

Spatial Dataset Development of Overweight and Obesity among Middle-Aged and Elderly Adults in China (2011, 2015)

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Abstract: Body Mass Index (BMI) and Waist-to-Height Ratio (WHtR) are crucial parameters for assessing human body weight status and overall health. Drawing on survey data for height, weight, and waist circumference from the China health and retirement longitudinal study (CHARLS) conducted in 2011 and 2015, this study develops a spatial distribution dataset of BMI and WHtR among middle-aged and elderly Chinese populations for those years in 124 prefecture-level cities. The dataset includes regional average values for both BMI and WHtR, alongside the prevalence rates of overweight and obesity. The dataset is archived in .shp and .xlsx formats, and consists of 9 data files with data size of 32.9 MB (compressed into one single file with 21.4 MB). This dataset supported the first author's doctoral thesis in Science.

Keywords: middle-aged and elderly people; Body Mass Index; Waist-to-Height Ratio; spatial distribution; doctoral thesis in Science

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Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: <https://doi.org/10.3974/geodb.2025.12.04.V1>.

1 Introduction

Body Mass Index (BMI) is a universally recognized standard for assessing general obesity and health status^[1]. Since 1995, the World Health Organization (WHO) has recommended BMI cut-off points of 25 kg/m² and 30 kg/m² as diagnostic criteria for overweight and obesity in adults, respectively. However, these criteria were primarily derived from populations in Western countries and are not universally applicable. In 2013, China issued

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the Standard for adult physical fitness assessment, which defined the normal BMI range for healthy Chinese adults as $18.5 \text{ kg/m}^2 \leq \text{BMI} < 24.0 \text{ kg/m}^2$. Under this standard, a BMI below 18.5 kg/m^2 indicates underweight, a BMI between 24.0 kg/m^2 and 27.9 kg/m^2 indicates overweight, and a BMI of 28.0 kg/m^2 or above indicates obesity. Concurrently, the Waist-to-Height Ratio (WHtR) serves as a robust universal indicator of central obesity. The rapid surge in overweight and obesity prevalence has emerged as a major threat to global public health^[2], a crisis particularly pronounced in developing nations^[3]. According to relevant studies, China, as the world's largest developing country, has become the nation with the largest number of overweight and obese individuals globally^[4]. Projections suggest that by 2030, 790 million Chinese adults will be classified as overweight or obese—accounting for approximately 65.3% of the total adult population. Correspondingly, medical costs attributable to these conditions are expected to reach 418 billion CNY, representing about 22% of total annual medical expenditures^[4]. Furthermore, China is undergoing the most rapid population aging process worldwide. According to the United Nations projections, the proportion of China's population aged 60 and older will grow at an annual rate of 2.35% between 2015 and 2055, vastly outpacing the global average of 1.43% for the same period^[5]. Because aging inherently elevates the risk of numerous diseases, the convergence of an aging population with high rates of overweight and obesity will inevitably pose severe challenges to China's public health infrastructure.

Existing research on overweight and obesity among middle-aged and elderly demographics predominantly concentrates on macro-level public health policies, often overlooking the nuanced weight status of populations across different regions. Studies that neglect these spatial disparities risk drawing erroneous conclusions. To more accurately capture the weight status of middle-aged and elderly individuals across various urban regions in China, this study calculated the BMI and WHtR for these populations using data from the CHARLS conducted in 2011 and 2015. Ultimately, this work aims to provide robust empirical data support for future scientific inquiries and the development of targeted public health policies.

2 Metadata of the Dataset

The metadata of the Spatial dataset of overweight and obesity among middle-aged and elderly adults in China (2011, 2015)^[6], including the dataset name, authors, geographic region, year of the dataset, temporal resolution, data format, data size, data files, data publisher, are summarized in Table 1.

