Evaluating Stroke Patients' Awareness of Risk Factors and Readiness to Change Stroke Risk–Related Behaviors in a Randomized Controlled Trial

Sally Eames, PhD,[1,2] Tammy C. Hoffmann, PhD,[1,3] and Nichola F. Phillips, B Occ Th (Hons)[1]

[1]Division of Occupational Therapy, School of Health & Rehabilitation Sciences, The University of Queensland, Brisbane, Australia; [2]Brighton Health Campus and Services, Metro North Hospital and Health Service, Brisbane, Australia; [3]Centre for Research in Evidenced-Based Practice, Bond University, Gold Coast, Australia

Purpose: To identify the effects of a brief educational intervention on stroke patients' recall and recognition of risk factors and performance of and stage of change for stroke risk–related behaviors. **Methods:** Sixty-six patients with stroke participated in a multisite randomized controlled trial. The intervention group (n = 35) received a brief education intervention (tailored written stroke information, verbal reinforcement of information for 3 months after discharge, and provision of a telephone number). The control group (n = 31) received usual care. Unprompted recall (personal and general), prompted recognition of risk factors (0-13), and performance of (0-10) and stage of change for up to 7 stroke risk–related behaviors were assessed before and 3 months after discharge. **Results:** No significant between-group differences were found. For all participants over time, there were significant improvements for personal (mean difference [*MD*], 0.3; 95% CI, 0.004-0.69; P = .05) and general (*MD*, 0.6; 95% CI, 0.09-1.16; P = .02) risk factor recall; performance of stroke risk–related behaviors (*MD*, 0.8; 95% CI, 0.28-1.26; P < .01); and progression from a nonaction to an action stage of change for 4 of 7 behaviors over time. There was a significant decline in total risk factor recognition scores (*MD*, -0.8; 95% CI, 0.39-1.13; P < .01). **Conclusion:** Stroke patients' unprompted recall of risk factors and performance of risk-related behaviors improved over time; readiness to change risk-related behaviors progressed for some behaviors. A brief educational intervention did not improve risk factor awareness or behavior change more than usual care. **Key words:** *behavior, patient, randomized controlled trial, readiness to change, risk factor, stroke*

Within 5 years of their first stroke, individuals are at high risk of stroke recurrence and death, with cumulative total risk estimates between 17% and 28% for stroke recurrence and between 32% and 65% for death.[1-3] Individuals can reduce their risk of secondary stroke by addressing the modifiable stroke risk factors through altering their lifestyle behaviors.[4,5] However, poststroke management of risk factors is typically suboptimal.[6-9]

Information about secondary stroke prevention information is an important, but frequently neglected, part of the stroke information that should be routinely provided to patients and carers after stroke.[10-12] If patients are to undertake actions to modify their risk factors, they need to have an awareness of them. However, many individuals who have had a stroke have poor awareness of their risk factors.[13,14] For example, in one study, 52% of patients with stroke undergoing rehabilitation were unable to name any stroke risk factors.[15] Even many individuals with adequate risk factor knowledge have difficulty engaging in healthy behaviors to address stroke risk.[16-20]

Exploration of associations between stroke knowledge and beliefs and subsequent risk-related behavior change is in its early stages. Sullivan and Waugh[18] found that beliefs related to perceived stroke seriousness and severity were the most predictive of behavior change in a group of community-based stroke and transient ischemic

Corresponding author: Sally Eames, PhD, Brighton Health Campus and Services, 449 Beaconsfield Terrace, Brighton, Australia 4017; phone: +61 7 3631 7316; fax: +61 7 3631 7504; e-mail: sally.eames@health.qld.gov.au

Top Stroke Rehabil 2014;21(Suppl 1):S52–S62

www.strokejournal.com

doi: 10.1310/tsr21S1–S52

attack (TIA) survivors. Lawrence et al[21] found that confusing or contradictory information and carers' beliefs and attitudes affected patients' beliefs and attitudes toward risk-related behavior change.

Models of behavior change can be used to inform interventions. The transtheoretical model of change (TTM) describes behavior change as a progression through a series of stages (precontemplation, contemplation, preparation, action, and maintenance), with progression from one stage to the next considered to increase the likelihood of successful behavior change.[22,23] According to this model, an individual's readiness to change (or "stage of change") a particular health behavior should be assessed and should guide the selection of interventions that aim to affect this behavior.[22]

Although this model has been applied to numerous populations and health behaviors,[24] only a few studies have used this model to guide the development of interventions for patients with stroke. It has been used to inform an intervention for people who were at risk of stroke,[25] to design a counseling session and lifestyle class for outpatient clinic patients with TIA or mild stroke,[26] to assess readiness to change exercise behaviors in community-based patients with stroke,[27] and to assess the effects of an enhanced secondary prevention intervention in outpatients with TIA or mild stroke.[28]

No studies have explored stroke inpatients' stage of change for health behaviors or investigated whether patients' stages of change shift after hospital discharge and, if so, whether the change differs among behaviors. The effect of a brief educational intervention on the stage of change of various risk-related behaviors has not been studied.

