

1 **Title:** Implementation and evaluation of the Graded Repetitive Arm Supplementary Program  
2 (GRASP) for people with stroke in a real-world community setting: Case Report

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24 **Abstract**

25 **Objective:** Exercise programs to improve upper extremity function following stroke in the  
26 community setting are needed as the length of hospital stay continues to reduce. However, little  
27 has been done to understand how to translate an evidence-based rehabilitation intervention to  
28 real-world programs. The purpose of the study is to undertake a process evaluation of the  
29 implementation of an evidence-based upper extremity rehabilitation intervention for stroke, the  
30 Graded Repetitive Arm Supplementary Program (GRASP), in a community setting.

31 **Case Description:** A partnership between a nonprofit support organization and a local  
32 community center was established to deliver the program in the community. The RE-AIM  
33 (Reach, Effectiveness, Adoption, Implementation, Maintenance) framework with mixed methods  
34 was used to evaluate the implementation.

35 **Results:** *REACH:* Twenty people were screened, 14 people were eligible, and 13 consented to  
36 participate in the study. The program reached approximately 1.25 % of the potential target  
37 population. *EFFECTIVENESS:* Stroke participants demonstrated significant improvement in  
38 upper extremity function and quality of life as measured by the Fugl-Meyer Upper Extremity  
39 Scale, Action Research Arm Test, Rating of Everyday Arm-use in the Community and Home  
40 Scale, and Stroke Impact Scale. *ADOPTION:* Factors that facilitate program uptake were well-  
41 planned implementation and the workplace coaching based on the audit results. Factors  
42 contributing to ongoing participation were the social support within the group environment and  
43 the instructor's capability of engaging the group. *IMPLEMENTATION:* A partnership between a  
44 nonprofit organization and a local community center was established successfully. The program  
45 was implemented as intended as verified by a fidelity checklist. Participants' adherence was high

46 as confirmed by the average attendance and practice time. *MAINTENANCE*: Both the partner  
47 organization and community center continued to offer the program.

48 **Conclusion:** The program had good fidelity of the critical principles and core components, and  
49 was effective in improving upper extremity function and quality of life. This partnership model  
50 may serve as the first step for future larger-scale implementation and can be used to move other  
51 stroke rehabilitation interventions into community settings.

52

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## 56 **Background**

57           Approximately 141,000 people in North America have a stroke every year <sup>1,2</sup>. Upper  
58 extremity (UE) paresis is one of the most common consequences following stroke and  
59 approximately 88% of individuals with stroke did not regain complete functional recovery in  
60 their upper extremities at 6 months post-stroke <sup>3</sup>. Many interventions are based on principles of  
61 high repetitive task-specific training and have shown to improve UE motor functions after stroke  
62 <sup>4</sup>. As the length of hospital stay continues to reduce, patients are returning to community living  
63 earlier where they have limited access to intensive therapy. Thus, exercise programs to improve  
64 UE function in the community setting are needed.

65           Despite the need for exercise programs to improve UE function in the community, little  
66 has been done to understand how to translate these interventions to real-world programs <sup>5</sup>.  
67 Moving an evidence-based interventions to real-world community settings is complex and  
68 challenging <sup>6-9</sup>. It can require identification of the essential components in the intervention (e.g.,  
69 intensity, frequency, type of exercises, etc.) <sup>10</sup>, specialized training to develop skills for service  
70 delivery staff <sup>11</sup>, or the balance between local contextualization (i.e., adapting the program to the  
71 local setting) and implementation fidelity <sup>12</sup>. Understanding how to optimize the implementation  
72 of interventions in community settings to enhance participant outcomes is critical.

73           The Graded Repetitive Arm Supplementary Program (GRASP) is a neurorehabilitation  
74 intervention for the paretic UE based on intensive, repetitive, and task-specific practice. The  
75 GRASP (<http://neurorehab.med.ubc.ca/grasp/>) has two versions of the program: Hospital  
76 GRASP and Home GRASP. Home GRASP is initially prescribed face-to-face, and then  
77 monitored and progressed by therapists using weekly phone call over 2 months for individuals

78 who have been discharged home <sup>13</sup>. GRASP has been included in the Canadian Stroke Best  
79 Practice Recommendations for UE management <sup>14</sup>.

