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Community Built Environment and Multilevel Social Determinants of Obesity: Evidence from China Health and Nutrition Survey

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Background, Purpose and Theoretical Framework

Background

- The prevalence of overweight and obesity is highest in wealthy countries like the United States, but is rapidly increasing in less developed countries.
- From 1992 to 2002, China had an increase from 14.6% to 21.8% in overweight and obesity
- Social determinants of obesity in developing countries remain poorly understood
- Further, these associations may vary by community built environment (BE) of developing countries

Methods

2006 China Health and Nutrition Survey
- Multistage, multi-level random cluster survey
- 9,586 adults from 9 provinces and 218 PSUs

2006 China General Social Survey
- Nationally representative
- Income inequality

Multilevel Variables
Dependent: BMI and obesity r
Independent:
- **Level-1: individual level**
  Education, Occupation, Absolute Income, Wealth quintiles, and Relative income
  Age, Sex, Marital status
  Smoking, Alcohol consumption
- **Level-2: community level**
  Mean income, Mean education, Urbanicity index, Gini coefficient, Cross-level interactions
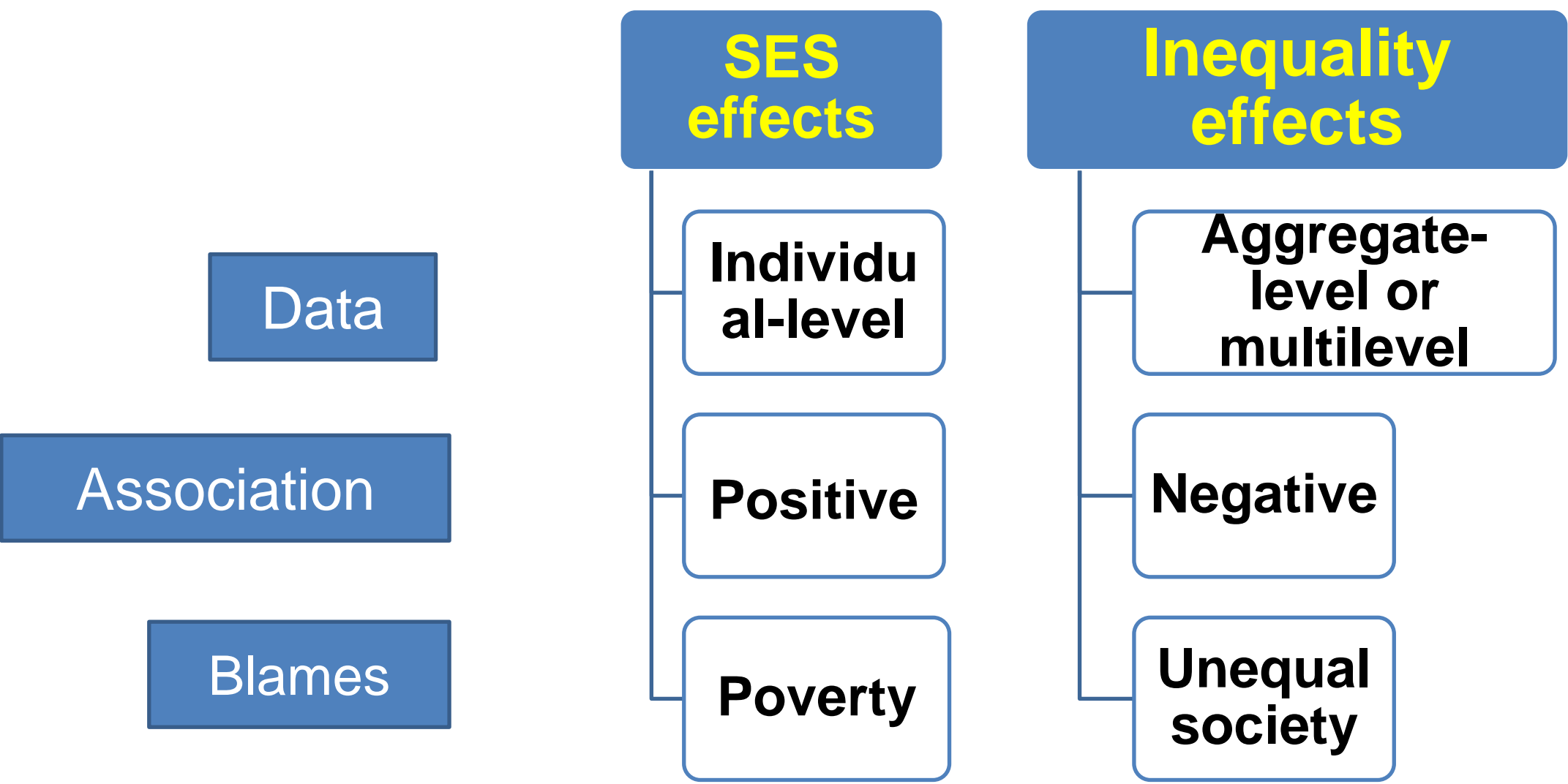
Statistical analysis
- Bivariate associations
- Hierarchical linear regression and multilevel logistic regression models adjusted for age, sex, marital status, urbanity index
- Forward selection and Goodness-of-fit (BIC)
- Stratified analysis by BE contexts. Likelihood ratio test (LRT) for comparison across different community BE contexts

