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## Successful aging in community seniors and stroke survivors: current and future strategies

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### ABSTRACT

There is growing evidence to suggest that aging is accompanied by enhancement in psychosocial well-being, despite age-related declines in physical and cognitive functioning. A small but growing body of research has reported on positive trajectories of well-being, and its determinants, among community-dwelling seniors as well as in people with specific diseases such as stroke. Current strategies for promoting successful aging include physical, cognitive and social activities, healthy lifestyle, social support, and positive traits such as resilience and optimism. These strategies have typically been employed in samples without serious illnesses, but an emerging body of evidence suggests that they are as relevant in cohorts with neurologic and other diseases. Future strategies will include those that work at the community level and not just at individual level, and will focus on use of technology as well as group interventions to enhance resilience and building age-friendly communities.

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Aging has traditionally been considered a period of progressive decline in physical, cognitive, and psychosocial functioning [1]. This deficit-driven view of aging is increasingly being countered by data showing that older adults commonly experience increased levels of psychological well-being and social functioning with age. There is growing evidence for such a 'paradox of aging,' with high levels of well-being and life satisfaction despite age-related losses in physical and cognitive functioning [2]. This paradox may also apply to some people with neurological disorders such as stroke, who despite a combination of impairments in physical and cognitive functioning, may continue to display a relatively high level of psychological and social functioning. As stroke mortality has been declining in recent years, a growing number of stroke patients with physical and neurocognitive disability are returning to the community [3]. The trajectories of aging and well-being in survivors of strokes and other neurological disorders are variable, with some persons declining but others maintaining, or occasionally, even improving in functioning compared to their pre-morbid levels. The ability to maintain high levels of subjective well-being in the face of declines in objectively measurable physical and cognitive disabilities reflects successful psychosocial aging – a construct of relevance for healthy older adults as well as those with cerebrovascular and other chronic diseases.

The concept of successful aging challenges the stereotypic notion that aging invariably involves functional decline. While, there is no cohesive unitary

definition [4], successful aging is generally viewed as a multi-dimensional construct. In the successful aging literature, physical functioning and disability are the most frequently assessed components. Other variables such as cognitive impairment, general health status, and longevity have also been closely studied [5]. Yet, markers of psychosocial functioning such as well-being and life satisfaction, social engagement, and environmental and financial conditions have received far less empirical attention in the past than they deserve. Fortunately, in recent years, there has been growing interest in the assessment of well-being as well as social and productive functioning as components of successful aging [4]. Other characteristics such as hardiness, coping skills, level of active social participation, and number of social ties may also be important elements of successful aging in cohorts of individuals without or with neurologic disorders. These factors speak to the importance of an individual's perseverance, social engagement, and sense of personal mastery in promoting positive health states.

### Predictors of successful aging

Various factors may extend the duration of positive biopsychosocial health as we age. Of note, these predictors of successful aging are not simply the opposite of the predictors of decline (e.g. absence of smoking); there is a complex set of interrelated variables that are subsumed under the construct of successful or healthy aging.

In the general healthy population, higher level of education and socio-economic status are associated with aging successfully [6]. Mental health factors such as resilience, other positive traits (e.g. wisdom, optimism), and absence of depressive symptoms are also predictors of successful aging [7–10]. Consistent with the known physical and behavioral components of successful aging, healthy lifestyle (e.g. exercise, proper nutrition, avoidance of tobacco use) has been shown to predict a longer ‘health-span’ [11,12]. Similarly, in individuals with neurologic disorders such as multiple sclerosis and stroke, there is some support for resilience as a predictor of positive outcomes [13,14].

The construct of successful aging has been investigated across international cohorts. Despite cultural differences in the daily experience of older adults, there are commonalities in the rates, predictors, and components of successful aging. In their cohort of community-dwelling older adults living in Shanghai, Li et al. [15] found that almost 46% of the seniors met broad criteria for successful aging (i.e. no physical disabilities, no self-rated mood disturbance, impairment in no more than one activity of everyday functioning, and an unimpaired score on the Chinese version of the Mini Mental State Examination). Similar rates were observed in a cohort of Australian older adults, where 44% of participants were classified as aging successfully (i.e. functioned in the community without disability, in excellent or good health, and with high cognitive functioning; [16]. In San Diego-based community samples of older adults, we have found that a sizable proportion of older adults rate themselves as aging successfully independent of the presence of diseases and disabilities [9].