80 This case report evaluates the implementation process from the first two iterations of the  
81 GRASP program in a community setting using a novel implementation model through  
82 partnership between a nonprofit organization and a local community center. The implementation  
83 process was examined using the RE-AIM framework, (Reach, Effectiveness, Adoption,  
84 Implementation, and Maintenance) which provides a systematic and comprehensive framework  
85 to evaluate the translation of an evidence-based intervention to practice <sup>15,16</sup>. The framework  
86 REAIM (<http://www.re-aim.org/>) has been widely used to design, implement, and evaluate  
87 research <sup>17</sup>.

## 88 **Case Description**

### 89 *Implementation overview*

90 The program implementation and study timeline are illustrated in Figure 1. As part of the  
91 implementation, the nonprofit Stroke Recovery Association of British Columbia (SRABC)  
92 established a partnership in September 2018 with a local community center (Templeton Park  
93 Pool Community Center, Vancouver, BC, Canada) to deliver the program. The SRABC provided  
94 in-kind promotion, administration, volunteer recruitment, printing costs (e.g., manuals, forms,  
95 etc.), and supervision of the instructor by the SRABC regional coordinator. The SRABC set cost-  
96 recovery fees to cover the salary of the instructor. The community center offered space,  
97 advertised the activity in their program guide, registered participants and collected program fees  
98 at no cost. The research team provided participant manuals and equipment to run the program in  
99 the first iteration, supported by a research grant, but not the second iteration. The research team,  
100 as an outreach facilitator <sup>18</sup>, provided support, audit, feedback, consultation, and

101 information/resources to promote the uptake and assist the implementation of the program by the  
102 SRABC. The workplace coaching and audits were conducted as part of the research team  
103 members' job responsibilities. Before the program started, the instructors received a half-day of  
104 training from the research team which consisted of lectures and hands-on practice with  
105 individuals with stroke. Information about stroke, the impact of stroke on the UE, the GRASP  
106 protocol, and program delivery was included. The hands-on practice focused on the selection of  
107 appropriate levels of exercise, progression, and modification of the GRASP exercises. A fidelity  
108 checklist that outlined the critical principles and core components of the GRASP community  
109 program was embedded into the training. Two 10-week iterations of the program were run, each  
110 with a different instructor and participants (see Figure 1 for details). Audits were undertaken by  
111 the research team during in-class observation in the 2<sup>nd</sup> and 6<sup>th</sup> weeks to assess program fidelity  
112 with feedback provided to the instructor before the next class. Post-testing and follow-up of the  
113 stroke participants were conducted within a week and 2 months after the program ended,  
114 respectively.

115 Figure 1 about here

#### 116 *GRASP program*

117 The GRASP community program was adapted from the Home GRASP for the local  
118 community center. The program consisted of 10 weeks of one-hour group classes, individualized  
119 homework exercises, and had a cost-recovery fee. In the first iteration, the GRASP participant  
120 manuals and equipment were given to the participants free of charge. In the second iteration, the  
121 cost of the manual was included in the pricing. Participants were encouraged to bring their  
122 caregivers or family members to the weekly class if available. Participants were requested to  
123 complete one hour of GRASP exercises every day and record the practice time in a log sheet

124 (Appendix 1). The weekly class was led by one instructor. The typical class consisted of 15 mins  
125 of experience sharing and discussion, 35 mins of exercise progression and modification, and 10  
126 mins of goal setting and wrap-up (Appendix 2).

### 127 *Stroke Participants*

128 Individuals with stroke who were interested in participating in the program contacted the  
129 SRABC and were linked with a program instructor who screened the participants. Participants  
130 were eligible to participate in the GRASP community program if they (1) were >19 years old,  
131 (2) had a stroke in the past, (3) have difficulty using the affected UE, (4) have some voluntary  
132 movement in the affected UE including the ability to lift the affected arm to the chest level and  
133 hold for 5 seconds, some ability to extend the affected wrist, and some ability to grasp and  
134 release an object such as a cup handle, 5) living in the community, 6) able to understand and  
135 follow instructions, and 7) are willing to practice GRASP exercises daily. Participants with  
136 severe pain that prevented the movement in affected arm and hand were excluded. Eligible  
137 participants could register for the community program. At that point, they were approached to  
138 participate and consent to an optional research study by the research team.

