Letter

Waist Circumference Status and Distribution in Chinese Adults: China Nutrition and Health Surveillance (2015–2017)

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Waist circumference (WC), which is a simple and effective indicator of central obesity, has been proved to be closely related to many chronic diseases, such as hypertension, diabetes, dyslipidemia, cardiovascular, cerebrovascular diseases, and so on[1]. Studies based on investigation conducted in limited regions of China have shown that the level of WC of Chinese adults is increasing by years[2], and the average level of WC may be affected by economic level, residence, diet, physical activity and other factors. The national WC levels and distribution among adults aged 18 or older in China remains unclear.

China Nutrition and Health Surveillance (CNHS) program[3] is a national representative survey collecting data about the nutrition and health status of adults and children in China. This study adopted CNHS 2015–2017, more precisely, the survey of 2015, China Adult Chronic Disease and Nutrition Surveillance (2015), to analysis waist circumference status and distribution in Chinese Adults. A previous study has detailed information concerning the study design, sampling method, and quality control process[3]. After exclusion because of missing information on essential indicators, 145,298 adult participants were included in the analysis. General demographic information and health related behaviors of participants were collected through a structured questionnaire, which was administered by trained investigators through one-on-one interviews. General demographic information included gender, birthdate, residence, region, marital status, education status, household income. Health related behaviors included tobacco use, alcohol consumption and physical activity. Physical activity was measured using the WHO Global Physical Activity Questionnaire (GPAQ), And moderate-vigorous intensity activity was defined as requiring moderate to hard physical effort and causing small to large increases in breathing or heart rate.

Anthropometric measurements included height, weight and waist circumference. Participants were asked to participant in the anthropometric measurements on an empty stomach. All equipment were selected by the CNHS program and all measurements were conducted by trained investigators. WC measurement followed the WHO suggestions, measuring at the midway point between the superior border of the iliac crest and the lowest rib, using a flexible tape of 1.5 meters in length, 1 cm in width, and 0.1 cm in minimum scale. According to the criteria of Weight for Adults promulgated by China in 2013, pre-central obesity was defined as 80 ≤ WC < 85 cm for female and 85 ≤ WC < 90 cm for male, central obesity was defined as WC ≥ 85 cm for female and WC ≥ 90 cm for male.

SAS (version 9.4; SAS Institute) software was used to clean and analyze the data. Categorical variables were described as N (%), and chi-square tests were used for comparison. The Rao-Scott chi-square test based on sampling design correction was used to compare the WC levels in different BMI groups. PROC SURVEYMEANS and PROC SURVEYFREQ were used to calculate the mean WC, WC levels and 95% CI for different BMI groups, respectively. It used the weight derived from the data published by the China National Bureau of Statistics in 2010 and stratified sampling survey to calculate the results. The complex sampling weight was the product of the sampling weight and post-hierarchical weight. The statistical significance of the above studies was defined as bilateral $P < 0.05$.

The general characteristics of the participants are

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shown in Table 1. The current study included sample participants aged 18 years or older from 31 provinces in China, including 67,535 males (46.48%) and 77,763 females (53.52%). The urban population accounts for 42.09%, and the rural population accounts for 57.91%.

Table 1. Characteristics of sample participants stratified by sex among adults in 2015–2017