Method

This study was a multisite randomized controlled trial to identify the effect of a brief educational intervention on stroke patients' recall and recognition of risk factors and their self-reported performance of and stage of change for stroke risk-related behaviors in the 3-month period after discharge.

Setting and participants

Participants were eligible for inclusion if they met the following criteria: (1) were admitted to 1 of 2 recruiting metropolitan hospitals in Brisbane, Australia, with a confirmed diagnosis of TIA or stroke; (2) were not living in a residential care facility before admission and were not expected to be transferred to one after discharge; (3) had adequate spoken English, cognition, communication, and corrected vision and hearing to complete the outcome measures; and (4) could be contacted by telephone within Australia after discharge. Members of the treating interdisciplinary team assisted in identifying eligible patients. For example, the treating speech pathologist advised on the patients' communication ability, and the treating doctor or occupational therapist advised on the patients' cognitive ability.

Procedure

Ethical approval for this study was obtained from relevant university and hospital ethics committees, and the study was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12608000469314). The Acute Stroke Team identified potential participants, and informed consent was obtained by a member of the research team (S.E.). The randomization schedule was prepared using a computer-generated random numbers table, and concealed allocation was achieved by using sealed opaque envelopes that were prepared by a person not affiliated with the study. Patients were randomly assigned to groups over a 13-month period between 2008 and 2009.

Approximately 1 week prior to discharge, a member of the research team completed a face-to-face interview with each participant, during which the Rapid Estimate of Adult Literacy in Medicine (REALM), a reading recognition test,[29] and baseline outcome measures were administered. Demographic and clinical details were obtained from participants and their medical charts. The follow-up interviews were administered by a blinded assessor at approximately 3 months after discharge. Hospital staff members were not advised of the consent, withdrawal, or allocation of participants.

Intervention

Participants in the intervention group received a brief educational intervention in addition to standard care. This intervention consisted of the provision of a previously evaluated and described computer-generated, tailored written information booklet (www.uq.edu.au/tru/strokebook),[30,31] which has a readability level of grade 5 on the rate index (RIX) and grade 7 on the SMOG,[32] and oral reinforcement of this information by a health care professional (S.E.). This oral reinforcement was offered face to face up to 3 times before discharge and over the telephone up to 3 times in the 3 months after discharge. Participants could tailor the content of the booklet by selecting desired topics from a list of 34 topics, the desired level of information detail by selecting detailed or brief, and the oral sessions by nominating the topics to be discussed. In addition, participants were provided with a telephone number that they could call if they had any questions after discharge. Participants in the control group received usual stroke unit care (standard medical, nursing, and allied health assessment and treatment, which included the provision of unstructured informal oral education and advice from various members of the treating team). Structured stroke education or support groups were not offered at either site during the time of this study, nor were written materials routinely provided.

Outcome measures

Unprompted recall of risk factors

Unprompted recall of personal risk factors was assessed by asking participants, "Do you know of any medical or health reasons that may have caused or contributed to your stroke?" Unprompted general risk factor recall was assessed by asking, "In general, do you know of any [other] medical or health reasons that can cause or contribute to someone having a stroke?" Responses were recorded verbatim, and the number of correct responses was tallied.

Prompted recognition of risk factors

Prompted recognition of personal risk factors was assessed by asking participants to identify (yes/no/unsure) their risk factors from a prompt list of 13 risk factors, obtained from the National Stroke Foundation's stroke checklist.[33] A maximum score of 13 was possible, with higher scores indicating better recognition of personally relevant risk factors. For each person, subgroup scores were also calculated for correct positives (those correctly identified as being a risk factor for that person) and correct negatives (those correctly identified as not a risk factor).

Stroke risk–related behaviors

Stroke risk–related behaviors were assessed by asking participants to identify, from a list of behaviors, which behaviors they were performing before the stroke occurred. At the follow-up interview, participants were asked to identify which behaviors they were currently performing. If patients required further clarification of behaviors, examples were provided.[33] Targeted behaviors (drawn from the Australian *Clinical Guidelines for Stroke Management*[11]) were cigarette smoking, consuming more than 2 standard alcoholic drinks per day, maintaining a healthy weight (as indicated by having a waist circumference of >94 cm for males and >80 cm for females), performing moderate activity for at least 30 minutes per day for most days of the week, having a healthy diet, taking medication as prescribed (for hypertension, high cholesterol, diabetes, and/or atrial fibrillation), and having regular checks of blood pressure, cholesterol, and/or blood glucose if advised to do so by a health care professional. Items related to smoking, drinking alcohol, and waist circumference were negatively scored as performance of these behaviors was not ideal. Additionally, if a behavior was not relevant to the participant (eg, the item about taking diabetes medication for a patient who did not have diabetes), a point was automatically awarded. Higher scores indicated performance of more ideal behaviors, with a maximum score of 10.

