Published in final edited form as:
J Stroke Cerebrovasc Dis. 2010 ; 19(4): 311–320. doi:10.1016/j.jstrokecerebrovasdis.2009.07.001.

Awareness, Treatment, and Control of Vascular Risk Factors Among Stroke Survivors

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Abstract

Introduction—Stroke survivors should recognize and control vascular risk factors to prevent recurrent strokes. We therefore assessed the prevalence, treatment and control of hypertension, diabetes, and dyslipidemia among stroke survivors versus stroke-free controls.

Methods—Cross-sectional analysis from the Reasons for Geographic And Racial Differences in Stroke (REGARDS) Study cohort, which includes oversampling from the Stroke Belt and African Americans. Patients were interviewed by telephone then visited for blood pressure, glucose, and lipid measurements. There were 2,830 participants reporting a past stroke or TIA ("stroke survivors") and 24,886 participants without past stroke or TIA (controls). Outcome measures included the recognition, treatment, and control of hypertension, diabetes, and dyslipidemia.

Results—Stroke survivors more likely had unrecognized hypertension (18.7% vs. 13.5%, p<0.0003), unrecognized Stage 2 hypertension (4.4% vs. 2.2%, p<0.0006), and unrecognized diabetes (4.2% vs. 3.2%, p<0.026) versus controls. Stroke survivors were more likely treated for hypertension (92.4% vs. 89.0%, p<0.0001), diabetes (88.3% vs. 81.4%, p<0.0001), and dyslipidemia (76.3% vs. 61.9%, p<0.0001). However despite treatment, stroke survivors were more likely to have hypertension (33.3% vs. 30.4%, p=0.0074) and Stage 2 hypertension (9.1 % vs. 7.6%, p=0.017). Predictors of unrecognized and undertreated risk factors in stroke survivors include increasing BMI, black race, and lower education.

Discussion—Despite having a past stroke or TIA, stroke survivors had higher rates of unrecognized hypertension, unrecognized diabetes, and undertreated hypertension. Better efforts are needed to help stroke survivors recognize and control vascular risk factor to prevent recurrent stroke.

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There are no conflicts of interest or financial gain from any authors contributing to this manuscript. Dr. George Howard (study PI) had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

INTRODUCTION

A stroke or transient ischemic attack (TIA) should raise an alarm to patients and their physicians to optimize therapy to prevent recurrent strokes. Stroke patients have a high risk of future stroke, with five-year stroke recurrence rates of up to 30%.(1–7) Among the 700,000 strokes a year in the United States, there are approximately 200,000 recurrent strokes.(8) TIAs are also very hazardous, as 10% of these patients can suffer strokes within 90 days.(9–11) Stroke survivors should therefore actively recognize and treat vascular risk factors.

Guidelines from the American Stroke Association for preventing recurrent stroke recommend managing vascular risk factors,(5, 12) however it is unclear how well these guidelines are implemented in actual practice. Several studies show that many high-risk patients have undiagnosed hypertension or untreated vascular risk factors.(13–18) In order to reduce the incidence of stroke recurrence, it is necessary to understand patterns of awareness, treatment, and control of vascular risk factors among patients with a stroke or TIA.

We therefore investigated the awareness, treatment, and control of vascular risk factors in individuals with a self-reported history of stroke or TIA from the Reasons for Geographic And Racial Differences in Stroke (REGARDS) study, a prospective cohort study designed to follow 30,000 Americans for stroke incidence.(19) We included hypertension, diabetes, and dyslipidemia, and how they differed by demographics, geographical region, socio-economic status, body mass index (BMI), and smoking status. We hypothesized that stroke survivors should have better recognition and control of these risk factors in order to prevent recurrent strokes.

METHODS

The REGARDS study is a national longitudinal cohort study of black and white Americans over age 45. REGARDS recruited 50% of participants from the “Stroke Belt”, an area of excess stroke mortality in the Southeastern United States that has existed since at least 1940.(20) Approximately 20% of the sample is from the “buckle” of the Stroke Belt (coastal plains of NC, SC, and GA), 30% from the remainder of the Stroke Belt (AL, MS, TN, AR, LA, and the rest of NC, SC, and GA), and the remaining 50% from the other 40 contiguous United States. Approximately 45% of the sample is black and 55% is white. Race was determined by selfreport; REGARDS only enrolled those reporting race as either “black” or “white”, because a major goal of REGARDS is to determine why there is 40% increased stroke mortality among black Americans.