	Men, *n* (%)*	Women, *n* (%)*	Total, *N* (%)*
N	67,535(46.48)	77,763(53.52)	145,298(100)
Age			
18–	5,713 (8.46)	7,048 (9.06)	12,761 (8.78)
30–	7,867 (11.65)	9,960 (12.81)	17,827 (12.27)
40–	14,791 (21.9)	18,163 (23.36)	32,954 (22.68)
50–	16,494 (24.42)	19,387 (24.93)	35,881 (24.69)
60–	1,5,303 (22.66)	16,315 (20.98)	31,618 (21.76)
≥70	7,367 (10.91)	6,890 (8.86)	14,257 (9.81)
Education level			
Primary school or below	26,502 (39.24)	41,776 (53.72)	68,278 (46.99)
Junior school	35,406 (52.43)	30,103 (38.71)	65,509 (45.09)
High school or above	5,627 (8.33)	5,884 (7.57)	11,511 (7.92)
Marital status			
Unmarried	3,753 (5.56)	2,212 (2.84)	5,965 (4.11)
Married	61,725 (91.4)	70,757 (90.99)	132,482 (91.18)
Divorced/Widowed	2,057 (3.05)	4,794 (6.16)	6,851 (4.72)
Residence			
Urban	2,7551 (40.8)	3,3604 (43.21)	6,1155 (42.09)
Rural	3,9984 (59.2)	4,4159 (56.79)	8,4143 (57.91)
Region of China			
Northern	9,949 (14.73)	11,579 (14.89)	21,528 (14.82)
Northeast	6,913 (10.24)	7,870 (10.12)	14,783 (10.17)
Eastern	18,748 (27.76)	20,944 (26.93)	39,692 (27.32)
Central	8,330 (12.33)	9,906 (12.74)	1,8236 (12.55)
Southwest	8,972 (13.28)	11,021 (14.17)	19,993 (13.76)
Northwest	9,205 (13.63)	9,992 (12.85)	19,197 (13.21)
Southern	5,418 (8.02)	6,451 (8.3)	11,869 (8.17)
Average annual household income			
< 5,000 yuan	15,747 (23.32)	17,611 (22.65)	33,358 (22.96)
5,000–9,999 yuan	15,843 (23.46)	18,439 (23.71)	34,282 (23.59)
10,000–18,999 yuan	18,951 (28.06)	22,186 (28.53)	41,137 (28.31)
≥19,000yuan	16,994 (25.16)	19,527 (25.11)	36,521 (25.14)
BMI (kg/m^2)			
Normal(18.5≤BMI<24)	31,202 (46.2)	35,859 (46.11)	67,061 (46.15)
Low(< 18.5)	2,246 (3.33)	2,913 (3.75)	5,159 (3.55)
Overweight(24≤BMI<28)	24,637 (36.48)	27,098 (34.85)	51,735 (35.61)
Obese(≥28)	9,450 (13.99)	11,893 (15.29)	21,343 (14.69)

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	Men, *n* (%)*	Women, *n* (%)*	Total, *N* (%)*
Smoking			
Non-smoker	23,224 (34.39)	75,003 (96.45)	98,227 (67.60)
Former smoker	34,814 (51.55)	2,118 (2.72)	36,932 (25.42)
Current smoker	9,497 (14.06)	6,42 (0.83)	10,139 (6.98)
Alcohol consumption			
Non-alcohol consumption in latest 12 month	40,418 (59.85)	13,773 (17.71)	54,191 (37.30)
Current alcohol consumption	27,117 (40.15)	63,990 (82.29)	91,107 (62.70)
Physical activity			
MVPA < 150 min/week	8,430 (12.48)	7,569 (9.73)	15,999 (11.01)
MVPA ≥ 150 min/week	59,105 (87.52)	70,194 (90.27)	129,299 (88.99)

Note. BMI, body mass index. *The data outside the brackets are the number of subjects, and the data inside the brackets are the composition ratio (%).

The waist circumference and its distribution of adults are shown in Table 2. The standardized average WC of adults aged 18 years or older in China was 82.21 ± 0.23 cm, of which 84.68 ± 0.27 cm for males , 79.71 ± 0.24 cm for females. The WC of Chinese adults was at a medium level compared with other Asian countries. A study conducted in Japanese population showed an average of 79.0 cm WC[4]. While data from Korea National Health and Nutrition Examination Survey (KNHANES)[5] showed mean WC of Korean aged 65 and above was 86.6 cm for men and 84.0 for women. The figure showed an fluctuating trend compared with former reports. This study shows higher WC compared to the report of CHNS 2002 (83.6 cm for male and 78.6 cm for female), and slightly lower figure than that in CHNS 2010−2012 (86.9 cm for male and 80.7 cm for female)[3]. The results showed that the mean WC of urban residents was 82.57±0.38 cm, and that of rural residents was 81.80 ± 0.28 cm. The average WC of adults in Northern China was higher than that of other regions in both genders (P < 0.01). This phenomenon may be due to the economic level and environmental factors. Northern China is a region with a prominent level of economic development in China. In addition, geography, climate and lifestyle will vary from region to region, which will also have a certain impact[2]. Yet no statistically significant difference in the average WC between the rural (81.80±0.28 cm) and urban(82.57 ± 0.38 cm) residents in this study, which may be related to the rapid development of the economy and the improvement of living standards in rural area. The average WC in 18~ age group was the lowest among all age groups in both sex. And the WC of adults reached its peak in the 50~ age group, which was similar to that in Europe, Central Asia, and high-income regions, but slightly later than that in the Middle East and Southeast Asia regions[6]. The changes in the body's metabolic level, and work intensity and physical activity level may be the reasons for this difference[7]. The WC level of adults was consistent with the growth trend of BMI.