Stage of change

Stage of change for each behavior was assessed by asking participants to select one statement, from a list of 5, describing how they felt about

that behavior at the time the question was asked. Statements were obtained from the Family Focused Health Risk Assessment,[34] and each represented one of the stages of the TTM. For example, "I intend to try and start doing this behavior in the next 6 months" represented the contemplation stage. For each behavior, participants could also indicate that the behavior was not relevant to them.

Data analysis

Data were analyzed using Stata 11 (StataCorp LP, College Station, TX). Between-group differences were tested using independent *t* tests for unprompted risk factor recall and risk factor recognition and behavior and chi-square tests for stage of change. For within-group differences, paired *t* tests were performed on unprompted risk factor recall and risk factor recognition and behavior, and the McNemar test was performed for stage of change. For all analyses, a significance level of $P = .05$ was set. For the purpose of analyzing the change in stage of change over time for each risk-related behavior, stage of change was collapsed into the categories of nonaction (pre-contemplation, contemplation, or preparation) and action (action or maintenance stages). Data were analyzed using intention-to-treat analysis. A separate sample size calculation was not conducted for this study as it formed part of a larger trial, which also included carers and carer-specific outcome measures. This detail is reported in a separate publication.[35]

Results

Of the 77 randomly assigned patients, 37 were allocated to the control group and 40 to the intervention group. Follow-up data were obtained from 66 participants. **Figure 1** shows the flow of participants through the study. **Table 1** shows the baseline characteristics of participants, which were similar between the 2 groups. Some of participants in the intervention group chose not to receive all 6 offered contacts, with the majority of intervention participants receiving 4 or more contacts (see **Table 2**). The mean number of contacts was 1.3 (*SD,* 0.6; range, 1-3) before discharge and 2.5 (*SD,* 0.9; range, 0-3) after discharge, and the mean total contact time (face-to-face and telephone) was 59.1 minutes (*SD,* 40.0; range, 9-196).

Table 3 shows the mean number of correct risk factors, both personally relevant and general, that participants provided in response to the unprompted recall question at both baseline and follow-up. Although there was an increase in the correct number of risk factors recalled, the difference between the groups at follow-up was not statistically significant. Within-group analysis showed significant improvement over time for recall of both personal (mean difference [*MD*], 0.3; 95% CI, 0.09-1.16; $P = .05$) and general risk factors (*MD*, 0.6; 95% CI, 0.004-0.69; $P = .02$) for both groups.

Table 4 shows the mean total, as well as positive and negative subscores, of correct risk factors by prompted recognition at baseline and follow-up. It also shows the mean number of targeted behaviors reported as performed by participants at baseline and follow-up. There was a significant decrease in total recognition scores from baseline to follow-up (*MD*, -0.8; 95% CI, 0.39-1.13; $P < .01$) for all participants. The improvement in self-reported performance of risk-related behaviors from baseline to follow-up was significant for the whole group (*MD*, 0.8; 95% CI, 0.28-1.26; $P < .01$), but not between groups.

Table 5 shows the proportion of participants in each group that were in the nonaction or action category for each risk-related behavior at both baseline and follow-up. There were no significant differences between the groups at follow-up for any of the behaviors. Within-group analysis showed that significantly more participants were reported to be in the action category at follow-up for the behaviors of maintaining a healthy diet ($P < .01$); maintaining a healthy weight range ($P < .01$); taking medications ($P < 0.01$); and having regular checks of blood pressure, cholesterol, and/or blood glucose ($P < .01$).

Discussion

There were no significant differences between the control and intervention groups for any of the outcomes. There are a number of possible explanations for this finding. The intervention that was provided in this study was brief. Its intensity and

