Journal of Racial and Ethnic Health Disparities
https://doi.org/10.1007/s40615-021-01221-2

Secondary Stroke Risk Reduction in Black Adults: a Systematic Review

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Received: 7 June 2021 / Revised: 3 August 2021 / Accepted: 23 December 2021

Abstract

Objective To address the fact that Black adults (BAs) experience significantly greater stroke burden than the general population, we conducted a systematic literature review which described evidence-based interventions targeting secondary stroke risk reduction in BAs.

Data Source Publications were selected from PubMed, Ovid, Cochrane, and Web of Science databases. We included peer-reviewed, longitudinal, English-language studies performed in the USA which reported results for BAs separately and had adult participants who had experienced stroke-related events.

Results Six of the 7 studies employed behavioral interventions which promoted education on stroke risk factors, problem-solving skills, and healthy-coping strategies. These studies demonstrated improvements in one or more biologic outcomes including cholesterol control and systolic blood pressure.

Conclusions Existing interventions on secondary stroke risk reduction approaches are effective in reducing secondary stroke risk among BAs, especially in individuals with poorly controlled blood pressure at baseline. However, additional research is needed because the current approaches may limit generalizability.

Keywords Stroke · Black adults · Secondary stroke · Risk reduction · Cardiovascular risk · Health disparities

Abbreviations

BA	Black adults
NHW	Non-Hispanic white
SLR	Systematic literature review
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
TIA	Transient ischemic attack
NOS	Newcastle–Ottawa Scale
LDL	Low-density lipoprotein
HDL	High-density lipoprotein
SBP	Systolic blood pressure
BMI	Body mass index
RCT	Randomized clinical trial

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Introduction

In the USA, stroke is the leading cause of death and long-term disability, affecting 795,000 adults annually [1, 2]. Approximately 77% of the strokes occurring in the USA are first-time cases, while 23% are recurrent strokes [1, 3]. As the fifth leading cause of mortality, stroke is responsible for about 140,000 deaths in the USA, and its impact on health resources (missed days of work, healthcare services, and treatment) is estimated to cost $46 billion a year [1, 2].

While preventative efforts to reduce cardiovascular risk factors (e.g., hypertension, high cholesterol, smoking cessation) [3–5] have decreased stroke incidence and mortality over the last decade, these trends are not uniform across all populations [2, 6, 7]. Racial/ethnic disparities in stroke rates and mortality are pervasive especially among Black adults (BAs) [2, 3, 6–9]. The risk of having a first stroke is nearly twice as high for BA compared to non-Hispanic white (NHW) Americans [2]. BAs experience strokes at younger ages and are more likely to experience complications, slower recoveries, and disability following an event [6, 7]. Stroke age-adjusted prevalence rates are 4 times higher among BAs compared to those of the overall US population [10]. Among first-time stroke survivors, about 25% will experience a recurrent stroke within 5 years; however, for BAs the risk of a recurrent stroke is drastically increased at about 60% [11, 12].

Racial disparities in stroke burden are especially pronounced among BA men [7, 13, 14]. In 2017, the adjusted death rates for stroke were 57.9 versus 36.0 per 100,000 populations for BA men and NHW men respectively [10]. More importantly, these poor outcomes in BA men may be related to potentially modifiable factors such as higher rates of smoking, social stressors, un/under-employment, obesity, less adaptive coping styles, and limited healthcare access [11, 15, 16].

Efforts to mitigate poor stroke outcomes include the integration of evidenced-based treatments during the acute stroke phase (pharmacological and/or surgical procedures) [17] and the post-stroke recovery period (stroke rehabilitation and secondary risk factor management) to prevent recurrent stroke [18–20]. Despite guidelines and treatment recommendations, disparities in care delivery and rehabilitation service utilization persist [16, 21–24]. National data has shown that 76% of BA stroke patients are discharged from acute care settings directly to their homes compared to 66% of NHW patients [24]. Racial disparities in stroke outcomes appear due to several factors, including sociodemographic status and less access to or underutilization of preventive services [12, 19, 25, 26]. Cultural factors may also play a role in stroke care and outcomes [8, 27, 28]. For example, BA patients and families may view nursing homes more negatively than do NHW families [25, 29]. Limited financial resources may also favor home-based care over rehabilitation settings [30]. However, informal home care may be insufficient to address the needs of BA stroke survivors [31].

Objective

Interventions focused on reducing risk factors for a recurrent stroke in BAs have the potential to reduce health disparities. Given this notion, we conducted a systematic literature review (SLR) to identify effective interventions for secondary stroke risk reduction among BAs. The aims of this SLR were to (1) describe approaches which have been studied to try to reduce secondary stroke risk for BAs, (2) determine whether these interventions are effective, (3) define outcomes which might be expected from successful programs, and (4) suggest directions for future research which might help to close the health disparities gap.

