Stoke is the third leading cause of morbidity and mortality in both men and women behind heart disease and cancer. The incidence of stroke is approximately the same in men and women; however, after the age of 75 years, the incidence of stroke is much greater in women. The lifetime risk of stroke is greater in women, which may be explained in part by women’s increased life expectancy. The 2-year recurrence rate for stroke was significantly higher in women in a high-risk population with symptomatic intracranial arterial stenosis. Although there has been a decline in mortality rates for stroke in men, this advance is not as evident in women explaining the alarming statistic that >67% of stroke deaths now occur in women.

Disability and functional outcomes also appear worse in women because they are more likely to require institutional care after a stroke compared with age-matched men, adding significantly to the economic burden of stroke. In addition, differences in the acute management of patients with stroke have been documented with women experiencing greater emergency department wait times and less diagnostic testing.

The risk profiles for stroke for men and women also differ with men being much more likely to have the risk factors of heart disease and smoking and women more likely to be hypertensive and have atrial fibrillation. It is uncertain whether the varying risk factor profiles are more reflective of biological differences or of lifestyle differences between the 2 groups.

Recently, investigators documented a midlife stroke surge in women ages 45 to 54, an age group traditionally at low risk for stroke. This difference was attributed to an increase in risk factors related to metabolic syndrome such as increased abdominal girth and diabetes. These results suggest that there is a need for targeted primary prevention in the perimenopausal age group. The factors of estrogen and pregnancy are modulators of vasculature. Because of recent publicity about hormone replacement therapy and heart disease and stroke, this group may be particularly receptive to education initiatives.

The objective of the current study was to integrate theory from social science research to understand knowledge of
stroke risk factors and warning signs as well as risk perception of stroke in middle-aged women with at least one risk factor for stroke.

Methods

A model was developed to show predicted relationships between studied variables (Figure 1). The key independent variables were personal risk factors and knowledge of risk factors. Perception of risk was the major dependent variable.

Participants

The University of Connecticut and the Hartford Hospital Institutional Review Board approved the study. Eight hundred five female patients, ages 50 to 70 years, from the University of Connecticut Cardiology Center (ages 50 to 70 years) were selected from the following International Classification of Diseases, 9th Revision billing codes: 250.0, 272.4, 401.1, 401.9, 410.1, 410.4, 411.1, 413.9, 414.0, 414.9, 427.31, 436.0, 440.21, and 443.9. The women received billing codes: 250.0, 272.4, 401.1, 401.9, 410.1, 410.4, 411.1, 413.9, 414.0, 414.9, 427.31, 436.0, 440.21, and 443.9. The women received the survey in 2 separate mailings with 37 envelopes returned for incorrect addresses. One hundred twenty-nine women responded to the first mailing and an additional 86 responded to the second mailing, for a total of 215 returned (28% response rate).

Questionnaire

A 36-item, 5-part questionnaire was developed using elements from prior surveys about knowledge, warning signs, and risk perception. Section 1 asked about knowledge of warning signs and risk factors for stroke. Section 2 addressed risk perception and Section 3 asked about personal risk factors. Section 4 addressed indicators for access to health care and Section 5 inquired about sociodemographic factors.

Women were asked to list up to 5 warning signs for stroke, for which coded answers included: weakness or numbness, vision changes, loss of balance or dizziness, headache, confusion, and speech problems (Figure 2A). A model was developed to show predicted relationships between studied variables (Figure 1). The key independent variables were personal risk factors and knowledge of risk factors. Perception of risk was the major dependent variable.

Figure 1. Research model. We hypothesized that a woman’s risk factors for stroke and risk perception as well as her access to medical care would mediate the success of primary prevention measures. We also predicted that health literacy measures such as education and knowledge of stroke warning signs/risk factors would predict perceived risk.

Figure 2. A, Warning signs of stroke and (B) identification of personal risk factors. A, Shown is the percentage of women who identified a particular warning sign for stroke. Subjects were asked to list up to 5 warning signs. Only the responses shown were coded. B, RF indicates risk factor; HBP, high blood pressure; Chol, high cholesterol; Tob, lifetime tobacco use; DM, diabetes mellitus; HD/MI, heart disease or myocardial infarction; CS, carotid stenosis; A Fib, atrial fibrillation; Total, number of women responding. The dark gray bar identifies the number of women who had the particular risk factor and identified it as a risk factor for stroke. The light gray bar is the number of women with the particular risk factor. The difference between the 2 bars is the number of women with a particular risk factor who did not identify it as a risk factor for stroke.

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taken out of the independent variable of interest so that only this variable’s contribution is assessed. The semipartial correlation is related to the change in $R^2$ when a variable is added to an equation so that the higher the number, the more important the variable’s contribution is to the correlation coefficient.

