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Fatty and lean red meat consumption in China: Differential association with Chinese abdominal obesity

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Abstract *Aim:* We examined the longitudinal association between red meat (RM) consumption and the risk of abdominal obesity in Chinese adults.
Methods and results: Our data are from 16,822 adults aged 18–75 in the China Health and Nutrition Survey from 1993 to 2011. We assessed RM intake with three 24-h dietary recalls. We defined abdominal obesity as a waist circumference (WC) ≥85 centimeters (cm) for men and ≥80 cm for women. Multilevel mixed-effect regression models showed that men experienced WC increases of 0.74 cm (95% confidence interval [CI]: 0.39–1.09) from a higher total intake of fresh RM and 0.59 cm (95% CI: 0.24–0. 95) from a higher intake of fatty fresh RM but 0.14 cm (95% CI: −0.39 to 0.66) from a higher intake of lean fresh RM in the top quartile versus non-consumers when adjusted for potential confounders. In contrast, after additional adjustment for baseline WC, the odds ratios of abdominal obesity in men were attenuated for total fresh RM (1.25 [95% CI: 1.06–1.47]) and fatty fresh RM (1.22 [95% CI: 1.03–1.44]) but were still not affected by lean fresh RM (0.95 [95% CI: 0.75–1.22]). Women also showed a positive association of fatty fresh RM intake with abdominal obesity.
Conclusion: Greater intake of fatty fresh RM was significantly associated with higher WC (men only) and abdominal obesity risk in Chinese adults. The gender-specific differential association of fatty versus lean fresh RM warrants further study.

Introduction

Over the past two decades, along with rapid economic growth and social changes, China has experienced marked shifts in diet and physical activity and concurrent shifts in disease patterns [1–3]. Several studies have suggested that cardiometabolic risk is pervasive across rural and urban China [4–6] and that abdominal obesity is highly predictive of metabolic risk in Chinese adults, irrespective of being overweight [7,8]. This emphasizes the key role of waist circumference (WC) in the prevention of cardiovascular disease, the leading cause of mortality in China. Study results show a rapid increase in abdominal obesity among Chinese adults between 1993 and 2006 from 17.9% to 42.5% for men and from 28.8% to 46.9% for women [9]. It is therefore important to identify modifiable risk factors, such as diet, to curb the abdominal obesity epidemic and associated disease risks in China.

Consumption of red meat (RM), specifically processed RM, has been associated with greater WC gain and an increased risk of abdominal obesity in Western populations,

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although the evidence is inconsistent. Some studies have suggested a positive association between consumption of RM and processed RM and WC gain and abdominal obesity [10,11] or have found a null association [12–14], and other studies indicate a beneficial role for RM consumption among adults [15]. RM consumption patterns vary across countries. Unlike Western populations, Chinese adults have a relatively low intake of total RM, including a much lower proportion of processed RM, and pork has been the predominant type of fresh RM consumed (over 90%) [16]. Given the differences in types and quantities of individual RM consumption, the associations of RM consumption with WC and abdominal obesity in the Chinese population may be different from those in Western populations. To date the possible association between RM consumption and abdominal obesity in the Chinese population has not been examined.

The currently accepted recommendation is to consume moderate amounts of lean fresh RM [17,18]. However, studies to determine the potentially different health influences of fatty versus lean RM are limited. In China RM is distinguished as either lean or fatty RM (with excessive fat retained in all fatty RM), providing a unique opportunity to study this dimension of the RM intake of a population over time [19].

The present study investigated the association between intakes of RM and its subtypes (fatty versus lean fresh RM) and the risk of increased WC and abdominal obesity in Chinese adults from the China Health and Nutrition Survey (CHNS), an ongoing, large-scale, longitudinal, prospective cohort survey (1993–2011).

Methods

Study population

All data used in this study were derived from the CHNS. The CHNS was initiated in 1989 and has been followed up every two to four years with a focus on assessing the relationships between the economic, sociological, and demographic transformation in China and the resulting effects on the health and nutritional status of the Chinese population. The CHNS used a multistage, random cluster process to draw the sample from the original eight provinces, and communities were selected randomly as the primary sampling units. The sampling procedure has been described in detail elsewhere [20]. Such sampling reflects the hierarchical data structure of the CHNS: measurement occasions (level 1) for individuals (level 2) nested in communities (level 3).

Our analysis used the seven waves of survey data between 1993 and 2011, because the WC measurement was added to the CHNS in 1993. Of all the participants aged 18–75 who had complete data on dietary, anthropometric, demographic, socioeconomic, and other lifestyle factors in a survey year, we excluded pregnant or lactating women, those having implausible energy intakes (<800 kilocalories [kcal] per day or >6000 kcal for men and <600 kcal or >4000 kcal for women) [21], and those having unrealistic WCs (<50 centimeters [cm] or >130 cm). The current analysis therefore consists of 16,822 participants (8089 males; 8733 females) clustered in 236 communities, resulting in 47,785 total responses in the seven survey years.

The protocol of the survey was approved by the Institutional Review Committees of the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety, Chinese Center for Disease Control and Prevention. All subjects gave written informed consent for their participation in the survey.

Dietary assessment

We assessed dietary intake at the individual level in three consecutive 24-h dietary recalls (two weekdays and one weekend day) in each wave of the CHNS. Trained health workers interviewed the participants on each of those days to collect the types and amounts of all food and beverage items (measured in grams [g]) consumed during the preceding 24 h [20].

We collected information on home cooking oil and condiment consumption of all the family members with a household food inventory weighing method on the same 3 day as the 24-h recall. We determined the percentage of the oil and condiments from the home inventory that each member consumed by the ratio of his or her energy intake to the energy intake of all family members. We calculated the individual total energy intake (TEI) by linking dietary intake data to the China Food Composition Table [22]. We used the average intake of RM, other foods and TEI for each individual from the three consecutive 24-h recalls.

Red meat groups

We classified RM as fresh RM and processed RM. Fresh RM included all muscle and organ meat from pork, beef, and mutton that had not been treated, whereas processed RM included the products of all types of RM that had undergone treatment, such as sausages, salami, ham, and luncheon meats. We further divided fresh RM into fatty fresh RM (≥10 g fat/100 g of edible fresh RM) and lean fresh RM (<10 g fat/100 g of edible fresh RM) based on the food grouping system developed by Barry M. Popkin et al. [20].

Given the considerable proportion of participants who did not consume RM or certain types of RM during the three-day survey period, our analysis categorizes the intakes of RM and each subtype into five levels separately by gender to reflect non-consumers and quartiles of intake among corresponding consumers. The lowest quartile of intake of RM or a subtype is the reference group.

Definition of abdominal obesity and overweight–obesity status

At each visit trained health workers measured individual WCs midway between the lowest rib and the iliac crest