Methods

Our systematic literature review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [32]. Four electronic databases—PubMed, Ovid, Cochrane, and Web of Science—were searched for relevant peer-reviewed articles.

Inclusion and Exclusion Criteria

In this review, we included English language studies with participants who had experienced a stroke, a transient ischemic attack (TIA), or an intracranial hemorrhage. Included studies had to either have participants who were exclusively identified as “African American” or “Black,” or they could have a mixed racial/ethnic minority sample with explicit and specific reports about their African American/Black sub-group. Studies were included if they examined the effect of an intervention or exposure intended to reduce stroke risk, such as randomized control trials, quasi experiments, and cohort studies. With the understanding that race is a social construct and that each country has their own social climate, only studies performed in the USA were included. Further, certain coagulative disorders such as sickle cell disease (SCD) increase one’s risk for stroke. Patients with such diseases may experience especially complicated strokes which occur at young ages; therefore, to control for such confounds, studies focused on participants with SCD and genetic coagulopathies were excluded, and only studies with adult samples age 18 or older were included,

The goal of this literature review is recurrent stroke prevention; studies that only described acute stroke management (within 7 days of stroke) or were cross-sectional with a single date of observation were excluded. Some other notable exclusion criteria included opinion pieces and editorials, other literature reviews, and book chapters. Inclusion and exclusion criteria are listed in Table 1.

Search Strategy

We completed searches in July 2020 for each database using various combinations of search terms. The search terms served two purposes: they helped narrow search results to the target sample population in question, and they helped to identify interventional studies. Some terms we used to isolate our populations of interest included “African American,” “Racial/ethnic minority,” “Black,” “high risk populations,” “secondary stroke,” and “recurrent stroke.” Some terms we used to isolate interventional studies included “stroke prevention” and “stroke risk reduction.”

Finalized search terms were created with the help of librarians from the University Hospitals Cleveland Medical Center. Various combinations of search terms were used to identify a baseline subset of 20–50 articles. Three authors (CC, NJ, and EL) reviewed these articles to determine whether the search terms provided relevant literature. If they

Table 1 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
• English language literature	• Opinion pieces/editorials
• Original research reports	• Other literature reviews
• Studies done in the USA	• Book chapters
• Humans only	• Papers which only describe research methods but lack any elements of intervention
• Interventional or cohort studies	• Cross-sectional studies
• Adult samples age 18 or older; mixed samples if adults are reported separately	• Studies on acute stroke management (within 7 days of stroke)
• Studies with a Black American sample; studies with diverse samples with the Black American sub-sample specifically identified	• Studies focused on stroke due to sickle cell disease or other genetic coagulopathies appearing in childhood
• Secondary stroke risk reduction	

did not, adjustments were made to optimize results. The final search terms we used to run our searches were:

> (african americans[mesh] OR minority groups[mesh] OR race factors[mesh] OR african american*[title/abstract] OR black*[title/abstract]) AND (stroke[mesh] OR stroke*[title/abstract]) AND (risk reduction behavior[mesh] OR secondary prevention[mesh] OR tertiary prevention[title/abstract] OR "prevention and control"[subheading] OR ((survivors[mesh] OR survivor*[title/abstract]) AND (reduc*[title/abstract] OR prevent*[title/abstract])) OR ((risk[mesh] OR risk*[title/abstract]) AND (reduc*[title/abstract] OR prevent*[title/abstract]))) AND english[lang]

Data Extraction, Data Synthesis, and Quality Assessment

Ultimately, 1164 articles were selected. Two authors (CC and NJ) independently screened all abstracts for possible inclusion based on how well they fit the inclusion criteria. Each author's decisions were blinded from the other to protect from bias. After both authors finalized their decisions, the blinding was removed, and a third author (EL) resolved any conflicts after discussing each conflicting decision with the other two authors. After this initial screening process, 11 citations remained for full text review. These articles were read by two authors (CC and NJ) to determine if they truly met inclusion criteria. The decision for inclusion versus exclusion was once again blinded to both authors until their determinations were finalized. Conflicts were once again resolved by a third author (EL) after a discussion. Ultimately, we determined that 8 citations fit within the desired criteria. Figure 1 illustrates the flow of studies through the review process.

Two authors (CC and NJ) both reread all 8 articles to extract data from them: the collected data included the study's goal, sample size, inclusion and exclusion criteria, design, methods, primary and secondary outcomes, results, and authors' conclusions. These results were sent to all authors to review.