Within each region, individuals were initially contacted from with mailings followed by telephone interview. For those agreeing to participate, telephone interviewers obtained demographic information, medical history, and past stroke history by asking “has a health care professional ever told you that you’ve had a stroke or TIA?” Trained examiners then visited all participants at their homes to measure blood pressure, height, weight, record medications, and collect blood and urine samples. The examiners were unaware of the participants’ stroke/TIA history.

This analysis uses information from both the telephone interview and home visit. The participation rate (percent agreeing to be interviewed among contacted eligible candidates) was 62%, according to standards proposed by Morton et al.(21) Study methods were reviewed and approved by the Institutional Review Boards at collaborating institutions. Additional details of the REGARDS study have been previously published.(19, 22)

Definitions

Participants who reported a past stroke or TIA were considered stroke survivors; those denying a previous stroke or TIA were considered stroke-free. Participants were also asked if a health care professional ever informed them that they had hypertension, diabetes, and dyslipidemia, and what medications they were taking. BMI was defined as weight in kilograms divided by height in meters squared (kg/m^2). Smoking was classified as current, past (>100 cigarettes during life), or never. Age, race, sex, education level, and annual family income were also assessed. Medication compliance was assessed by the Morisky Scale (23).

At the home visit, blood pressure was recorded as the average of two measurements five minutes apart using a regularly-tested aneroid sphygmomanometer, measured after the participant was seated for five minutes with both feet on the floor. Hypertension was defined as SBP>140 mm Hg or DBP>90 mm Hg, self report of hypertension, or use of anti-hypertension medication; stage 2 hypertension was defined as SBP>160 mm Hg or DBP>100 mm Hg.(24) Diabetes was defined as a fasting glucose level greater than 126 mg/dL (7.0 mmol/L), nonfasting glucose level greater than 200 mg/dL (11.1 mmol/L), self report of diabetes, or use of diabetic medication. Dyslipidemia was defined as LDL cholesterol >100 mg/dL, self report of dyslipidemia, or the use of lipid-lowering agents. Home interviewers examined pill bottles and recorded patients' medications.

Participants were considered "unaware" of the risk factor if they denied having it but had measured values above the thresholds defined above. Participants were considered "treated" for the risk factor if they reported the risk factor and were taking medication for it. Participants were considered "controlled" for the risk factor if they were treated and had SBP < 140 mm Hg and DBP < 90 mm Hg, glucose < 126 mg/dL, or LDL cholesterol < 100 mg/dL measured at the home examination. This analysis includes 27,716 participants enrolled from January 2003 through June 2007 who completed both the telephone interview and at-home visit. There were 2,830 participants self-reporting a prior stroke or TIA and 24,886 stroke-free controls.

Statistical Analysis

The Chi-square test evaluated differences between stroke survivors and controls in the proportion unaware of risk factor, treated for the risk factor (among those aware), and successful control of the risk factor (among those treated). These analyses were performed for three study outcomes: 1) prevalence and predictors of undiagnosed risk factors, defined as the condition being present (i.e., blood pressure, glucose, or LDL above thresholds) among participants unaware of them; 2) prevalence and predictors of treatment among participants self-reporting a risk factor; 3) prevalence and predictors of control (i.e., blood pressure, glucose, or LDL below thresholds) among participants who took medication for a risk factor. Differences of awareness and treatment were analyzed with logistic regression in a univariate model, then adjusted for age. Control of risk factors was analyzed in a univariate model, adjusted for age, then adjusted for age and medication compliance. Finally, demographics, socio-economic status, BMI, and smoking status were assessed with logistic regression among stroke survivors.

RESULTS

The baseline characteristics of the study population are shown in Table 1. Participants reporting a history of stroke or TIA were older, were more likely to be African American, were more likely to be current or past smokers, and had lower levels of education and income versus strokefree participants. Those with stroke/TIA were slightly less compliant

with medications than those without past stroke/TIA as assessed by the Morisky Scale, with 68% of stroke/TIA survivors reporting no exceptions to taking medications versus 71% of stroke-free participants reporting no exceptions. The mean Morisky score was 0.065 (S.E. 0.019) higher (less compliant) for those with stroke/TIA ($p = 0.0008$), and increased to 0.078 (S.E. 0.020) after adjusting for age ($p < 0.0001$).

