Overweight and Obesity in Young Adulthood and the Risk of Stroke: a Meta-analysis

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Background: A systematic review assessing the association between overweight and obesity in young adulthood and stroke risk is lacking. Therefore, we conducted a meta-analysis to evaluate the association between overweight and obesity in young adulthood and stroke risk. *Methods:* We systematically searched PubMed and Embase databases for related studies of human subjects in the English language. Two investigators independently selected original studies in a 2-step process. Fixed- and random-effects models were used to calculate pooled relative risks (RRs) and 95% confidence intervals (CIs). Subgroup analyses were also performed. *Results:* Eight studies met the inclusion criteria. The pooled adjusted RR of stroke was 1.36 (95% CI: 1.28-1.44) for overweight in young adulthood and 1.81 (95% CI: 1.45-2.25) for obesity in young adulthood. In subgroup analyses, overweight and obesity in young adulthood increased the risk of stroke in most groups, except for the group of stroke subtype. For ischemic stroke, the adjusted RR was 1.40 (95% CI: 1.24-1.58) for overweight in young adulthood and 1.78 (95% CI: 1.003-3.16) for obesity in young adulthood, whereas adjusted RR for hemorrhagic stroke was 1.25 (95% CI: .83-1.90) for overweight in young adulthood and 1.80 (95% CI: .97-3.35) for obesity in young adulthood. *Conclusions:* Overweight and obesity in young adulthood are associated with an increased risk of stroke, probably, independent of other cardiovascular risk factors. The risk effect gradually increases with increasing body weight. **Key Words:** Young adults—body mass index—obesity—overweight—stroke—meta-analysis.

Introduction

Stroke, a common neurological disease with high morbidity, disability, and mortality rates, negatively affects human health and quality of life. The burden of stroke is likely to rise due to an increase in the aging population and the prevalence of unhealthy lifestyles, especially in developing countries.[1,2] In China, stroke has been the leading cause of death and adult disability.[3] According to the primary stroke prevention guidelines established by the American Heart Association and American Stroke Association in 2014, effective prevention remains the best approach for reducing the burden of stroke.[4] Considering that more than 76% of strokes are first events, primary prevention is of particular importance.[5] Modifiable risk factors of stroke mainly include dyslipidemia, hypertension, diabetes mellitus, smoking, obesity, and so on. Among

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these factors, obesity plays a very important role in the epidemiology of stroke. According to a recent analysis, the number of overweight and obese individuals worldwide has increased from 857 million to 2.1 billion, which represents the highest increase mainly in individuals aged 20-40.[6] Therefore, overweight and obesity in young adulthood have been a major public health concern worldwide.[7,8] Overall, these findings emphasize the need to assess the association between overweight and obesity in young adulthood and stroke risk.

To the best of our knowledge, no randomized controlled trials have been performed assessing the effects of overweight and obesity in young adults on stroke risk. A recent meta-analysis reported that overweight or obesity was really associated with an increased risk of cerebral infarction and hemorrhage; however, the study included only 45,235 participants from Japan and was not stratified by age.[9] Results from another meta-analysis, which involved 2 million individuals, revealed that overweight and obesity were associated with a progressively increased risk of ischemic stroke, but also failed to assess the effects of age on the association between excess body weight and stroke risk.[10] A report showed that obesity had a greater impact on stroke deaths in younger groups than in older groups,[11] and other studies revealed that obesity in young adulthood contributed to an increased risk of coronary heart disease and mortality independent of weight changes in later life.[12,13] On the other hand, some studies have reported no association between overweight and obesity in childhood or early adulthood and stroke risk.[14,15] So the relationship of overweight and obesity in young adulthood with the risk of stroke remains controversial.

Therefore, we conducted a meta-analysis to assess whether there is an association between excess body weight in young adulthood and stroke risk.

Materials and Methods

Literature Search

A systematic search of studies published until August 2015 was performed using PubMed and Embase databases. The search strategy was conducted using the following terms, where * represents a word truncation: young adult*, "young people," young person*, "young women," "young men," "young male," "young female," youth*, younger, youngster*, puber*, pubescen*, early adulthood, young adulthood, obes*, overweight*, over weight*, "obesity, morbid," "body mass index," "body fat distribution," "waist circumference," "body composition," "abdominal fat," adipos*, fat, fatt*, BMI, body mass ind*, waist-hip ratio*, skinfold thickness*, bodyweigh*, body fat*, "carotid artery diseases," "carotid artery thrombosis," "intracranial arterial diseases," "cerebral arterial diseases," "cerebrovascular disorders," stroke*, "intracranial thrombosis," "cerebral infarction," "brain infarction," "brain ischemia," "hypoxia-ischemia, brain," "Intracranial embolism and thrombosis," apoplex*, cerebral vasc*, cerebrovasc*, cva, bva, brain vasc*, intracranial vasc*, "cerebral hemorrhage," "intracranial hemorrhages," vertebrobasil* bleeding, cerebr* bleeding, cerebell* bleeding, and so on. All searches were restricted to human clinical studies published in English. Additionally, we manually searched the reference lists of all retrieved articles and related review articles for other applicable studies.

Inclusion Criteria

The inclusion criteria were as follows: (1) the age of study subjects at baseline was 15-50 years; (2) the study design was a cohort study that evaluated the association between overweight or obesity in young adulthood and stroke disease; (3) the follow-up duration was at least 2 years (median or mean); (4) the exposure factors of interest were excess body weight, which should be divided into overweight and obesity groups by body mass index (BMI) categories or could be combined into overweight and obesity groups; (5) the outcomes of interest were stroke events, with a well-defined diagnostic criteria; (6) the quantitative estimates of relative risks (RRs) or hazard ratios with 95% confidence intervals (CIs) were provided or there were sufficient data for their calculation; and (7) statistical analyses should incorporate a multivariable model that controlled potential confounders. Studies were excluded if (1) the diagnosis of cases was undefined; (2) the study design was a cross-sectional or case–control study; (3) the exposure factors were not clearly defined; (4) the method of data collection was not valid; (5) the statistical methods were not provided or were incorrect; or (6) the studies were duplicate articles, reviews, commentaries, editorials, or letters.

A 2-step selection process was used to select eligible studies. In the first step, 2 investigators initially excluded studies based on their title and abstract. In the second step, the investigators independently assessed the full text of the remaining studies. These studies that did not meet all the inclusion criteria would be excluded. Disagreements between the 2 investigators would be resolved by discussion with a third investigator.

Study Quality Assessment and Data Extraction

The Newcastle–Ottawa Scale (NOS) was used to assess study quality.[16] A full NOS score of 9 points represented the best quality. In our analysis, the studies were considered to be of high quality if the NOS score was 7 points or higher. Two investigators independently extracted data according to a standardized form, and any discrepancy in the process was resolved via consensus with a third investigator. The following data were extracted from each included study: first author's name, country of the population studied, year of publication, study design, sample size, follow-up duration, gender,