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The China Health and Nutrition Survey, 1989–2011

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Abstract

The China Health and Nutrition Survey (CHNS) began in 1989 with the goal of creating a multilevel method of data collection from individuals and households and their communities to understand how the wide-ranging social and economic changes in China affect a wide array of nutrition and health-related outcomes. Initiated with a partial sample in 1989, the full survey runs from 1991 to 2011, and this issue documents the CHNS history. The CHNS cohort includes new household formation and replacement communities and households; all household members are studied. Furthermore in-depth community data are collected. The sample began with eight provinces and added a ninth, Heilongjiang, in 1997 and three autonomous cities, Beijing, Shanghai, and Chongqing, in 2011. The in-depth community contextual measures have allowed us to create a unique measure of urbanicity that captures major dimensions of modernization across all 288 communities currently in the CHNS sample. The standardized, validated urbanicity measure captures the changes in 12 dimensions: population density; economic activity; traditional markets; modern markets; transportation infrastructure; sanitation; communications; housing; education; diversity; health infrastructure; and social services. Each is based on numerous measures applicable to each dimension. They are used jointly and separately in hundreds of studies.

Keywords

Longitudinal Survey; Urbanicity; China; Nutrition

The Goals of the China Health and Nutrition Survey

China's dramatic economic, demographic, and social transformation continues to unfold. Unique to China is the fact that most of these changes are based on exogenous provincial- and national-level factors that vary in timing and geography, with cohorts experiencing rapid environmental change at different ages. The China Health and Nutrition Survey (CHNS) captures major events from 1991 to 2011, including numerous changes in family planning and welfare schemes;^{1–3} major shifts in population age distribution; work and child care patterns and related gender roles;^{4–7} the introduction of the free market for food; entry into the World Trade Organization (WTO) and concomitant structural changes in tariffs; the increased modernization of the Chinese food system; continued use and greater dissemination of modern technology in manufacturing, transportation, and leisure; housing,

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health system and educational system changes; and new pressures on the labor, environmental, and social systems.⁸⁻¹³ Further dynamics include population aging,¹⁴ continued changes in highly decentralized family planning policies,¹⁵ and health and health care.¹⁶ Rates of poverty have declined significantly,¹⁷⁻²⁴ and the educational, health care, and insurance systems have been revamped repeatedly (e.g., rural village schools were closed, and children moved to town schools) during this period. The social, economic, and health consequences of these changes continue and are captured with the CHNS between 1991 and 2011.

The goal of the CHNS was to develop a multipurpose longitudinal survey that would allow the researchers to understand how social, economic, and demographic changes in China affected health and health behaviors across the life cycle. The CHNS was established as a joint project of the University of North Carolina at Chapel and the Chinese Academy of Preventive Medicine [now the China Center for Disease Control and Prevention (CCDC)]. The National Institute of Nutrition and Food Safety in China was given the lead. Its perspective was multilevel, so we could document at the community, household, and individual levels all the various components representing these factors in depth. A detailed paper describing the cohort is published elsewhere.²⁵ The vision of Madame Chunming Chen, Barry M. Popkin, and two colleagues who no longer work with the CHNS, John S. Akin and Gail Henderson, led to the original agreement that ultimately developed this long-term joint effort with a very large number of scholars from the CCDC and the University of North Carolina at Chapel Hill.

One of the most important and unique features of the CHNS is that from its inception it has been a publicly available dataset that scholars from across the globe can access for free. This was the first large-scale survey dataset created in such a fashion from individual and household data in China. CHNS users number 15,284 and range across social science and public health research communities. Only recently have other surveys in China funded jointly by Chinese and international agencies been made available for free to scholars (e.g., the China Health and Retirement Survey, <http://charls.ccer.edu.cn/en>).

To capture modernization and urbanicity as it has affected each household and individual, we developed a unique measure of the multiple dimensions of social change. It provides in-depth measurement over time and place of the changes in China in 12 dimensions of community social and economic systems and physical infrastructure as related to health and nutritional status and welfare. We use this measure to show the dynamics in China spatially and temporally in the papers presented in this issue.

Who Is in the Sample?