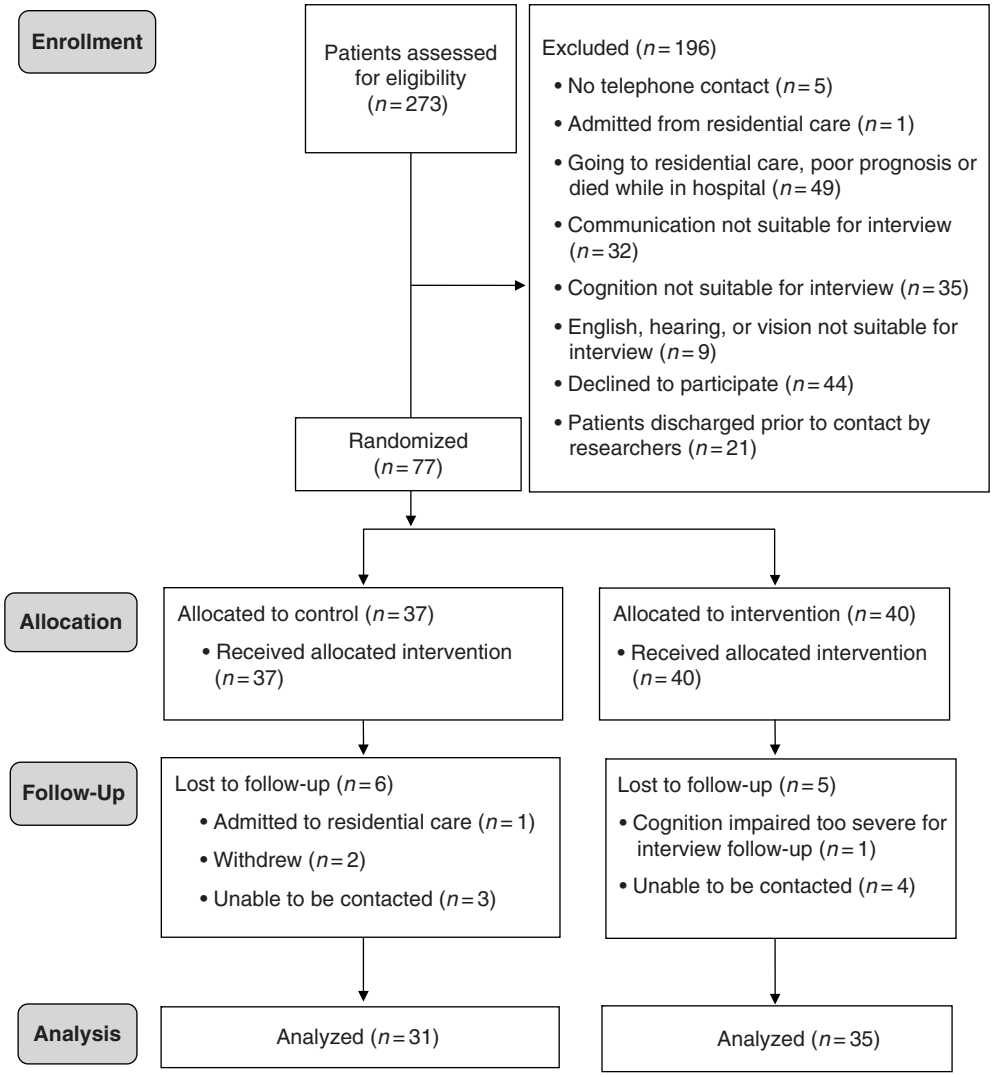

Figure 1. Flow of participants through the study.

duration may not have been sufficient to promote a change in outcomes greater than the change achieved by usual care. Additionally, although hospital staff were not advised of the allocation of participants, they may have observed some participants receiving a face-to-face contact because the intervention was provided on the ward. This may have prompted an unintentional increase in their provision of information to all ward patients. Usual care typically involves patients being given some form of education, advice, and support (almost all in the form of oral communication) while in the hospital and after discharge. Because no comprehensive record of the secondary prevention information provided to patients as part of usual care could be kept, we do not know the extent to which participants were provided with risk factor and secondary prevention information as part of usual care. Furthermore, because our intervention was patient centered and the educational content was tailored according to each participant's needs, the intervention that some participants received did not specifically focus on risk factor information or lifestyle behavior change strategies. The tailored nature of the study's intervention may therefore have caused a dilution of any treatment effect specific to secondary prevention behaviors. Of note is the finding by Green et al[26] that an intervention focused only on lifestyle behaviors with stroke patients resulted in a significant increase in stroke knowledge

Table 1. Baseline characteristics of participants in the intervention and control groups

	Control group (n = 37)	Intervention group (n = 40)
Age, mean (*SD*) years	64.1 (14.3)	57.0 (16.6)
Days since stroke, mean (*SD*)	10.6 (5.1)	11.5 (7.8)
Years of formal education, mean (*SD*)	11.5 (3.1)	12.4 (3.7)
REALM grade, *n* (%)[a]	(*n* = 33)	(*n* = 36)
3rd grade and below	0	1 (2.5)
4th to 6th grade	3 (8.1)	3 (7.5)
7th to 9th grade	12 (32.4)	13 (32.5)
9th grade and above	18 (48.6)	19 (47.5)
Male gender, *n* (%)	19 (51.4)	22 (55.0)
Type of stroke, *n* (%)[b]		
TIA	0	1 (2.5)
Infarct	31 (83.8)	29 (72.5)
Hemorrhage	5 (13.5)	10 (25.0)
First-time stroke, *n* (%)	31 (83.8)	27 (67.5)

Note: REALM = Rapid Estimate of Adult Literacy in Medicine; TIA = transient ischemic attack.

[a]Eight patients were unable to complete the REALM because of poor vision.

[b]One patient's stroke type was not provided (control group).