The B value reflects the slope of the regression line as determined by the contributions of each significant independent variable. A B value $>0$ represents a positive correlation, with a larger number indicating a more robust relationship. A B value $<0$ indicates an inverse relationship, with a more negative number indicating a more robust relationship. The $P$ value evaluates the unique variance that an independent variable adds to the regression coefficient, and thus an important independent variable that shares variance with another independent variable may be insignificant in the analysis. The 95% CIs for the B value were also included (Table 3B) to show that the slope did not cross zero.

### Results

#### Sample Characteristics

Women ranged in age from 50 to 73 years with a mean age of 63.0 years (SD, 7.2). The majority of the sample was white (91.5%; Table 1). A total of 33.1% of the population earned more than $75,000 annually and 28.6% of the population had attended graduate or professional school.

#### Stroke Knowledge and Risk Factors

Women identified an average of 2.7 (SD, 1.6) out of 6 possible warning signs (Figure 2A). Although 71.2% of women identified weakness or numbness as a warning sign, approximately one third of respondents named vision changes (34.1%), dizziness or balance problems (33.6%), headache (32.2%), or confusion (26%) as a warning sign. A total of 69.3% of women identified trouble speaking as a warning sign.

Patients’ risk factors for stroke are shown in Table 2A. Women also were asked to identify any risk factors for stroke (Table 2B). An average of 3.9 (SD, 1.8) out of 11 coded modifiable risk factors were identified. Only 3.3% of women (n=7) identified atrial fibrillation as a risk factor for stroke. Heart disease was identified as a risk factor 16.3% of the time (n=35). Women often did not identify their own risk factors as placing them at risk for stroke (Figure 2B). For example, only 2 of the 37 (5.4%) women with atrial fibrillation and 11 of the 71 women with heart disease (15.5%) identified their own health condition as a risk factor.

Stroke knowledge, measured by number of stroke warning signs and risk factors identified, did not correlate with worrying about stroke or risk perception in bivariate analysis.

#### Perception of Risk

Mean perception of risk was 5.7 (SD, 2.3; 10-point scale) and perception of other women’s risk was rated as 5.5 (SD, 1.7; 10-point scale; Table 3A). Women saw their risk as similar to that of their peers. A majority of women worry about stroke rarely or never, whereas one third of women worry about stroke sometimes or frequently. A total of 64.6% of women perceived their health as good or excellent.

Predictors of risk perception in multivariate analysis included: other women’s risk of stroke ($B=0.336$, $P<0.001$), worrying about stroke ($B=0.734$, $P<0.001$), and having...

### Table 1. Sample Characteristics

<table>
<thead>
<tr>
<th>Sample Characteristics</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, years</td>
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<tr>
<td>Race</td>
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<td></td>
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<tr>
<td>White</td>
<td>194</td>
<td>91.5</td>
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<tr>
<td>Black</td>
<td>12</td>
<td>5.6</td>
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<tr>
<td>Other</td>
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<td>2.9</td>
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<tr>
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<tr>
<td>Divorced/separated</td>
<td>44</td>
<td>21.5</td>
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<tr>
<td>Widowed</td>
<td>24</td>
<td>11.2</td>
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<tr>
<td>Never married</td>
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<td>10.3</td>
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<tr>
<td>Income</td>
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<td>&lt;$25,000</td>
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<td>21.6</td>
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<td>$25,000 to 34,999</td>
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<td>11.3</td>
</tr>
<tr>
<td>$35,000 to 49,999</td>
<td>22</td>
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<td>8</td>
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<td>High school diploma or GED</td>
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<tr>
<td>Some college or trade school</td>
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<td>22.1</td>
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<tr>
<td>College degree</td>
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<td>21.1</td>
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<tr>
<td>Graduate or professional school</td>
<td>61</td>
<td>28.6</td>
</tr>
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</table>

