

Train-Your-Brain Program for Informal Caregivers of Stroke Survivors: A Pilot Community-Based Cognitive Intervention Study to Promote Healthy Dietary Behaviors and Social Participation

[Xiang Cong Tham](#) , [Vanessa Jing Xin Phua](#) , [Evelyn Kit Yee Ho](#) , Tingting Yan , Nicole Yun Ching Chen , Mabel Qi He Leow , Xin Yi Seah , Vivien Xi Wu , Wentao Zhou , Edward Wing Hong Poon , Wei Fong Liao , [Yanhong Dong](#) *

Posted Date: 15 March 2023

doi: 10.20944/preprints202303.0264.v1

Keywords: post-stroke; community intervention; stroke survivors; caregivers; diet; fruits; vegetables; social participation



Preprints.org is a free multidiscipline platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Article

Train-Your-Brain Program for Informal Caregivers of Stroke Survivors: A Pilot Community-Based Cognitive Intervention Study to Promote Healthy Dietary Behaviors and Social Participation

Xiang Cong THAM ¹, Vanessa Jing Xin PHUA ¹, Evelyn Kit Yee HO ¹, Tingting YAN ², Nicole Yun Ching CHEN ³, Mabel Qi He LEOW ^{4,5}, Xin Yi SEAH ⁶, Vivien Xi WU ^{1,7}, Wentao ZHOU ¹, Edward Wing Hong POON ^{4,8}, Wei Fong LIAU ⁹ and Yanhong DONG ^{1,*}

¹ Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore, Singapore

² Nursing Department, Liaocheng Vocational and Technical College, China

³ Changi General Hospital, Singapore

⁴ St Luke's ElderCare, Singapore

⁵ SingHealth Polyclinics, Singapore

⁶ Singapore Community Hospitals, Singapore

⁷ NUSMED Healthy Longevity Translational Research Programme, National University of Singapore, Singapore

⁸ Singapore Institute of Technology, Singapore

⁹ National University Polyclinics, Singapore

* Correspondence: nurdy@nus.edu.sg; Tel: +65 6516 8686

Abstract: Informal caregivers are essential in supporting stroke survivors' recovery, but it is unclear whether community interventions can promote healthy eating behaviors and social participation among stroke survivors and their caregivers. The Train-Your-Brain (TYB) program's impact on adherence to national dietary guidelines and social participation among informal caregivers and stroke survivors were assessed in a quasi-experimental study. The TYB program had nine sessions, with one focusing on healthy lifestyle. Participants were prompted to discuss the topics covered, leading to social participation. Dietary habits were assessed using fruits and vegetables consumption questions, while social participation was measured using the Social Impact Measurement Framework. Mann-Whitney U-test and Wilcoxon Signed Rank Test were utilized to analyze the data. Eighteen informal caregivers and 27 stroke survivors participated in the program. Results showed a significant increase in fruit and vegetable intake and social participation in informal caregivers after the program, but there were no significant changes in stroke survivors. Informal caregivers play a crucial role in stroke survivors' lifestyle habits and in encouraging social connections with other stroke survivors. Thus, healthcare professionals should prioritize caregiver support and education to facilitate long-term dietary and social changes that can positively impact stroke survivor's recovery and quality of life.

Keywords: post-stroke; community intervention; stroke survivors; caregivers; diet; fruits; vegetables; social participation

1. Introduction

Informal caregivers are unpaid individuals who provide regular care or assistance to a family member or friend with a health issue or disability [1]. Informal caregiving involves a broad range of tasks, such as helping with personal needs and household chores, managing finances, etc. Typically, informal caregivers are relatives or close friends of the person who requires care and may or may not live in the same household [1]. The importance of caregivers' role has been recognized by other studies, and their involvement in interventional studies is widely acknowledged [2,3].

1.1. Role of Informal Caregivers of Stroke Survivors in Fruits and Vegetables Consumption

Fruits and vegetables provide vital nutrients such as vitamins, minerals, fiber, and antioxidants that are necessary for maintaining overall health. These nutrients have been linked to a reduced risk of chronic diseases [4–6]. A diet high in fruits and vegetables offers numerous benefits for stroke survivors such as reducing the risk of recurrent strokes [7], enhancing cognitive function [8], and reducing the risk of obesity and type 2 diabetes [9]. Informal caregivers play an important role in stroke survivors' diet. These caregivers help in encouraging stroke survivors to adhere to healthy diet by incorporating fruits and vegetables into meals.