The CHNS was designed as a prospective household-based study that includes multiple ages and cohorts across nine diverse provinces and eight rounds of surveys between 1989 and 2009. The CHNS was designed to provide representation of rural, urban, and suburban areas varying substantially in geography, economic development, public resources, and health indicators with a focus on examining household- and individual-level sociodemographic factors, diet, physical activity, health, and behavior changes relative to community-level urbanicity and social, and economic change²⁵. It is the only large-scale, longitudinal study of its kind in China. The original survey in 1989 used a multistage, random cluster design in eight provinces (Liaoning, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi, and Guizhou) to select a stratified probability sample. Using this sampling strategy, two cities (one large and one small, usually the provincial capital and a lower-income city) and four counties (stratified by income, one high-, one low-, and two middle-income) per province were selected. Within cities, two urban and two suburban communities were randomly

selected. Within counties, one community in the capital city and three rural villages were randomly chosen. Twenty households per community were then randomly selected for participation.

Since 1993 all new households formed by individuals within the sample households were also added to the sample (e.g., children from the original household who themselves later formed families and new households). In 1997 Heilongjiang Province was added, because Liaoning was unable to participate in the CHNS for that wave of data collection (Liaoning was added back in 2000). In addition from 1997 onward new households and communities were added to replace those lost since the previous wave of the survey. In 2011 the three largest municipal cities (Beijing, Shanghai, and Chongqing) were added. By the last survey in 2011 the CHNS included at the primary sampling unit (province/autonomous city) 12 sample units and at the secondary sampling unit (community) 288 communities with 27,447 individuals from 5,884 households, including 60 urban neighborhoods, 60 suburban neighborhoods, 42 towns, and 126 villages. The CHNS cohort initially mirrored national age-gender-education profiles,^{26–28} and by 2011 the provinces included in the CHNS sample constituted 47% of China's population (according to the 2010 census). Given the addition of new provinces/autonomous cities and households, attrition in the CHNS is assessed relative to the 1989 primary sample (60%) and relative to the previous round of data collection (80–88% across all surveys).

The CHNS is a collaborative project between the Carolina Population Center (CPC), University of North Carolina at Chapel Hill, and the National Institute of Nutrition and Food Safety, CCDC. Each CHNS participant has provided a written informed consent, and the study was approved by institutional review boards at the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety. Further information on survey procedures and the rationale of the CHNS is in the cohort profile²⁵ and at <http://www.cpc.unc.edu/projects/china>.

How Frequent Are the Follow-ups?

The CHNS rounds have been completed in 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011. Due to cancellation of travel linked with the SARS outbreak, the CHNS 2003 was moved to 2004. Funding has come from the National Institute of Child Health and Development, one small National Science Foundation (NSF) grant, an institutional development and training grant from the National Institutes of Health (NIH) Fogarty Institute, CPC support for the first wave, and some small foundation support. The CCDC and provincial CDCs have provided strong cofunding support for local field survey costs, including cars, manpower, and per diems in the initial four or five surveys. More recently for CHNS 2009 the China-Japan Friendship Hospital joined as a collaborator handling the biomarker collection and analysis. In 2011 the Chinese National Human Genome Center in Shanghai joined to handle DNA extraction and analysis, and the Beijing Center for Disease Control and Prevention joined to handle toenail preparation and biomarker analysis.

What Has Been Measured?

Essentially all rounds of the CHNS have collected identical data from the community and the household with some adjustments as welfare payment systems changed and new assets emerged as important to demarcate wealth. The CHNS 1989, undertaken as the first survey to collect individual dietary intake data in China, collected dietary, clinical, and anthropometric data from children under age 6 and all adults aged 20 to 45. All subsequent surveys have obtained clinical, dietary, anthropometric, and all other individual data from each household member (table 1).

Capturing Urbanicity and Modernization

The classification of places as either urban or rural is typically based on an absolute threshold of population and/or population density. However, conceptual definitions of urbanicity encompass dimensions beyond population size and density. Multiple important distinguishing characteristics have been described. The crude classification of places as urban or rural coupled with infrequent updates to this information create a measure that is prone to misclassification error. Our goal was to develop a validated multidimensional measure of urbanicity that would capture a number of critical domains that represent modernization and urbanization. Because we used established scaling procedures and a wide array of variables in constructing and testing the scale, it represents an improvement over previous attempts at such a scale and will provide a reliable and valid measurement tool for researchers in this arena.²⁹

We identified 12 components thought to define and distinguish urbanicity that could be operationalized in the CHNS data.