Individuals with neurological illnesses experience threats to successful aging, with evidence indicating that they experience a more rapid rate of physical and cognitive decline, higher mortality, and social disability [17–19]. For example, following a stroke, an individual may experience physical limitations such as deficits in movement, sensory functioning and communication, and psychological sequelae such as depression and anxiety, and a wide range of cognitive impairments ranging from impaired language to poor decision-making, depending on the location of the stroke. These physical and neuropsychological deficits may have a negative impact on social functioning, and all three factors may interact to decrease the individual’s quality of life. Despite these negative effects, there is considerable variability in the trajectories of psychosocial functioning. For example, Ploughman and colleagues [14] found evidence of successful psychosocial aging in patients with multiple sclerosis, and reported that factors such as employment, social engagement, healthy lifestyle habits, a sense of independence, resilience, cognitive function,

mental health, and social support were critical to subjective well-being. Similarly, among stroke survivors, positive factors such as social support appeared to buffer the negative effects of physical disability [13]. Specifically, these authors reported that post-stroke, individuals with high levels of social support were less adversely impacted by functional disability and had higher self-ratings of well-being compared to their counterparts with low levels of social support. Also, relative to patients with fewer years of education, those with more years of education reported a greater sense of personal growth, purpose in life, and environmental mastery [13].

Stroke survivors often experience a sense of loss and disappointment related to unmet expectations regarding recovery; this emotional distress results in reduced quality of life, increased risk of second stroke, and greater mortality [20]. Accordingly, in patients with stroke, positive emotional factors such as acceptance, engaging in active coping strategies, and positive affect are associated with improved well-being and functioning. For instance, in their study of stroke survivors being discharged from an inpatient medical rehabilitation facility, Berges et al. [21] reported that individuals with higher levels of positive affect at discharge had greater social engagement at a three-month follow-up. Similarly, Desrosiers et al. [22,23] found that positive affect predicted social functioning up to four years after discharge from acute medical rehabilitation. Together, these data provide support for the durability of the impact that positive affect may have on future well-being in stroke survivors.

Positive affect may promote improved functioning post-stroke through positive cognitive appraisals of the individual’s circumstances [24]. This complements other findings that individuals with high positive emotions perceive difficult situations to be less challenging as compared to persons who are anxious or depressed [25,26]. Positive affect may also drive other mental health factors (e.g. optimism, sense of mastery) and behavioral changes (e.g. use of adaptive coping strategies, utilizing social and environmental resources); these, in turn, may facilitate the patient’s return to independence in executing everyday activities and eventual improvement in subjective well-being [27].

Social support is another strong predictor of well-being in stroke patients. In a Canadian cohort of stroke survivors, compared to the patients who were dissatisfied with the quality of their social supports, those who rated their network to be satisfactory had higher ratings of well-being in multiple domains including environmental mastery, positive relations, and self-acceptance [13]. These findings suggest that the magnitude and perceived quality of social resources may mitigate the negative effects of stroke-related physical disability on well-being.

## General strategies to promote successful aging

Longitudinal studies have identified the benefits of physical activity, including lower risk of mortality, disability, cardiovascular disease, osteoporosis, and certain types of cancer. Physical activity (exercise) is associated not only with improved cardiac health, but also with better cognitive outcomes and emotional functioning in the short- and long-term [28]. Several studies suggest that in older adults, aerobic exercise compared to non-aerobic activity is more strongly related to preserved cognition [29]. For example, moderate exercise in mid- and late-life was reported to reduce the risk of mild cognitive impairment [30]. In a cohort of 6434 community-dwelling older adults, Lindsay and colleagues [31] found that regular physical activity was associated with a 31% lower risk of developing Alzheimer's disease at a 5-year follow-up. Similarly, in the Framingham Study, older men who engaged in moderate levels of physical activity had a significantly reduced risk of stroke compared to those who engaged in lower levels of activity [32]. The mechanisms by which exercise sustains cognitive functioning are not fully understood, but animal studies suggest that exercise increases levels of Brain Derived Neurotrophic Factor, which may contribute to neurogenesis. Additionally, physical activity also impacts neurotransmitter systems linked with positive influences on cognitive as well as emotional functioning [29].

Diet and caloric restriction have also garnered much attention with regard to their role in promoting healthy aging. High calorie diets and obesity are risk factors for dementia. Data from animal studies suggest that dietary factors and caloric restriction may extend the lifespan and improve functioning over time. Bordone and Guarente [33] demonstrated that reduced caloric intake resulted in improvements in physical and biological markers such as blood pressure, body mass index, and cholesterol and triglyceride levels. In a cohort of older women, an intervention targeting a 30% reduction in caloric intake over three months led to a significant improvement in memory performance [34]. Preliminary data suggest that the mechanisms underlying this association may be mainly linked to improved insulin sensitivity and reduced inflammation [34]. Another approach to reducing risk of neurologic diseases is through modifying dietary habits. For example, dementia risk appears to be reduced by adherence to a Mediterranean diet rich in fruits and vegetables [35,36], and by fish intake [35]. The protective effects of fruit and vegetable-based diets and fish may be linked to antioxidant, anti-inflammatory, and metabolic benefits of these food groups [37]. Not surprisingly, diets rich in fruit and vegetables have shown beneficial effects in reducing stroke-risk [38].