1.2. Role of Informal Caregivers of Stroke Survivors in Social Participation

Social participation refers to the diverse ways in which individuals engage with others and make positive contributions to their communities [10]. This entails actively participating in social activities. Social participation plays a vital role in enabling individuals to establish social connections and foster a sense of community, which is an indispensable aspect of human life [10].

Social participation plays a crucial role in stroke survivors' recovery and rehabilitation. Individuals with high social participation were found to have beneficial outcomes including enhanced self-esteem, reduced isolation, and improved mood [11–15]. Informal caregivers play an important role in facilitating such participation by providing their stroke survivors opportunities and support for social activities [16,17]. To the authors' knowledge, there is a lack of understanding if cognitive-based community interventions can promote healthy eating and enhance social participation among stroke survivors and their informal caregivers.

The aims of the study are to examine how the Train-Your-Brain (TYB) Program affects the following: 1) adherence to the national healthy dietary guidelines, specifically the consumption of two servings of fruits and two servings of vegetables per day [18]; and 2) the degree of social participation among program participants (stroke survivors and informal caregivers).

2. Materials and Methods

2.1. Study Design

This investigation utilized a quasi-experimental method to examine the effects of the TYB program on the stroke survivors and caregivers. The participants were selected from a community-based study on brain health for stroke recovery in Singapore. The recruitment process involved reaching out to a variety of service providers, such as day rehabilitation centers, primary healthcare polyclinics, and stroke associations, in addition to word-of-mouth recommendations. Out of the 64 eligible participants from the brain health study, 56 (87.5%) participants consented to take part. To be considered eligible for participation, the individuals had to meet either of the following criteria: 1) stroke survivors who were at least three months post-stroke and had no major language (aphasia) or motor function impairments (apraxia) that could impede their ability to provide informed consent, or 2) caregivers of stroke survivors. All participants were also required to have sufficient proficiency in the English language to provide informed consent and partake in the group program.

Before the initiation of the program, the study team sent a survey link to the participants and conducted in-home visits to obtain baseline assessments. The TYB programme was held virtually via the Zoom video conferencing software, and upon its conclusion, the study team visited the participants again to conduct follow-up assessments. This study received ethical approval from the National University of Singapore-Institutional Review Board (NUS-IRB) (ref: NUS-IRB-2021-412). The study was conducted from 20 October to 30 December 2022.

2.2. Intervention

The TYB program was led by clinical neuropsychologists and conducted in English. The content was based on a previous version for older adults with mild cognitive impairment in a public hospital [19]. The program consisted of nine sessions lasting between 60 to 90 minutes, with two to three

sessions held each week. Within each session, there were about 20 to 30 participants. Participants who completed the first eight sessions were considered to have completed the program. Each session covered a specific topic related to cognitive and emotional health. Participants were also encouraged to discuss their strategies on applying what was taught in the sessions within the group. Participants were also given homework assignments after each session to reinforce the concepts learnt.

This nine-session program was designed to educate individuals who have suffered from strokes on how to manage memory and thinking difficulties, address mood-related concerns, and prevent future strokes. Table 1 displayed a summary of the program. A more elaborate depiction of each session can be found in a separate manuscript [20]. Session 2 centered on adopting a healthy lifestyle, which comprised of consuming sufficient servings of fruits and vegetables. Although there was no dedicated session for social participation, participants were consistently prompted to engage in discussions with each other throughout the program.

Table 1. Summary of each session of the Train-Your-Brain program.

