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Obesity Increases Risk of Ischemic Stroke in Young Adults

Andrew B. Mitchell[1], **John W. Cole, MD, MS**[1,3], **Patrick. F. McArdle, PhD**[2], **Yu-Ching Cheng, PhD**[2,3], **Kathleen A. Ryan, MPH**[2], **Mary J. Sparks, RN, BSN**[1], **Braxton D. Mitchell, PhD**[2], and **Steven J. Kittner, MD, MPH**[1,3,*]

[1]Department of Neurology, University of Maryland School of Medicine, Baltimore, MD 21201

[2]Department of Medicine, University of Maryland School of Medicine, Baltimore, MD 21201

[3]Department of Veterans Affairs and Veterans Affairs Medical Center Baltimore, Baltimore MD 21201

Abstract

Background and Purpose—Body mass index (BMI) has been associated with ischemic stroke in older populations, but its association with stroke in younger populations is not known. In light of the current obesity epidemic in the United States, the potential impact of obesity on stroke risk in young adults deserves attention.

Methods—A population-based case-control study design with 1201 cases and 1154 controls was used to investigate the relationship of obesity and young-onset ischemic stroke. Stroke cases were between the ages of 15 and 49. Logistic regression analysis was used to evaluate the association between BMI and ischemic stroke with and without adjustment for co-morbid conditions associated with stroke.

Results—In analyses adjusted for age, sex, and ethnicity, obesity (BMI > 30 kg/m^2) was associated with an increased stroke risk (odds ratio, 1.57, 95% C.I. = 1.28–1.94), although this increased risk was highly attenuated and not statistically significant after adjustment for smoking, hypertension, and diabetes mellitus.

Conclusion—These results indicate that obesity is a risk factor for young onset ischemic stroke, and suggest that this association may be partially mediated through hypertension, diabetes mellitus, and/or other variables associated with these conditions.

Keywords

stroke; obesity; young adult

INTRODUCTION

Obesity rates in America have been steadily increasing throughout the past several decades. In 2011–2012, the prevalence of obesity in the United States was 16.9% in youth and 34.9%

*Corresponding Author: Steven J. Kittner, M.D., M.P.H., 655 West Baltimore Street- Rm12-006, Baltimore, MD 21201-1559, Phone: 410-706-0414, Fax: 410-706-0816, SKittner@som.umaryland.edu.

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in adults.[1] Although obesity is a well-recognized risk factor for stroke in older adults[2] and there is evidence for increasing ischemic hospitalization rates for young adults with concurrent increases in obesity,[3] few studies have directly examined the association between obesity and early-onset stroke. To evaluate this issue, we used data from a case-control study in the Baltimore-Washington area.

METHODS

The Stroke Prevention in Young Adults Study was designed as a population-based case-control study of young-onset ischemic stroke. During 3 study periods between 1992 and 2008, cases with a first-ever ischemic stroke ages 15–49 were identified by discharge surveillance from 59 hospitals in the greater Baltimore/Washington, DC area and by direct referral from regional neurologists. Controls were matched to cases by age, sex, region of residence and, except for the initial study phase, were additionally matched for ethnicity. Details of the study design and case adjudication have been previously described.[4]

A standardized interview was used to obtain information about stroke risk factors, including age at stroke (or age at interview for controls), ethnicity, smoking status, hypertension and diabetes mellitus. Height and weight were obtained via self-report during the interview and used to compute body mass index (BMI), calculated as weight (in kg) divided by height (in m) squared. BMI was classified into weight categories according to federal guidelines[5] with participants categorized as underweight (BMI < 18.5 kg/m^2), normal weight (18.5 to 24.9 kg/m^2), overweight (25.0 to 29.9 kg/m^2), and obese (BMI > 30 kg/m^2).

We compared stroke risk factors between stroke cases and controls by t-tests and chi-square tests. Odds ratios and confidence intervals were calculated using logistic regression for three models: a reduced model adjusted only for age, sex, and race, an intermediate model adjusted for prior covariates and current smoking, and a full model adjusted for these prior covariates plus hypertension and diabetes. Sequential adjustment was chosen because cigarette smoking is a behavior, while hypertension, diabetes and obesity cluster together physiologically as part of the metabolic syndrome.

RESULTS

The study population included a total of 1,201 cases and 1,154 controls. Table 1 shows that, compared to controls, cases were slightly older, had higher BMI, and had a higher prevalence of current smoking, hypertension, and diabetes (all $p < 0.01$). Table 2 shows odds ratios for the overweight and obese categories compared to the normal BMI category using the reduced, intermediate, and full models. Table 2 also shows analyses stratified by sex and race and is based on 1168 cases and 1123 controls. For this analysis, the 27 cases and 28 controls in the underweight category were excluded due to our desire to compare overweight and obese to the normal weight category. In addition, to allow comparisons across the three models using the same sample, 3 controls and 6 cases were excluded due to missing information on hypertension or diabetes. Participants in the obese category had an excess risk of stroke under the reduced and intermediate models, but the association was attenuated and no longer statistically significant after additional adjustment for hypertension and

diabetes in the full model. There is a suggestion that BMI is more strongly associated with stroke among men and blacks, although the interactions of BMI categories with sex and race were not statistically significant.

