Determinants Influencing the Prestroke Health Behaviors and Cardiovascular Disease Risk of Stroke Patients: A Cross-Sectional Study

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Background: Knowledge about stroke and stroke prevention may provide motivation to lead a healthy lifestyle to prevent stroke. The goal of this study is to quantify the knowledge of stroke and stroke prevention of patients with a recent stroke and its association with health behaviors and cardiovascular disease risk. *Methods:* We conducted a prospective cross-sectional study utilizing consecutive stroke admissions at 2 hospitals in Vancouver, Canada. We included patients within 48-72 hours of admission. Stroke knowledge was measured prior to any hospital education. The Health-Promoting Lifestyle Profile II (HPLP II), a 52-item self-report scale was used to quantify health behavior for the week prior to the stroke. The cardiovascular risk score was calculated. Hierarchical multiple regression was used to assess the determinants of HPLP II and cardiovascular disease risk. *Results:* We enrolled patients with primarily mild stroke (n = 100). The mean age of participants was 66.6 ± 13.6 years and 60% were male. The participants had poor knowledge of stroke symptoms and risk factors. In the first regression analysis, the final model explained 27% of the variance in health behavior ($F(6, 93) = 5.69$, $p = <0.001$) with only age and knowledge of risk factors as statistically significant variables. In the second regression analysis, the final model explained 15% of the variance in cardiovascular disease risk ($F(7, 84) = 2.163$, $p = 0.046$) with only physical activity remaining as a statistically significant variable. *Conclusion:* The findings would inform the development of novel programs to improve the knowledge and health behavior for prevention of stroke.

Key Words: Cardiovascular disease risk—health behavior—health promoting life style profile II—stroke knowledge—stroke prevention

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Introduction

The risk for recurrent stroke is high in stroke survivors. Modifiable risk factors play a major role in the occurrence of stroke. There are several studies that explored the benefits of various health behaviors on prevention of stroke. For example, a meta-analysis showed that moderately intense physical activity had a protective effect on stroke,[1] while other studies have demonstrated that the risk of stroke is decreased with an increasing number of health behaviors.[2,3] In addition, knowledge of stroke symptoms, risk factors, and prevention could potentially motivate people to pursue a healthy lifestyle. A review of 39 published articles about stroke knowledge[4] showed that the ability to name 1 stroke symptom ranged from 25%-72%, and 1 stroke risk factor ranged from 18% to 94%, indicating that the level of knowledge regarding recognition and prevention of stroke is generally poor. In that review, 2 studies[5,6] assessed the knowledge in acute stroke patients, and both of these studies were done more than 15 years ago. Knowledge assessed close to the time of the stroke represents both the patient's prestroke and existing level of knowledge. One of these acute studies[5] assessed stroke patients within 12-48 hours following their admission into emergency departments and found that almost 40% were unaware of stroke symptoms or risk factors. The second acute study[6] compared the stroke knowledge of 4 groups: patients at risk of stroke, patients with stroke/Transient Ischemic Attack (TIA) within 48 hours of their admission in hospital, members of the general public, and nurses. The stroke survivors demonstrated more gaps in their knowledge of risk factors than the other 3 groups.

Recently, there have been extensive public campaigns and media coverage to promote awareness about stroke symptoms using the FAST stroke symptom criteria (Face, Arm, Speech, and Time to call 911). In addition, there has been increasing focus on healthy lifestyles and risk factors to prevent stroke and heart disease in the last decade.[7-9] Given the greater attention on health promotion and stroke risk factors, it is timely to re-examine the current understanding of stroke survivors. Thus, the first objective of this study was to quantify the level of knowledge of stroke risk factors, symptoms, and stroke prevention among stroke survivors in the early poststroke period. Knowing the risk factors of a stroke survivor early after their stroke can help with determining what education or services are required to reduce the risk of another stroke. The second objective was to assess health behaviors of individuals leading up to their stroke and identify predictors, ie, age, gender, education, living status, stroke severity, including level of stroke knowledge. Finally, this study investigated the relation between prestroke health behaviors and cardiovascular risk burden.