The quality of each retrieved article was determined using an adapted version of the Newcastle–Ottawa Scale (NOS) (Table 2) [33]. The NOS is a widely used tool to evaluate the quality of studies based on several components: 1) representativeness of the sample, 2) ascertainment of exposure, 3) selection of intervention and control groups, 4) comparability of groups, 5) assessment of outcomes, and 6) sample size. The possible scoring range on the adapted NOS was 0 to 12 with higher scores indicating greater quality of methods. Table 3 summarized adapted NOS results.

Results

Quality of Studies

The adapted Newcastle–Ottawa Scale (NOS) ratings from the 7 studies ranged from a low of 8 [34, 35] to a high of 11[36–38]. All of the studies were prospective and interventional rather than observational, which is a major strength. Six studies were RCTs [36–41], and the other studies utilized a lag-control design in which half of its participants acted as controls while the other half partook in the intervention for 12 weeks before the groups switched roles during a second 12-week period [34, 35]. Further, most of the studies ($n=5$) had robust sample sizes greater than 400 participants. Four studies also utilized intention-to-treat analyses [37–40] which minimized type I errors [42].

Overview of Studies

Of 1164 reports reviewed, 8 papers composed of 7 independent studies met inclusion criteria and were included in the final analyses (Table 3). The study sample sizes ranged from 35 to 1809, and mean age of participants across the

Fig. 1 Flow diagram of studies

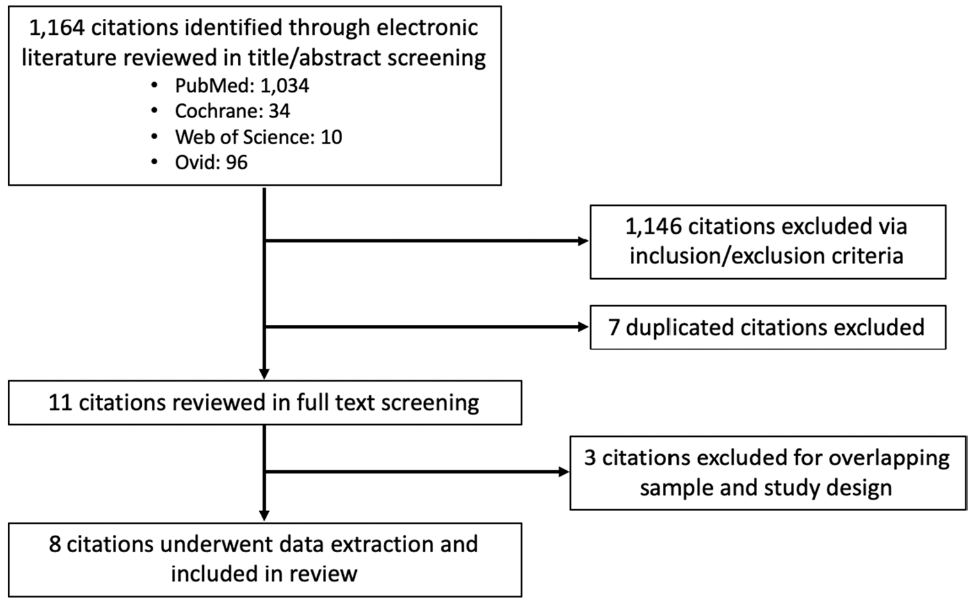

Table 2 Adapted Newcastle–Ottawa Quality Assessment Scale

Representativeness of the sample	
0	No description of sampling strategy
1	Sample included only a select group of individuals (select type of stroke, e.g., TIA)
2	Somewhat representative (inpatient sample)
3	Somewhat representative (outpatient sample)
4	Truly representative (database or epidemiological study)
Ascertainment of exposure (history of previous stroke)	
0	Self-report
1	Medical record
2	Medical record that was reviewed and confirmed
Selection of intervention and control groups	
0	No control (e.g., case series, cohort)
1	Case–control
2	Randomized-controlled trial
Comparability of groups	
0	No groups, or no matching of subjects
1	Subjects of the groups were comparable, as determined by the matching of demographic factors
Assessment of outcome	
0	Inadequate and/or not justified
1	Justified and satisfactory
Sample size	
0	Not justified
1	Adequately powered to detect a difference
2	Justified and satisfactory

reports was between 52 and 66 years [34–40]. Four studies included equal numbers of male and female participants [34, 36, 38, 40], while 1 favored males (60.3% males) [36], 1 only included male participants [41], and the last favored females (74.3% female) [34, 35]. In terms of racial ethnic populations, most studies were focused on minorities, but included a large portion of Black adult (BA) individuals; two studies [38, 41] included only BA participants. In addition, 4 studies [36, 37, 39, 40] performed subgroup analyses based on race/ethnicity.