### 139 *Staff*

140 Two different paid instructors, with experience leading SRABC stroke recovery program  
141 group classes led each iteration of the program. One instructor was a licensed occupational  
142 therapist, and the other had a bachelor's degree in health science. One to three volunteers were  
143 available to assist with classes with at least 1 instructor/volunteer for every 3 participants. One  
144 volunteer had completed the occupational therapy master program, and the others were health  
145 science students. All volunteers were trained by the instructors to assist with exercise progression  
146 and modification under the instructor's supervision. The SRABC regional coordinator provided

147 operational and logistical oversight, including communicating with the community center,  
148 recruiting instructors and volunteers, advertising the program, supervising instructors' group  
149 facilitation, and working with the research team to develop all supporting documents for program  
150 delivering.

### 151 *Data collection*

152 A mixed-methods approach was used to evaluate the implementation. Table 1 provides  
153 an overview of the variables under each RE-AIM element, the data sources used to assess each  
154 variable, and the data collection timeline.

155 Table 1 about here

### 156 *Data analysis*

157 Descriptive analysis (frequencies, mean, median, and change scores) were used to  
158 summarize baseline demographic, stroke characteristics, individual changes in clinical  
159 assessment scores, responses to the questionnaires, as well as program and individual records.  
160 The Friedman tests were used to evaluate the differences across three time points with a within-  
161 group factor of time (baseline, post-test, follow-up). Significance level was set as  $p < 0.05$ . Post  
162 hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction  
163 applied, resulting in a significance level set at  $p < 0.017$ . SPSS 25.0 software (IBM, Armonk,  
164 NY, USA) was used for statistical analyses.

## 165 **Results**

### 166 *Reach – Size and representativeness of enrolled participants*

167 A total of 20 individuals were screened for eligibility and 14 were eligible. Five had  
168 insufficient voluntary movement in the affected arm/hand and one person did not have a stroke.  
169 All eligible individuals (N=14) registered for the GRASP community program and 13 of the 14



170 consented to participate in the research study. With 55,000 individuals experiencing the effects  
171 of stroke in British Columbia, Canada <sup>19</sup>, it was estimated that 7,480 individuals in the City of  
172 Vancouver (13.6% of BC) experiencing the effects of stroke. With approximately 15 % of them  
173 have moderate to mild UE impairment <sup>20</sup> we estimated that potential participants were 1,122. The  
174 program reached approximately 1.25 % of the potential target population. Nine out of thirteen  
175 participants found out about the program through SRABC while the others via program  
176 advertisement posters at local hospitals. The baseline characteristics can be found in Table 2.

177 Table 2 about here

### 178 *Effectiveness – Effects of the GRASP program on participants’ outcomes*

179 Table 3 presents the statistical results of clinical outcomes across time points. Subject 2  
180 was excluded from the *Effectiveness* analysis for low attendance (4/10 sessions) and lack of  
181 GRASP homework activity. At post-test, for FM-UE (Figure 2A), six of seven participants with  
182 moderate-mild impairment (FM-UE: 35-53) exceeded the MCID (5.25 points) <sup>21</sup>. The participant  
183 with mild impairment (FM-UE  $\geq$  54) with a baseline of 62 on the FM-UE and achieved the  
184 maximum score (66) at post-test. At post-test, three of seven moderate-mildly participants  
185 exceeded the ARAT MCID (5.7 points)<sup>22</sup> (Figure 2B). The grip strength in one moderate-mildly  
186 impaired participant exceeded the MCID (6.2 kg) <sup>23</sup> (Figure 2C). Four of the seven moderate-  
187 mildly participants exceeded the MCID of the SIS-hand (17.8 points) <sup>24</sup> (Figure 2D). Eight out of  
188 12 participants showed meaningful changes in affected UE use as measured by the REACH  
189 Scale (increased one level).