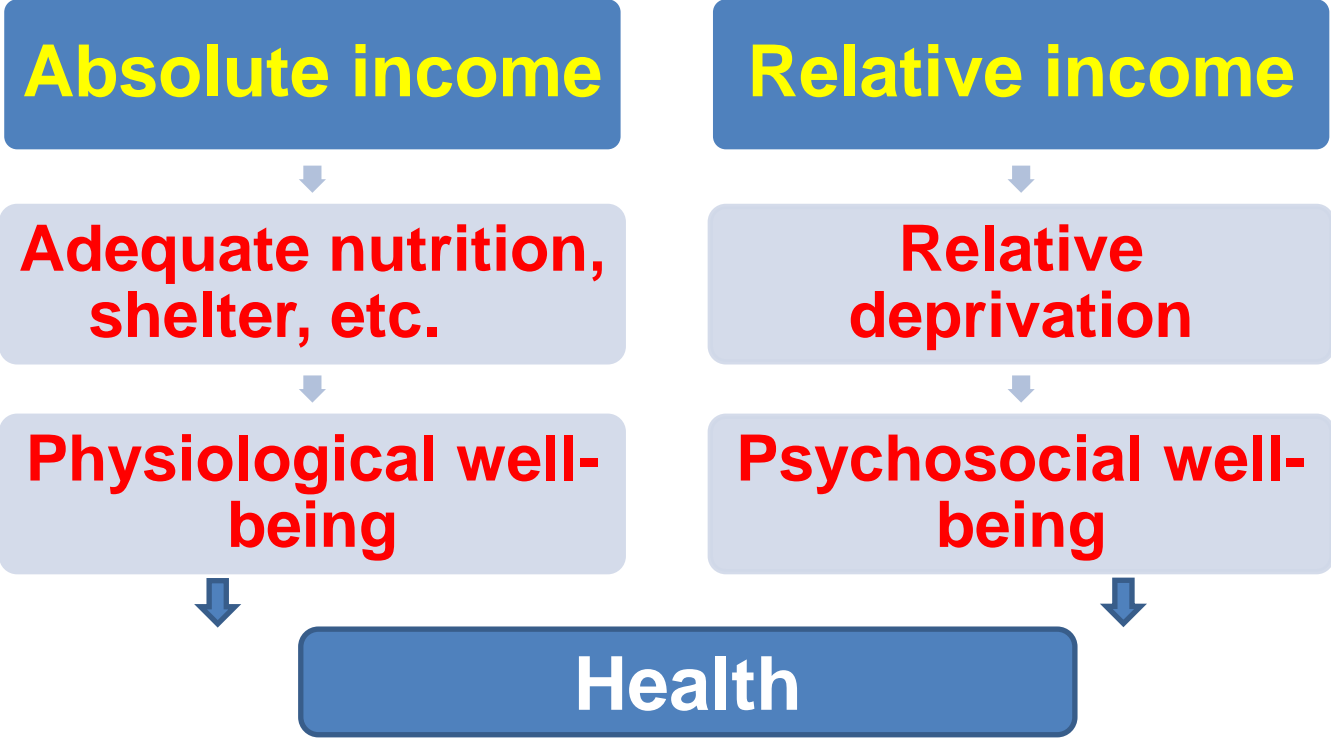|		Local Recreational and Sports Environment	
		Yes	No
Local Fast Food Environment	Yes	Presence-Presence	Presence-Absence
	No	Absence-Presence	Absence-Absence