Table 3 Summary of goal, study design, sample size, demographics, primary outcomes, and quality of included reports

Citation (year)	Goal	Study Design	Sample and previous stroke-related event	Mean age	Female (%)	Proportion of BA participants (%)	Primary outcome and additional stroke-related outcomes	Adapted Newcastle–Ottawa Quality Assessment Scale
Cheng et al. [36]	To test the efficacy of a chronic care model-based intervention compared to usual care in reducing stroke risk among vulnerable ischemic or transient ischemic stroke survivors	RCT of intervention vs. control, followed up for 1 year	404 Intervention 204 Control 200 TIA or ischemic stroke within 90 days prior to the start of the study	57	39.7	14.6	Primary: Change in SBP Other: LDL reduction, antithrombotic medication use, smoking cessation, physical activity	11
Sajato-vic et al. [41]	To test the efficacy of a novel self-management treatment compared to usual care in reducing stroke risk in BA male stroke survivors	RCT followed up for 6 months	38 Intervention 19 Control 19 Previous stroke or TIA; start of study within 12 months of hospital dis-charge or release from Emergency Department	52	0.0	100.0	Primary: Change in self-reported medication adherence Other: Blood pressure, HbA1c, lipids, weight, standardized measures of health behavior (diet, exercise, smoking, substances), depression, quality of life, qualitative evaluations of the perspective of TEAM participants	9
Boden-Albala et al. [39]	To test the efficacy of a culturally tailored skills-based educational intervention compared to usual care in reducing stroke risk a multiethnic cohort of patients with mild/moderate strokes/TIAs	RCT followed up for 1 year	552 Intervention 271 Control 281 Presentation or transfer to an enrolling site (medical centers in NYC) with a diagnosis of TIA, IS, or ICH within NIHSS < 5 at enrollment	65	50.9	33.1	Primary: Change in SBP Other: risk factors and outcome events of stroke, risk factors and outcome events of MI, risk factors and outcomes of vascular death	10
Gorelick et al. [38]	To test the efficacy and safety of aspirin and ticlopidine in preventing recurrent stroke in BAs	RCT followed up for 2 years	1809 Ticlopidine 902 Aspirin 907 Noncardioembolic ischemic stroke within onset at least 7 days but not more than 90 days prior to start of study	61	53.5	100.0	Primary: Composite end point of recurrent stroke, MI, or vascular death Other: fatal or nonfatal stroke	11

Table 3 (continued)

Citation (year)	Goal	Study Design	Sample and previous stroke-related event	Mean age	Female (%)	Proportion of BA participants (%)	Primary outcome and additional stroke-related outcomes	Adapted Newcastle–Ottawa Quality Assessment Scale
Rimmer et al. [35]	To test the efficacy of a 12-week exercise training program in reducing stroke risk factors in BA stroke survivors	Lag-control Group Design with each iteration lasting 12 weeks	35 First iteration 18 Second iteration 17 Post-stroke at least 6 months prior to start of study	53	74.3	88.6	Primary: Peak VO2, maximal workload, time to exhaustion, overall strength, grip strength, body weight, total skinfolds, waist to hip ratio, hamstring/low back flexibility, shoulder flexibility Other: none	8
Rimmer et al. [34]	To test the efficacy of a 12-week exercise health promotion intervention in reducing stroke risk factors in BA stroke survivors	Lag-control Group Design with each iteration lasting 12 weeks	35 First iteration 18 Second iteration 17 Post-stroke at least 6 months prior to start of study	53	74.3	88.6	Primary: Lipid profiles, exercise ability, nutrition Other: none	8
Feldman et al. [37]	To test the efficacy of a transitional care model aimed at controlling hypertension in BA and Hispanic stroke survivors receiving home health care	RCT followed up for 12 months	495 Interven-tion I 165 Intervention II 165 Control 165 First-time or recurrent TIA at any point prior to start of study	66	57.0	69.7	Primary: Change in SBP Other: none	11
Kronish et al. [40]	To test the efficacy of peer education in secondary stroke prevention among predominantly minority stroke survivors	RCT followed up for 6 months	600 Intervention 301 Control 299 Reported occurrence of stroke or "mini stroke" (ex. TIA) within 5 years prior to start of study	63	59.5	41.4	Primary: Proportion of participants with a composite of controlled BP (< 140/90 mm Hg), LDL cholesterol < 100 mg/dL, and use of antithrombotics Other: control of individual stroke risk factors	9

Note. *RCT* randomized control trial, *SBP* systolic blood pressure, *BA* Black American, *TIA* transient ischemic attack, *IS* ischemic stroke, *ICH* intracranial hemorrhage, *MI* myocardial infarction,*VO2* rate of oxygen consumption, *LDL* low-density lipoprotein

Intervention Characteristics

Interventions varied considerably across studies in terms of format, delivery, and duration. Gorelick et al. [38] conducted a pharmacological intervention, while the other 7 papers sought to reduce risk of recurrent strokes via educational and/or behavioral approaches [34–37, 39–41]. Two studies [34, 36] used community leaders and peers to support their participants, while others [34, 37, 41] involved enhanced follow-up with healthcare professionals such as postdoctoral research associates [35], health coaches[38], nurse educators [41], registered nurses and dieticians [35], nurse practitioners [37, 38], physician assistants [37], psychologists [35], and social workers [35] (Table 4).