Observational studies have documented a strong relationship between cognitive activity and cognitive aging including dementia risk. Individuals with higher

levels of education and/or cognitive engagement have lower rates of Alzheimer's disease and other dementias; brain and cognitive reserve may explain this relationship. Brain reserve refers to the amount of neural damage that can be tolerated, while preserving functioning, whereas cognitive reserve refers to the ability of the brain to recruit alternate brain regions to compensate for neural damage [39]. Brain reserve is likely heritable, and not amenable to great change over the course of one's life. Cognitive reserve on the other hand, is believed to be a modifiable construct. Higher educational attainment, participating in mentally challenging occupations and cognitively stimulating activities are thought to boost cognitive reserve. In contrast, such cognitive activities do not appear to greatly modify brain reserve. Evidence from early trials suggests that cognitive training in cognitively unimpaired older adults may improve specific cognitive outcomes and afford some benefit to everyday functioning [37]. The optimal timing (i.e. during youth, middle adulthood, or old age) as well as the most beneficial duration of cognitively stimulating activities remain to be carefully investigated. The nature of the activities has also received growing empirical attention. Some studies have found that with regard to cognitive aging (i.e. a process of gradual changes in cognition that occurs as people get older), strategies such as social and intellectual engagement and lifelong learning have shown some promise in reducing the risk of decline [40].

Across all ages, social engagement has been shown to have positive effects on health and well-being. Observational studies have found that individuals with an extensive social network are less likely to develop dementia, compared to those with smaller social networks [41]. Social engagement via participation in leisure activities is also associated with a lower dementia risk [42]. However, a causative effect of greater social activity on reducing the risk of degenerative neurologic diseases remains to be established.

Similarly, evidence showing the role of positive affect as a protective factor against cerebrovascular disease through psychological, health behavioral, and biological mechanisms is mixed. While, some studies have reported a protective effect of positive affect on the incidence rate of stroke in community-based older adults [43–45], Freak-Poli et al. [46] found that neither negative nor positive affect was associated with 12-year incidence of cardiovascular disease or stroke in community-dwelling seniors.

In a pilot study of seniors without stroke, Carlson et al. [47] found that a community-based social, physical, and cognitive activity intervention improved broad cognitive outcomes over time only in the individuals with impairment of executive functioning at baseline, but not in those whose executive functioning was unimpaired at baseline.

## Successful aging strategies in stroke survivors

While, the strategies listed above address possible targets to delay or potentially prevent the onset of cerebrovascular disease, there remains a need to characterize effective approaches to promote healthy aging post-stroke. The unique morbidities of stroke warrant particular consideration: strategies that rely on physical engagement may not be feasible in individuals with hemiparesis whereas those that depend on verbal feedback and participation may be unsuitable for patients who are aphasic. As such, strategies to promote well-being must be tailored to the patient's abilities.

Given that psychiatric sequelae of cerebrovascular diseases may include depression, anxiety, agitation, apathy, and psychiatric interventions in these patients have the potential of improving patients' quality of life and subjective sense of well-being. Recreational activities, relaxation, and music therapy have shown promising benefits for reducing agitation and anxiety in patients with dementia [48]. Although such efforts to boost mental health may not alter the progression of the neurologic disease, they may have a significant positive impact on the individual's quality of life as well as that of the patient's caregivers. In stroke survivors, cognitive behavioral therapy appeared to reduce negative mood and enhance well-being [49,50]. In a randomized controlled trial, stroke patients were assigned to receive brief psychosocial and behavioral intervention as well as antidepressant medication, or antidepressant medication and treatment-as-usual. The former intervention was associated with a remission in depressive symptoms that lasted at least 12 months [50]. Improving social support and training patients to effectively use coping strategies are two other approaches that may have some benefit as secondary prevention strategies in stroke [27], but are yet to be closely investigated using an interventional study design.

## Future strategies for successful aging

There is growing interest in developing and testing interventions for successful aging across patient groups. As such, a number of novel interventional avenues have been explored in the literature. Below, we describe selected strategies likely to gain prominence in the near future. These work at the community level and not just at the individual level, and will thus become increasingly important as the gap between the need for and supply of healthcare providers for older adults will continue to grow during the next decade and beyond.