Summary of Each Session
<p>Session 1: Memory and Thinking Difficulties Related to Stroke</p> <p>Participants learned about how to identify these difficulties, understand normal ageing and memory processes, and set SMART (Specific, Measurable, Achievable, Realistic/Relevant and Timed) [21] goals for recovery and brain health. This session included memory games and a discussion on common memory and thinking problems after stroke. Participants were encouraged to complete homework tasks to improve brain health and memory, by setting daily goals, remembering new people's names, and repeating memory strategies daily.</p>
<p>Session 2: Health and Lifestyle Impact on Memory, Thinking and Stroke Recovery</p> <p>Participants learned about the risk factors of recurrent stroke and the importance of healthy lifestyle choices to improve brain health. The session included discussions on common risk factors like diabetes, heart disease, high blood pressure, high cholesterol, depression and anxiety, obesity, and lack of physical activity on brain health. Participants were encouraged to set SMART goals for daily or weekly improvement in brain health, such as getting a health screening, eating more fruits and vegetables, practising good sleep habits, and to pair up and choose a strategy to implement together.</p>
<p>Session 3: Generating Better Mood, Memory, and Recovery</p> <p>The facilitator led a discussion on the relationship between depression, anxiety, stress, memory, and thinking difficulties. The group was taught techniques to improve memory by managing mood and stress. Participants were encouraged to set a SMART goal to achieve "Better Mood, Sharper Brain", and practised the strategies taught during the session.</p>
<p>Session 4: Improving Attention, Memory, and Recovery</p> <p>The facilitator educated participants about the different types of attention. The session also included tips on how to improve focus, such as following a routine, choosing the best time for activities, focusing on one task, minimizing distractions, using strategies, being aware of limitations, and managing anxiety. As homework, the participants were encouraged to formulate a SMART goal to enhance their focus for the week and put their strategies into practice.</p>
<p>Session 5: Learning Good Planning, and Organization Skill to Optimize Recovery</p> <p>In this session, the facilitator emphasized the significance of good planning and organizational skills in enhancing recovery. Participants received psychoeducation on how these skills affect memory and thinking and were taught strategies to enhance them. Participants were encouraged to set daily goals to achieve a "SMART Plan, Organized Brain." The homework assignment required participants to write a SMART goal to help them become more organized and practise their strategies.</p>

Session 6: When to Return to Work, Phased Return or Full-time Work?

The facilitator provided psychoeducation on fatigue related to stroke and shared coping strategies for managing it. The session discussed returning to work after stroke and the importance of setting SMART goals for brain health and work reintegration. Participants were encouraged to discuss about the facilitators and barriers to returning to work.

Homework included setting daily goals for improving brain health and memory, remembering new people's names, setting recovery goals, and practising memory strategies.

Session 7: Manage Fatigue, Mood, and Stress to Meet Work Demand

Participants were taught about pacing and monitoring activities, and physical exercise to build stamina using cognitive behavioral therapy principles. The facilitator provided education on managing low mood and stress, discussing physical and behavioral symptoms of depression, and techniques to improve mood. Participants were given homework assignments to set daily and weekly goals to make small changes to better manage their fatigue, mood, and stress.

Session 8: Applying Memory and Thinking Strategies to Work Effectively

The session focused on applying memory and thinking skills learned in previous sessions to work environments. Participants were engaged in a mindfulness exercise, learned about the benefits of mindfulness, and reviewed previous lessons on memory, thinking difficulties, and lifestyle factors that support brain health and mood. The facilitator encouraged participants to set goals for applying these skills in the workplace as homework.

Session 9: Review Session

Participants were encouraged to share their progress and experiences, incorporating the knowledge and strategies learned throughout the program. The facilitator summarized the important points covered in each session. Participants were given a final homework assignment, which encouraged them to continue to engage with the strategies and concepts learned during the program to promote ongoing growth and improvement.

2.3. Measurements

Participants' socio-demographic profiles were collected from the community-based brain health for stroke recovery study. Before home visits, they were asked to complete an online survey that covered their lifestyles, levels of social participation, and other aspects of their lives. The participants' cognitive abilities were evaluated during their home visits.

2.3.1. Dietary Habits (Fruits and Vegetables)

To evaluate the dietary habits of the participants, the survey asked two questions pertaining to this aspect, which were: "How many servings of fruits (excluding fruit juice) do you usually eat on a typical day?" and "How many servings of vegetables do you eat on a typical day?". In a local study conducted by Lim et al. [22], identical questions were posed concerning the consumption of fruits and vegetables, with the aim of eliciting a 24-hour recall response from the participants. The criteria for meeting national dietary guidelines were based on the consumption of two servings of fruits and two servings of vegetables per day [18]. Participants were shown sample pictures of one serving of fruits and vegetables after each question to assist them in understanding the questions better.

2.3.2. Social Participation

The Social Impact Measurement Framework (SIMF) was implemented as a means of measuring the level of social engagement among the participants. This framework was used to assess various aspects of their social participation. The SIMF was created through the collaboration of SG Enable, a Singapore organization that seeks to empower persons with disabilities, and National University of Singapore (NUS)-Institute of Systems Science (ISS), an institution in NUS. SIMF was designed to

evaluate the effectiveness of social and health programs and services. The development of SMIF involved obtaining sufficient validation from both individuals with disabilities and their caregivers [23]. The SMIF consists of 20 items designed for individuals with disabilities and 19 items intended for caregivers. To assess the internal consistency and reliability of the scale, Cronbach’s alpha coefficient was examined with 16 stroke survivors and 17 caregivers from the brain health study prior to the implementation of SIMF. The α values for stroke survivors and caregivers were calculated to be 0.81 and 0.88, respectively. The results of this analysis led to the utilization of SIMF in the current study.