As for health related behavior, the WC of current smokers and current drinkers in the total population was higher than that of other groups. Smoking can cause obesity is the current consensus, but whether drinking will increase obesity is controversial. A cohort study showed that women who drank moderate amounts of alcohol had a lower risk of overweight / obesity than non-drinkers[8]. No significant difference was observed between insufficient and sufficient physical activity groups. This may be related to the different standards of physical activity in various studies.

Table 3 provides the central obesity under different BMI groups. After weighted calculation, abnormal WC not only existed in overweight and obese people, but also in people with BMI < 24 kg/m^2. The proportion of abnormal WC in people with BMI < 24 kg/m^2 was 19.45%, including 18.40% in men and 22.72% in women. This result indicates that the problem of normal weight with central obesity (NWCO) among Chinese adults is gradually emerging. Previous studies have shown that patients with NWCO have more visceral adipose tissue than those with normal weight and non-central obesity (NWNCO), and it has been proven to be positively correlated with an increased risk of various cardiovascular events and metabolic disorders[9].

Table 2. The average waist circumference among adults with different characteristics in China (2015–2017)

	Male			Female			Total		
	Mean	95% *CI*	*P*	Mean	95% *CI*	*P*	Mean	95% *CI*	***P***
Total	84.68	(84.15, 85.21)	–	79.71	(79.25, 80.18)	–	82.21	(81.75, 82.66)	–
Age									
18–	81.48	(80.61, 82.34)	–	75.33	(74.68, 75.98)	–	78.42	(77.73, 79.11)	–
30–	85.48	(84.44, 86.52)	< 0.01	78.29	(77.64, 78.94)	< 0.01	81.93	(81.16, 82.69)	< 0.01
40–	86.58	(86.15, 87.02)	< 0.01	80.87	(80.50, 81.25)	< 0.01	83.76	(83.40, 84.11)	< 0.01
50–	85.75	(85.29, 86.22)	< 0.01	83.22	(82.79, 83.64)	< 0.01	84.50	(84.12, 84.87)	< 0.01
60–	84.95	(84.37, 85.54)	< 0.01	83.65	(83.19, 84.11)	< 0.01	84.31	(83.83, 84.78)	< 0.01
≥70	84.26	(83.51, 85.01)	< 0.01	82.11	(81.30, 82.92)	< 0.01	83.12	(82.45, 83.78)	< 0.01
Education level									
Primary school or below	83.45	(82.95, 83.96)	–	81.83	(81.40, 82.26)	–	82.48	(82.06, 82.90)	–
Junior school	84.96	(84.30, 85.62)	< 0.01	79.04	(78.46, 79.63)	< 0.01	82.37	(81.77, 82.96)	0.69
High school or above	85.76	(84.84, 86.68)	< 0.01	76.10	(75.43, 76.77)	< 0.01	81.07	(80.34, 81.79)	< 0.01
Marital status									
Unmarried	80.98	(79.98, 81.98)	–	73.02	(71.70, 74.33)	–	77.99	(76.93, 79.06)	–
Married	85.37	(84.89, 85.84)	< 0.01	80.34	(79.96, 80.72)	< 0.01	82.81	(82.41, 83.20)	< 0.01
Divorced/Widowed	84.36	(83.10, 85.62)	< 0.01	81.30	(80.50, 82.09)	< 0.01	82.31	(81.57, 83.05)	< 0.01
Residence									
Urban	85.78	(84.89, 86.66)	–	79.31	(78.60, 80.02)	–	82.57	(81.83, 83.32)	–
Rural	83.45	(82.83, 84.06)	< 0.01	80.16	(79.64, 80.68)	0.06	81.80	(81.26, 82.34)	0.10
Region of China									
Northern	87.43	(86.27, 88.59)	–	81.92	(81.17, 82.68)	–	84.71	(83.98, 85.44)	–
Northeast	86.10	(85.09, 87.11)	0.09	80.47	(79.66, 81.29)	0.01	83.31	(82.51, 84.10)	< 0.01
Eastern	85.50	(84.72, 86.29)	< 0.01	79.81	(79.09, 80.53)	< 0.01	82.67	(81.98, 83.36)	< 0.01
Central	83.99	(82.61, 85.37)	< 0.01	79.68	(78.68, 80.68)	< 0.01	81.80	(80.68, 82.93)	< 0.01
Southwest	82.35	(81.63, 83.07)	< 0.01	79.20	(78.46, 79.95)	< 0.01	80.77	(80.15, 81.39)	< 0.01
Northwest	84.66	(83.46, 85.86)	< 0.01	79.93	(79.18, 80.68)	< 0.01	82.33	(81.54, 83.12)	< 0.01
Southern	81.06	(79.63, 82.49)	< 0.01	76.19	(74.47, 77.91)	< 0.01	78.67	(77.26, 80.07)	< 0.01
Average annual household income									
< 5,000 yuan	83.32	(82.71, 83.93)	–	80.42	(79.91, 80.93)	–	81.84	(81.35, 82.34)	–
5,000–9,999 yuan	84.04	(83.47, 84.60)	< 0.01	79.72	(79.28, 80.16)	< 0.01	81.85	(81.41, 82.29)	0.98
10,000–18,999 yuan	84.86	(84.18, 85.54)	< 0.01	80.14	(79.67, 80.60)	0.32	82.50	(82.01, 83.00)	0.02
≥19,000yuan	85.90	(84.98, 86.82)	< 0.01	78.73	(77.75, 79.71)	< 0.01	82.44	(81.53, 83.36)	0.23
BMI(kg/m^2)									
Normal(18.5≤BMI< 24)	78.20	(77.85, 78.55)	–	74.53	(74.15, 74.90)	–	76.26	(75.95, 76.57)	–
Low(< 18.5)	67.92	(66.84, 69.00)	< 0.01	65.46	(64.67, 66.25)	< 0.01	66.57	(65.76, 67.38)	< 0.01
Overweight(24≤BMI< 28)	88.65	(88.39, 88.90)	< 0.01	84.09	(83.84, 84.35)	< 0.01	86.54	(86.31, 86.76)	< 0.01
Obese(≥28)	98.67	(98.31, 99.02)	< 0.01	93.79	(93.42, 94.16)	< 0.01	96.37	(96.06, 96.69)	< 0.01
Smoking									
Non-smoker	85.05	(84.43, 85.68)		79.66	(79.19, 80.13)		81.20	(80.72, 81.67)	