Table 2. Number of intervention contacts received by the intervention group participants (n = 35)

Total no. of intervention contacts received (maximum of 6 available)	Intervention group participants, *n* (%)
2	3 (8.6)
3	6 (17.1)
4	21 (60.0)
5	3 (8.6)
6	2 (5.7)

at the 3-month follow-up when compared with a control group, but there were no significant differences between the groups for risk-related behaviors. The authors of this study suggested that the period of the intervention may have been too short or that patients may have focused their attention on adapting to the biophysical effects of stroke rather than on lifestyle behavioral changes.[26] In contrast, a recent trial of an enhanced secondary prevention measure (consisting of further information and explanation about stroke and individual stroke risk factors, a motivational interview focused on intended behavior change, and development of a behavior change plan if appropriate) demonstrated significantly improved self-reported exercise and fruit and vegetable consumption at 3 months.[28]

For this study, participants in both groups demonstrated a significant increase in recall of personal and general risk factors. In a small 3-arm trial, people at risk of having a stroke were randomly assigned to a control group, a second group that received basic advice about their risk factors and the importance of reducing risk factors, or a third group that received a brief behavior change intervention tailored to stage of change. Subjects in all groups demonstrated an increase in knowledge of stroke symptoms and major risk factors.[25] Even though subjects in the third group had the greatest improvement in knowledge of newly initiated stroke risk-reducing behaviors at the 3-month follow-up, this study illustrates that improvement in risk factor knowledge can occur in the absence of an intervention that specifically focuses on behavior change. Such improvement may occur as a result of the informal education that is provided as part of usual care and/or from information sources that patients and their family independently seek out. In this study, although there was significant improvement in risk factor recall between the 2 time points, a low awareness of risk factors remained. Most participants were only able to recall between 1 and 3 risk factors at follow-up. This is of concern because poor awareness places individuals at risk for poor long-term outcomes and stroke recurrence.[13]

Table 3. Mean (*SD*) number of correct risk factors (personal and general) by unprompted recall at baseline and 3-month follow-up

	Between-group results							Within-group results				
	Baseline		Follow-up									
Risk factors	CG (*n* = 31)	IG (*n* = 35)	CG (*n* = 31)	IG (*n* = 35)	Mean difference	95% CI	*P*	Baseline (*n* = 66)	Follow-up (*n* = 66)	Mean difference	95% CI	*P*
Personal	1.2 (1.2)	1.1 (1.2)	1.3 (1.2)	1.6 (1.0)	0.3	−0.83 to 0.27	.32	1.2 (1.2)	1.5 (1.1)	0.3	0.004 to 0.69	.05
General	1.8 (1.7)	2.2 (2.2)	2.3 (1.8)	2.9 (1.9)	0.6	−1.57 to 0.26	.16	2.0 (2.0)	2.6 (1.9)	0.6	0.09 to 1.16	.02

Note: CG = control group; IG = intervention group.

Table 4. Mean (*SD*) number of correct risk factors by prompted recognition and performance of relevant stroke risk–related behaviors at baseline and 3-month follow-up

	Between-group results							Within-group results				
	Baseline		Follow-up									
	CG (*n* = 31)	IG (*n* = 35)	CG (*n* = 31)	IG (*n* = 35)	Mean difference	95% CI	*P*	Baseline (*n* = 66)	Follow-up (*n* = 66)	Mean difference	95% CI	*P*
Recognition												
Total[a]	11.8 (1.2)	11.2 (1.3)	10.7 (1.5)	10.8 (1.3)	0.1	−0.81 to 0.56	.72	11.5 (0.2)	10.7 (0.2)	−0.8	0.39 to 1.13	<.01
Positive[b]	3.9 (2.0)	4.0 (2.9)	3.6 (1.9)	3.9 (1.9)	0.3	−1.56 to 0.30	.18	4.0 (2.1)	3.6 (1.9)	−0.4	−0.12 to 0.85	.14
Negative[c]	7.9 (2.2)	7.2 (2.6)	7.4 (2.3)	6.9 (2.2)	−0.5	−0.59 to 1.60	.36	7.5 (2.4)	7.2 (2.2)	−0.3	−0.003 to 0.79	.05
Behavior[d]	7.5 (2.0)	7.6 (1.8)	8.6 (1.3)	8.1 (1.3)	−0.5	−0.18 to 1.10	.15	7.5 (0.2)	8.3 (0.2)	0.8	0.28 to 1.26	<.01

Note: CG = control group; IG = intervention group.

[a] Total recognition of personally relevant risk factors (maximum score of 13).

[b] Positive subgroup score indicates the number of risk factors correctly recognized as being a risk factor for that person.

[c] Negative subgroup score indicates the number of risk factors correctly recognized as not a risk factor for that person.

[d] Ideal stroke risk–related behaviors (maximum score of 10).