2.4. Statistical Analysis

A total of eight participants, constituting 14.3% of the sample, were excluded from the analysis due to their incomplete home visit assessments. Since the sample size was relatively small, consisting of 27 stroke survivors and 21 caregivers, normality was not assumed. Within the caregiver participants, 18 of them were informal caregivers. Mann-Whitney *U*-test was utilized to compare the outcomes of the two groups (i.e., stroke survivors and informal caregivers), while the Wilcoxon Signed Rank Test was implemented to assess the change in dietary habits and social participation among participants within the same group after TYB. The statistical analyses were conducted using Python version 3.9.12. A *p*-value less than 0.05 was regarded as statistically significant in a two-tailed test.

3. Results

3.1. Socio-Demographic Profiles

Table 2 displayed the socio-demographic profiles of the participants. Out of the 18 informal caregivers, 11 of them were spouses and the remaining seven were children of stroke survivors.

Table 2. Demographic profiles of participants.

	Stroke Survivors (n=27)	Informal Caregivers (n=18)
Female, n (%)	11 (40.7)	13 (72.2)
Chinese, n (%)	22 (81.5)	15 (83.3)
Age, median years	59.0 (IQR 50.0-69.0)	55.5 (IQR 46.0-68.5)

3.2. Dietary Habits and Social Participation between Participant Groups

The outcomes of the Mann-Whitney *U*-Test are shown in Tables 3 and 4. Table 3 showed that there were no considerable variations between the participant groups. On the other hand, Table 4 showed that there was a significant difference in social participation levels between stroke survivors and informal caregivers following the completion of the TYB program (*p*=.02).

Table 3. Comparison of consumption of fruits and vegetables, and social participation between participant groups before the commencement of Train-Your-Brain program.

	Stroke Survivors (n=27)	Informal Caregivers (n=18)	<i>U</i> -statistics	<i>p</i> -value
Servings of Fruits, median	1.0 (IQR 1.0-2.0)	1.0 (IQR 1.0-1.3)	285.0	.28
Servings of Vegetables, median	2.0 (IQR 1.0-2.0)	2.0 (IQR 1.0-2.0)	226.0	.68
Total Servings of Fruits and Vegetables, median	3.0 (IQR 2.0-4.0)	3.0 (IQR 2.0-3.3)	256.5	.75

Social Participation, median	67.0 (IQR 62.0-70.0)	72.5 (IQR 63.3-82.0)	168.5	.09
IQR: Inter-quartile range.				

Table 4. Comparison of consumption of fruits and vegetables, and social participation between participant groups after the completion of Train-Your-Brain program.

	Stroke Survivors (n=27)	Informal Caregivers (n=18)	U-statistics	p-value
Servings of Fruits, median	1.0 (IQR 1.0-2.0)	1.5 (IQR 1.0-2.0)	192.0	.17
Servings of Vegetables, median	2.0 (IQR 1.0-2.0)	2.0 (IQR 1.8-2.3)	185.5	.15
Total Servings of Fruits and Vegetables, median	3.0 (IQR 2.0-4.0)	4.0 (IQR 3.0-4.0)	173.5	.10
Social Participation, median	68.0 (IQR 62.0-74.0)	78.5 (IQR 64.8-81.5)	141.5	.02
IQR: Inter-quartile range.				

3.3. Dietary Habits and Social Participation before and after Train-Your-Brain Program

The Wilcoxon Signed Rank Test analysis, in Table 5, showed that there was a significant improvement in social participation in informal caregivers ($p<.01$). Moreover, there was also a significant increase in the number of servings of fruits consumption ($p=.03$). Similarly, the total servings of fruits and vegetables consumption increased significantly ($p=.02$). Although the increase in the number of servings of vegetables intake was not statistically significant, the p -value was very close to the level of significance ($p=.06$). However, there were no significant changes in the stroke survivors (see Table 6).

Table 5. Comparison of consumption of fruits and vegetables, and social participation in informal caregivers (n=18).