Methods

Study Design

The investigation conforms with the principles outlined in the Declaration of Helsinki. In this prospective cross-sectional study, we assessed a cohort of consecutively-admitted stroke patients within 48-72 hours of their admission. A consecutively-admitted cohort can reduce the biases associated with convenient samples. Participants, prior to receiving any formal stroke prevention education, were asked questions exploring their knowledge of stroke symptoms and risk factors, including health behaviors. We obtained ethics approval from the University of British Columbia Office of Research Services-Clinical Research Ethics Board (study number H15-01338). This study used the STROBE Statement (Strengthening The Reporting of Observational studies in Epidemiology)[10] to guide the reporting of its details.

Participants

All participants provided written consent. Participants were enrolled if they were 19 years or older; able to understand, follow instructions and communicate in English; neurologically stable (eg, out of intensive care, alert to time, place, and person); living independently prior to their stroke, and admitted to a stroke unit. We also excluded patients with subarachnoid hemorrhage, severe aphasia, dementia, and serious co-morbid conditions (eg, end-stage renal disease, Parkinson's disease, or multiple sclerosis).

Outcome Measurements

A trained research coordinator measured blood pressure using as per American Heart Association standards,[11] Body Mass Index, the Montreal Cognitive Assessment,[12] and collected socio-demographic characteristics. Medical charts were reviewed for the following information: past medical history, plasma levels of total cholesterol, triglycerides, high-density lipoprotein (HDL), low-density lipoprotein, Hemoglobin A1c, and National Institutes of Health Stroke Scale (NIHSS) score[13] on the admission to the unit. All blood work was done immediately after the stroke as per standard of care.[14]

Knowledge Assessment Questionnaire

No standardized stroke knowledge assessment questionnaire exists. Thus, we developed a tool to quantify the current level of knowledge of stroke patients based on existing literature.[5,6,15-19] The questionnaire was comprised of 7 items covering 5 main areas: (1) stroke warning symptoms and risk factors, (2) nutrition, (3) blood pressure management, (4) physical activity, and (5) stress management. The total scores ranged from 0 to 25 with higher scores indicating more knowledge of stroke risk factors, symptoms, and stroke prevention (Appendix 1). The questionnaire was revised using iterative feedback

from a wide range of stakeholders, including stroke patients and clinicians with backgrounds in neurology, physical medicine, nursing, physical therapy, and occupational therapy.

Health Behavior

We used the Health-Promoting Lifestyle Profile (HPLP II),[20] a 52-item self-report scale, to assess health behaviors in the areas of physical activity, nutrition, health responsibility, spiritual growth (eg, openness to new experiences), interpersonal relationships (eg, maintaining relationships with others), and stress management. Measurements from the HPLP II have established test-retest reliability (r = .892), internal consistency (alpha = .943), and construct validity (r = .678).[20] Patients were asked to reflect on their activities in the last week prior to their stroke using a 4-point Likert scale, with higher scores indicating better health behaviors.

Cardiovascular Disease Risk Score

We calculated the Framingham cardiovascular disease risk score[21] for each person. This well-validated score considers age, sex, smoking status, diabetes, and cardio-metabolic risk factors for stroke such as HDL, total cholesterol, and systolic blood pressure, as well as pharmacological treatment.[22,23]

Data Analysis

The G-Power 3.0.10 computer program was used to calculate the sample size for this study, based on multiple regression analyses quantifying the effect of level of knowledge and other variables on the health behavior-dependent variable. We calculated that a maximum model of 10 variables would require 75 participants to detect a small effect (0.2), at an alpha of .05 with 80% power. We recruited 100 participants to account for potential missing data.