Table 5. Number (%) of participants in nonaction and action category of change for risk-related behaviors at baseline and follow-up

		Between-group results						Within-group results			
		Baseline		Follow-up							
Behavior	Stage of change	CG (n = 31)	IG (n = 35)	CG (n = 31)	IG (n = 35)	Difference	P	Baseline (n = 66)	Follow-up (n = 66)	Difference	P
Maintaining a healthy diet	Nonaction	8 (25.8)	12 (34.3)	3 (9.7)	2 (5.7)	−1	.54	20 (30.3)	5 (7.6)	−15	<.01
	Action	23 (74.2)	23 (65.7)	28 (90.3)	33 (94.3)	5		46 (69.7)	61 (92.4)	15	
Reducing or maintaining a healthy weight	Nonaction	10 (32.3)	15 (42.9)	4 (12.9)	5 (14.3)	1	.72	25 (37.9)	9 (13.6)	−16	<.01
	Action	21 (67.7)	19 (54.3)	27 (87.1)	26 (74.3)	−1		40 (60.6)	53 (80.3)	13	
Increasing or maintaining adequate levels of physical activity	Nonaction	14 (45.2)	17 (48.6)	12 (38.7)	11 (31.4)	−1	.54	31 (47.0)	23 (34.8)	−8	.12
	Action	16 (51.2)	18 (51.4)	19 (61.3)	24 (68.6)	5		34 (51.5)	43 (65.2)	9	
Taking all medication as prescribed	Nonaction	6 (19.4)	9 (25.7)	0	0	0	N/A	15 (22.7)	0	−15	<.01
	Action	25 (80.6)	25 (71.4)	29 (93.5)	32 (91.4)	3		50 (75.8)	61 (92.4)	11	
Reducing or maintaining low alcohol consumption	Nonaction	5 (16.1)	4 (11.4)	2 (6.5)	3 (8.6)	1	.37	9 (13.6)	5 (7.6)	−4	.48
	Action	2 (6.5)	18 (51.4)	16 (51.6)	10 (28.6)	−6		30 (45.5)	26 (39.4)	−4	
Quitting smoking	Nonaction	6 (19.4)	3 (8.6)	2 (6.5)	5 (14.3)	3	.45	9 (13.6)	7 (10.6)	−2	.48
	Action	13 (41.9)	12 (34.3)	9 (29.0)	11 (31.4)	2		25 (37.9)	20 (30.3)	−5	
Having regular checks of blood pressure, cholesterol, or glucose	Nonaction	6 (19.4)	9 (25.7)	1 (3.2)	1 (2.9)	0	.96	15 (22.7)	2 (3.0)	−12	<.01
	Action	24 (77.4)	25 (71.4)	29 (93.5)	31 (88.6)	2		49 (74.2)	60 (90.9)	11	

Note: CG = control group; IG = intervention group; N/A = not applicable.

Between baseline and follow-up, there was a decrease in the recognition of risk factors. It is unclear why recognition decreased despite the improvement in recall. One possible explanation is the contribution of the negative subscore (ie, those risk factors correctly identified as not being risk factors for that person). Another possible explanation is that the question may have been misinterpreted by some participants. For example, if a participant had hypertension but was taking medication at follow-up to control it, he or she may not have interpreted this risk factor as still being present.

There was a significant progression from a nonaction to action category for 4 of the 7 behaviors: healthy eating, maintaining a healthy weight, taking medication, and having regular medical checks. The sudden onset of stroke may cause patients to seek out preventative information to help them understand and regain control.[36] This, coupled with the encouragement to adopt healthy behaviors that is often provided from general practitioners and/or family and friends after discharge, may have been sufficient to motivate participants to attempt to change these behaviors, at least in the short-term. The follow-up timeframe for the current study was 3 months, so participants' lifestyle behaviors in the longer term are unknown. Longer term observational studies have indicated that compliance with medication adherence declines 1 year[37] and 2 years[38] after stroke. Furthermore, the Stop Stroke intensive intervention described by Wolfe et al,[39] which aimed at reducing secondary stroke risk, resulted in no significant differences for participants in the intervention group on the key outcomes of antihypertensive therapy, antiplatelet therapy treatment, or smoking cessation at 12 months.

In this study, there were no significant changes in the stage of change category between baseline and follow-up for the behaviors of performing regular physical activity, reducing smoking, or reducing alcohol consumption. This is supported by a previous finding that 46% to 89% of persons with a history of stroke did not adopt these behaviors over the first 2 years after stroke.[40] Additionally, although Hornnes, Larsen, and Boysen[37] found a significant reduction in the proportion of patients with an overuse of alcohol, they found no change in the frequency of cigarette intake and a significant increase in physical inactivity 12 months after stroke in the absence of any additional intervention. Physical impairments are the most common impairment after stroke,[41] and participants may have been unable to perform regular physical activity as a result of these impairments. Furthermore, many psychological and social factors can influence the uptake of physical activity.[42] This highlights the need for the inclusion of theoretical bases and psychosocial considerations in intervention design[42] as well as patient education about how to be active, despite physical impairments. The addictive nature of smoking and alcohol consumption may have contributed to the lack of change in these behaviors, along with the smaller number of participants who reported these behaviors as relevant. Alternatively, the complexity of these behavior changes may result in lower adherence rates.[43] There is limited research on whether patients with stroke are more likely to change certain risk-related behaviors than others. Research that explores whether particular behaviors are more likely to change, along with the barriers and facilitators of change from the stroke patients' perspective, would be valuable and may inform the development of interventions.