Undiagnosed Risk Factors

Table 2a shows the recognition of vascular risk factors in stroke survivors compared to controls. Stroke survivors were more likely to have unrecognized hypertension versus controls (18.7% vs. 13.5%, p=0.0003) and twice as likely to have unrecognized Stage 2 hypertension versus controls (4.4% vs. 2.2%, p=0.0006). In addition, stroke survivors were more likely to have unrecognized diabetes versus controls (4.2% vs. 3.2%, $p = 0.026$). Conversely, stroke survivors were less likely to have undiagnosed dyslipidemia compared to the stroke-free cohort (59.1% vs. 65.5%, $p < 0.0001$). Table 3 shows that adjusting for age slightly decreased the effect for hypertension, Stage 2 hypertension, and dyslipidemia, but the effects remained significant. Adjusting for age had no effect for the recognition of diabetes. This suggests that the age difference between the two groups does not explain these observations.

Table 4 shows the predictors of unrecognized risk factors among stroke survivors. Patients with higher BMI had a significant trend for unrecognized hypertension (from 27.2% for BMI >30 to 14.4% for BMI<25, p=0.0065) and diabetes (from 5.6% for BMI>30 to 2.0% for BMI<25, $p < 0.0066$); however BMI was not significantly associated with undiagnosed dyslipidemia. Higher education was associated with lower rates of unrecognized diabetes (0.65% for at least college education to 6.0% for less than a high school education, $p = 0.028$). There was a marginally significant higher prevalence of unrecognized hypertension among participants with less than a high school education ($p = 0.069$). Black stroke survivors were more likely to have undiagnosed hypertension compared to whites (23.4% vs. 16.2%; $p = 0.033$). Finally, there was a higher prevalence of unrecognized dyslipidemia among incomes below $20,000 (63.0%) and above $75,000 (72.0%) than for those with incomes between these extreme groups (52.7% for those with incomes $20,000–$35,000 and 56.6% for those with income from $35,000–$75,000; p=0.0056).

Risk Factor Treatment

Table 2b shows treatment rates of risk factors among stroke survivors compared to controls. Stroke survivors were more likely treated for all risk factors versus controls, including hypertension (92.5% vs. 89.0%, p<0.0001), diabetes (88.3% vs. 81.4%, p<0.0001), and dyslipidemia (76.3% vs. 61.9%, p<0.0001). Table 3 shows that adjusting for age slightly decreased the effect for treating hypertension and dyslipidemia, but it remained significant. Adjusting for age had no effect for treating diabetes. This suggests that the age difference between the two groups does not explain these observations.

Table 5 shows predictors of treatment of among stroke survivors aware of their vascular risk factors. Hypertension was more likely treated among blacks (94.2 vs. 90.6%, p=0.0013) and higher BMI (94.8% for participants with BMI ≥ 30 kg/m^2 compared to 89.8% for participants with BMI < 25 kg/m^2). None of the predictors explained differences in diabetes treatment among stroke survivors. Treatment of dyslipidemia among stroke survivors was more frequent in men than women (82.2% versus 71.4%; $p < 0.0001$), past smokers than current smokers (75.0% of never smokers, 79.7% of past smokers, and 70.9% of current smokers; $p = 0.0057$), for older participants (64.4% of those 45–54, 74.7% for 55–64, 78.3% for 65–74, and 77.7% for those 75 or older; $p = 0.022$), with higher BMI (71.6% of those

with BMI < 25 kg/m^2, 77.5% for those with BMI between 25 and 29.9, and 77.8 for those with BMI ≥ 30; p = 0.047), and for those reporting moderately high incomes (p = 0.013).