DISCUSSION

Our results show an association between increased BMI and early-onset stroke, which is consistent with studies conducted in older adults.[2] The association between BMI and stroke was attenuated after adjustment for hypertension and diabetes mellitus, and no longer achieved statistical significance. From the public health perspective, the unadjusted association is more meaningful because hypertension and diabetes mellitus are at least partially caused by obesity.

Limitations of our report include the use of self-reported height and weight. Although the use of self-reported data to calculate BMI has been found to be valid for identifying relationships in epidemiological studies[6], it is likely that the use of such data will underestimate the association between BMI and stroke risk because obese participants are more likely to underestimate their weight. Furthermore, obesity indices other than BMI, such as waist to hip ratio, have shown stronger associations with stroke risk.[7] Additional limitations include potential selection bias in ascertainment of cases and controls, and inability to examine all possible confounders, mediators, and effect modifiers of the association between BMI and stroke risk. Further research in young adults is needed to replicate our findings and to examine potential differences by sex and race. In addition, future studies should evaluate the association of obesity with ischemic stroke subtypes, which was not possible in this report because of small sample size among stroke subtypes.

Recent reports have shown that the incidence of stroke is decreasing in the overall population, and have attributed the decline to reductions in stroke risk factors such as smoking and hypertension.[8] Available evidence suggests that young adults may not be sharing in this decline of stroke incidence.[9] This report adds to the concern that younger individuals may be experiencing an increased stroke risk resulting from increasing levels of obesity and accompanying co-morbidities and supports the need for vigorous public health initiatives to reverse this trend.

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Table 1

Characteristics of Cases and Controls

	Cases (n = 1201)	Controls (n = 1154)	p-value *
Age (yrs), mean ± SD	40.8 ± 7.1	38.6 ±7.4	<0.01
Male, %	52.0	46.5	0.01
White, % †	50.1	56.9	<0.01
Hypertension, %	42.3	18.1	<0.01
Diabetes, %	16.9	4.6	<0.01
Current smoker, %	44.8	29.4	<0.01
BMI (kg/m^2), mean (SD)	29.7 ± 7.6	27.6 ±6.1	<0.01
BMI categories, (%)			<0.0001
<18.5	2.3	2.4	
18.5–24.9	27.0	35.6	
25.0–29.9	31.3	33.0	
>30.0	39.5	29.0	

BMI indicates body mass index

*p-value for association with case/control status computed by t-test or chi-square.

†Non-whites include: African American (44.8% cases vs. 38.3% controls) and other ethnicity (5.1% cases vs. 4.8% controls).

Table 2

Odds Ratios* for Stroke by BMI Category, Under 3 Models, with Stratification by Sex and Race

	Reduced Model (age, sex, race)	Intermediate Model (age, sex, race, smoking)	Full Model (age, sex, race, smoking, HTN, DM)
All (n=2291)			
Overweight	1.12 (0.91–1.38)	1.13 (0.92–1.40)	1.02 (0.82–1.27)
Obese	1.57 (1.28–1.94)	1.65 (1.33–2.04)	1.21 (0.96–1.51)
Males (n=1147)			
Overweight	1.13 (0.84–1.53)	1.22 (0.90–1.66)	1.04 (0.76–1.43)
Obese	1.73 (1.27–2.40)	1.92 (1.40–2.65)	1.34 (0.96–1.88)
Females (n = 1144)			
Overweight	1.13 (0.84–1.52)	1.06 (0.78–1.44)	0.99 (0.72–1.36)
Obese	1.46 (1.10–1.95)	1.42 (1.06–1.91)	1.07 (0.79–1.46)
Whites (n = 1221)			
Overweight	1.05 (0.80–1.40)	1.07 (0.80–1.42)	0.99 (0.74–1.33)
Obese	1.37 (1.02–1.82)	1.40 (1.04–1.88)	1.04 (0.76–1.43)
Blacks (n = 958)			
Overweight	1.08 (0.76–1.53)	1.09 (0.76–1.54)	0.96 (0.67–1.38)
Obese	1.62(1.16–2.25)	1.71 (1.22–2.39)	1.26 (0.89–1.79)

BMI indicates body mass index; HTN, hypertension; DM, diabetes mellitus

*Reference category is normal BMI