	Before TYB	After TYB	W-statistics	p-value
Servings of Fruits, median	1.0 (IQR 1.0-1.3)	1.5 (IQR 1.0-2.0)	3.0	.03
Servings of Vegetables, median	2.0 (IQR 1.0-2.0)	2.0 (IQR 1.8-2.3)	0.0	.06
Total Servings of Fruits and Vegetables, median	3.0 (IQR 2.0-3.3)	4.0 (IQR 3.0-4.0)	3.0	.02
Social Participation, median	72.5 (IQR 63.3-82.0)	78.5 (IQR 64.8-81.5)	20.0	<.01
IQR: Inter-quartile range, TYB: Train-Your-Brain.				

Table 6. Comparison of consumption of fruits and vegetables, and social participation in stroke survivors (n=27).

	Before TYB	After TYB	W-statistics	p-value
Servings of Fruits, median	1.0 (IQR 1.0-2.0)	1.0 (IQR 1.0-2.0)	20.0	.74
Servings of Vegetables, median	2.0 (IQR 1.0-2.0)	2.0 (IQR 1.0-2.0)	13.5	.93
Total Servings of Fruits and Vegetables, median	3.0 (IQR 2.0-4.0)	3.0 (IQR 2.0-4.0)	34.5	.71
Social Participation, median	67.0 (IQR 62.0-70.0)	68.0 (IQR 62.0-74.0)	163.0	.75

IQR: Inter-quartile range, TYB: Train-Your-Brain.

4. Discussion

The study aimed to evaluate the impact of the Train-Your-Brain (TYB) Program on adherence to the national healthy dietary guidelines and social participation among informal caregivers and stroke survivors. Results indicated that there were no significant differences between the participant groups before and after the commencement of TYB program for fruits and vegetables consumption. However, the findings revealed there was a significant improvement in social participation levels between the informal caregivers and stroke survivors following the TYB program. There was also a significant improvement in social participation among informal caregivers, and an increase in the number of fruit servings and total servings of fruits and vegetables consumed. No significant changes were observed among stroke survivors after the program.

The study found that stroke survivors did not make significant dietary changes after TYB program, possibly due to already imposed dietary restrictions or post-stroke recovery plans following the onset of stroke symptoms [24]. It is also important to recognize that dietary changes may take time to become a habit and that, repeated encouragement and support from informal caregivers may be necessary to effect long-term change [25]. In addition, the study revealed no significant differences between participant groups in their consumption of fruits and vegetables daily before and after the commencement of TYB. The results implied that the eating habits of the informal caregivers could have influenced the dietary behavior of stroke survivors, particularly if they were living together, as most participants were spouses. This may be attributed to their close relationship as they likely exhibited similar behavioral habits before and after the introduction of TYB [26].

Although the objective of the study did not focus on the prevalence of participants' dietary habits, it is noteworthy that they did not meet the national dietary guidelines of consuming two servings of fruits and two servings of vegetables daily at baseline. This finding is consistent with a previous review that reported older adults worldwide failing to comply with dietary recommendations [27]. Additionally, Tham et al.'s study [20] on the impact of TYB on mood found that stroke survivors had heightened levels of depression, anxiety, and stress, which was attributed to their inadequate consumption of fruits and vegetables [28]. Moreover, stroke survivors may have faced psychological obstacles in adhering to healthcare professionals' recommended dietary restrictions due to the informal caregivers' failure to meet the dietary guidelines themselves [29]. Therefore, informal caregivers play a crucial role in influencing the lifestyle habits of stroke survivors, not only by providing support and assistance but also by acting as role models.

The TYB program provided an opportunity for informal caregivers to learn and receive support to promote healthy eating habits and improve the well-being of themselves and the stroke survivors they care for. The results of the study indicated that the informal caregivers' dietary intake had improved significantly following their participation in the program. The program's success could be

attributed to its emphasis on active discussions and encouraging participants to implement the strategies learned in each session, which likely helped the caregivers become effective role models for the stroke survivors. It is also worth noting that active group discussions and frequent practices are essential for forming healthy habits [30,31]. The TYB program has taken these principles into account, and its design may have played a critical role in its success. By offering a platform for discussion and encouraging the participants to practise what they had learned, the program may have facilitated the development of new dietary habits among the informal caregivers, which in turn could have positively impacted the stroke survivors they cared for.