The majority of the studies ($n = 6$) incorporated self-management elements in the intervention. Cheng et al. [36] implemented a self-management method in which participants were provided with report cards that assessed their performance in reducing their stroke risk factors, such as tobacco cessation, physical activity, and medication adherence. Other studies implemented interventions that consisted of meetings with peers or caregivers as part of self-management support, the provision of education on common stroke risk factors, and training in problem-solving skills and healthy coping strategies [34–41].

Authors of many of these studies noted that underrepresented minorities have unique cultural and social needs that have not been met by traditional post-stroke treatments. Of the 8 papers, half used peer support to help address cultural congruity [34, 38, 40, 41]. The study by Boden-Albala et al. [39]. was particularly mindful of cultural differences and offered their educational program in different languages and highlighted culturally appropriate themes such as family and faith in accordance to the participants' values.

The duration of interventions ranged from 1 education session [39] to 12-week programs [34, 35]. Of the 6 behavioral studies, the average number of interventional sessions was 7.5 (SD 3). There was one outlier study that included 36 interventional sessions [34, 35].

All the included studies utilized control groups to compare the efficacy of their interventions to. For the behavioral randomized control studies [36, 37, 39–41], the control group received usual stroke care which was largely composed of follow-up visits with primary care providers which occurred roughly once every 6 months [36]. The control groups also commonly received a brochure from the American Heart Association about strokes and associated risk factors [36, 37]; Kronish et al. [40] gave control group participants packets on strokes which were written in a culturally sensitive manner and provided participants with written results on their blood pressure and low-density lipoprotein (LDL). Feldman et al. [37] noted that their control group was given rehabilitation therapy, patient education and monitoring, home health, and social services as needed.

Outcomes

Analysis of the included studies suggested the primary variable used to assess the efficacy of interventions in the included studies was systolic blood pressure (SBP); all but 1 [34, 35] of the studies targeting behaviors reported on changes in SBP. Many of the studies also reported on laboratory values such as cholesterol levels [34, 35, 37, 42]. Some of the studies examined additional variables corresponding to health including knowledge of stroke risk factors [37, 42], exercise ability and strength [34, 35], number of out-patient visits [42], mood (depression, positive peer support, satisfaction) [34, 35, 42], and medication adherence [34, 37].

Biological Variables

Five of the 6 behavioral intervention studies reported on changes in SBP, and all 5 found that their intervention group experienced a decrease in SBP over time. Boden-Albala et al. [39] study determined that their intervention arm decreased their SBP by 7.0 mm Hg and their usual care arm decreased their SBP by 4.3 mm Hg between baseline and 12-month follow-up. This reduction was not statistically different between groups ($\beta = 2.5$ mm Hg; 95% CI, -1.9 to 6.9). While the decrease in SBP was not statistically different between the control and intervention arm in this study [39], the other 4 found that those in their intervention group exhibited significantly greater changes in SBP compared to controls. Kronish et al. [40] determined that compared to their control participants, those in their intervention group experienced a greater change in SBP at 6 months (-3.63 SD 19.81 mm Hg versus $+0.34$ SD 23.76 mm Hg, $p = 0.04$). Further, Sajatovic et al. [41] determined that there were significant group differences in SBP reduction at their 24-week mark ($p = 0.03$) with their intervention arm decreasing their SBP from 129.8 to 128.1 and their control arm increasing their SBP from 128.6 to 143.5. Notably, in Cheng et al. [36] and Feldman et al. [37] studies, SBP differences were only statistically significant for the BA participant subset and not for their sample as a whole: Cheng et al. [36] found that their intervention arm dropped their SBP by 17.3 mm Hg while their usual care arm dropped their SBP by 13.7 mm Hg over 12 months; this improvement alone was not statistically significant (-3.6 mm Hg (95% CI (9.3,2.2)). However, subgroup analyses revealed that BA study participants had significantly greater SBP in the intervention arm compared to the usual care arm. Similarly, Feldman et al. [37] found that participants across all study arms dropped around 10 mm Hg in over their 12-month study period. But when they compared results between their participants—all of whom