Socio-demographics, disease-specific characteristics, and knowledge levels were analyzed using descriptive statistics, with continuous variables reported as means and standard deviations, and categorical variables expressed as frequencies and percentages. In addition, as a measurement of the cohort's knowledge (objective 1), we calculated the proportion of patients with a history of conventional vascular risk factors (ie, hypertension, dyslipidemia, smoking, diabetes) to the proportion of this group who were able to identify their co-morbid conditions as risk factors for stroke.

We identified variables from the existing literature in constructing our regression model for objective 2. Since age, education,[24] gender,[25] living status,[26] stroke severity,[27] and stroke knowledge[25] are associated with health behaviors, these independent variables were included in the model as potential determinants of health behavior represented by the HPLP II (dependent variable). We used a hierarchical multiple regression strategy and entered blocks of variables based on theoretical grounds. Age and gender were entered at Block 1; education and living status at Block 2; stroke severity (NIHSS) at Block 3, and knowledge at Block 4.

For the last objective, to investigate the relation between the health behavior and cardiovascular disease risk, we first entered the 6 domains of the HPLP II (health responsibility, physical activity, nutrition, spiritual growth, interpersonal relations, stress management) in Block 1 to identify potential predictors of the Framingham risk score (dependent variable). We entered stroke knowledge in Block 2. For statistical analyses, the Statistical Package for the Social Sciences[28] software was used, employing an alpha of .05 (2 tailed). Checks were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity in the models.

Results

This study recruited 100 participants with primarily mild stroke. The mean age of the sample was 66.6 ± 13.6 years, the majority was male, approximately 1 quarter lived alone and more than half of them had at least high school education (Table 1).

Knowledge of Stroke Patients

The participants scored low on stroke knowledge (Table 1). The most frequently known stroke symptoms were weakness in the arms/legs and difficulty with speech, while headache was the least commonly identified symptom (Fig 1).

There was a discrepancy in the proportion of stroke patients with an established history of common vascular risk factors and their knowledge of those risk factors. Of concern, 58 patients had an established history of hypertension, but only 18 of them identified hypertension as a risk factor (Fig 2).

Half of the participants cited regular exercise (51%) and healthy diet (51%) as a way to reduce blood pressure or maintain a healthy blood pressure level, while a smaller proportion (37%) cited taking antihypertensive medications. Knowledge was limited regarding the amount of physical activity that adults should do to minimize risk of stroke. Although participants recognized that exercise should be done regularly, only 22% had answers that aligned with the recommendations from national physical activity guidelines (120-160 minutes of moderate physical activity per week). For dietary changes that may help to decrease the risk of stroke, patients listed decreased cholesterol (57%), followed by increased consumption of vegetables (52%). Lastly, knowledge on strategies to manage stress was good, with participants identifying engagement in leisure activities (58%), followed by practicing meditation, yoga, or mindfulness (35%).

Table 1. *Demographic and health behaviour characteristics of the participants*

Characteristics	Mean ± SD; or n (%)
Age	66.6 ± 13.6 years
Male	60 (60%)
Lives alone	28 (28%)
Education	At least high school education 52 (52%)
Caucasian	66 (66%)
Ischemic stroke	95 (95%)
MoCA	24.7 ± 3.8
NIHSS	2.6 ± 3.0
BMI	27.0 ± 6.0
Systolic blood pressure	140.50 ± 23.0 mmHg
Diastolic blood pressure	74.8 ± 11.6 mmHg
HbA1c	6.3 ± 1.5 mmol/L
LDL	2.4 ± 0.95 mmol/L
HDL	1.3 ± 0.41 mmol/L
Cholesterol	4.3 ± 1.1 mmol/L
Triglycerides	1.4 ± 0.72 mmol/L
Stroke knowledge (max 25)	14.5 ± 5.1
HPLP II total (max 208)	136.6 ± 21.8
Health responsibility (max 36)	20.9 ± 4.6
Physical activity (max 32)	16.1 ± 4.7
Nutrition (max 36)	23.6 ± 5.3
Spiritual growth (max 36)	26.9 ± 5.7
Interpersonal relations (max 36)	27.7 ± 5.2
Stress management (max 32)	21.3 ± 5.1
CVD risk score	15.6 ± 5.0

Note: Sample size of 100 except for CVD risk score (n = 92).