190 Table 3 about here

191 Figure 2 about here

192 *Adoption –factors affecting program uptake (staff level) and ongoing participation (individual*  
193 *level)*

194 Staff level. Factors that facilitate program uptake included well-planned implementation,  
195 helpful feedback from the audit, and the coaching based on the audit results. One instructor and  
196 the coordinator reported that the equipment provided by the program made it very accessible for  
197 participants to do the exercises, and the self-explanatory pictures and clear descriptions of  
198 exercises in the GRASP manual were easy to follow for participants. The coordinator  
199 commented that the combination of individual exercise time and group discussion that facilitated  
200 positive peer support in the group had been a key element to the successfulness of the program.  
201 One challenge in delivering the class raised by the two instructors and the coordinator was  
202 accommodating participants with different levels of UE impairment during group discussion.  
203 Therefore, efficient and creative group facilitation techniques to allow each participant to speak  
204 and encourage participants with different levels of UE impairment to share their thoughts on the  
205 topics especially related to UE impairment (e.g., how everyone has used their affected hand over  
206 the last week) should be included in the training. Another challenge noted by the coordinator was  
207 that the role and expectations of the caregivers could be more clearly described as one caregiver  
208 might not be encouraging and supportive.

209 Individual level. Common factors that facilitated ongoing participation included that the  
210 instructor was encouraging and well trained, as well as the participants liked the group, and they  
211 perceived improvements. Two participants, identified the instructor as the best part of the class,  
212 for example: “The instructor was kind, encouraging, warm, affective, diligent, and helping us to  
213 improve.” Another participant identified the group situation as supportive: “The  
214 social/community aspect of being with other participants and sharing/getting to know them made

215 me feel less alone and supported.” A few participants reported that the barriers to doing the  
216 GRASP exercises were that exercises could be boring, difficult, and fatiguing. Two participants  
217 mentioned areas of improvement included that the location was not convenient for them and they  
218 would like to have more classes per week or longer class (more than an hour).

219

220 *Implementation – Implementation strategy, adaptations made during the implementation, fidelity*  
221 *(program level), and participants’ adherence (individual level)*

222 Program level. The partnership established between a nonprofit organization (i.e., the  
223 SRABC), and a local community center successfully coordinated the delivery of the program.  
224 After the first iteration, the research team and the SRABC changed to in-person screening from  
225 phone-based screening to improve selection of appropriate people. The program total fee  
226 increased from 50 CAD to 85 CAD for the second iteration to cover an increase in the  
227 instructor's working hours (2.5 hours per week) to account for in-person screening, class  
228 preparation, and class debriefing with volunteers. The fee was waived for one participant  
229 experiencing financial hardship. After the two iterations, recognizing the lack of information on  
230 group facilitation techniques specific to the GRASP program from the staff survey, we included  
231 resources to manage the group in the instructor manual including general group facilitation  
232 principles (e.g., how to encourage and balance participation, how to set up the environment, etc.)  
233 and some sample dialogue to motivates ways to use the affected UE. The program was  
234 implemented as intended in terms of program preparation, program parameters including  
235 frequency and length of the program as verified by the fidelity checklist.

236 Individual level. The average attendance was 8.9 classes (SD=1.8), with 12 out of 13  
237 participants attending  $\geq 70\%$  of classes. The average GRASP practice time per day across

238 participants ranged from 30.9 mins to 77.4 mins (mean=58.4 mins, SD=12.4). Two participants  
239 consistently practiced approximately 30 and 45 mins/day, respectively, whereas the other  
240 participants practiced  $\geq 60$  mins/day.

241

242 *Maintenance – The extent to which the program becomes part of routine practices*

243 Both the partner organization (SRABC) and community center plan to continue to offer  
244 the program. Another completed 10-week iteration (January 2020) has been completed.

245

## 246 **Discussion**

247 The study found that a novel partnership-based implementation model was effective in  
248 improving UE function in people after stroke by adapting an evidence-based exercise program to  
249 a ‘real-world’ setting. To our knowledge, this is the first study showing the translation of an  
250 evidence-based rehabilitation intervention specifically focused on improving UE recovery  
251 following stroke to a real-world program. The RE-AIM framework was valuable in guiding the  
252 implementation evaluation and factors for the successful implementation of an evidence-based  
253 intervention and challenges that may affect future program delivery. This approach led to a  
254 robust evaluation of the implementation a community-based exercise program, which may be  
255 useful for other researchers looking to implement programs in real world settings. The  
256 establishment of a partnership between a nonprofit support organization and a local community  
257 center was pivotal in the success of this program.