### Table 2. Presence of Risk Factors (A) and Identification of Risk Factors (B)

<table>
<thead>
<tr>
<th>A, Have Risk Factor</th>
<th>N</th>
<th>Percent</th>
<th>B, Identified Risk Factor</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>162</td>
<td>76.4</td>
<td>Hypertension</td>
<td>154</td>
<td>71.6</td>
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<tr>
<td>High cholesterol</td>
<td>157</td>
<td>77.3</td>
<td>Smoking</td>
<td>135</td>
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<tr>
<td>Smoke ever</td>
<td>111</td>
<td>52.4</td>
<td>Overweight</td>
<td>122</td>
<td>56.7</td>
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<tr>
<td>Diabetes</td>
<td>68</td>
<td>32.5</td>
<td>High cholesterol</td>
<td>116</td>
<td>54</td>
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<tr>
<td>Angina/coronary artery disease</td>
<td>55</td>
<td>27</td>
<td>Lack of exercise</td>
<td>102</td>
<td>47.4</td>
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<tr>
<td>Atrial fibrillation</td>
<td>37</td>
<td>17.8</td>
<td>Diabetes</td>
<td>78</td>
<td>36.3</td>
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<tr>
<td>Carotid stenosis</td>
<td>37</td>
<td>17.9</td>
<td>Poor diet</td>
<td>74</td>
<td>34.4</td>
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<tr>
<td>Prior heart attack</td>
<td>36</td>
<td>17.1</td>
<td>Increased stress</td>
<td>46</td>
<td>21.5</td>
</tr>
<tr>
<td>Prior stroke/transient ischemic attack</td>
<td>23</td>
<td>11.1</td>
<td>Heart disease/coronary artery disease</td>
<td>35</td>
<td>16.3</td>
</tr>
<tr>
<td>Smoke currently</td>
<td>15</td>
<td>7.1</td>
<td>Carotid stenosis/atherosclerosis</td>
<td>16</td>
<td>7.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Atrial fibrillation</td>
<td>7</td>
<td>3.3</td>
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</table>
hypertension (B=0.686, P=0.037) and diabetes (B=0.893, P=0.004). Variables included in the model showed a significant correlation with bivariate analysis. The following variables were not significant in the model: perceived health, prior stroke, prior transient ischemic attack, carotid artery stenosis, smoking (at least 100 lifetime cigarettes), and HMO coverage (Table 3B).

Access to Health Care
The majority of the sample had health insurance, prescription coverage, and a primary care doctor. However, even in this population, 9.9% of women (n=21) reported being unable to attend a medical appointment because of cost, and 17.8% of women (n=37) reported being unable to take a medication because of cost. Women had seen their primary care physician an average of 7.5 months prior with a range from 0 to 84 months. The average office copay was $16.97 (SD, $31.90) and the average spent per month on prescriptions was $97.49 (SD, $157.24).

In multivariate analysis, having prescription coverage (B=−41.803, P<0.001) and a primary care provider (B=−10.391, P=0.017) was inversely related to the length of time since an office visit. Statistically significant in bivariate correlations but not in the model were: having health insurance, being unable to see doctor of cost (in the past 12 months), and amount of office visit copay. Those who lack prescription coverage and a primary care provider are more likely to have increased time in between office visits. There was no significant relationship for number of health conditions and length of time since seeing a physician.

Primary Prevention
Several aspects of primary prevention were addressed in this survey. A total of 86.6% (n=136) of patients with hypertension reported good control with blood pressures <140/90 mm Hg. Over half of women (52.4% [n=111]) had smoked >100 cigarettes in their lifetime, but only 7.1% of women (n=15) still smoked. A total of 62.1% (n=41) of diabetics reported having an A1C <6.5%. Only 63.9% of women with atrial fibrillation (n=23) reported taking warfarin. Cholesterol control was defined as a low-density lipoprotein of <100, and 68.3% (n=97) patients reported obtaining this goal. A total of 62.6% (n=132) of subjects reported taking daily aspirin, whereas 22.2% (n=46) had a medical condition that made taking aspirin unsafe.

Discussion
This survey analysis found that a group of high-risk women have low perception of their personal risk for stroke and that they do not perceive their risk to be different from other women. In light of recent data that show a stroke surge in women ages 45 to 54 years, this may be the group who most serves to gain from primary prevention efforts. The lack of knowledge and risk perception in this population is a strong call to action to make stroke education a priority for women of all racial/ethnic and socioeconomic backgrounds.

Stroke Knowledge of Warning Signs and Risk Factors
Health literacy was measured in our model (Figure 1) by stroke knowledge of warning signs and risk factors as well as correctly identifying personal health conditions as stroke risk factors. Low knowledge of risk factors and warning signs for stroke has been documented in large-scale surveys. People are generally able to name risk factors such as stress, high blood pressure, diet, and smoking as causes of stroke, but do not identify health conditions such as atrial fibrillation.
or diabetes. Our data supported these findings. Knowledge of warning signs is still lacking in many at-risk populations, which may directly affect emergency room arrival times. Many women listed warning signs such as chest pain or arm pain, suggesting that confusion remains about the difference between a stroke and a heart attack.