Risk Factor Control

Table 2c shows successful control of hypertension, diabetes, and lipids among participants treated for these risk factors. Stroke survivors had higher rates of uncontrolled hypertension (33.3% vs. 30.4%, p=0.0074) and Stage 2 hypertension (9.1% vs. 7.6%, p=0.017). Table 3 shows that adjusting for age slightly decreased the effect for hypertension and Stage 2 hypertension, but differences were still significant. Adjusting for age and medication compliance decreased the effect slightly further for hypertension and Stage 2 hypertension, but the effect became non-significant. This suggests that medication compliance may have a very small effect in explaining these observations. There was no difference in control of diabetes between cases and controls (p = 0.48). Stroke survivors were more likely to control LDL to <100mg/dL versus stroke-free controls (46.2% vs. 36.7%; p < 0.0001). Adjusting for age slightly decreased the effect for dyslipidemia, but it remained significant. Adjusting further for age and medication compliance had no effect for dyslipidemia.

Table 6 shows predictors of risk factor control among stroke survivors. Hypertension was better controlled among whites versus blacks (72.8% vs. 61.2%; p < 0.0001), lower BMI (p<0.0001), higher income (p = 0.0010), higher education (p = 0.0013), and residents of the Stroke Belt (p=0.030). Control of diabetes was not significantly associated with any predictive factor (p > 0.05). Control of dyslipidemia was better in males (53.7% versus 39.7%; p < 0.0001), and among whites (53.7% versus 39.7; p = 0.0003). Successful control of lipids improved with age, ranging from 38.6% in younger patients to 50.6% in older patients (p = 0.0020). Finally, control of dyslipidemia was better (p < 0.0001) among past smokers (52.4%) compared to never (40.7%) or current smokers (42.1%).

COMMENT

Although stroke and TIA survivors require optimal management of vascular risk factors, these results show that they have striking rates of undiagnosed hypertension and diabetes: nearly one-fifth had unrecognized hypertension, 4.4% had unrecognized Stage 2 hypertension, and 4.2% had unrecognized diabetes. Rates of unrecognized risk factors were higher in stroke/TIA survivors versus stroke-free participants: stroke survivors were twice as likely to have unrecognized Stage 2 hypertension versus stroke-free controls. In addition, stroke survivors taking blood pressure medication were less likely to effectively control their hypertension. Clearly, stroke survivors are not effectively recognizing and managing vascular risk factors to prevent subsequent strokes.

While rates of recognition and control of vascular risk factors in stroke survivors are unacceptably high, certain subgroups were worse. Increasing BMI was associated with increasing rates of unrecognized hypertension and diabetes. Lower education was associated with higher rates of unrecognized diabetes and a tendency for unrecognized hypertension. Finally, lower income was associated with unrecognized dyslipidemia and lower treatment rates of all three risk factors. Therefore, stroke survivors in these subgroups require extra attention for risk factor control.

A limitation of this study is that these self-reported past strokes and TIAs were not confirmed through medical records (REGARDS does confirm incident strokes). However, self-reported stroke is relatively sensitive, specific,(25, 26) and reliably reported.(27) The confirmation rate of self-reported stroke is reported as 54% to 70%,(28–31) suggesting that some self-reported strokes in REGARDS could be false positives. However, self-reported

stroke is a well-known predictor of subsequent stroke; therefore these patients should still have heightened recognition and control of these risk factors.

Conversely, some of the stroke-free controls in this study may have had a stroke or TIA but did not report it. A previous REGARDS publication found that 17.8% of patients who reported never having had a stroke or TIA actually reported past stroke symptoms, such as transient speech difficulties, hemiplegia, or hemisensory loss.(22) Although 10–15% of strokes are hemorrhagic,(32) there is no information on stroke types for these self-reported strokes (REGARDS does subtype incident strokes). However, hypertension is a major risk factor for all stroke types and should be treated in all strokes subtypes. In contrast, aggressive lowering of lipids is mandated for ischemic but not hemorrhagic stroke.(33) Finally, patients and physicians may not consider TIAs as hazardous as strokes, even though they are ominous for future stroke and deserve serious attention.(9–11)

Hypertension is the leading risk factor for stroke and is present in nearly 1 in 3 American adults.(34) The risk of stroke continuously increases above blood pressures of 115/75 mm Hg.(35) and the guidelines recommend treating hypertension in all stroke patients, except in the hyperacute period.(5, 36) The guidelines don't give specific blood pressure targets, although they state that normal blood pressure is <120/80 mm Hg by JNC-7(24) and that benefit is associated with reductions starting at just 10/5 mm Hg. Studies have shown that a 5 mm Hg reduction in diastolic blood pressure is associated with a 30% – 40% lower stroke risk.(35, 37, 38) Our definition of controlled hypertension was SBP <140 and DBP <90 mm Hg, measured at the in home examination, although in actual practice lower blood pressures are desirable. Rates of uncontrolled hypertension would have higher in both groups had we defined controlled hypertension at a lower threshold.

