

# Transition to a market economy and C-reactive protein concentrations among rural communities in Hainan Island, China.

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## I. Introduction

Health problems due to urbanization are not only an issue in urban areas of developed countries. Due to improved modes of transportation, people in the most remote areas of the world have access to an “urban” lifestyle. Consequently, rural areas have begun to suffer from an increased prevalence of chronic diseases. Although an increasing number of studies have focused on the health impact of urbanization in China, the situation in rural areas remains unclear. We conducted a study in rural communities of Hainan Island, China, where local residents have experienced a rapid lifestyle change in the last 20 years. We collected dried blood samples and measured C-reactive protein (CRP), a biomarker of future cardiovascular disease (CVD).

### Study Objectives

- [1] To elucidate the association between CRP concentrations and the extent of economic development (indexed as average household income in each community)
- [2] To elucidate the association between CRP concentrations and personal lifestyle parameters after adjusting for the effect of average household income in each community.

## II. Methods

### Research Location

Hainan Island is located south of mainland China (Fig. 1). The population of the province was 8.6 million in 2010, the majority of the population are Han (83%), followed by ethnic minorities such as Li (16%). Hainan province was designated as a Special Economic Zone in 1988 and received large investments from mainland China and overseas.

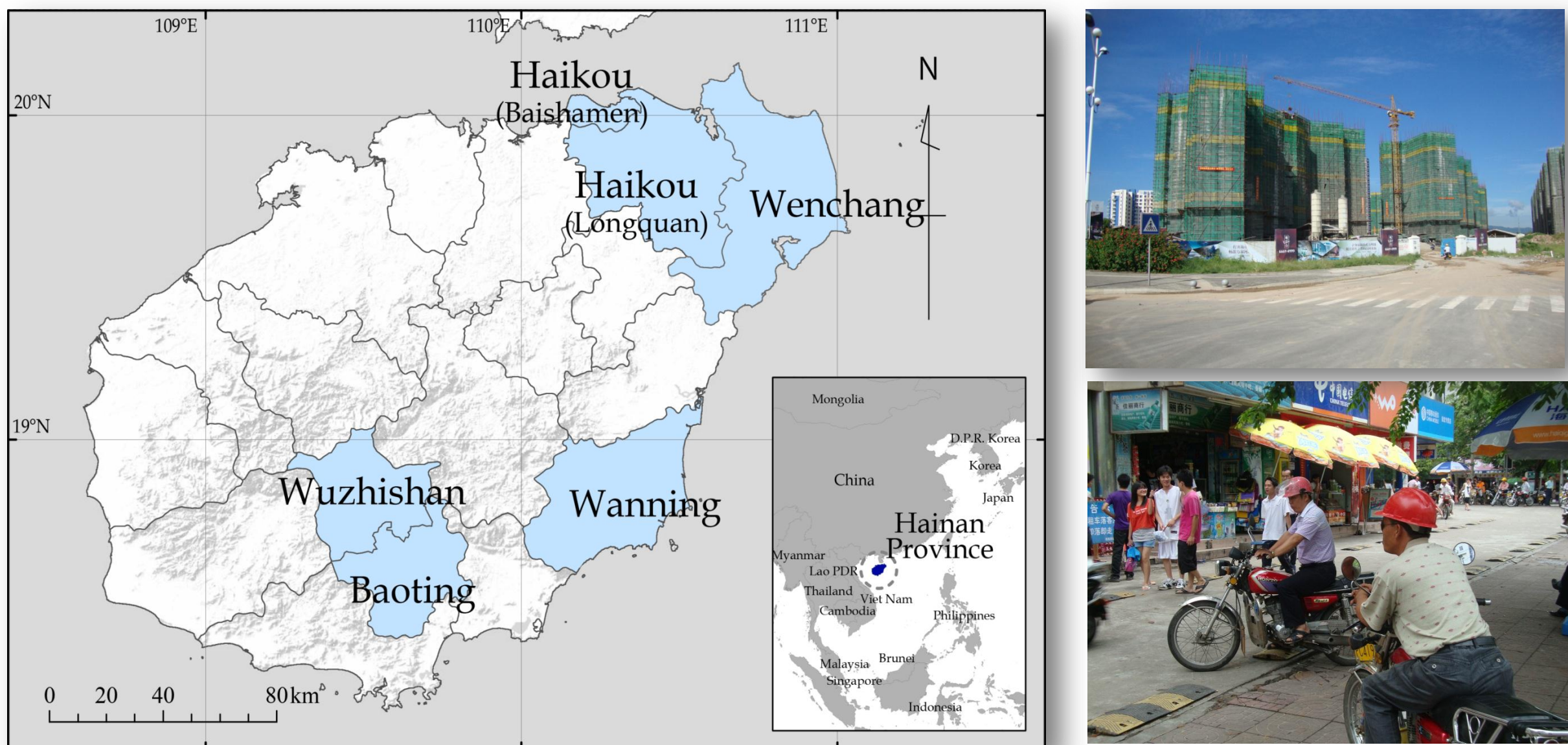


Figure 1. Map of Hainan Island.

Table 1. The numbers of communities and participants.