In one study, knowledge of a risk factor was shown to be superior in those affected by it. Our results suggest that this is not the case in our population. Surprisingly, persons with atrial fibrillation or carotid stenosis often did not identify these conditions as a risk factor for stroke, although they are known to dramatically increase risk. Stroke knowledge has been shown to be poorest in groups at highest risk, and these groups represent missed opportunities for primary prevention.

Perception of Risk
Risk perception, as suggested by the Health Belief Model, is a key element in understanding how persons become motivated to change health behaviors. Many factors such as education, presence of disease-specific symptoms, media campaigns, physician or peer recommendations, socioeconomic variables, or cultural beliefs can influence the likelihood of behavioral change. This model can be used to study the primary prevention of stroke in that individual risk perception may modulate primary prevention measures such as blood pressure control, medication adherence, or behavioral and lifestyle changes. In assessment of our model, stroke knowledge of risk factors or warning signs did not predict perception of risk. The number of risk factors also did not correlate with risk perception. This suggests that risk perception is a subjective measure, which is not entirely modulated by stroke knowledge or actual risk.

Breast cancer campaigns targeted at women such as “Race for the Cure” and the pink ribbon campaign are examples of a successful education and outreach initiative that has increased risk perception. Women perceive breast cancer to be one of the largest health concerns they face today despite the fact that 6 times more women die of stroke and heart disease. Patients’ perception of high self-risk has been shown to be a reliable predictor of mammography screening rates. Most women do not perceive stroke or heart disease to be a major health concern and report that they are not well informed about their risk. The American Heart Association’s recent campaign “Go Red for Heart Disease” may serve as a vehicle to increase risk perception about heart disease and stroke.

Access to Health Care
The patient population studied had increased access considering that they had received specialty care within the past year at a cardiology practice. However, even in this select population, there were barriers to optimal care. A proportion of women reported being unable to see a physician for a scheduled appointment in the past year because of cost. Whether this was a primary care visit or specialty visit was not reported. An even greater percentage was unable to take a medication because of cost in the past year. Efforts in education and increasing risk perception are undermined if high-risk populations are unable to obtain the advice or the medications that are essential to reducing their stroke risk factors. Surprisingly, perception of risk was not related to access to a physician or length of time since follow-up. This suggests that specialty physicians, treating conditions such as hypertension, diabetes, and heart disease, are not emphasizing patients’ stroke risk in clinical encounters.

Primary Prevention
Primary prevention is the goal and the final step in our model, which is intrinsically dependent on access to care and adherence to treatment. In women, it has been shown that a healthy lifestyle, consisting of low body mass index, abstinence from smoking, moderate consumption of alcohol, and a healthy diet and regular exercise were associated with a lower incidence of ischemic and total stroke. This survey did not address health outcomes, but even in this patient population who seeks regular specialty care, there were still women smoking, not taking aspirin with no contraindication to do so, and with poorly controlled hypertension and cholesterol.

Most surprisingly, more than one third of our sample with atrial fibrillation reported not taking warfarin. This population may represent a mix of women with true contraindications to warfarin use as well as reflect patients for whom physicians are averse to prescribing anticoagulation therapy. This is despite evidence in that patients with a stroke and a history of atrial fibrillation, the majority are subtherapeutic or not taking warfarin at the time of their event. In addition, women with atrial fibrillation have higher rates of off-warfarin thromboembolic risk compared with men, placing them at higher risk.

There are several limitations of this study. Like in all survey studies, there was a selection bias for women who returned the survey. Women were predominately white and living in a suburban area, and whether these results can be extended to a more urban, ethnically diverse population is unknown. It would be expected that barriers to primary prevention would be greater in such populations. In addition, all women were asked to identify warning signs and risk factors without any prompting, which would tend to underreport what women actually know. The benefit of this method is that there is a sense of relationships that women have between health and behavior without cues. It is also possible that women do not identify medical terms such as “atrial fibrillation” unless they themselves have the condition.

Public Health Significance
Perimenopausal women have an increasing level of risk factors related to metabolic syndrome and increased stroke rates compared with men. To reduce stroke risk, this population must be motivated to produce behavioral change. Risk perception is a parameter that is separate from stroke knowledge and presence of personal risk factors. This parameter may predict the likelihood of behavioral change for primary prevention efforts for reducing stroke risk such as obtaining blood pressure goals, maintaining A1C below an acceptable level, quitting smoking, or increasing exercise. Our study shows that risk perception for stroke is generally low and that women often do not identify their personal health conditions placing them at increased risk. Future education campaigns
should target risk perception as an outcome measure to move toward reducing the burden that stroke places on all communities.

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Disclosures

None.

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Perception of Risk and Knowledge of Risk Factors in Women at High Risk for Stroke
Jennifer L. Dearborn and Louise D. McCullough

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