3 Methods

3.1 Data Sources

Raw data were sourced from the China health and retirement longitudinal study (CHARLS), a high-quality micro-level dataset comprising data on middle-aged and elderly Chinese households and individuals aged 45 and older. CHARLS was specifically designed to investigate the dynamics of population aging in China and to foster interdisciplinary research on the subject^[8]. The national baseline survey for CHARLS was conducted in 2011, encompassing approximately 17,000 respondents.

Measurement protocols for height, weight, and waist circumference are meticulously documented in the CHARLS physical examination questionnaires for both 2011 and 2015. Height was measured using a stadiometer, with results recorded in centimeters (cm) under the variable “qi002”. Weight was assessed using a standard weighing scale, with results logged in kilograms (kg) under the variable “ql002”. Waist circumference was measured using a flexible measuring tape and documented in centimeters (cm) under the variable “qm002”.

Table 1 Metadata summary of the Spatial dataset of overweight and obesity among middle-aged and elderly adults in China (2011, 2015)

Item	Description
Dataset Name	Spatial dataset of overweight and obesity among middle-aged and elderly adults in China (2011, 2015)
Dataset Short Name	Overweight&ObesityChina2011&2015
Authors	Wang, P. H., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, wangpeihan24@mailsucas.ac.cn Duan, J. Z., University of Chinese Academy of Sciences, djz0715@bistu.edu.cn Li, K. X., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, likx@igsnr.ac.cn Wang, Z. B., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, wangzb@igsnr.ac.cn
Geographical area	124 prefecture-level cities, prefectures and autonomous prefectures in China
Year	2011, 2015
Temporal resolution	Year
Data format	.shp, .xlsx
Data size	32.9 MB
Data files	The average values of BMI, average values of WHtR, as well as the prevalence of overweight and obesity in 124 prefecture-level cities in 2011 and 2015; Statistical data on BMI, WHtR, and the prevalence of overweight and obesity among middle-aged and elderly people in 124 prefecture-level cities in China, etc.
Foundation	National Natural Science Foundation of China (42407621)
Data Publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	(1) <i>Data</i> are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use <i>Data</i> subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute <i>Data</i> subject to written permission from the GCdataPR Editorial Office and the issuance of a <i>Data</i> redistribution license; and (4) If <i>Data</i> are used to compile new datasets, the “ten percent principal” should be followed such that <i>Data</i> records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset ^[7]
Communication and searchable system	DOI, CSTR, Crossref, DCL, CSCD, CNKI, SciEngine, WDS, GEOSS, PubScholar, CKRSC

3.2 Data Preprocessing

Errors and missing values are inevitable artifacts of data collection and compilation. The presence of missing or anomalous values in height, weight, and waist circumference survey data can significantly skew subsequent analyses; therefore, the raw variables were preprocessed to filter out anomalies. First, all missing values were excluded. Subsequently, the interquartile range (IQR) method was employed to identify and exclude outliers. The IQR is calculated as the difference between the third quartile (Q3) and the first quartile (Q1), expressed by the following Equation:

$$IQR=Q3-Q1 \tag{1}$$

Data points falling below $Q1-1.5IQR$ or above $Q3+1.5IQR$ were classified as abnormal values and systematically removed.

3.3 Algorithm

3.3.1 Body Mass Index (BMI) Calculation

Individual BMI was calculated using STATA software (Version 14) via the following Equation:

$$BMI=w/h^2 \tag{2}$$

Where *BMI* is measured in kg/m^2 , *w* is body weight in kilograms (kg), and *h* is height in meters (m). In accordance with the Chinese guidelines for the clinical management of obesity (2024 Edition)^[9] and pertinent directives from the National Health Commission of

China, the weight status of Chinese adults is categorized as follows: BMI <18.5 kg/m² indicates underweight, 18.5≤ BMI <24.0 kg/m² indicates normal weight, 24.0≤BMI<28.0 kg/m² indicates overweight, and BMI ≥28.0 kg/m² indicates obesity.