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	Male			Female			Total		
	Mean	95% *CI*	*P*	Mean	95% *CI*	*P*	Mean	95% *CI*	***P***
Former smoker	84.08	(83.53, 84.62)	< 0.01	81.22	(80.24, 82.20)	< 0.01	83.97	(83.44, 84.50)	< 0.01
Current smoker	86.30	(85.73, 86.87)	< 0.01	83.53	(81.95, 85.11)	< 0.01	86.13	(85.58, 86.68)	< 0.01
Alcohol consumption									
Non-alcohol consumption in latest 12 month	84.19	(83.68, 84.70)		80.01	(79.62, 80.40)		81.32	(80.94, 81.70)	
Current alcohol consumption	84.96	(84.29, 85.63)	0.05	78.56	(77.65, 79.46)	0.74	83.43	(82.70, 84.17)	< 0.01
Physical activity									
MVPA < 150 min/week	85.14	(84.48, 85.80)		79.64	(79.01, 80.27)		82.73	(82.16, 83.30)	
MVPA≥150min/week	84.61	(84.07, 85.15)	0.74	79.72	(79.26, 80.19)	0.05	82.13	(81.67, 82.60)	< 0.01

Table 3. Waist circumference levels in different BMI groups

BMI	The situation of central obesity (%, 95% *CI*)			Rao–Scott χ^2	*P*–Value
	Normal	Pre–central obesity	Central obesity		
Male (kg/m^2)				15,423.8127	< 0.01
18.5≤BMI< 24	97.32 (95.82, 98.82)	1.56 (0.32, 2.80)	1.12 (0.31, 1.92)		
BMI < 18.5	84.28 (82.72, 85.84)	11.24 (10.24, 12.24)	4.48 (3.72, 5.24)		
24≤BMI< 28	25.51 (23.89, 27.12)	33.04 (31.66, 34.43)	41.45 (39.56, 43.33)		
BMI≥28	2.41 (1.74, 3.08)	5.65 (4.74, 6.56)	91.95 (90.76, 93.13)		
Female (kg/m^2)				8,899.5294	< 0.01
18.5≤BMI< 24	97.12 (95.37, 98.88)	2.36 (0.64, 4.08)	0.52 (0.12, 0.92)		
BMI < 18.5	80.16 (78.46, 81.86)	13.76 (12.61, 14.90)	6.08 (5.32, 6.85)		
24≤BMI< 28	23.92 (22.27, 25.57)	32.80 (31.49, 34.10)	43.28 (41.43, 45.14)		
BMI≥28	1.54 (1.16, 1.92)	9.26 (7.98, 10.55)	89.20 (87.85, 90.55)		
Total (kg/m^2)					
18.5≤BMI< 24	97.39 (96.20, 98.58)	1.84 (0.74, 2.95)	0.77 (0.34, 1.19)	22,289.6597	< 0.01
BMI < 18.5	83.16 (81.76, 84.56)	11.99 (11.11, 12.86)	4.85 (4.20, 5.51)		
24≤BMI< 28	26.46 (25.01, 27.92)	32.79 (31.81, 33.78)	40.74 (39.20, 42.28)		
BMI≥28	2.26 (1.81, 2.71)	8.12 (7.19, 9.45)	89.62 (88.51, 93.73)		

Note. BMI, body mass index.