- Population density: total population of the community divided by community area, from official records.
- Economic activity: typical daily wage for ordinary male workers (reported by community officials) and percentage of the population engaged in nonagricultural work.
- Traditional markets: distance to the market in three categories (within the boundaries of the community, within the city but not in this community, or not within the city/village/town) and number of days of operation for eight types of market (including food and fuel markets).
- Modern markets: number of supermarkets, cafés, Internet cafés, indoor restaurants, outdoor fixed and mobile eateries, bakeries, ice cream parlors, fast food restaurants, fruit and vegetable stands, and bars within the community boundaries.
- Transportation infrastructure: most common type of road, distance to bus stop, and distance to train stop. Distance is categorized as within the community, ≤ 1 kilometer from the community, or > 1 kilometer from the community.
- Sanitation: proportion of households with treated water and prevalence of households without excreta present outside the home.
- Communications: availability (within community boundaries) of a cinema, newspaper, postal service, or telephone service; percentage of households with a computer; percentage of households with a television; and percentage of households with a cell phone.
- Housing: average number of days a week that electricity is available to the community, percentage of the community with indoor tap water, percentage of the community with flush toilets, and percentage of the community that cooks with gas.
- Education: average education level among adults > 21 years old.
- Diversity: variation in community education levels and variation in community income levels.
- Health infrastructure: number and type of health facilities in or nearby (≤ 12 kilometers) the community and number of pharmacies in the community.

- Social services: provision of preschool for children under three years old and availability of (offered in community) commercial medical insurance, free medical insurance, and/or insurance for women and children

We explicitly did not include food and other prices, as these are separately measured and, while dependent to some extent on many of the factors in our urbanicity measure, actually provide separate important information for policy analysis.

These 12 components form a scale from 1 to 120 that is time varied, collected and measured at the time of each survey in each of the now 288 communities in the CHNS. As will be shown in the array of analyses presented in this issue, it captures important dimensions of social, economic, and physical change. Also as we have shown in a number of studies published with this measure, it varies over time and space. Some rural areas have actually increased their urbanicity scores more than many urban areas, and some have reduced their scores as factories closed or other changes occurred in the communities.^{29–33} This scale and its documentation and the core publication are available on the CHNS website.

A Means to Capture Major Nutrition-Related Behavioral Change and Health Outcomes

The papers in this special supplement use the CHNS and earlier data to document the dynamic shifts in the Chinese economy. They attempt to highlight some of the myriad ways change in China has been captured in the CHNS to document in one place the enormous economic, social, nutritional, and health changes that have occurred in China.

The paper by Shufa Du and colleagues shows the remarkable transition in overall food consumption in China from a diet dominated by coarse grains and carbohydrates with minimal animal-source foods to one in which refined rice and wheat and animal-source foods have increased significantly and carbohydrates have declined.³⁴ The authors also describe briefly the large decline in physical activity, including occupational and transportation shifts. Finally, they use historical anthropometric data to show the remarkable increase in height and weight from the 1956 survey to the 1992 survey and observe a decline in 1962, right after the Great Leap Forward and the related famine of 1958–61. One important note related to subsequent papers is that obesity was emerging in the 1982–92 period. As we have shown in other studies of 1989–91, much of the increase in overweight began during this period or right before it.^{35, 36}

Bing Zhang et al. introduce the CHNS and provide an in-depth layout of the sampling and the urbanicity index³⁷. This paper explains the broad scope and depth of data collected at the individual, household, and community levels during the two decades of the CHNS to date.

