *The metabolic syndrome in the West Bank population: an urban-rural comparison.* Diabetes Care, 2001. **24**(2): p. 275-9.
12. Abdul-Rahim, H.F., et al., *Obesity in a rural and an urban Palestinian West Bank population.* Int J Obes Relat Metab Disord, 2003. **27**(1): p. 140-6.
13. Sobal, J. and A.J. Stunkard, *Socioeconomic status and obesity: a review of the literature.* Psychol Bull, 1989. **105**(2): p. 260-75.
14. Monteiro, C.A., et al., *Socioeconomic status and obesity in adult populations of developing countries: a review.* Bull World Health Organ, 2004. **82**(12): p. 940-6.
15. McDade, T.W. and L.S. Adair, *Defining the "urban" in urbanization and health: a factor analysis approach.* Soc Sci Med, 2001. **53**(1): p. 55-70.
16. Yach, D., C. Mathews, and E. Buch, *Urbanisation and health: methodological difficulties in undertaking epidemiological research in developing countries.* Soc Sci Med, 1990. **31**(4): p. 507-14.
17. Vlahov, D. and S. Galea, *Urbanization, urbanicity, and health.* J Urban Health, 2002. **79**(4 Suppl 1): p. S1-S12.
18. Champion, A.G. and G. Hugo, *New forms of urbanization : beyond the urban-rural dichotomy*. 2004, Aldershot, Hants, England ; Burlington, VT: Ashgate. xxiv, 420.

19. Mendez, M.A., et al., *Measuring Urbanization and its Potential Impact on Health: the China Case.* 2004.
20. Kasarda, J.D. and E.M. Crenshaw, *Third World urbanization: dimensions, theories, and determinants.* Annu Rev Sociol, 1991. **17**: p. 467-501.
21. Wharton, B.A., *Child health in an urbanized world.* Acta Paediatr, 2002. **91**(1): p. 14-5.
22. DeVellis, R.F., *Scale development : theory and applications*. 2nd ed. Applied social research methods series v. 26. 2003, Thousand Oaks, Calif.: SAGE Publications. viii, 171 p.
23. Adair, L.S., *Dramatic rise in overweight and obesity in adult filipino women and risk of hypertension.* Obes Res, 2004. **12**(8): p. 1335-41.