Table 4 Summary of interventions and major findings of included studies

Citation (year)	Description of intervention	Major findings
Cheng et al. (2018) [36]	• Regular clinical care with a NP/PA care manager at 1 and 7 months post-enrollment. NP/PA care manager monitors stroke risk factors (tobacco cessation, physical activity, depression, medication adherence). Report cards given after each clinical visit. Each of these sessions was scheduled for 1 h • Participants attend group clinics at 2, 5, and 10 months post-enrollment. Each of these sessions was scheduled for 2 h, but in total, 8 h was devoted to group work (including scheduling and coordinating) • At home blood pressure monitoring	No significant difference between the chronic-care based intervention arm compared to the usual care arm among the student participants as a whole. SBP decreased by 17.3 mm Hg in their intervention arm and 13.7 mm Hg in their control arm after 12 months (− 3.6 mm Hg (95% CI (9.3,2.2)). BA participants experienced a significantly greater decrease in SBP in the intervention arm than the usual care arm
Sajatovic et al. (2018) [41]	• One 60-min 1:1 session between participants, their care partner, and a Nurse Educator. Four 60-min group sessions with 4–7 other participants and their caretakers. Seven short 10–20-min telephone sessions which correspond with the other sessions. Intervention as a whole lasts 6 months • All sessions focused on 1) patient and care partner needs, 2) problem-solving practice, and 3) attention to emotional and role management	No significant difference in self-reported medication adherence between the two groups. Those in the self-management based intervention arm had significantly lower SBPs than the usual care group after 6 months ($p=0.03$). The intervention arm decreased their SBP from 129.8 to 128.1, and the usual care arm increased their SBP from 128.6 to 143.5 over during this time
Boden-Albala et al. (2019) [39]	• Participants engaged in an interactive educational session with a community health educator prior to discharge • Participants received a patient-paced workbook and video emphasizing 1) patient-physician communication, 2) medication adherence, 3) accurate stroke risk perception with risk reduction skills • Care coordinator conducted follow-up calls at 72 h, 1 month, and 3 months post-discharge to enhance the themes of the workbook • All participants, including controls, had in-person follow-ups to assess stroke risk factors at 6 and 12 months	No significant difference in SBP reduction between the two groups ($\beta=2.5$ mm Hg; 95% CI, − 1.9 to 6.9). The Hispanic subgroup experienced a significantly greater decrease in SBP in the intervention arm compared to the usual care arm (estimated mean difference at 12 months = 9.4 mm Hg; 95% CI, 1.7–17.1. No other racial/ethnic subgroup (non-Hispanic white ($\beta=3.3$; 95% CI, − 4.1 to 10.7) or non-Hispanic black ($\beta=-1.6$; 95% CI, − 10.1 to 6.8)) exhibited differences in SBP reduction between intervention and usual care arms
Gorelick et al. (2003) [38]	• Participants either received 650 mg/day of Ticlopidine or 500 mg/day of Aspirin	No significant difference between the medications in preventing the composite primary end-point of recurrent stroke, MI, or vascular death
Rimmer et al. (2000) [34, 35]	• 12-week program that occurs 3 days/week. Programming targeted the domains of exercise, nutrition, education, and health behavior change. Each day of programming involved 1 h of exercise, a 1-h class on nutrition led by a registered dietician. Health behavior classes met for 60–90 min 2–3 days/week; classes were led by a psychologist, social worker, and/or registered nurse	The intervention group made significant gains over the controls in reduction of total cholesterol, cardiovascular fitness, increased strength and flexibility, and greater life satisfaction

Table 4 (continued)

Citation (year)	Description of intervention	Major findings
Feldman et al. (2020) [37]	• 2 types of interventions • Usual Home Care (UHC) + NP: NP led a 30-day transitional care program involving 3 in-home visits and 3 patient/caregiver telephone contacts. These visits involved helping participants communicate with their other health care providers, monitoring participants health, and creating culturally sensitive self-management plans • UHC + NP + Health Coach (HC): all the interventions the UHC + NP group received as well as 60 days of support from a HC. This protocol added 3 in-home visits and 3 telephone contacts. The HC promoted risk factor awareness, supported self-management, and facilitated patient re-integration into their community	Across all 3 groups, there was a 9–10 mm Hg decline in SBP at the 1-year follow-up. The majority of this decline occurred within the first 3 months post-discharge, but was maintained for the entire year. Among the BA participants, the UHC + NP group exhibited significantly greater decline in SBP compared to the other 2 groups ($p = 0.04$)
Kronish et al. (2013) [40]	• 6 weeks of weekly 90-min peer education workshops. Each workshop involved group work between 9 and 10 participants, and workshops were led by 2 peer leaders with similar socioeconomic backgrounds and health conditions as the participants. Workshops focused on explaining the biology of stroke and stroke treatments, stressing the importance of medication adherence, providing suggestions for how to improve medication adherence and communication with healthcare teams, and creating an action plan	There was no difference in the composite outcome between the intervention and control group. At 6 months, the proportion of individuals with controlled BP was significantly greater in the intervention than the control group (−3.63 SD 19.81 mm Hg versus + 0.34 SD 23.76 mm Hg, $p = 0.04$). No interaction between race/ethnicity and the effects of the intervention

