

Red Meat Consumption and the Risk of Stroke: A Dose–Response Meta-analysis of Prospective Cohort Studies

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Background: Prospective studies of red meat consumption and risk of stroke have provided inconsistent results. We aimed to assess this association by conducting a meta-analysis of prospective cohort studies. **Methods:** Relevant studies were identified by searching PubMed and EMBASE through April 1, 2013. Summary relative risks (RR) and the corresponding 95% confidence intervals (CIs) were estimated by random-effect or fixed-effect models. **Results:** Seven prospective cohort studies were included in the analyses, involving 2,079,236 subjects and 21,730 strokes cases. Total red meat consumption was associated with total stroke (RR = 1.14, 95% CI 1.05–1.24), cerebral infarction (RR = 1.13, 95% CI 1.0–1.28), and ischemic stroke (RR = 1.22, 95% CI 1.01–1.46). A significant association was found between consumption of processed red meat and total stroke (RR = 1.17, 95% CI 1.09–1.27). Consumption of fresh red meat was significantly associated with total stroke (RR = 1.13, 95% CI 1.04–1.22) and ischemic stroke (RR = 1.15, 95% CI 1.03–1.29). However, no evidence suggests that any type of meat was associated with hemorrhagic stroke. Also, no association was found between consumption of processed red meat and ischemic stroke (RR = 1.15, 95% CI .98–1.36) and between consumption of fresh red meat and cerebral infarction (RR = 1.06, 95% CI [.94, 1.20]). A significant risk for total stroke could be observed when the consumption of total red meat was above 50 g/day, processed red meat was just above 0 g/day, and fresh red meat was above 70 g/day. **Conclusion:** Our findings indicate that high consumption of red meat, especially processed red meat, will increase the risk of stroke. **Key Words:** Meat—stroke—prospective studies—meta-analysis—dose–response.

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Introduction

As the global population aging process accelerates, stroke brings great harm to middle aged and elderly people, which aggravates the patient's family and results in socioeconomic burden. According to the American Heart Association report, each year 795,000 people experience a new or recurrent stroke and every 4 minutes someone dies from the disease.¹ Owing to the high incidence and high mortality of stroke, the medical community ranks it as 1 of 3 top diseases that threatens human health, along with coronary heart disease and cancer.^{2–4}

Strokes can be classified into 2 major categories: ischemic and hemorrhagic, and ischemic stroke is the predominant type accounting for 87% of all cases.⁵ Ischemic stroke can also be divided into 2 main types: thrombotic and embolic. Thrombotic stroke is clinically referred to as cerebral thrombosis or cerebral infarction, and this type of event is responsible for almost 50% of

all strokes. Owing to the category difference between cerebral infarction and ischemic stroke, it can be inferred that some factors that can cause ischemic stroke do not necessarily cause cerebral infarction, so stroke can also be divided into 3 types: cerebral infarction, hemorrhagic stroke, and ischemic stroke.

Meat consumption accounts for a large part of the diet and meat acts as a major source of protein, fat, and energy for humans. However, the 2005 U.S. Dietary Guidelines for Americans recommend that consumption of red and processed meat should be moderated.⁶ Such recommendations are in large part derived from epidemiological evidence that high consumption of red meat was associated with increased risk of type 2 diabetes, digestive system disease, cancer, and cardiovascular disease.⁷⁻¹⁰ Recently, red meat consumption as a potential risk for stroke has been studied in 2 observational studies.^{11,12} However, sufficient evidence for direct relationships between red meat consumption and stroke has been lacking to support more quantitative recommendations about specific consumption levels of meats.

Accordingly, we performed a systematic review and a meta-analysis of prospective studies to assess the relation between consumption of red meat (fresh red meat, processed meat, and total red meat) and the risk of total stroke and stroke subtypes, which could not be addressed in the previous meta-analysis.

Subjects and Methods

Search Strategy

We performed a meta-analysis on the basis of guidance of Meta-analysis of Observational Studies in Epidemiology. We performed a comprehensive literature search on PubMed database through April 1, 2013, by using key words such as “meat,” “red meat,” “processed meat,” “meat products,” “beef,” “pork,” “lamb,” “steak,” “mutton,” “cardiovascular disease,” “hemorrhagic stroke,” “ischemic stroke,” “mortalities,” “risk,” “death,” “fatal,” and “incidence” (Fig 1). In addition, we reviewed the reference lists of published articles to identify additional relevant studies. To obtain additional data or main results for the meta-analysis, we contacted authors of primary studies (Table 1).¹³⁻¹⁹

“Red meat” was defined as unprocessed beef, pork and lamb except for poultry, fish and eggs; “processed meat” was mainly processed red meat such as bacon, baloney, salami, hot dog, and luncheon meats except for fish and eggs; “total red meat” was defined as the total of these 2 categories.^{20,21} When possible, we conducted a linear dose-response analysis of stroke risk per increment in consumption of 100 g/day for red meat and 50 g/day for processed meat using generalized least-squares trend estimation analysis developed by Greenland and Longnecker.²²

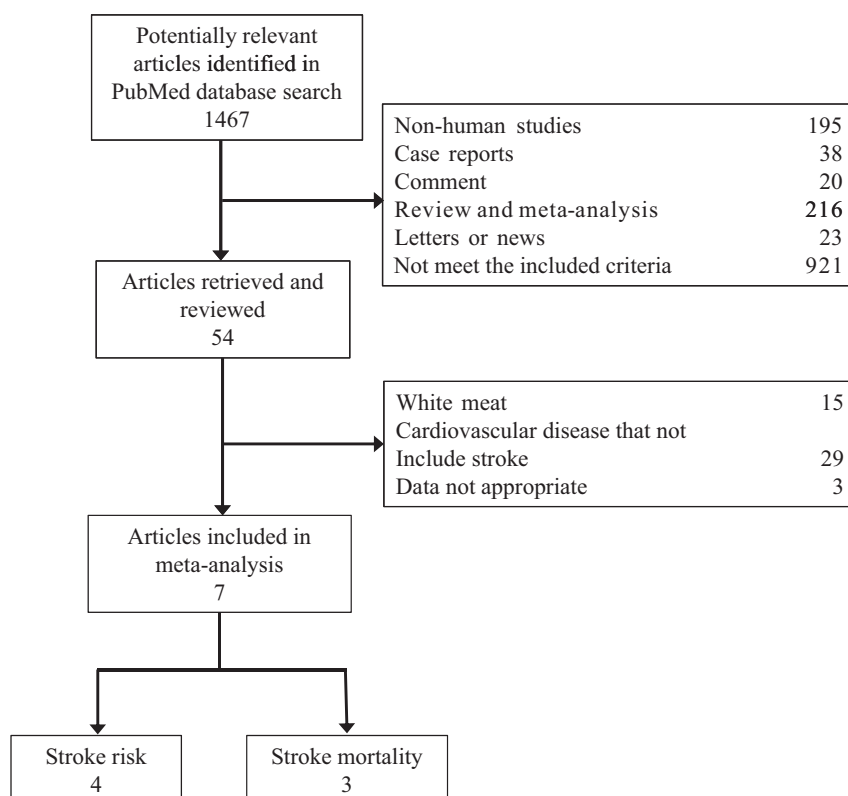


Figure 1. Literature searched and selection of studies in the meta-analysis.

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