Diabetes is a clear risk factor for both first-ever and recurrent strokes. The guidelines recommend treating glucose to near-normoglycemic levels in stroke or TIA patients with diabetes, and more rigorous control of hypertension and dyslipidemia in diabetic stroke patients.(5) Diabetes was an independent predictor of secondary stroke in 1,111 stroke patients in Rochester, Minnesota (RR, 1.7; 95%CI, 1.26–2.24, p = 0.0004)(1) and in 1,626 stroke patients from South London (HR: 1.85; 95%CI, 1.18, 2.90).(4) The current REGARDS data show that rates of undiagnosed diabetes not as bad as for hypertension; however treatment and control of diabetes was worse.

Dyslipidemia is the third risk factor included, however it is not as strong a risk factor for stroke as it is for coronary heart disease. A recent update to the guidelines recommend that stroke survivors take statins if they have atherosclerotic ischemic stroke or TIA regardless of coronary heart disease.(12) LDL should be treated to <100mg/dL or to <70mg/dL for patients with multiple risk factors.(5, 12) Our analysis dichotomized values at <100mg/dL, so the rates of unrecognized and uncontrolled dyslipidemia would have been even higher if the cut-off were <70 mg/dL. Unlike hypertension and diabetes, the rate of undiagnosed dyslipidemia was lower among stroke survivors than controls, suggesting that more attention should be directed to hypertension and diabetes in stroke survivors.

Although these patients were aware of a past stroke or TIA, many were unaware of being hypertensive or diabetic. While it is possible that these unrecognized and uncontrolled risk factors existed prior to and contributed to the stroke, it is surprising that so many stroke survivors were so poorly managed after their strokes or TIAs. It is certainly frustrating that current guidelines are not effectively implemented in clinical practice. Considering the huge impact of stroke on society, innovative approaches are needed to improve control of vascular risk factors in stroke survivors.

Acknowledgments

The authors acknowledge the participating investigators and institutions for their contributions: University of Alabama at Birmingham, Birmingham, Alabama (Study PI, Data Coordinating Center, Survey Research Unit): George Howard, Leslie McClure, Virginia Howard, Virginia Wadley, Rodney Go; University of Vermont (Central Laboratory): Mary Cushman; Wake Forest University Medical Center (ECG Reading Center): Ron Prineas; Alabama Neurological Institute (Stroke Validation Center, Medical Monitoring): Camilo Gomez; University of Arkansas for Medical Sciences (Survey Research): LeaVonne Pulley; University of Cincinnati: Brett Kissela, Dawn Kleindorfer; Examination Management Services Incorporated (In-Home Visits): Andra Graham; and National Institute of Neurological Disorders and Stroke, National Institutes of Health (funding agency): Claudia Moy.

REGARDS is supported by a cooperative agreement U01 NS041588 from the National Institute of Neurological Disorders and Stroke, National Institutes of Health, Department of Health and Human Services. This funding supports the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, and approval of the manuscript.

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Table 1

Characteristics of participants self-reporting stroke or TIA(stroke survivors) and those without (controls).

Characteristic		Stroke survivors	Controls
N		2,830	24,886
Age (%)	45–54	6.2	12.3
	55–64	29.0	29.7
	65–74	35.8	32.2
	75+	29.1	15.9
Female (%)		53.3	55.4
African American (%)		49.3	41.8
Region (%)	Stroke Belt	34.7	36.5
	Stroke Buckle	18.6	19.3
	Rest of Nation	46.7	44.2
BMI (%)	≤25	26.1	24.7
	25–30	35.9	36.8
	30+	38.0	38.4
Smoking (%)	Never	39.0	45.6
	Past	43.4	40.1
	Current	17.6	14.4
Income (%)	<$20K	32.7	20.2
	$20K – $35K	33.4	27.4
	$35K – $75K	25.0	34.5
	$75K+	9.0	17.9
Education (%)	<High School	21.6	12.0
	High School Grad	27.0	26.2
	Some College	25.9	27.0
	College Grad	25.4	34.9