258 For other communities who wish to start exercise programs in the community, this study  
259 provides evidence of overall effectiveness and the importance of screening. Of particular note is  
260 the sub-group of participants, people with moderate-mild impairment, who demonstrated the best

261 improvement exceeding the MCID in both observational clinical assessments and self-reported  
262 measurements. Individuals with severe-moderate UE impairment demonstrated the least or no  
263 improvement in observational clinical assessments but still showed positive changes in self-  
264 reported measurements. One participant was deemed eligible via the phone screen, but would  
265 likely not have been deemed eligible from an in-person screen due to insufficient voluntary  
266 movement in the affected UE and had difficulty performing most of the exercises in the manual.  
267 The discrepancy between observational and self-reported measures may result from participants  
268 being more confident in using their affected UE performance in their daily life rather than motor  
269 recovery itself. Although there are many factors that may also contribute to the self-report  
270 measures <sup>25</sup>, the fact that no one self-scored themselves less at the post-test was a good indicator  
271 of beneficial effects of the GRASP community program. However, the possibility of response  
272 bias due to socially desirability cannot be ruled out <sup>26</sup>. To appropriately select participants based  
273 on the screening criteria, future programs should use in-person screening procedure rather than  
274 phone screening.

275         While translating research into practice with fidelity can be challenging <sup>27</sup>, several  
276 elements of this case-study were found to be useful in supporting the translation, including  
277 resources and the program structure. Firstly, the resources (manuals) were presented using client-  
278 friendly language. The fact that only simple and easily accessible equipment was required  
279 helped. As well, the group setting contributed to the positive effects on UE function and use as  
280 has been previously reported <sup>28</sup>, possibly due to motivating dynamics of group work <sup>29</sup>. The  
281 social support within the group environment and engagement of the group with the instructor  
282 should be incorporated and emphasized in future community exercise programs. the use of a  
283 checklist and ‘audit-feedback’ coaching was useful in improving the implementation fidelity.

284 The fidelity checklist was helpful to identify missing elements of the program delivery and to  
285 facilitate intervention fidelity<sup>30</sup>. As training service delivery staff is an essential component of  
286 successful implementation<sup>31</sup>, the training workshop embedded with the fidelity checklist prior to  
287 the program and two workplace coaching session based on the audit results were able to provide  
288 sufficient knowledge to support program fidelity. Given that implementation fidelity can affect  
289 program effectiveness<sup>32</sup>, ensuring high fidelity by providing training workshops, delivering  
290 workplace coaching, and conducting audits using quality and easy to use resources are warranted  
291 in future iterations and implementation. .

292 Challenges to be cognisant of when establishing community programs include the  
293 management of participants with very different functional abilities and strategies to support  
294 adherence. Although time to review individual exercise progression and modification was  
295 allocated in each weekly class, it was still challenging to review each participant's progress  
296 given the different levels of UE function in a group setting. Thus, group facilitation techniques  
297 specific to the GRASP program was added to the instructor manual  
298 (<http://neurorehab.med.ubc.ca/grasp/>). For future program delivery, nonadherent participants  
299 who are identified through attendance rates, behavioural contracts, and homework log sheets  
300 may be supported by the instructors with actions such as follow up phone calls.

301 Limitations of this case study include that it is a process evaluation from two iterations  
302 in one setting. Additional insight may emerge with more iterations of the program or with scaling  
303 up of the programs to other sites. Although the percentage of people post-stroke with UE  
304 impairment that we reached in the City of Vancouver was small, we still demonstrated high level  
305 of *Reach* to these individuals who had an interest in improving their UE function and responded  
306 to the recruitment activities. One should be cautious in the generalizability of the findings due to

307 age, ethnicity, side of hemiparesis, and time poststroke. Our participants were younger (mean  
308 age: 62 years) compared to the general population with stroke in Canada<sup>33</sup>, all participants had  
309 left-sided hemiparesis, over half of the participants were Asian, and time poststroke varied  
310 widely; all of these factors may limit the generalizability of our findings. It is possible that  
311 people with aphasia (who often have right-side hemiparesis) may be less comfortable to  
312 participate in a group program. However, one individual with aphasia participated in the program  
313 with good adherence and expressed positive experiences in the exit survey. For future  
314 implementation, program advertisements should indicate that the program is an ‘aphasia-  
315 friendly’ program to improve the recruitment of people with aphasia.