However, patients with NWCO are often overlooked in clinical guidelines and risk reduction strategies. This suggests that neither the measurement of body mass index (BMI) alone nor that of waist circumference alone is a perfect assessment method due to underestimate health risks. Therefore, WC should be included in stratified indicators when conducting obesity related health risk studies. And the combined use of BMI and waist circumference will help to identify more targeted obesity phenotypes, and raise attention on population with NWCO.

The study presented national status of WC in China under different demographic characteristic, health related behavior and physical activity levels and found that people with normal weight also had risks in central obesity. Thus it is necessary to consciously and actively monitor waist circumference levels for weight control and prevention of diseases associated with central obesity[10]. However, this study has some limitations. Since data from the latest round of the survey, the survey of 2022–2023, has not released, this study used data from CNHS 2015–2017, which reflected the national waist circumference status of China nearly 10 years ago. Furthermore, CNHS was a cross-

sectional study that could not track the impact of waist circumference levels on individual health. Long-term and prospective studies and interventional trials are needed to reveal impact of WC, NWCO and the transition from NWNCO to NWCO on health.

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Competing interests The authors declare no conflicts of interest.

Ethics This study was approved by the Ethics Committee of National Institute for Nutrition And Health, Chinese Center for Disease Control and Prevention(approval no.: 201519-A). The data used in this study were anonymized without individually identifiable information.

Author's contribution Conceptualization: Jing Nan , Shuya Cai and Dongmei Yu; Methodology: Jing Nan; Investigation and Resources: Liyun Zhao and Dongmei Yu; Data curation: Wei Piao; Formal analysis: Jing Nan; Writing-original draft: Jing Nan; Validation and Software: Fusheng Li and Yuxiang Yang; Writing-review and editing: Mulei Chen, Hongtao Yuan and Qiuye Cao; Supervision: Shuya Cai.

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REFERENCES

1. Reges O, Test T, Dicker D, et al. Association of waist circumference and body mass index deciles ratio with all-cause mortality: findings from the national health and nutrition examination survey. Nutrients, 2024; 16, 961.
2. Zhai Y, Feng HY, Yu WT, et al. Changes in waist circumference and abdominal obesity among Chinese adults over a ten-year period. Biomed Environ Sci, 2017; 30, 315−22.
3. Yu DM, Zhao LY, Zhang J, et al. China nutrition and health surveys (1982-2017). China CDC Wkly, 2021; 3, 193−5.
4. Nagayama D, Fujishiro K, Tsuda S, et al. Enhanced prediction of renal function decline by replacing waist circumference with "A Body Shape Index (ABSI)" in diagnosing metabolic syndrome: a retrospective cohort study in Japan. Int J Obes, 2022; 46, 564−73.
5. Kim SH, Lim J, Lee J, et al. Relationship of domain-specific quality of life with body mass index and waist circumference in a Korean elderly population. Aging Clin Exp Res, 2021; 33, 3257−67.
6. GBD 2021 Adult BMI Collaborators. Global, regional, and national prevalence of adult overweight and obesity, 1990-2021, with forecasts to 2050: a forecasting study for the Global Burden of Disease Study 2021. Lancet, 2025; 405, 813−38.
7. Hajian-Tilaki KO, Heidari B. Prevalence of obesity, central obesity and the associated factors in urban population aged 20-70 years, in the north of Iran: a population-based study and regression approach. Obes Rev, 2007; 8, 3−10.
8. Wang L, Lee IM, Manson JE, et al. Alcohol consumption, weight gain, and risk of becoming overweight in middle-aged and older women. Arch Intern Med, 2010; 170, 453−61.
9. Ren ZY, Sun WD, Wang SH, et al. Status and transition of normal-weight central obesity and the risk of cardiovascular diseases: a population-based cohort study in China. Nutr Metab Cardiovasc Dis, 2022; 32, 2794−802.
10. Fang HJ, Berg E, Cheng XG, et al. How to best assess abdominal obesity. Curr Opin Clin Nutr Metab Care, 2018; 21, 360−5.