Note. *NP* nurse practitioner, *PA* physician's assistant, *SBP* systolic blood pressure, *MI* myocardial infraction, *BMI* body mass index, *BA* Black American identified as black or Hispanic—they found that compared to their Hispanic subgroup, their black subgroup tended to have a greater reduction in SBP over time ($p = 0.04$). These two studies also found that the greatest amount of change was exhibited in the first 3 months of the intervention. Finally, while Boden-Albala et al. [39] did not find a difference in SBP change between intervention group vs. controls, they found a statistical trend in which each follow-up phone call (a part of their study's intervention) was followed by a reduction in SBP (1 call, 0.4 mm Hg; 2 calls, 6.1 mm Hg; 3 calls, 8.3 mm Hg; $F = 0.77$; $p = 0.51$).

Four of the 6 behavioral intervention studies measured cholesterol, although they did so in different ways. Cheng et al. [36] and Kronish et al. [40] examined LDL; Sajatovic et al. [41] examined HDL, LDL, and total cholesterol; and Rimmer et al. [34] examined total cholesterol. Cheng et al. [36] and Kronish et al. [40] defined well-controlled LDL levels as those < 100 mg/dL; Kronish et al.[40] did not find a significant difference in well-controlled LDL between the control and intervention groups, but Cheng et al. [36] found that their intervention group had significantly better LDL control. Rimmer et al. [34, 35] also found that their intervention group exhibited significantly greater total cholesterol control compared to their lag-control group. Further, Sajatovic et al. [41] found that there was a significant difference between the HDL levels of their intervention and usual care arm after 24 weeks with their intervention group exhibiting greater HDL levels. Total serum cholesterol and LDL levels were comparable between the groups at the end of their study. They also examined diabetes control in their intervention group and found that the 8 participants with diabetes in this group decreased their HbA1C level by 1.04 during the study. The study by Rimmer et al. [35], which assessed nutrition and fitness, found that their intervention group exhibited greater exercise capacity (as measured by peak VO2, strength, flexibility, body weight, BMI, and cardiovascular fitness) compared to their lag control group.

Additional Health and Well-Being Outcomes

Given the focus on self-management, some studies examined process measures for variables thought to be important in stroke recovery such as stroke knowledge. While Cheng et al. [36] did not find that attendance in group sessions (part of their intervention) was statistically correlated with knowledge of stroke risk factors, Sajatovic et al. [41] found that their intervention group exhibited significantly greater knowledge of these factors compared to controls. Rimmer et al. [34] utilized questionnaires (Life Satisfaction Questionnaire and Symptom Check List-90 Revised) to assess the psychological well-being of their participants and found that their intervention group had significantly greater life satisfaction; greater self-management skills; less social isolation; greater satisfaction with social relationships; less incidences of feeling trapped, caught, slowed down, or like they had low energy; less anhedonia; and less moments when they felt like everything was an effort. Kronish et al. [40] used the Patient Health Questionnaire and determined that there was a slightly lower incidence of depression in their intervention group. Using questionnaires (Diet Habit Survey, International Physical Activity Questionnaire, Fagerstrom test for Nicotine Dependence, Addiction Severity Index, Hospital Anxiety and Depression Scale, and Stroke Impact Scale), Sajatovic et al. [41] found that there was no difference in quality of life, depression, and standard measures of health behavior between their two groups. Finally, Kronish et al. [40] did not find a difference between how well their intervention and control groups were adhering to antithrombotic use, but Cheng et al. [36] reported that their intervention group improved their use of antithrombotics compared to their control group.

Discussion

This systematic literature review (SLR) examined the current evidence on interventions targeting secondary stroke risk reduction among Black adults (BAs), a sub-group of the US population that continues to disproportionately suffer from strokes and related complications. While the number of identified studies was limited ($N = 7$), the overall sample of BA was 2714 individuals, and the quality of studies was generally very high, with predominantly RCT designs and primary outcomes highly relevant to stroke recurrence. The average age of study participants ranged from 52–66 years, and most of the studies included both men and women.

The overwhelming majority (7/8, 87.5%) of the papers focused on patient self-management practices and included trials that used counseling, often in group settings and with healthcare providers. Self-management training and support included helping individuals to recognize stroke-risk factors, learn healthy behavior change, and promote being able to better communicate with their medical providers. These findings suggest that health literacy and empowering self-efficacy are critical in this process: focusing on these elements may therefore be a worthwhile element of counseling black patients who have had a stroke.