Purpose
To understand how multilevel social determinants of obesity varied by different types of built environments assessed by the presence/absence of local fast food restaurants and sports facilities.

Mechanisms that SES and inequality affect health

SES effects	Inequality effects
Data	Individual-level	Aggregate-level or multilevel
Association	Positive	Negative
Blames	Poverty	Unequal society

Theoretical framework of social determinants of health

Absolute income	Relative income
Adequate nutrition, shelter, etc.	Relative deprivation
Physiological well-being	Psychosocial well-being
	Health

Characteristics of 2006 CHNS participates

Variables	Mean	SD	Min	Max
Dependent Variable				
BMI	23.35	3.63	15	40
Obesity (Yes=1)	0.26	0.44	0	1
Independent Variables, individual-level				
Female	0.52	0.50	0	1
Age	49.34	15.29	18	97
Marital status (Married=1)	0.83	0.37	0	1
Work Status (Working=1)	0.59	0.49	0	1
Education	7.42	4.43	0	19
Low (0-6)	0.43	0.49	0	1
Intermediate (7-12)	0.51	0.50	0	1
High (12+)	0.07	0.25	0	1
Occupation				
Professional	0.17	0.37	0	1
Manual	0.63	0.48	0	1
Service	0.20	0.40	0	1
Smoking	0.32	0.47	0	1
Alcohol Consumption	0.31	0.46	0	1
Wealth Index	2.32	1.02	0	5.00
1st Qunitile	0.91	0.36	0	1.37
2nd Qunitile	1.67	0.16	1.38	1.93
3rd Qunitile	2.20	0.16	1.93	2.54
4th Qunitile	2.86	0.20	2.54	3.26
5th Qunitile	3.76	0.36	3.26	5.00
Income (in 1000 *yuan*)	11.92	15.28	-6.44	315.61
1st Qunitile	1.68	1.07	-6.44	3.2
2nd Qunitile	4.74	0.89	3.21	6.34
3rd Qunitile	8.29	1.21	6.34	10.57
4th Qunitile	13.55	1.96	10.57	17.33
5th Qunitile	31.35	24.72	17.36	315.61
Deaton's RDI	0.23	0.18	0	1
Independent Variables, community-level				
Mean Income (in 1000 *yuan*)	11.92	7.52	2.58	55.01
Mean Education (in years)	7.43	2.17	2.24	13.64
Urbanicity Index	64.43	20.40	27.22	101.6
Urban Community (Urban=1)	0.31	0.46	0	1
Gini Coefficient * 100	47.30	7.02	38.63	59.61
Jiangsu	0.11	0.32	0	1
Guangxi	0.12	0.33	0	1