Abbreviations: BMI, body mass index; CVD risk score, Framingham cardiovascular disease risk score; HbA1c, glycated hemoglobin; HDL, high-density lipoprotein; HPLP II, health promoting lifestyle profile II; LDL, low-density lipoprotein; MoCA, Montreal Cognitive Assessment; NIHSS, National Institutes of Health Stroke Scale.

Health Behaviors

The final hierarchical regression model explained 27% of the variance in health behaviors (Table 2). Stroke knowledge explained an additional 13% of the variance in health behaviors, after controlling for age, gender, education, living status, and stroke severity (NIHSS) (Table 2). In the final model, only age and knowledge were statistically significant, with knowledge recording a higher beta value (beta = .411, $P = .0001$) than age (beta = .284, $P = .005$) indicating that those who had better stroke knowledge or those with older age had better health behaviors.

Cardiovascular Disease Risk Score

We were able to calculate a Framingham cardiovascular disease risk score for 92 participants. The 8 who were excluded were all missing HDL values; 2 of them with intracerebral hemorrhage were missing total cholesterol values as well.

The domains of the HPLP II explained 12% of the variance in Framingham risk score. After entry of the knowledge variable, the total variance explained by the model was 15% (Table 3). In the final model, only physical activity was statistically significant (beta value of −.316, $P = .007$) while there was a trend ($P = .081$) for stroke knowledge to improve the Framingham risk score.

Discussion

Knowledge of Stroke Patients

This study aimed to quantify stroke knowledge and health-related behaviors in people with very recent stroke, and their relation with cardiovascular disease risk. In contrast to a previous study,[5] where only 26% had knowledge about weakness in the arms and legs as a stroke symptom, 64% of our study participants reported knowledge about weakness, and 57% identified problems with speech. This may reflect the success of the recent educational campaign and media coverage about the FAST stroke symptom criteria.

It was highly concerning to find such large gaps in knowledge regarding participants' own risk factors for stroke, particularly hypertension. This is in contrast to an older study, where 57% of the respondents from the general public with a history of hypertension identified hypertension as a risk factor for stroke.[29] Furthermore, in our participants, knowledge of healthy behaviors for stroke prevention was poor, with a lack of even basic stroke knowledge for some. In addition, our findings confirm the need to support efforts to link lifestyle behaviors to risk of stroke as part of primary prevention strategies.[30] Our study identifies a need to educate the public regarding stroke risk factors, specifically the causal relationship between blood pressure and stroke.

Association between Stroke Knowledge, Health Behaviors, and Cardiovascular Disease Risk

This study demonstrated a positive association between stroke knowledge and health behaviors. Of interest, the contribution of knowledge to health behavior was of similar magnitude to that in a Chinese study in stroke patients with an established history of hypertension.[25] We found a relationship between increasing age and better health behaviors. However, this relationship is not consistent in other studies, with some finding no association between age and knowledge,[25,31] and others finding a better level of knowledge in younger patients.[32] This relationship likely depends on the specific combination of health behaviors studied. Our findings support the need for guidelines recommending healthy behaviors to reduce stroke risk.[30] In particular, our study supported the inclusion of physical activity in stroke prevention programs, given our finding of its relation to cardiovascular risk. Nurses and other health-