The Fengying Zhai et al. paper on dietary change in China³⁸ focuses on the large shift in nutrient composition and foods consumed and the underlying food behaviors that are linked with these changes. These behaviors include a decrease in the healthy cooking methods of steaming, baking, and boiling and an increase in frying foods, snacking, and eating away from home. The paper ends with a discussion of the emergence of the modern food system with convenience stores and super- and megamarkets, that system's very rapid growth, and expectations of continued rapid expansion. This and the other papers highlight the important effects of urbanicity in China. In the diet area, initially most of the rapid shifts occurred in urban areas, but the food changes and many eating behaviors in rural areas have caught up with urban areas and are following the same pathway of change. By juxtaposing the trends from 1991 to 2011 for the nine provinces with the three autonomous cities (megacities), this paper shows what the future might portend as incomes and urbanicity increase and the modern food system penetrates deeper into China.

The Shu Wen Ng et al. paper³⁹ builds on a number of papers on physical activity trends in China, including several recent publications.^{32, 40, 41} This paper focuses on the four major domains of adult physical activity: occupational, domestic, travel, and active leisure. The authors examine distributional changes using quantile regression for both adult men and adult women. The primary areas of change are in occupational activity for men and both occupational and domestic activity for women. They show that controlling for urbanicity considerably mitigates the decrease in occupational activity for both men and women. Also if the degree of urbanicity stayed constant, women who had lower occupational physical activity levels actually decreased their occupational physical activity more than those who had higher occupational physical activity levels.

The Gordon-Larsen et al. paper⁴² on the overweight dynamics in China provides an important window into the complex ways body composition is changing in that country. Among its key points, this paper highlights the large increase in incident overweight in the past decade, a huge cohort effect that means the younger generation will be much heavier than older generations,⁴³ the interesting weight trajectories of different subpopulations, and the rapid increases in waist circumference (WC). The WC measurements show that individuals across the body mass index spectrum have higher WCs.⁴⁴

Linda Adair et al.'s paper presents a comprehensive examination of the prevalence of cardiometabolic problems across all age groups seven years and older in China from the CHNS 2009 fasting blood analysis.⁴⁵ The paper explores in depth the roles of overweight and abdominal obesity as primary risk factors and shows a doubling or greater of the prevalence rate for hypertension and diabetes, inflammatory and dyslipidemia markers. The authors also examined the associations of diet and physical activity with these outcomes and found that low physical activity in particular was a strong and consistent predictor for risk across nearly all outcomes and age-sex groups.

The final paper by Popkin⁴⁶ addresses some of the ways the research from the CHNS, as the only large-scale longitudinal survey with detailed dietary, activity, smoking, drinking, anthropometry, and blood pressure data, has provided a window into nutrition-related shifts across the globe. In the diet, physical activity, and obesity areas, the survey has been valuable, and his paper provides detailed examples of the contributions of the CHNS work to a broader understanding of patterns and trends across other low- and middle-income countries in addition to China. The survey has been less valuable for understanding other cardiometabolic risk factors but this will change with future surveys that collect fasting blood and begin to provide incidence data.

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Abbreviations

CHNS	China Health and Nutrition Survey
WTO	World Trade Organization

CCDC	China Center for Disease Control and Prevention
CPC	Carolina Population Center
NSF	National Science Foundation
NIH	National Institutes of Health
WC	waist circumference

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Table 1

Key domains of CHNS data

Data Domains	CHNS
Samples	9 provinces
Number of surveys	9 (1989–2011), planning 2014–16 now
Households/individuals (100%)	3,926/14,799 in 1991; 5,884/27,447 in 2011
Detailed household composition/education	All surveys
Marriage history	All surveys
Family planning use/birth history	All surveys
Detailed income/employment by sector of work	All surveys
Assets	All surveys
Inter- and intrageneration transfers	All surveys
Aging, activities of daily living, instrumental activities of daily life	Yes—not all rounds
Detailed health service use/insurance	All surveys
Detailed smoking/drinking	All surveys
Detailed diet (individual/household)	All surveys: 3 days, weighed and measured
Time allocation/physical activity-inactivity	Detailed time/effort for occupational work, home production, transport, leisure, sedentary behavior
Anthropometry (weight/height/Waist Circumference/Skin Folds)	All surveys
Clinical exams with blood pressure data	All surveys
Blood spots	2009
Fasting blood	2009
Toenails	2009
DNA extraction	2009
GPS coordinates	Begin 2009
In-depth contextual data	All surveys