Results

Stratified analysis of community BE contexts and obesity

Fixed effects	Overall Model OR	SE	Absence-Absence OR	SE	Absence-Presence OR	SE	Presence-Absence OR	SE	Presence-Presence OR	SE
Level-1 Variables:										
Demographic Control										
Female	1.000	0.051	1.173*	0.083	0.916	0.087	0.74	0.124	0.685*	0.122
Age	1.123***	0.013	1.111***	0.018	1.128***	0.025	1.161***	0.045	1.172***	0.049
Age²	0.999***	<.001	0.999***	<.001	0.999***	<0.001	0.999***	<0.001	0.999***	<0.001
Married	1.217*	0.099	1.344*	0.159	1.274	0.193	0.796	0.194	0.889	0.24
SES										
Education (ref.=0-6)										
Medium Education (7-12)	0.918	0.058	1.029	0.087	0.859	0.104	0.528**	0.118	0.908	0.22
High Education (12+)	0.725*	0.096	0.874	0.193	0.826	0.178	0.155***	0.068	0.763	0.301
Work Status (ref.=not working)	0.948	0.083	1.022	0.132	0.969	0.152	0.872	0.245	0.836	0.22
Occupation (ref.= service)										
Professional	0.815	0.093	0.915	0.162	0.686	0.138	0.986	0.333	0.864	0.273
Manual	0.720***	0.064	0.692**	0.087	0.723*	0.117	0.686	0.218	0.716	0.237
Wealth (ref.=1st Q)										
2nd Qunitile	1.157	0.101	1.078	0.111	1.371	0.252	1.562	0.713	1.329	0.636
3rd Qunitile	1.131	0.101	1.156	0.128	1.108	0.200	1.057	0.467	1.142	0.567
4th Qunitile	1.307**	0.126	1.358*	0.171	1.257	0.240	1.313	0.546	1.815	0.843
5th Qunitile	1.363**	0.143	1.199	0.181	1.343	0.280	1.932	0.789	1.756	0.788
Income (ref.=1st Q)										
2nd Qunitile	1.042	0.097	1.064	0.127	1.086	0.204	1.441	0.529	0.711	0.309
3rd Qunitile	1.249*	0.141	1.173	0.177	1.531	0.351	2.100	0.935	1.316	0.619
4th Qunitile	1.448**	0.2	1.352	0.252	1.469*	0.529	3.807**	2.073	1.003	0.558
5th Qunitile	1.457*	0.269	1.345	0.343	2.467*	0.907	3.123	2.248	0.762	0.548
Relative Income (RDI)	0.702	0.22	0.673	0.299	0.385	0.240	0.263	0.299	1.716	1.895
Level-2 Variables:										
Community Characteristics										
Mean Income (in 1000 yuan)	0.989	0.007	0.979	0.012	0.987	0.012	0.919**	0.027	1.036	0.032
Mean Education (in years)	0.951*	0.023	0.953	0.033	0.970	0.045	1.072	0.068	0.828	0.097
Urbanicity Index	1.008**	0.003	1.24	0.164	1.066	0.179	0.694	0.155	1.062	0.411
Urban (ref.=Rural)	1.077	0.097	1.006	0.004	1.005	0.006	1.012	0.009	1.027	0.015
Gini Coefficient *100	0.932***	0.006	0.918***	0.009	0.939***	0.011	0.944**	0.027	0.934***	0.019
Province Indicator										
Jiangsu	2.493***	0.353	2.908***	0.713	2.077**	0.524	3.232*	1.699	2.908**	1.210
Guangxi	0.496***	0.061	0.539***	0.085	0.449***	0.094	(omitted)		0.751	0.311
Random-effects Parameters										
ICC	0.025	(0.006)	0.017	(0.008)	0.024	(0.011)	0.001	(0.017)	<0.001	(<0.001)
Level-2 Variance	0.085	(0.001)	0.056	(0.003)	0.082	(0.004)	<0.001	(<0.001)	<0.001	(<0.001)
Model Chi-square	476.58		260.86		171.89		81.11		66.00	
Model df	25		25		25		24		25	
-2 LL	10,285.180		5,411.650		2,997.18		915.616		858.091	
LRT	102.646*									
N	9,586		5,222		2,777		791		796	

SES and Obesity (Income, Wealth)