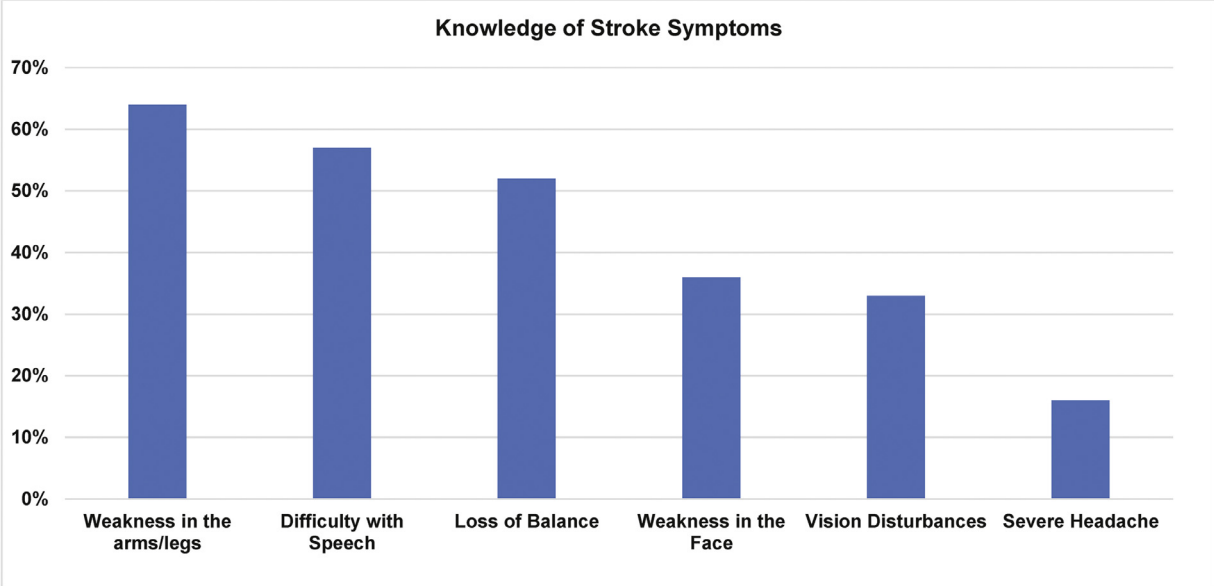

Figure 1. *Knowledge of stroke symptoms. (Color version of figure is available online.)*

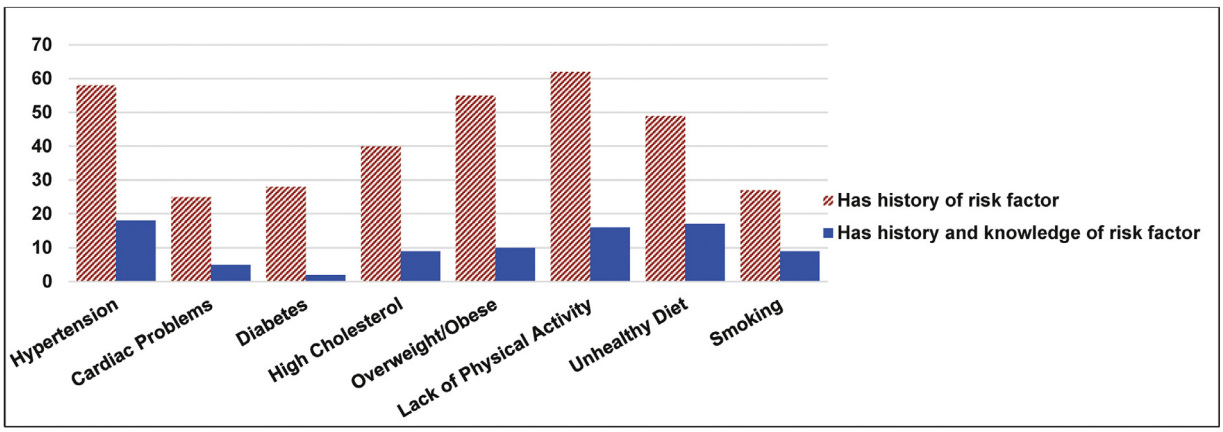

Figure 2. *Comparison of the number of participants with a history of risk factors versus those with a history and knowledge of the risk factor. (Color version of figure is available online.)*

care professionals with additional training in stroke and behavioral change techniques could play a leading role in improving both primary and secondary prevention.