The stroke survivors in the study did not display any significant improvement in their social participation following the TYB program. Some stroke survivors in the study may encounter challenges in communicating their ideas and viewpoints possibly due to aphasia and apraxia, leading to difficulties in expressing themselves. Apart from communication difficulties, stroke survivors may also experience emotional disturbances that can affect their social participation. Research studies had shown that social isolation and loneliness were common among stroke survivors, which could lead to further physical and psychological health problems [32,33]. The challenges could stem from either the negative societal perception towards those with communication impairments, or the individual's own emotions such as distress, embarrassment, or apprehension of exclusion. This notion is reinforced by Tham et al.'s [20] study which indicated that stroke survivors exhibited elevated levels of depression, anxiety, and stress. Hence, this accounts for the lack of statistically significant improvements in the stroke survivors' level of social participation after undergoing the TYB program.

The results of the study showed that the TYB program led to a significant increase in social participation among informal caregivers, as well as a significant increase in social participation in comparison to stroke survivors. This outcome could be attributed to their active engagement in social activities to encourage social participation among stroke survivors. This finding aligns with another study, which found no improvement in depression, anxiety, and stress among caregivers [20], suggesting that the main objective of caregivers was to connect with others in the program, possibly stroke survivors. By building stronger connections, caregivers may be looking for companionship and social support with other stroke survivors and caregivers. Through these connections, caregivers could discover additional ways to support and benefit their own stroke survivors as well as coping strategies for themselves. During the stroke recovery process, it is crucial that survivors have the chance to interact with fellow peers, share their experiences and knowledge, receive emotional support, and participate in activities that encourage physical and cognitive rehabilitation [34]. Therefore, participating in the TYB program and connecting with other stroke survivors allowed caregivers to play a vital role in supporting their stroke survivors' recovery and overall well-being.

4.1. Limitations

Firstly, there was no evaluation of the long-term effects of TYB on healthy dietary consumption and social participation levels as the follow-up measurements were conducted shortly after the program ended. Therefore, it was not possible to determine if the improvements would be sustained. Secondly, due to the possibility that the Social Impact Measurement Framework has not been sufficiently validated in the context of stroke, the survey's capacity to precisely assess social participation levels among participants may be limited. Thirdly, the sample size of the study was small. As a result, the statistical analysis power was reduced, and generalizability to a larger population was limited. This pilot study suggests the need for future studies to conduct a randomized controlled trial (RCT) with a larger sample size to address these limitations. Finally, since the study was only conducted with English-speaking participants, it is possible that non-English speakers may have had different outcomes, particularly in a diverse society like Singapore.

5. Conclusion

The study highlighted the important role that caregivers play in the dietary and social aspects of stroke survivors' recovery and rehabilitation. While stroke survivors may already have dietary

restrictions or recovery plans in place, caregivers can provide support by being positive role models themselves by consuming adequate servings of fruits and vegetables. Notably, the TYB program was conducted over a relatively short period of fewer than 3 months, yet it was proven to be effective in encouraging caregivers to eat healthily and participate socially. The TYB program is an effective intervention for promoting healthy dietary habits among caregivers, and its design may have played a critical role in its success. Moreover, the program resulted in a rise in social participation among caregivers, potentially prompting them to seek camaraderie with other stroke survivors to foster social connections with their own stroke survivors, which is essential for stroke survivors' overall well-being. Therefore, healthcare professionals should also prioritize caregiver support and education to facilitate long-term dietary and social changes that can positively impact the stroke survivor's recovery and quality of life.

Author Contributions: XT and YD contributed to conception and design of the study. YD obtained the funding. XT organized the database and performed the statistical analysis. XT wrote the first draft of the manuscript with critical revision from YD. XT, VP, EH, TY, NC and YD contributed to the data collection and facilitation of the program. All authors contributed to manuscript revision, read, and approved the submitted version.

Funding: This study is funded by Tote Board Enabling Lives Initiatives grant (ref: GC52017NUSBH). Y. Dong is a recipient of the Singapore National Medical Research Council (NMRC) Transition Award (TA) award [NMRC/TA/0060/2017].

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of National University of Singapore (protocol code NUS-IRB-2021-412 and date of approval: 8 September 2022).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the participants to publish this paper.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available as such request requires ethical approval.