## Technology

New computer-based technologies, including social media in senior-friendly formats are a unique asset in that they can be relatively easily customized to meet the specific needs of a particular individual. This is especially beneficial for a stroke population, where there is a wide

range of cognitive and physical impairments depending on location of the stroke. These technologies have the potential of helping older adults including stroke survivors to communicate with relatives and friends who live far away, thus enhancing their social functioning. The technologies may also help the seniors compensate for their limited mobility, and remotely conduct business transactions or execute daily activities such as grocery shopping. Tablet devices may serve to provide cognitive stimulation and quick access to soothing stimuli such as pictures and music to manage agitation in patients with dementia and also reduce caregiver burden [51]. They may serve a similar purpose in patients with stroke-related cognitive deficits; although this remains to be fully investigated. For stroke survivors, tablet devices may also serve as a compensatory tool that can be used to dictate/read out loud text messages and email or voice-activate applications and home appliances, thereby overcoming some of the limitations imposed by motor deficits. Sensors and monitors are being designed and deployed to ensure that older individuals, including stroke survivors, can continue to live safely in their own homes despite declines in physical ability. The technologies will seek to leverage the existing functional abilities of seniors including stroke survivors to adapt to physical and cognitive challenges secondary to aging and/or neurologic diseases. These technologies can also be employed to support timely clinical services relevant to stroke care. Preliminary results from the STRoke DOC trial, a telemedicine approach to remote evaluation of strokes, suggest feasibility and positive outcomes for suspected stroke patients evaluated via telemedicine [52].

## Age-friendly communities

The World Health Organization's Age-Friendly Communities Initiative reflects a large-scale intervention aimed at providing resources to seniors that target critical facets of successful aging [53]. There is a growing interest in establishing community-wide projects to change physical and social environments so that individuals with physical limitations, such as people with strokes (especially those with motor deficits), do not encounter barriers to social participation [54]. Transportation assistance, provision of sidewalk benches, creating community senior centers, and hosting social, cultural, or recreational events are some modifications that have received consideration. Such approaches are critical to building age-friendly communities that promote active aging and enhance quality of life by providing resources for health, societal participation, and security for older adults. These efforts are important from a public health standpoint as well, because they address various primary and secondary prevention strategies (e.g. physical activity and social engagement).

An excellent example of a community-wide project to reduce the incidence of myocardial infarction and strokes is 'Be There San Diego,' a campaign to make

San Diego a heart attack- and stroke-free zone [55]. It is a coalition of patients, communities, healthcare systems, and others working together to prevent heart attacks and strokes in our community. The underlying philosophy is that 70% of heart attacks and strokes can be prevented through healthy lifestyles and appropriate treatments, such as stopping smoking, increasing physical activity, and reducing salt in the diet; community changes to create healthier living spaces, such as safe places to exercise and smoke-free areas; and managing high blood pressure, high cholesterol, and diabetes. This initiative involves: (a) educating and engaging patients and communities in understanding and taking action to address the risk factors that cause heart attacks and strokes; (b) sharing and promoting the use of evidence-based medicine and innovative clinical practices to aggressively treat risk factors for heart attacks and strokes in the clinical settings; and (c) identifying and supporting transformations to the healthcare system to ensure that every patient receives the preventive care needed to reduce the risk of heart attacks and strokes.

In conclusion, successful aging is a construct that has gained some traction in recent years and, increasingly, can be applied to further understanding what protects and promotes health and well-being among community-dwelling seniors, including individuals with cerebrovascular disease. Interventions such as physical activity, dietary change, and social engagement have shown positive effects on well-being and health in older adults, which may reduce the risk of cerebrovascular disease. Some of these strategies may be also be of particular benefit in people those who have already experienced a stroke. The concepts of 'Positive Psychiatry,' including well-being, resilience, optimism and successful aging, are as applicable to people with physical illnesses as they are to those with mental illnesses [56]. Studies of mechanisms, optimization, and dissemination of interventions to promote successful aging among persons with stroke and other neurological illnesses should be the next frontiers in research.

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**Dilip V. Jeste**, MD, is a geriatric neuropsychiatrist, who specializes in successful aging, neurobiology of wisdom as well as schizophrenia and other psychotic disorders including psychosis of dementia, and their treatment in older adults. He is the senior associate dean for Healthy Aging and Senior Care, Estelle and Edgar Levi Chair in Aging, distinguished professor of Psychiatry and Neurosciences, and director of the Sam and Rose Stein Institute for Research on Aging at the University of California, San Diego (UC, San Diego).

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