3.3.2 Waist-to-Height Ratio (WHtR) Calculation

Individual WHtR was similarly computed using STATA software (Version 14) using the Equation:

$$WHtR=y/h \tag{3}$$

Where *WHtR* represents the Waist-to-Height Ratio, *y* is waist circumference (cm), and *h* is height (cm).

3.3.3 Spatial Data Computing

The CHARLS dataset assigns a unique identification number (ID) to each respondent and a unique community identifier (communityID) for their affiliated community or administrative village. Additionally, a “PSU.dta” file provides the geographic mapping between these community identifiers and their corresponding cities.

Leveraging this mapping relationship, respondents were geolocated to their respective prefecture-level cities or autonomous prefectures. Subsequently, the average BMI, average WHtR, and the prevalence rates of overweight and obesity were computed for each jurisdiction. The average BMI and WHtR were calculated as the arithmetic means of the respondents’ metrics within each corresponding city. The prevalence of overweight and obesity was determined by dividing the number of overweight or obese individuals in a given city by the total number of respondents with valid BMI data in that same area. Finally, spatial mapping was conducted using ArcGIS Pro (Version 3.0).

The technical roadmap for dataset development is shown in Figure 1.

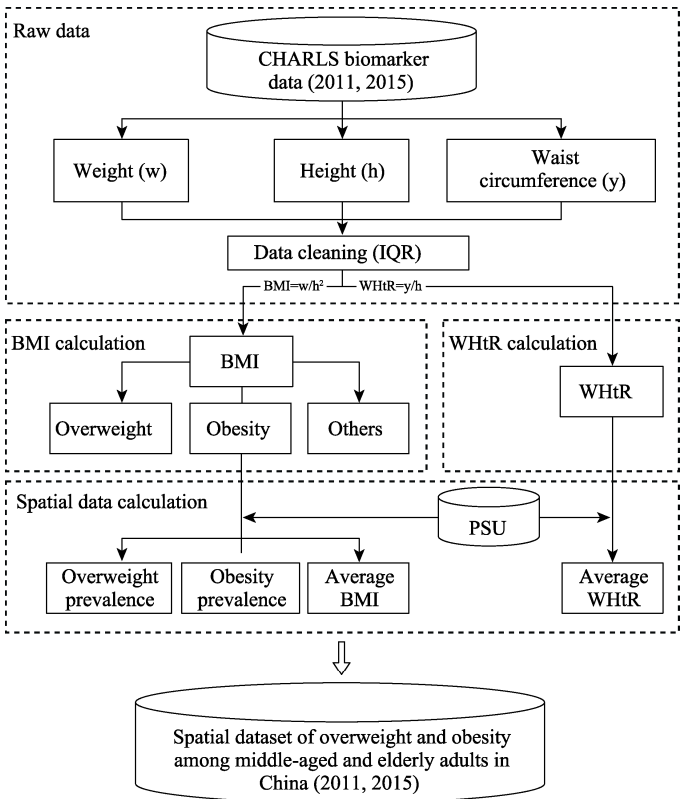


Figure 1 Flowchart of the dataset development

4 Data Results

4.1 Dataset Composition

This dataset comprises BMI and WHtR data for middle-aged and elderly populations across 124 prefecture-level cities and autonomous prefectures in China. It is formatted as spatial polygon data within a “.shp” file, with the specific attribute fields detailed in Table 2.

Table 2 Attribute field table in the dataset

No.	Field name	Example of field content
1	Province	安徽省, 北京市, 福建省 ...
2	Province_e	Anhui, Beijing, Fujian ...
3	City	Anqing City, Bozhou City, Fuyang City...
4	BMI_15	23.576335, 24.31438, 24.881645 ...
5	WHtR_15	0.540555, 0.553583, 0.558989 ...
6	over_15	0.258929, 0.423611, 0.440945 ...
7	obesity_15	0.116071, 0.125, 0.173228 ...
8	BMI_11	22.996226, 23.815128, 23.860671 ...
9	WHtR_11	0.531289, 0.561965, 0.554696 ...
10	over_11	0.265957, 0.327731, 0.321429 ...
11	obesity_11	0.053191, 0.12605, 0.130952 ...