Acknowledgments: The authors would like to thank Saint Luke's ElderCare, National University Polyclinics, and Singapore National Stroke Association for their active participation in this study in referring interested participants to us. The authors would also like to acknowledge the research team who have contributed to this study.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

1. Ainamani HE, Alele PE, Rukundo GZ, Maling S, Wakida EK, Obua C, Tsai AC. Caring for people with dementia in rural Uganda: qualitative study of caregiving burden experienced by informal and formal caregivers. *J Glob Health Rep.* 2020;4:e2020038. doi: 10.29392/001c.12848
2. Legg LA, Quinn TJ, Mahmood F, Weir CJ, Tierney J, Stott DJ, Smith LN, Langhorne P. Non-pharmacological interventions for caregivers of stroke survivors. *Cochrane Database Syst Rev.* 2011;(10):CD008179. doi: 10.1002/14651858.CD008179.pub2
3. White CL, Cantu AG, Trevino MM. Interventions for caregivers of stroke survivors: an update of the evidence. *Clin Nurs Stud.* 2015;3(3):87-95. doi: 10.5430/cns.v3n3p87
4. Van Duyn MAS, Pivonka E. Overview of the health benefits of fruit and vegetable consumption for the dietetics professional: selected literature. *J Am Diet Assoc.* 2000;100(12):1511-1521. doi: 10.1016/S0002-8223(00)00420-X
5. Key TJ. Fruit and vegetables and cancer risk. *Br J Cancer.* 2011;104(1):6-11. doi: 10.1038/sj.bjc.6606032
6. Slavin JL, Lloyd B. Health benefits of fruits and vegetables. *Adv Nutr.* 2012;3(4):506-516. doi: 10.3945/an.112.002154
7. Huang ZX, Lin XL, Lu HK, Liang XY, Fan LJ, Liu XT. Lifestyles correlate with stroke recurrence in Chinese inpatients with first-ever acute ischemic stroke. *J Neurol.* 2019;266:1194-1202. doi: 10.1007/s00415-019-09249-5
8. Lamport DJ, Saunders C, Butler LT, Spencer JP. Fruits, vegetables, 100% juices, and cognitive function. *Nutr Rev.* 2014;72(12):774-789. doi: 10.1111/nure.12149