Table 2

a) Proportion unaware of risk factor discovered during the in-home examination. b) Proportion treated for risk factor among those aware of having it. c) Proportion controlled if treatment for risk factor. Note that treated was considered only among those self-reporting the risk factor, and therefore there's no possible value for Stage 2 hypertension in the treated column.

		a) Unrecognized			b) Treated			c) Controlled		
Condition		**Denying condition N**	**Condition present N (%)**	***P***	**Aware N**	**Reporting treatment N (%)**	***P***	**Treated N**	**Successfully controlled N (%)**	***P***
HTN	Stroke/TIA	593	111 (18.7%)	0.0003	2,218	2,051 (92.5%)	<0.0001	2,200	1,468 (66.7%)	0.0074
	Control	10,834	1,459 (13.5%)		13,838	12,322 (89.0%)		13,715	9,541 (69.6%)	
HTN Stage 2	Stroke/TIA	593	26 (4.4%)	0.0006				2,200	2000 (90.9%)	0.017
	Control	10,834	239 (2.2%)					13,715	12,671 (92.4%)	
Diabetes	Stroke/TIA	1,750	73 (4.2%)	0.026	982	867 (88.3%)	<0.0001	895	530 (59.2%)	0.48
	Control	18,808	599 (3.2%)		5,163	4,203 (81.4%)		4,876	2,949 (60.5%)	
Dyslipidemia	Stroke/TIA	1,018	602 (59.1%)	<0.0001	1,720	1,313 (76.3%)	<0.0001	1,555	718 (46.2%)	<0.0001
	Control	11,363	7,445 (65.5%)		12,650	7,828 (61.9%)		11,923	4,373 (36.7%)	

Table 3

OR (95% CI) of stroke/TIA participants having unrecognized risk factor, treatment, and success control for each risk factor compared to stroke-free participants in several models:

Condition	Unrecognized	Treated	Controlled
HTN	1.48 (1.20–1.83) * 1.25 (1.01 –1.55) **	1.51 (1.28–1.79) * 1.41 (1.19–1.66) **	0.88 (0.80 – 0.97) * 0.90 (0.82 – 0.99) ** 0.93 (0.84–1.03) †
HTN Stage 2	2.03 (1.35–3.08) * 1.78 (1.17–2.71) **		0.82 (0.70 – 0.97) * 0.84 (0.72 – 0.98) ** 0.87(0.73–1.02) †
DM	1.32 (1.03–1.70) * 1.35 (1.05–1.74) **	1.72 (1.40–2.12) * 1.73 (1.40–2.12) **	0.95 (0.82–1.10) * 0.92 (0.79–1.06) ** 0.95(0.817–1.11) †
Dyslipidemia	0.76 (0.67 – 0.87) * 0.80 (0.70–0.91) **	1.99 (1.77–2.23) * 1.82 (1.62–2.05) **	1.48 (1.33–1.65) * 1.35 (1.21 –1.51) ** 1.37 (1.22–1.53) †

* univariate,

** adjusted for age,

† adjusted for age and medication compliance measured by the Mori sky scale.

Table 4

Predictors of undiagnosed risk factors among stroke/TIA survivors.