Specifically, “BMI_11” and “BMI_15” denote the average urban BMI values for middle-aged and elderly people in 2011 and 2015, respectively; “WHtR_11” and “WHtR_15” indicate the average urban WHtR values for the same demographic in those years. The fields “over_11” and “over_15” represent the urban prevalence of overweight individuals in 2011 and 2015, while “obesity_11” and “obesity_15” denote the urban

prevalence of obesity for those corresponding years.

4.2 Data Results Analysis

The raw CHARLS data utilized for this dataset originally contained 17,710 samples for 2011 and 21,113 samples for 2015. Following the exclusion of missing data and the filtering of outliers, a final cohort of 13,488 samples for 2011 and 15,989 samples for 2015 was retained for computational analysis. These validated samples span 124 prefecture-level cities and autonomous prefectures across China.

Statistical analyses were performed on the BMI and WHtR data of middle-aged and elderly populations in China based on the results, as presented in Table 3. As shown in the table, the global *Moran’s I* values exhibited a significant increasing trend from 2011 to 2015, indicating that the spatial distribution of overweight and obesity in urban areas showed a gradual tendency of clustering, with regional disparities widening over time. Among these indicators, the mean values of urban BMI and WHtR showed negligible differences, whereas the median prevalence rates of overweight and obesity increased. Specifically, the prevalence of overweight rose markedly from 0.29 to 0.34, while the prevalence of obesity increased slightly from 0.10 to 0.11. These findings suggest that overweight among middle-aged and elderly individuals in China has become increasingly severe, whereas the prevalence of obesity has remained relatively stable.

Calculations of the differences in the prevalence rates of overweight and obesity between 2011 and 2015 (Figure 2) reveal the following findings. In terms of overweight prevalence (Figure 2a), compared with 2011, most cities recorded an increase in overweight prevalence among middle-aged and elderly residents in 2015, with Xuzhou City, Jiangsu Province showing the largest increase of approximately 34.1%. A small number of cities exhibited a decline in overweight prevalence, among which Dezhou City, Shandong Province registered the most pronounced decrease of about 19.7%. Regarding obesity prevalence (Figure 2b), the majority of cities also displayed an upward trend, with the Garzê Tibetan Autonomous Prefecture in Sichuan Province recording the highest increase of roughly 22.6%. Several cities experienced a notable reduction in obesity

prevalence, with Liaocheng City, Shandong Province showing the greatest decline of around 42.3%.

Table 3 Statistical analysis of prefectural-level BMI and WHtR data of middle-aged and elderly people in China

Name	Year	Minimum value	Maximum value	Average value	Standard deviation	Median	Moran'I	P value
Average BMI	2011	20.25	27.42	23.45	1.20	23.43	0.213515	<0.01
	2015	20.57	26.16	23.79	1.06	23.80	0.241040	<0.01
Mean WHtR	2011	0.48	0.61	0.54	0.02	0.54	0.056649	<0.01
	2015	0.51	0.60	0.55	0.02	0.55	0.100135	<0.01
Prevalence of overweight	2011	0.00	0.60	0.30	0.09	0.29	0.106580	<0.01
	2015	0.06	0.57	0.34	0.08	0.34	0.194017	<0.01
Prevalence of obesity	2011	0.00	0.54	0.11	0.08	0.10	0.135871	<0.01
	2015	0.01	0.29	0.12	0.06	0.11	0.213515	<0.01