Conclusions

Despite decades of public campaigns on health promotion and stroke prevention, people with recent mild-to-moderate strokes still lack even basic knowledge about stroke. Those with better stroke knowledge have better health behaviors and those with increased physical activity have reduced risk for cardiovascular disease. Future stroke prevention efforts may adopt an educational approach to address multiple risk factors among high-risk patients and stroke survivors to improve their health behaviors.

Implications for Practice

- This study shows that stroke patients lack knowledge about stroke and stroke prevention.
- Only a small proportion of stroke patients with an established history of hypertension had knowledge that hypertension was a risk factor for stroke.
- This study also shows that those who have better stroke knowledge have better health behaviors and those who are physically active prior to their stroke have less risk for cardiovascular disease.
- The findings would inform the development of novel programs to address multiple risk factors among high risk patients and stroke survivors to

Table 2. *Multiple regression analysis: predictors of health behavior (health promoting life style profile II)*

Models	Variables	R2	Adjusted R^2	R^2 square change	Sig. F	Unstandardized coefficients (B)	95.0% CI for B		Standardized coefficients (Beta)	*P* value
							Lower bound	Upper bound		
	Age					.243	−.075	.562	.152	.132
	Sex					−4.623	−13.41	4.163	−.104	.299
Model 1		.037	.017	.037	.164					
	Age					.241	−.073	.556	.151	.131
	Sex					−5.291	−14.065	3.483	−.12	.234
	Education					6.631	−1.966	15.228	.153	.129
	Living					7.747	−1.709	17.203	.16	.107
Model 2		.089	.051	.052	.063					
	Age					.207	−.102	.515	.129	.187
	Sex					−6.719	−15.379	1.94	−.152	.127
	Education					5.91	−2.514	14.334	.136	.167
	Living					6.873	−2.398	16.144	.142	.144
	NIHSS					−1.67	−3.085	−.255	−.229	.021
Model 3		.139	.093	.05	.014					
	Age					.455	.144	.765	.284	.005
	Sex					−4.775	−12.857	3.307	−.108	.244
	Education					3.733	−4.147	11.613	.086	.349
	Living					6.325	−2.271	14.921	.131	.147
	NIHSS					−.74	−2.128	.648	−.101	.293
	Knowledge					1.774	.906	2.641	.411	< .001
Model 4		.269	.221	.13	<.001					

Dependent variable: Health promoting life style profile II.
Sig. F: Significance value of the F-test.

Table 3. *Multiple regression analysis: predictors of cardiovascular disease risk (Framingham risk score)*

Models	Variables	R2	Adjusted R^2	R^2 change	Sig. F	Unstandardized coefficients (B)	95.0% CI for B		Standardized coefficients (Beta)	*P* value
							Lower bound	Upper bound		
	Physical activity					−.36	−.596	−.125	−.348	.003
	Nutrition					.139	−.083	.36	.149	.217
	Spiritual growth					−.033	−.285	.219	−.038	.794
	Interpersonal relations					.07	−.167	.306	.074	.56
	Stress management					−.068	−.322	.185	−.071	.593
	Health responsibility					.042	−.215	.3	.04	.746
Model 1		.12	.059	.121	.081					
	Physical activity					−.327	−.562	−.091	−.316	.007
	Nutrition					.157	−.063	.376	.169	.16
	Spiritual growth					−.031	−.28	.218	−.036	.804
	Interpersonal relations					.098	−.138	.333	.104	.412
	Stress management					−.072	−.322	.178	−.075	.568
	Health responsibility					.08	−.178	.338	.076	.538
	Stroke knowledge					−.189	−.402	.024	−.195	.081
Model 2		.15	.082	.031	.046					

Dependent variable: Framingham cardiovascular disease risk score.
Sig. F: Significance value of the F-test.

improve their knowledge and health behaviors for prevention of stroke.

Contribution of Each Author

J.E. and B.P.-the conception and design of the study, acquisition of data, analysis and interpretation of data, drafting the article, and revising it critically for important intellectual content and final approval of the version to be submitted.