SES and Obesity (Education, Manual occupation)

Gini Coefficient and Obesity

Gini Coefficient by Province
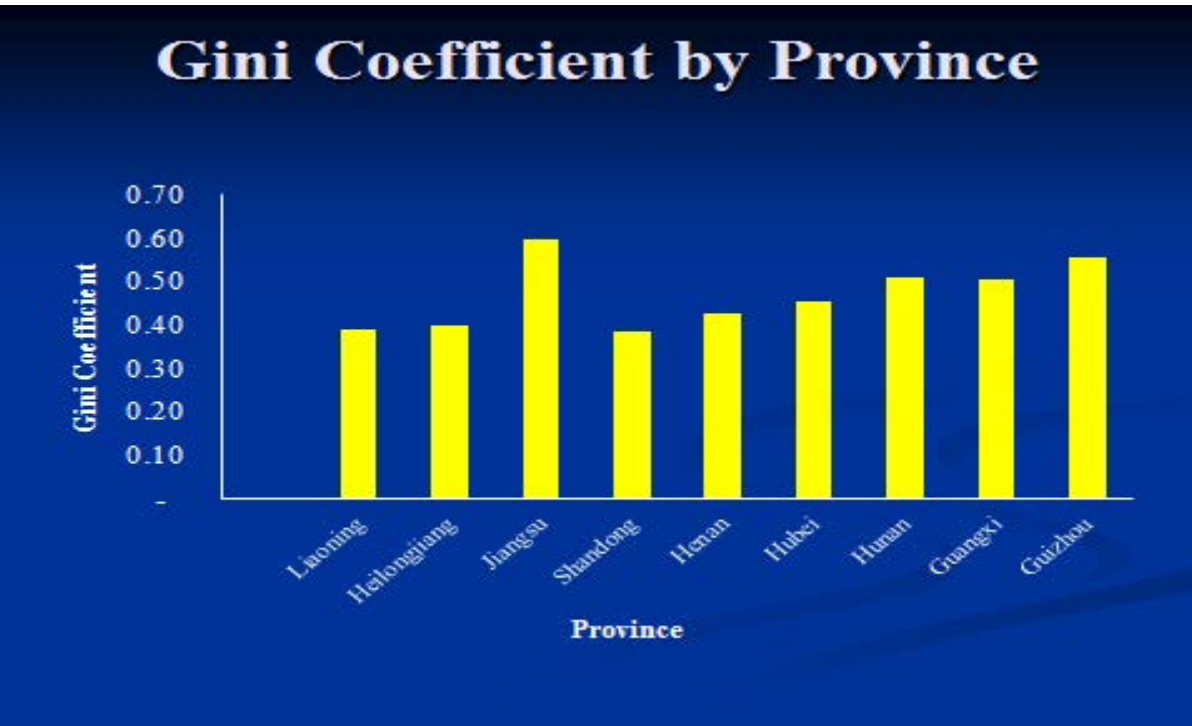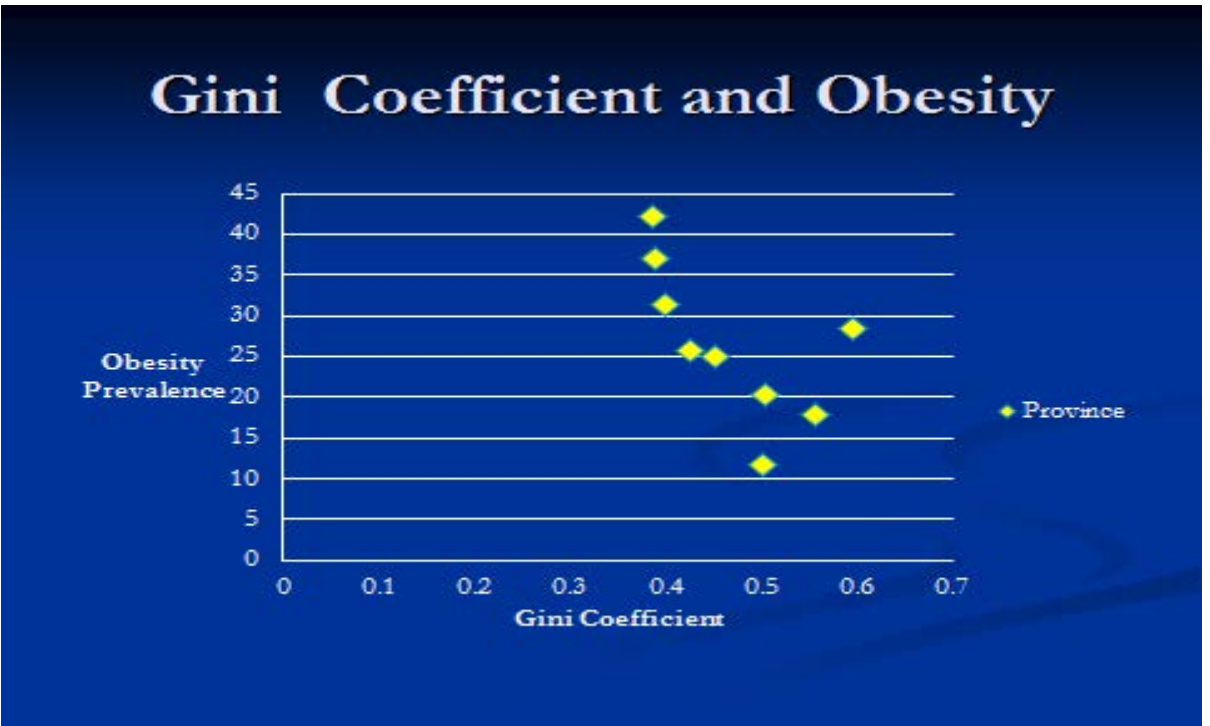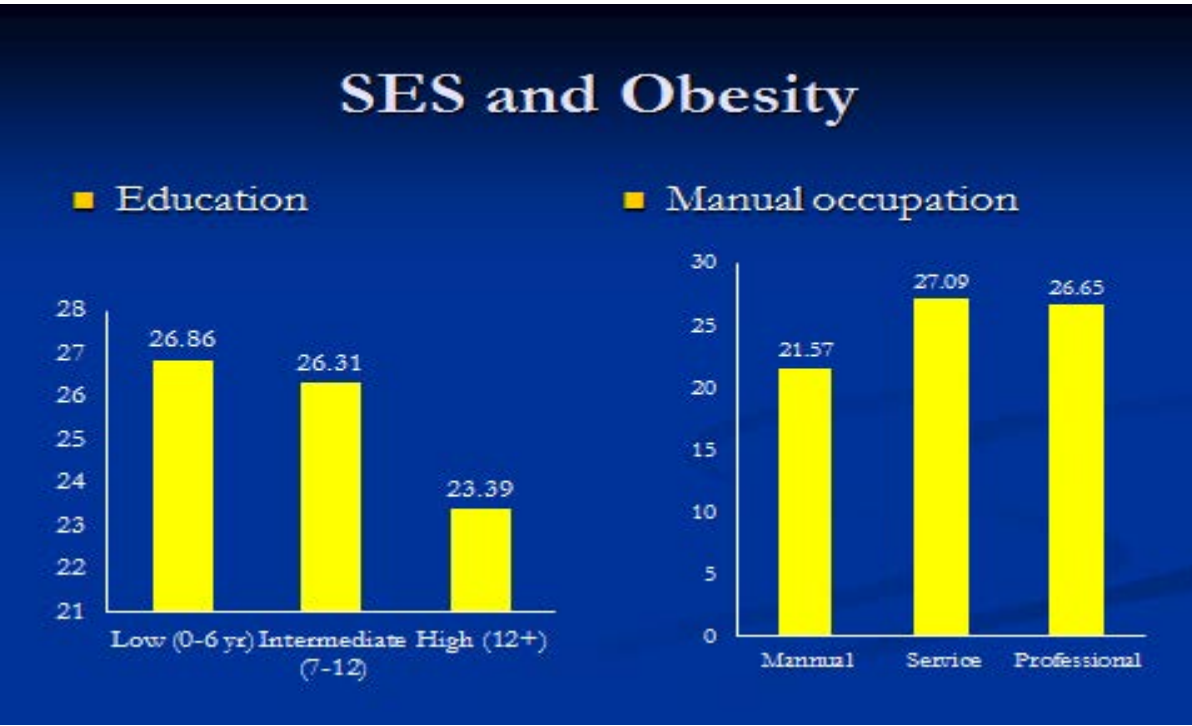