Baoting	Wuzhishan	Wanning	Haikou Longquan	Wenchang	Haikou Baishamen
No of communities					
3	4	3	3	6	2
No of Participants					
230	367	372	386	389	441

(The participants in Baishamen were not included in the present analysis.)

The study communities were situated in six regions on the island with different degrees of economic development (Baoting, Wuzhishan, Wanning, Wenchang, Longquan, and Baishamen) (Table 1). Communities with different degrees of economic development in each locale were selected following discussions with local authorities.

### Data Collection

A field survey was conducted in November and December 2010. The authors collected dried blood spots (DBS) and administered a questionnaire to residents aged ≥15 years. The field surveys were conducted after obtaining ethical approval (University of Tokyo, No. 3406).

Dependent Variable
CRP — DBS samples (903 Protein Saver Cards, Whatman). CRP > 3mg/L was defined as elevated CRP.
Explanatory Variables
<i>Community level</i> — Average annual household income in each community
<i>Individual level</i>
(1) Age, sex and body mass index (BMI)
(2) Smoking status (do not smoke / smoke)
(3) Weekly alcohol consumption (in mL)
(4) Diet: Weekly consumption (pork and chicken) (0/1; dichotomized at the median)
(5) Migratory work in the last year (yes/no)

We used a two-level random intercept multilevel model with individuals (level 1) nested within community (level 2).

## III. Results

Table 2. Basic characteristics of the study participants.

	Male (N=811)	Female (N=886)
	Mean [SD]	
Age	45.1 [17.5]	46.9 [18.3]
BMI	21.2 [2.9]	20.7 [3.1]
CRP (log mg/L)	-0.3 [0.5]	-0.4 [0.5]
> 3 mg/L (n [%])	135 [16.6%]	117 [13.2%]

### [1] Association between CRP concentrations and the extent of economic development (indexed as average household income in each community)