316

## 317 **Conclusions**

318 An implementation model through the partnership between the community center and a  
319 nonprofit support organization was effective and can be used in moving evidence-based stroke  
320 rehabilitation interventions to real-world community settings in the future. This process  
321 evaluation demonstrates the feasibility of implementing an ongoing UE program for stroke in the  
322 community and provides recommendations for further contextualizing the implementation  
323 process. By incorporating multiple data sources and gather information regarding  
324 implementation from key stakeholders to assess each RE-AIM component, the study provided  
325 rich data to inform the next steps for future iterations and larger scale implementation.

326

## 327 **Author Contributions and Acknowledgements**

328 Concept/idea/research design: C.-L. Yang, J.J. Eng

329 Writing: C.-L. Yang

330 Data collection: C.-L. Yang  
331 Data analysis: C.-L. Yang  
332 Project management: C.-L. Yang  
333 Fund procurement: J.J. Eng  
334 Consultation (including review of manuscript before submitting): C.-L. Yang, M.-L. Bird, J.J.  
335 Eng

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338

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340 All study procedures were approved by the University of British Columbia Behavioural Research  
341 Ethics Board, study number H18-03101.

342

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453 the Upper Extremity in Chronic Stroke. *Arch Phys Med Rehabil.* 2017;98(3):456-462.  
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455

456 Table 1. RE-AIM measures and data sources used to obtain information

Assessment level	Measures	Data sources	Timeline
Reach	• Recruitment rate	• Screening and enrollment log sheet (Instructors)	Pre-program
	• Participant demographic	• Intake form (Stroke participants)	Baseline
Effectiveness <sup>a</sup>	<ul style="list-style-type: none"> <li>• FM-UE</li> <li>• ARAT</li> <li>• Grip strength <sup>b</sup></li> <li>• REACH</li> <li>• SIS-Hand</li> <li>• SIS-Recovery</li> </ul>	• Clinical assessments (Stroke participants)	Baseline, post-test, follow-up
Adoption	• Satisfaction and challenges of the program	<ul style="list-style-type: none"> <li>• Staff survey (Instructors and coordinator)</li> <li>• Exit survey (Stroke participants)</li> </ul>	Immediately post-program
Implementation	• Implementation strategy	• Partnership establishment	Before-program
<i>Program level</i>	<ul style="list-style-type: none"> <li>• Fidelity checklist</li> <li>• Adaptions made</li> </ul>	<ul style="list-style-type: none"> <li>• Audit record (University researchers)</li> <li>• The University researchers and SRABC</li> </ul>	In-class (2 <sup>nd</sup> and 6 <sup>th</sup> ) observations During-study
<i>Individual level</i>	<ul style="list-style-type: none"> <li>• Program attendance rate</li> <li>• GRASP practice time</li> </ul>	<ul style="list-style-type: none"> <li>• Attendance record (Instructor)</li> <li>• GRASP log sheet (Stroke participants)</li> </ul>	During-program
Maintenance	• Extent to which the GRASP program is intended to be sustained over time	• Next implementation planning (The University researchers, SRABC, and the local community center)	Immediately and at 6 months post-program

457 ARAT, Action Research Arm Test; FM-UE, Fugl-Meyer (upper extremity); REACH, The Rating  
 458 of Everyday Arm-use in the Community and Home Scale; SIS, Stroke Impact Scale. <sup>a</sup> The  
 459 effectiveness data collected from the stroke participants was done by one university researcher  
 460 who was not involved in delivering the GRASP program to the participants. <sup>b</sup> The Jamar  
 461 dynamometer was used to measure grip strength of the affected hand <sup>34</sup> and an average of three  
 462 trials was recorded.