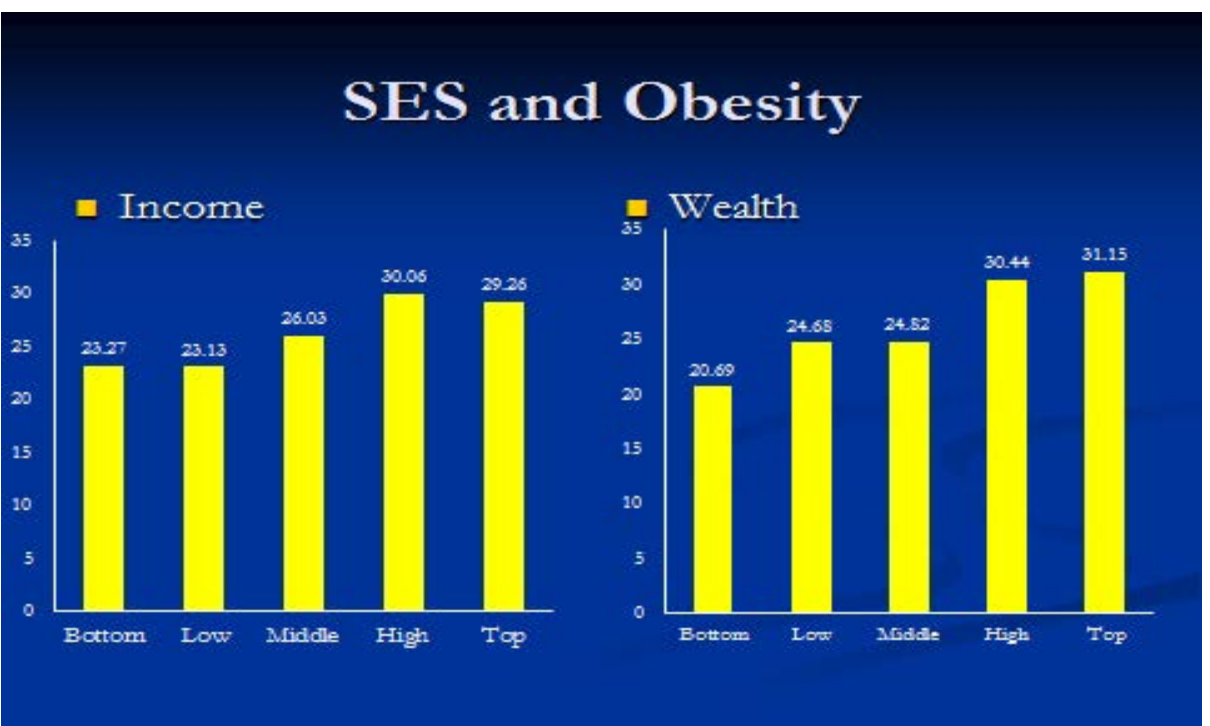
Conclusions

- **Patterns of SES and inequality affecting obesity risks in developing countries can be uniquely different from that in developed societies.**

- **To the best of our knowledge, this is the first study reporting consistently strong negative effects of inequality on obesity, opposite of Wilkinson's income inequality hypothesis of health in developed countries.**