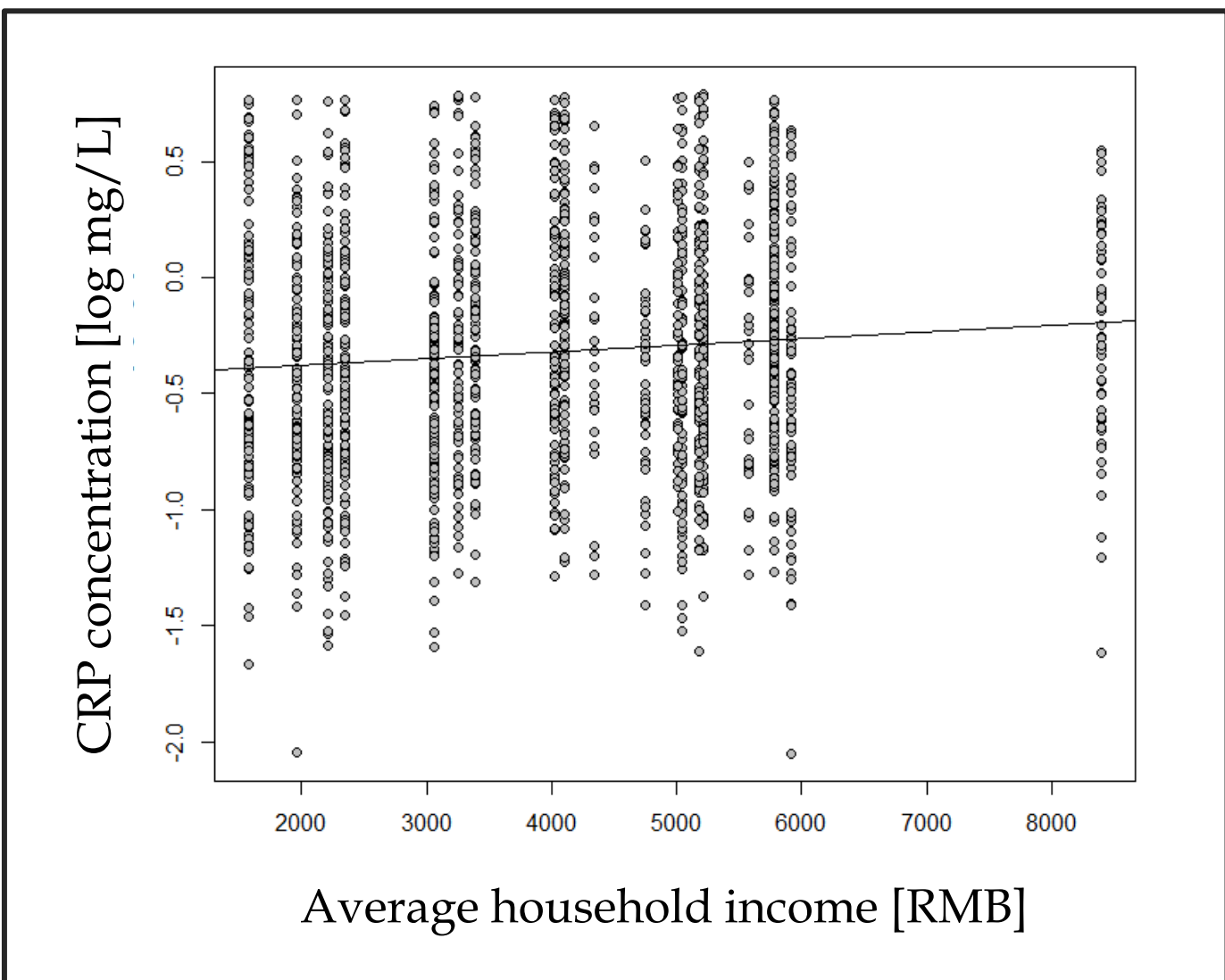


Figure 2. Association of CRP and extent of economic development.

Average income of households in each community ranged from 1579 to 8400 RMB (1 RMB = 0.15 USD as of Nov., 2010). The association of average income with CRP was positive (Pearson  $r = 0.09$ ,  $p < 0.001$ ).

Hainan Average (2009)  
Urban: 13,751 RMB  
Rural: 4,744 RMB

### [2] Association of CRP concentration and personal lifestyle parameters after adjusting for the effect of average household income in each community (Table 3).

Age and BMI were positively associated with CRP. CRP was higher in males. A dietary pattern analysis revealed that consuming chicken was associated with CRP. Rural to urban migration in the last year was also associated with CRP.

The association between CRP and average household income of the communities tended to be positive, although it did not reach statistical significance.