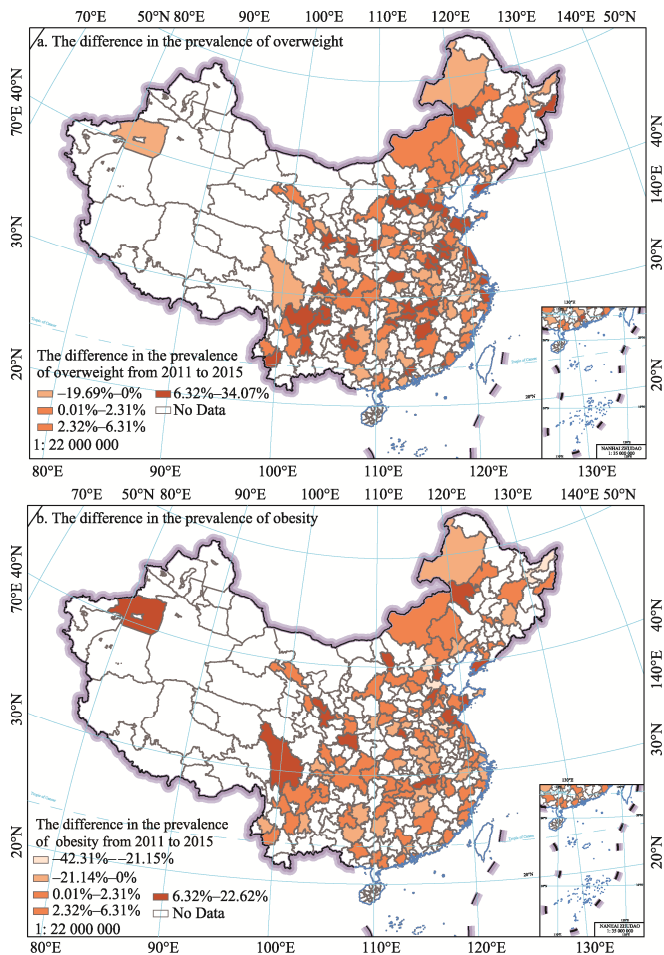


Figure 2 Distribution maps of prevalence differences in overweight and obesity among middle-aged and elderly people in China (2011–2015)

Overall, the general trends of overweight and obesity prevalence among middle-aged and elderly populations in China were consistent between 2011 and 2015. However, inconsistent trends between overweight and obesity prevalence were observed in

individual cities. For instance, cities such as Beijing, Cangzhou, and Luoyang showed an increase in overweight prevalence but a decrease in obesity prevalence during this period. In contrast, regions including Aksu, Lanzhou, and Garzê exhibited the opposite pattern: a decline in overweight prevalence accompanied by a rise in obesity prevalence.

5 Conclusion

An elevated BMI significantly heightens the risk of numerous chronic diseases, influencing the public health and overall quality of life. Understanding the spatial distribution patterns of BMI and WHtR is essential for mapping epidemiological development trends. Such spatial insights offer critical guidance for advancing clinical treatments for overweight and obesity among middle-aged and older populations, as well as for formulating targeted mitigation policies.

Leveraging publicly available survey data, this study calculated and spatially analyzed mean BMI, mean WHtR, and the prevalence of overweight and obesity among middle-aged and elderly demographics across various Chinese regions. This effort culminated in the construction of a comprehensive spatial distribution dataset. Although the dataset does not encompass every municipality in the nation, it successfully captures the broader spatial paradigms of weight status among China's aging population. Given the logistical and financial barriers to conducting comprehensive national census surveys on clinical obesity, this dataset effectively bridges the current spatial data gap, providing a robust empirical foundation for future epidemiological and geographical research on overweight and obesity. This dataset supported the first author's doctoral thesis in Science.

Author Contributions

Wang, P. H. was responsible for data processing and manuscript drafting. Duan, J. Z. assisted in data processing and undertook Chinese-English proofreading. Li, K. X. was in charge of research topic selection and provided methodological guidance. Wang, Z. B. provided overall academic supervision and project guidance.

Conflicts of Interest

The authors declare no conflicts of interest.

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