		Undiagnosed Hypertension			Undiagnosed Diabetes			Undiagnosed Dyslipidemia		
		N	Present by Measurement N(%)	P-Value	N	Present by Measurement N(%)	P-Value	N	Present by Measurement N(%)	P-Value
Age	45–54	61	8 (13.1%)	0.19	122	2 (1.6%)	0.38	80	55 (68.8%)	0.20
	55-64	156	30 (19.2%)		463	23 (5.0%)		277	169 (61.0%)	
	65-74	180	28 (15.6%)		583	22 (3.8%)		366	193 (57.4%)	
	75+	196	45 (23.0%)		581	26 (1.5%)		323	183 (56.7%)	
Sex	Female	305	59 (19.3%)	0.69	942	39 (4.4%)	0.94	518	320 (61.8%)	0.077
	Male	288	52 (18.1%)		808	34 (4.2%)		499	281 (56.3%)	
Race	Black	205	48 (23.4%)	0.033	721	36 (5.0%)	0.15	545	320 (58.7%)	0.79
	White	338	63 (16.2%)		1029	37 (3.6%)		472	281 (59.5%)	
Region	Nonbelt	289	60 (20.8%)	0.34	826	32 (3.9%)	0.77	491	280 (57.0%)	0.079
	Belt	193	35 (18.1%)		592	25 (4.2%)		339	217 (64.0%)	
	Buckle	111	16 (14.4%)		332	16 (4.8%)		188	105 (55.9%)	
BMI	<25	209	30 (14.4%)	0.0065	553	22 (2.0%)	0.0066	304	175 (57.6%)	0.57
	25-30	228	39 (17.1%)		660	32 (4.9%)		344	212 (61.6%)	
	30+	151	41 (27.2%)		527	29 (5.6%)		353	209 (59.2%)	
Smoking	Never	212	34 (16.0%)	0.39	686	30 (1.7%)	0.54	396	231 (58.3%)	0.10
	Past	252	53 (21.0%)		733	33 (4.5%)		437	249 (57.0%)	
	Current	127	24 (19.9%)		325	10 (3..1%)		180	119 (66.1%)	
Income	<$20K	127	20 (6 3.0%)	0.19	150	5 (3.3%)	0.87	289	182 (63.0%)	0.0056
	$20K - $35K	175	39 (22.3%)		406	17 (4.2%)		302	159 (52.7%)	
	$35K - $75K	146	24 (16.4%)		672	32 (4.8%)		212	120 (56.6%)	
	$75K+	55	6 (10.9%)		414	14 (3.4%)		75	54 (72.0%)	
Education	< HS	99	27 (27.3%)	0.069	437	26 (6.0%)	0.028	215	129 (60.0%)	0.88
	HS Grad	159	25 (15.7%)		495	18 (3.6%)		271	155 (57.2%)	
	Some College	149	30 (20.1%)		406	22 (5.4%)		260	154 (49.2%)	
	College Grad	186	29 (15.6%)		154	1 (0.65%)		268	162 (60.5%)	

J Stroke Cerebrovasc Dis. Author manuscript; available in PMC 2013 March 23.

Table 5

Predictors of treatment among stroke/TIA survivors among those aware.

		Treatment for Hypertension			Treatment for Diabetes			Treatment for Dyslipidemia		
		N	Diabetes N (%)	P-Value	N	Diabetes N(%)	P-Value	N	Treated N(%)	P-Value
Age	45–54	112	101 (90.2%)	0.82	47	36 (76.6%)	0.052	90	58 (64.4%)	0.022
	55–64	626	612 (92.5%)		334	302 (90.4%)		518	387 (74.7%)	
	65–74	826	765 (92.6%)		391	344 (88.0%)		640	501 (78.3%)	
	75+	616	571 (92.7%)		209	184 (88.0%)		471	366 (77.7%)	
Sex	Female	1190	1108 (93.1%)	0.22	508	442 (87.0%)	0.20	933	666 (71.4%)	< 0.0001
	Male	1028	943 (91.7%)		474	425 (90.0%)		787	647 (82.2%)	
Race	Black	1155	1088 (94.2%)	0.0013	591	527 (89.2%)	0.28	767	587 (76.5%)	0.85
	White	1062	962 (90.6%)		390	339 (86.9%)		952	725 (76.2%)	
Region	Nonbelt	1024	954 (93.2%)	0.37	465	419 (90.1%)	0.19	780	597 (76.5%)	0.98
	Belt	781	714 (91.4%)		342	294 (86.0%)		609	464 (76.2%)	
	Buckle	413	383 (82.7%)		175	154 (88.0%)		331	252 (76.1%)	
BMI	<25	512	460 (89.8%)	0.0017	144	124 (86.1%)	0.13	394	282 (71.6%)	0.047
	25–30	764	700 (91.6%)		310	226 (85.8%)		626	485 (77.5%)	
	30+	900	853 (94.8%)		505	455 (90.1%)		670	521 (77.8%)	
Smoking	Never	882	821 (93.1%)	0.25	372	330 (88.7%)	0.27	660	495 (75.0%)	0.0057
	Past	964	894 (92.7%)		459	404 (88.0%)		763	608 (79.7%)	
	Current	366	331 (90.4%)		150	133 (88.7%)		295	209 (70.9%)	
Income	<$20K	656	606 (92.4%)	0.010	311	268 (86.2%)	0.012	457	336 (73.5%)	0.013
	$20K – $35K	621	590 (95.0%)		284	262 (92.3%)		483	365 (75.6%)	
	$35K – $75K	451	404 (89.6%)		182	158 (86.8%)		376	311 (82.7%)	
	$75K+	159	146 (91.8%)		55	43 (78.2%)		137	103 (75.2%)	
Education	<HS	508	467 (91.9%)	0.89	247	216 (87.5%)	0.75	367	281 (76.6%)	0.88
	HS Grad	597	551 (92.3%)		256	230 (89.8%)		468	352 (75.2%)	
	Some College	579	539 (93.1%)		265	231 (87.2%)		452	344 (76.1%)	
	College Grad	527	489 (92.8%)		210	187 (89.1%)		431	334 (77.5%)	