T.F. and W.M.-revising the manuscript critically for important intellectual content and final approval of the version to be submitted.

B.S.-analysis and interpretation of data and revising it critically for important intellectual content and final approval of the version to be submitted.

Other contributors: Moira McPeake-data collection.

Conflict of Interest

The Author(s) declare(s) that there is no conflict of interest.

Appendix 1: Stroke Knowledge Assessment Questionnaire

The purpose of this questionnaire is to assess the knowledge of symptoms and risk factors for stroke in patients who have had a stroke.

There are 7 questions. The subject's answers are compared against the answer sheet. One point is awarded for each correct answer. There are no points for incorrect or uncertain answers. Ask questions in order. The previous answers cannot be changed while answering a subsequent question. If the subjects identify several responses for the same category (eg, different food items), then prompt them to other areas by asking "you have given me 3 responses that relate to food items, are there other areas you can consider?" If subjects provide a correct and incorrect answer for a single point, they would score 0 on that point.

Note: for the questions on Stroke Prevention Strategies, the greatest weight (and therefore points) has been provided to questions involving strategies/risks that have demonstrated the strongest relationship to recurrent stroke or cardiovascular events.

1 List 5 warning signs or symptoms that a person might first have if they are having a stroke.

One point for each of the following answers, up to a max of 5:

- Numbness or weakness in the face
- Numbness or weakness in the arms or legs or poor motor control
- Confusion, difficulty speaking or understanding speech
- Vision disturbances in one or both eyes
- Dizziness, trouble walking, loss of balance, or coordination
- Severe headache

2 List 5 reasons that may cause or contribute to having a stroke. Please try to focus on the factors that people might be able to change.

One point for each of the following answers, up to a max of 5:

- High blood pressure
- High cholesterol
- Lack of physical activity (exercise)
- Stress
- Smoking
- Alcohol use
- Cardiac problems (eg, atrial fibrillation/valvular disease/MI)
- Diabetes
- Unhealthy diet (eg, less intake of fruits, vegetables, and fiber, more intake of sodium in diet, more fatty food)
- Medication hormonal
- Drug abuse
- Overweight/obese

3 List 3 ways to reduce blood pressure or maintain a healthy blood pressure level

Two points for each of the following answers, up to a max of 6:

- Take blood pressure reducing medications regularly
- Regular exercise
- Healthy diet (eg, more intake of fruits, vegetables, and fiber, less intake of sodium in diet)
- Stress management (e.g., yoga, meditation, breathing exercise, mindfulness)

4 Moderate physical activity is defined as activity that causes the heart to beat faster and also cause some shortness of breath but still allows you to talk comfortably (eg, brisk walking, lawn mowing, bicycling). What is the recommended minimum number of minutes per week of moderate physical activity that adults should do to minimize the risk of stroke?

- 120-160 min (2 points)
- 160-315 min (1 point)

- Less than 120 or greater than 315 (0 point)

5 What is the recommended minimum (least) number of time per week should you participate in moderate physical activity?

- 3-7 times per week (2 points)
- 1 or 2 times per week (0 points)

6 List 3 different types of changes in diet that may help decrease the risk of stroke.

One point for each of the following answers, up to a max of 3:

- Increase in fiber (whole grain)
- Increase in fruits
- Increase in vegetables
- Decrease in salt (sodium)
- Decrease in cholesterol (fat, fried food)
- Increase in olive oil (or other oils high in Omega 3 fatty-acid)
- Increase in nuts
- Decrease in red meat
- Cut down on alcohol

7 List 2 different ways people can manage the stress in their life.

One point for each of the following answers, up to a max of 2:

- Practice meditation, yoga, or mindfulness
- Maintain work life balance (eg, set aside time for yourself, delegate, adequate sleep)
- Seek social support (eg, talk to your friend)
- Engage in leisure activities (eg, watch movie, reading, gardening, playing games, exercise)
- Time management (setting priorities)
- Seek professional counseling
- Medication

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