A strength of this study is its collection of readiness-to-change data for each risk-related behavior. However, generalization of our results may be limited beyond this sample. For example, patients were excluded if they had cognitive and/or communication impairments that prevented them from participating in the interview. The small sample size of this study is another limitation, along with potential bias that can arise from participants' self-report of behavior and stage-of-change information. The lack of available stroke-specific stage-of-change outcome measures with established psychometric properties was also a limitation of this study, as acknowledged by other authors.[28]

Conclusion

This study revealed that free recall of risk factors and performance of risk-related behaviors improved over time for participants in both groups. Additionally, readiness to change risk-related behaviors varied between behaviors and according to time since stroke. The brief intervention evaluated did not provide any additional benefit beyond that provided by usual care, and so the

optimal method of increasing stroke patients' knowledge about risk factors and facilitating the adoption of behavior changes after stroke remains unknown. The variation in stage of change across behaviors should be considered by designers of future interventions for reducing stroke recurrence.

Acknowledgements

Financial support: At the time of the study, the lead author (S.E.) was in receipt of an Australian Post-Graduate Award scholarship, funding full-time doctoral research conducted at The University of Queensland. T.H. is supported by a National Health and Medical Research Council of Australia/Primary Health Care Research Evaluation and Development Career Development Fellowship (number: 1033038) with funding provided by the Australian Department of Health and Ageing.

Additional contributions: The authors thank Associate Professor Kryss McKenna and Professor Linda Worrall for advice on project development and Dr. Asad Khan for advice on statistical analysis.

REFERENCES

1. American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics—2010 update: A report from the American Heart Association. *Circulation.* 2010;121:948-954.
2. Hillen T, Coshall C, Tilling K, Rudd AG, McGovern R, Wolfe CDA. Cause of stroke recurrence is multifactorial: Patterns, risk factors, and outcomes of stroke recurrence in the South London Stroke Register. *Stroke.* 2003;34:1457-1463.
3. Sacco RL, Shi T, Zamanillo MC, Kargman DE. Predictors of mortality and recurrence after hospitalized cerebral infarction in an urban community: The Northern Manhattan Stroke Study. *Neurology.* 1994;44:626-634.
4. Grysiewicz R, Thomas K, Pandey D. Epidemiology of ischemic and hemorrhagic stroke: Incidence, prevalence, mortality, and risk factors. *Neurol Clin.* 2008;26:871-895.
5. Joubert J, Reid C, Barton D, et al. Integrated care improves risk factor modification one year after stroke: Initial results of the ICARUSS model. *J Neurol Neurosurg Psychiatry.* 2009;80:279-284.
6. Asberg S, Henriksson KM, Farahmand B, et al. Ischemic stroke and secondary prevention in clinical practice: A cohort study of 14 529 patients in the Swedish Stroke Register. *Stroke.* 2010;41:1338-1342.
7. Rudd AG, Lowe D, Hoffman A, Irwin P, Pearson M. Secondary prevention for stroke in the United Kingdom: Results from the National Sentinel Audit of Stroke. *Age Ageing.* 2004;33:280-286.
8. van Wijk I, Kappelle LJ, van Gijn J, et al. Long-term survival and vascular event risk after transient ischaemic attack or minor ischaemic stroke: A cohort study. *The Lancet.* 2005;365:2098-2104.
9. Kopunek SP, Michael KM, Shaughnessy M, et al. Cardiovascular risk in survivors of stroke. *Am J Prev Med.* 2007;32:408-412.
10. Intercollegiate Stroke Working Party. *National Guidelines for Stroke.* 3rd ed. London: Royal College of Physicians; 2008.
11. National Stroke Foundation. *Clinical Guidelines for Stroke Management 2010.* Melbourne, Australia: National Stroke Foundation; 2010.
12. National Stroke Foundation. *National Stroke Audit—Rehabilitation Services Report.* Melbourne, Australia: National Stroke Foundation; 2012.
13. Croquelois A, Bogousslavsky J. Risk awareness and knowledge of patients with stroke: Results of a questionnaire survey 3 months after stroke. *J Neurol Neurosurg Psychiatry.* 2006;77:726-728.
14. Carroll C, Hobart J, Fox C, Teare L, Gibson J. Stroke in Devon: Knowledge was good, but action was poor. *J Neurol Neurosurg Psychiatry.* 2004;75: 567-571.
15. Koenig KL, Whyte EM, Munin MC, et al. Stroke-related knowledge and health behaviors among poststroke patients in inpatient rehabilitation. *Arch Phys Med Rehabil.* 2007;88:1214-1216.
16. Wilkinson PR, Wolfe CDA, Warburton FG, et al. A long-term follow-up of stroke patients. *Stroke.* 1997;28:507-512.
17. Joseph LN, Babikian VL, Allen NC, Winter MR. Risk factor modification in stroke prevention: The experience of a stroke clinic. *Stroke.* 1999;30: 16-20.
18. Sullivan K, Waugh D. Toward the development of the Cerebrovascular Attitudes and Beliefs Scale (CABS): A measure of stroke-related health beliefs. *Top Stroke Rehabil.* 2007;14:41-51.
19. Bak S, Sindrup SH, Alslev T, Kristensen O, Christensen K, Gaist D. Cessation of smoking after first-ever stroke: A follow-up study. *Stroke.* 2002;33:2263-2269.
20. Redfern J, McKevitt C, Dundas R, Rudd AG, Wolfe CDA. Behavioral risk factor prevalence and lifestyle change after stroke: A prospective study. *Stroke.* 2000;31:1877-1881.
21. Lawrence M, Kerr S, Watson H, Paton G, Ellis G. An exploration of lifestyle beliefs and lifestyle behaviour following stroke: Findings from a focus group study of patients and family members. *BMC Family Pract.* 2010;11:97.