In terms of who may benefit from these interventions, age and sex did not appear to predict outcomes in any of the studies. Therefore, it may be meaningful to utilize such interventions with all adults at risk for stroke recurrence. However, participants who started with higher baseline SBP appeared to have the greatest amount of improvement over time. This might suggest these interventions might be particularly useful for individuals who are most likely to have a stroke recurrence because of severe and uncontrolled hypertension.

Many of the included studies relied on healthcare professionals to administer the interventions [34, 37, 41]. Professionals ranged from postdoctoral research associates [34], to registered nurses, social workers [34], and physician assistants [36]. The wide range of healthcare workers who aided in these studies suggests that a variety of individuals and roles with knowledge about stroke, cardiovascular health, and psychosocial well-being can be involved in such programs. Further, while very targeted studies like Rimmer et al. [34, 35] may need special equipment for exercise and nutrition classes, most of the interventions only required facility spaces for meetings and basic health instruments such as sphygmomanometers. These results suggest that interventions to reduce stroke risk in vulnerable sub-groups may be broadly generalizable across providers. While the skills to deliver the types of approaches demonstrated in studies described in this SLR may be found in multidisciplinary healthcare teams, there could be additional barriers to broad scale up that are not obvious in research studies, such as lack of dedicated time to administer behavioral care and capturing financial compensation for staff effort.

Overall, most studies demonstrated improvement in one or more stroke risk outcomes, and interventions with in-person follow-up were generally associated with favorable results. Cheng et al. [36] and Sajatovic et al. [41] intervention included 5 in-person follow-ups with nurse practitioners and nurse educators respectively, and Kronish et al. [40] involved 6 in-person group meetings, and the intervention groups in these studies exhibited significantly greater decreases in SBP compared to controls. Rimmer et al. studies [34, 35] had very extensive interventions which included 12 weeks of fitness, nutritional, and educational programming 3 times/week. The researchers found that their intervention group exhibited improvements in multiple measures of both fitness and mood. The only study [37] which did not yield favorable changes in primary or secondary outcomes for their BA participants did not focus on follow-ups; rather, their intervention was largely on providing extra counseling during discharge. While they incorporated some follow-up care, these check-ins were performed virtually (over the phone). These results suggest that intensive, stroke-specific, interactive interventions revolving around increased follow-up appeared to have particularly robust and positive outcomes across multiple stroke risk domains.

Despite promising results, these SLR findings suggest some gaps in knowledge and areas in which future research is needed. While interventions involving interactive and targeted in-person approaches appeared effective at reducing stroke risk in BA patients and may not require much equipment, the fact that many of these interventions required fairly intensive patient and health professional involvement may limit their generalizability. Extensive programming can be difficult for both providers and patients to implement and sustain. Further, the COVID-19 pandemic has brought up the opportunity and the need to deliver interventions in virtual formats. Based on the included studies, the efficacy of virtual follow-up appointments is uncertain [37]. Further, underserved populations may experience technologic discrimination, so certain remote solutions such as streaming may not be possible for communities that lack access to WIFI and other resources [34–36]. Additionally, all but one [40] of these studies recruited participants from hospitals and clinics. While recruiting participants from these settings largely allowed for validation of their previous stroke-related event, it may represent a skewed subset of the BA population who have ready access to medical care.

In conclusion, the results of this SLR suggest that incorporating self-management training and support into patient care planning are key elements in reducing secondary stroke risk in Black adults. These interventions may improve outcomes for all Black adults, especially those with increased stroke risk related to uncontrolled hypertension. Counseling and follow-up approaches used in published studies appear broadly applicable to multidisciplinary healthcare teams. Greater amounts of stroke-specific follow-up may yield the best results. However, the effort burden of current approaches may limit generalizability, and research on developing and testing practical, acceptable, and effective approaches in reducing stroke burden among BA are still urgently needed.

Author Contribution MS and CHS contributed to the study conception, and all authors contributed to the design. The literature search and data analysis were performed by CC, NJ, and EL. The first draft of the manuscript, figures, and tables was written by CC with help from NJ. Major edits were performed by CC with the help of NJ. MS and CHS read and edited the manuscript and all stages, and they approved the final manuscript.

Funding This project was supported by a research grant from the US National Institutes of Health IR01NR018023-01A1 (PIs Sajatovic & Still).

Availability of Data and Material Full manuscripts of mentioned articles can be found through PubMed, Ovid, Cochrane, and Web of Science databases.

Code Availability Not applicable.

Declarations

Conflict of Interest The authors declare no competing interests.

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