9. Bailey RR, Singleton JR, Majersik JJ. Association of obesity and diabetes with physical activity and fruit and vegetable consumption in stroke survivors. *Fam Pract.* 2021;38(1):56-61. doi: 10.1093/fampra/cmaa101
10. Ammar A, Chtourou H, Boukhris O, Trabelsi K, Masmoudi L, Brach M, ... ECLB-COVID19 Consortium. COVID-19 home confinement negatively impacts social participation and life satisfaction: a worldwide multicenter study. *Int J Environ Res Public Health.* 2020;17(17):6237. doi: 10.3390/ijerph17176237
11. Chau JP, Thompson DR, Twinn S, Chang AM, Woo J. Determinants of participation restriction among community dwelling stroke survivors: A path analysis. *BMC Neurol.* 2009;9:49. doi: 10.1186/1471-2377-9-49.
12. Cooper CL, Phillips LH, Johnston M, Radlak B, Hamilton S, McLeod MJ. Links between emotion perception and social participation restriction following stroke. *Brain Inj.* 2014;28(1):122-126. doi: 10.3109/02699052.2013.848379.
13. Woodman P, Riazi A, Pereira C, Jones F. Social participation post stroke: a meta-ethnographic review of the experiences and views of community-dwelling stroke survivors. *Disabil Rehabil.* 2014;36(24):2031-2043. doi: 10.3109/09638288.2014.887796.
14. Cooper CL, Phillips LH, Johnston M, Whyte M, MacLeod MJ. The role of emotion regulation on social participation following stroke. *Br J Clin Psychol.* 2015;54(2):181-199. doi: 10.1111/bjc.12068.
15. Zhou X, Du M, Weng Y, Zhou L. Hard return: the development and transformation process of social participation in stroke survivors; a qualitative study and initial theory. *Clin Rehabil.* 2020;34(6):824-836. doi: 10.1177/0269215520917191.
16. Waldinger RJ, Schulz MS. What's love got to do with it? Social functioning, perceived health, and daily happiness in married octogenarians. *Psychol Aging.* 2010;25(2):422-431. doi: 10.1037/a0019087.
17. Gardener H, Levin B, DeRosa J, Rundek T, Wright CB, Elkind MS, Sacco RL. Social connectivity is related to mild cognitive impairment and dementia. *J Alzheimers Dis.* 2021;84(4):1811-1820. doi: 10.3233/JAD-210519.
18. Health Promotion Board. *Fruits and Veggies* [Internet]. 2023. [cited 2023 Feb 28]. Available from <https://www.healthhub.sg/programmes/56/fruits-and-veggies>.
19. Granland KA, Thompson CL, Dong Y. "Train Your Brain" Cognitive Intervention Group Program for Singaporean Older Adult Patients With Mild Cognitive Impairment: A Pilot Feasibility Study. *J Geriatr Psychiatry Neurol.* 2022;35(3):442-449. doi: 10.1177/08919887211002661.
20. Tham XC, Phua VJX, Ho EKY, Yan T, Chen NYC, Zuo L, Thompson CL, Dong Y. Train-Your-Brain Program to Reduce Depression, Anxiety, and Stress in Stroke Survivors: A Pilot Community-Based Cognitive Intervention Study. *Front Neurol.* (in review).
21. Schut HA, Stam HJ. Goals in rehabilitation teamwork. *Disabil Rehabil.* 1994;16(4):223-226. doi: 10.3109/09638289409166616
22. Lim RBT, Tham DKT, Müller-Riemenschneider F, Wong ML. Are university students in Singapore meeting the international and national recommended daily servings of fruits and vegetables? *Asia Pac J Public Health.* 2017;29(3):199-210. doi: 10.1177/1010539517696553
23. Greulich-Smith T. *Measuring the Social Impact of Disability Support* [Internet]. Singapore: Institute of Systems Science, National University of Singapore; 2017 [cited 2023 Feb 28]. Available from: <https://www.iss.nus.edu.sg/community/newsroom/news-detail/2017/03/22/measuring-the-social-impact-of-disability-support>
24. Sabbouh T, Torbey MT. Malnutrition in stroke patients: risk factors, assessment, and management. *Neurocrit Care.* 2018;29(3):374-384. doi: 10.1007/s12028-017-0436-1
25. Arlinghaus KR, Johnston CA. Advocating for behavior change with education. *Am J Lifestyle Med.* 2018;12(2):113-116. doi: 10.1177/1559827617745479
26. McCarthy MJ, Lyons KS, Schellinger J, Stapleton K, Bakas T. Interpersonal relationship challenges among stroke survivors and family caregivers. *Soc Work Health Care.* 2020;59(2):91-107. doi: 10.1080/00981389.2020.1714827
27. Nicklett EJ, Kadell AR. Fruit and vegetable intake among older adults: A scoping review. *Maturitas.* 2013;75(4):305-312. doi: 10.1016/j.maturitas.2013.05.005
28. Matison AP, Mather KA, Flood VM, Reppermund S. Associations between nutrition and the incidence of depression in middle-aged and older adults: A systematic review and meta-analysis of prospective observational population-based studies. *Ageing Res Rev.* 2021;70:101403. doi: 10.1016/j.arr.2021.101403

29. Parappilly BP, Mortenson WB, Field TS, Eng JJ. Exploring perceptions of stroke survivors and caregivers about secondary prevention: a longitudinal qualitative study. *Disabil Rehabil.* 2020;42(14):2020-2026. doi: 10.1080/09638288.2018.1544296
30. Wood W, Neal DT. Healthy through habit: Interventions for initiating & maintaining health behavior change. *Behav Sci Policy.* 2016;2(1):71-83. doi: 10.1353/bsp.2016.0008
31. Shvedko A, Whittaker AC, Thompson JL, Greig CA. Physical activity interventions for treatment of social isolation, loneliness or low social support in older adults: A systematic review and meta-analysis of randomised controlled trials. *Psychol Sport Exerc.* 2018;34:128-137. doi: 10.1016/j.psychsport.2017.10.003
32. Valtorta NK, Kanaan M, Gilbody S, Ronzi S, Hanratty B. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. *Heart.* 2016;102(13):1009-1016. doi: 10.1136/heartjnl-2015-308790
33. Freak-Poli R, Wagemaker N, Wang R, Lysen TS, Ikram MA, Vernooij MW, Dintica CS, Vernooij-Dassen M, Melis RJ, Laukka EJ, Fratiglioni L. Loneliness, not social support, is associated with cognitive decline and dementia across two longitudinal population-based cohorts. *J Alzheimers Dis.* 2022;85(1):295-308. doi: 10.1080/13607863.2021.1940097
34. Wan X, Chau JPC, Mou H, Liu X. Effects of peer support interventions on physical and psychosocial outcomes among stroke survivors: A systematic review and meta-analysis. *Int J Nurs Stud.* 2021;121:104001. doi: 10.1016/j.ijnurstu.2021.104001

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.