22. Prochaska JO, DiClemente CC, Norcross JC. In search of how people change. Applications to addictive behaviors. *Am Psychol.* 1992;47:1102-1114.
23. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *Am J Health Promot.* 1997;12:38-48.
24. Prochaska JO, Redding CA, Evers KE. The transtheoretical model and stages of change. In: Glanz K, Rimer BK, Viswanath K, eds. *Health Behavior and Health Education: Theory, Research and Practice*. 4th ed. San Franciso: Jossey-Bass; 2008.
25. Miller ET, Spilker J. Readiness to change and brief educational interventions: Successful strategies to reduce modifiable stroke risk factors. *J Neurosci Nurs.* 2003;35:215-222.
26. Green T, Haley E, Eliasziw M, Hoyte K. Education in stroke prevention: Efficacy of an educational counselling intervention to increase knowledge in stroke survivors. *Can J Neurosci Nurs.* 2007;29:13-20.
27. Garner C, Page SJ. Applying the transtheoretical model to the exercise behaviors of stroke patients. *Top Stroke Rehabil.* 2005;12:69-75.
28. Gillham S, Endacott R. Impact of enhanced secondary prevention on health behaviour in patients following minor stroke and transient ischaemic attack: A randomized controlled trial. *Clin Rehabil.* 2010;24:822-830.
29. Davis TC, Long SW, Jackson RH, et al. Rapid estimate of adult literacy in medicine: A shortened screening instrument. *Fam Med.* 1993;25:391-395.
30. Hoffmann T, McKenna K, Worrall L, Read SJ. Randomised trial of a computer-generated tailored written education package for patients following stroke. *Age Ageing.* 2007;36:280-286.
31. Hoffmann T, Russell T, McKenna K. Producing computer-generated tailored written information for stroke patients and their carers: System development and preliminary evaluation *Int J Med Inform.* 2004;73:751-758.
32. Hoffmann T, McKenna K. Analysis of stroke patients' and carers' reading ability and the content and design of written materials: Recommendations for improving written stroke information. *Patient Educ Couns.* 2006;60:286-293.
33. National Stroke Foundation. Risk Factor Tick Test. http://www.strokefoundation.com.au/images/stories/risk%20factor%20tick%20test%20pad.pdf. Accessed June 13, 2008.
34. Niederhauser V, Arnold M. Assess health risk status for intervention and risk reduction. *Nurse Pract.* 2004;29:35-42.
35. Eames S, Hoffmann T, Worrall L, Read S, Wong A. Randomised controlled trial of an education and support package for stroke patients and their carers. *BMJ Open.* 2013;3:5.
36. Wiles R, Pain H, Buckland S, McLellan L, Wiles R. Providing appropriate information to patients and carers following a stroke. *J Adv Nurs.* 1998;28:794-801.
37. Hornnes N, Larsen K, Boysen G. Little change of modifiable risk factors 1 year after stroke: A pilot study. *Int J Stroke.* 2010;5:157-162.
38. Glader E-L, Sjölander M, Eriksson M, Lundberg M. Persistent use of secondary preventive drugs declines rapidly during the first 2 years after stroke. *Stroke.* 2010;41:397-401.
39. Wolfe CD, Redfern J, Rudd AG, Grieve AP, Heuschmann PU, McKevitt C. Cluster randomized controlled trial of a patient and general practitioner intervention to improve the management of multiple risk factors after stroke: Stop stroke. *Stroke.* 2010;41:2470-2476.
40. Newsom JT, Huguet N, McCarthy MJ, et al. Health behavior change following chronic illness in middle and later life. *J Gerontol B Psychol Sci Soc Sci.* 2012;67:279-288.
41. Senes S. *How We Manage Stroke in Australia.* Canberra: Australian Institute of Health and Welfare; 2006.
42. Morris J, Oliver T, Kroll T, MacGillivray S. The importance of psychological and social factors in influencing the uptake and maintenance of physical activity after stroke: A structured review of the empirical literature. *Stroke Res Treat.* 2012; Article ID 195249.
43. Lovota CY, Green LW. Maintaining employee participation in workplace health promotion programs. *Health Educ Behav.* 1990;17:73-88.