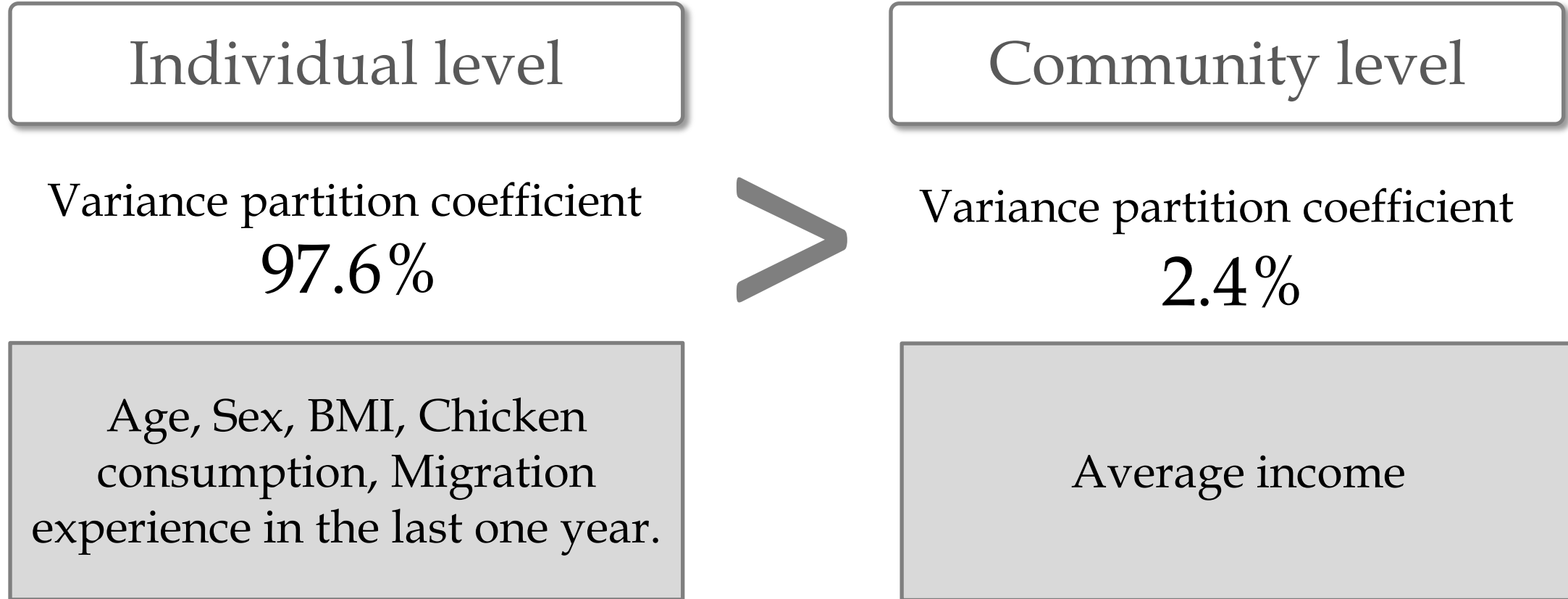
The variance partition coefficient (VPC) at the community level was 2.4%.

Table 3. Results of logistic multilevel models investigating the association of CRP with personal lifestyle characteristics.

	Estimate	p	
Fixed Effect			
Level 1: Individual level			
Age	0.024	< 0.001	***
Sex (ref. female)	2.227	0.041	*
BMI	0.113	< 0.001	***
Smoking (ref. < median)	0.195	0.327	
Alcohol (ref. < median)	-0.048	0.768	
Pork consumption	0.307	0.148	
Chicken consumption	0.520	0.034	*
Migratory work	0.799	0.016	*
BMI × Sex	-0.050	0.273	
Pork consumption × Sex	-0.368	0.207	
Chicken consumption × Sex	-0.587	0.095	.
Migratory work × Sex	-0.313	0.450	
Level 2: Community level			
Average income	0.013	0.059	.
Average income × Sex	-0.015	0.088	.
	Var.	VPC	
Random Effect			
Level 2: $\delta_{\mu 0}$	0.08	2.4 %	
Level 1: $\delta_e$	3.29	97.6 %	

\*\*\*:  $p < 0.001$ ; \*\*:  $p < 0.01$ ; \*:  $p < 0.05$ ; .:  $p < 0.10$

## IV. Summary of Findings



Although the extent of economic development, as indexed by average annual income of households in each community, showed a six-fold difference, the association between CRP concentrations and individual lifestyle was stronger than that at the community-level of economic development. This result suggests that inter-individual variation in lifestyle explains the variation in CRP concentrations better than location of residence.

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