Table 6

Successful control of risk factors among treated stroke/TIA survivors (hypertension: SBP < 140 mmHg, DBP < 90 mmHg; diabetes: glucose < 126 mg/dL fasting or < 200 mg/dL nonfasting, and LDL < 100 mg/dL)

		Control of Hypertension			Control of Diabetes			Control of Dyslipidemia		
		N	Diabetes N (%)	P-Value	N	Diabetes N(%)	P-Value	N	Treated N(%)	P-Value
Age	45–54	111	79 (71.2%)	0.21	44	23 (52.3%)	0.37	83	32 (38.6%)	0.020
	55–64	656	419 (63.9%)		303	173 (57.1%)		455	189 (41.5%)	
	65–74	819	561 (68.5%)		356	211 (59.3%)		575	274 (47.7%)	
	75+	612	408 (66.7%)		191	122 (63.9%)		441	233 (50.6%)	
Sex	Female	1181	796 (67.4%)	0.47	448	278 (62.1%)	0.084	832	330 (39.7%)	< 0.0001
	Male	1019	672 (66.0%)		447	252 (56.4%)		723	338 (53.7%)	
Race	Black	1148	703 (41 .1%)	<0.0001	535	318 (59.4%)	0.84	684	281 (41.1%)	0.0003
	White	1051	765 (72.8%)		358	211 (58.8%)		870	437 (50.2%)	
Region	Nonbelt	1016	649 (63.9%)	0.030	422	249 (59.0%)	0.62	719	315 (43.8%)	0.22
	Belt	774	533 (68.9%)		308	178 (57.8%)		532	255 (47.9%)	
	Buckle	410	286 (69.8%)		165	103 (62.4%)		304	148 (48.7%)	
BMI	<25	511	355 (69.5%)	<0.0001	124	79 (63.7%)	0.28	354	153 (43.2%)	0.13
	25–30	754	537 (71.2%)		291	178 (61.2%)		580	285 (49.1%)	
	30+	897	548 (61.1%)		461	262 (56.8%)		596	264 (44.3%)	
Smoking	Never	875	581 (66.4%)	0.48	333	201 (60.4%)	0.63	605	246 (40.7%)	<0.0001
	Past	958	651 (68.0%)		433	257 (59.4%)		696	365 (52.4%)	
	Current	361	233 (64.5%)		128	71 (55.5%)		252	106 (42.1%)	
Income	<$20K	651	415 (63.8%)	0.0010	275	160 (58.2%)	0.67	400	182 (45.5%)	0.65
	$20K – $35K	616	394 (64.0%)		262	149 (56.9%)		446	216 (48.4%)	
	$35K – $75K	444	324 (73.0%)		173	108 (62.4%)		349	174 (49.9%)	
	$75K+	158	118 (74.1%)		52	32 (61.5%)		127	63 (49.6%)	
Education	<HS	506	311 (61.5%)	0.0013	219	119 (54.3%)	0.10	320	133 (41.6%)	0.078
	HS Grad	591	382 (64.6%)		240	135 (56.3%)		440	199 (45.2%)	
	Some College	574	395 (68.8%)		235	150 (63.8%)		395	202 (51.1%)	

		Control of Hypertension			**Control of Diabetes**			**Control of Dyslipidemia**		
		N	**Diabetes N (%)**	**P-Value**	**N**	**Diabetes N(%)**	**P-Value**	**N**	**Treated N(%)**	**P-Value**
	College Grad	522	377 (72.2%)		197	124 (62.9%)		398	183 (46.0%)	