463

464 Table 2 Stroke Participant Characteristic (n=13<sup>a</sup>)

Age, years, mean ± SD [Range]	62.12 ± 14.24 [28.8 – 88.1]
Sex, F/M	7 F / 6 M
Ethnicity, Asian/Caucasian/Hispanic/European	9/2/1/1
Time Poststroke, months, mean ± SD [Range]	57.0 ± 51.2 [1 - 145.2]
Side of Paresis, L/R	13 L / 0 R
Dominant Side, L/R	0 L / 13 R
FM-UE (/66), mean ± SD [Range]	41.7 ± 15.4 [13 – 62]
Impairment level, Severe/severe-moderate/moderate-mild/mild <sup>a</sup>	1/2/7/3
Caregiver available to support	6

465 FM-UE, Fugl-Meyer Upper Extremity Score. <sup>a</sup> There were 7 participants in the first iteration and 6  
 466 participants in the second iteration. <sup>b</sup> The cut-off points of FM-UE for severe (FM-UE: 0-15),  
 467 severe-moderate (FM-UE: 16-34), moderate-mild (FM-UE: 35-53), and mild impairment (FM-  
 468 UE ≥ 54) were established by Woytowicz et al.<sup>35</sup>

469

470 Table 3. Median (IQR) [Range] and statistical results of clinical outcomes.

	<b>Baseline</b>	<b>Post-test</b>	<b>Follow-up</b>
<b>FM-UE*†‡</b>	45.50 (19) [22-62]	51 (17.75) [24-66]	52 (18.25) [22-66]
<b>ARAT</b>	35 (30.25) [8-57]	38 (24) [9-57]	39 (29.25) [10-57]
<b>Grip Strength (kg) *†‡</b>	10.30 (6.21) [3.20-22.40]	13.17 (7.12) [2.33-23.00]	12.86 (7.58) [3.07-23.67]
<b>REACH*†‡</b>	2.50 (1.25) [1-4]	3 (1) [2-5]	3 (1) [1-5]
<b>SIS-Hand*†</b>	28 (20) [0-68]	32 (27) [20-80]	38 (36) [8-76]
<b>SIS-Recovery*‡</b>	45 (24) [30-75]	60 (22.5) [15-85]	60 (31.25) [30-90]

471 ARAT, Action Research Arm Test; FM-UE, Fugl-Meyer (upper extremity); REACH, The Rating  
 472 of Everyday Arm-use in the Community and Home Scale; SIS, Stroke Impact Scale.

473 \*Indicate significant differences across time points. †Indicate significant improvement between  
 474 baseline and post-test. ‡Indicate significant improvement between baseline and follow-up.



475 **Figure legends**

476

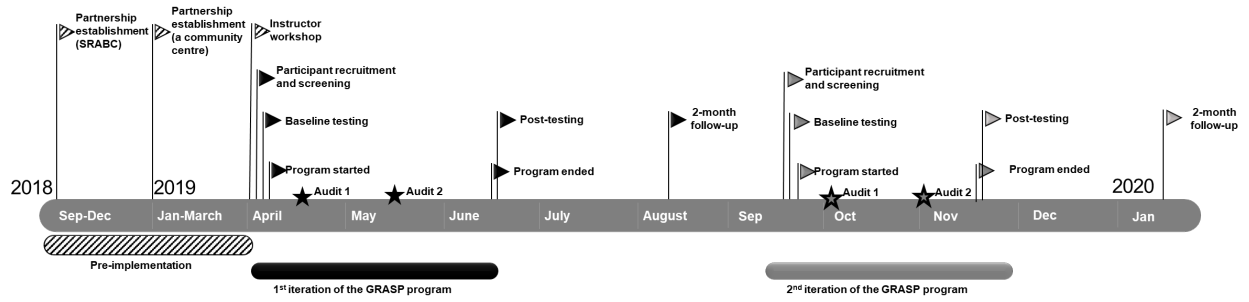
477 Figure 1. Implementation process and study timeline. Patterned symbols indicate pre-  
478 implementation. Black symbols indicate 1<sup>st</sup> iteration of the GRASP program. Gray symbols  
479 indicate 2<sup>nd</sup> iteration of the GRASP program.

480

481

482 Figure 2. Individual scores for baseline, post-test, 2-month follow-up are shown for (A) FM-UE,  
483 (B) ARAT, (C) grip strength, and (D) SIS-Hand. ARAT, Action Research Arm Test; FM-UE,  
484 Fugl-Meyer (upper extremity); SIS-Hand, Stroke Impact Scale - Hand domain.

485



486

487 Figure 1.

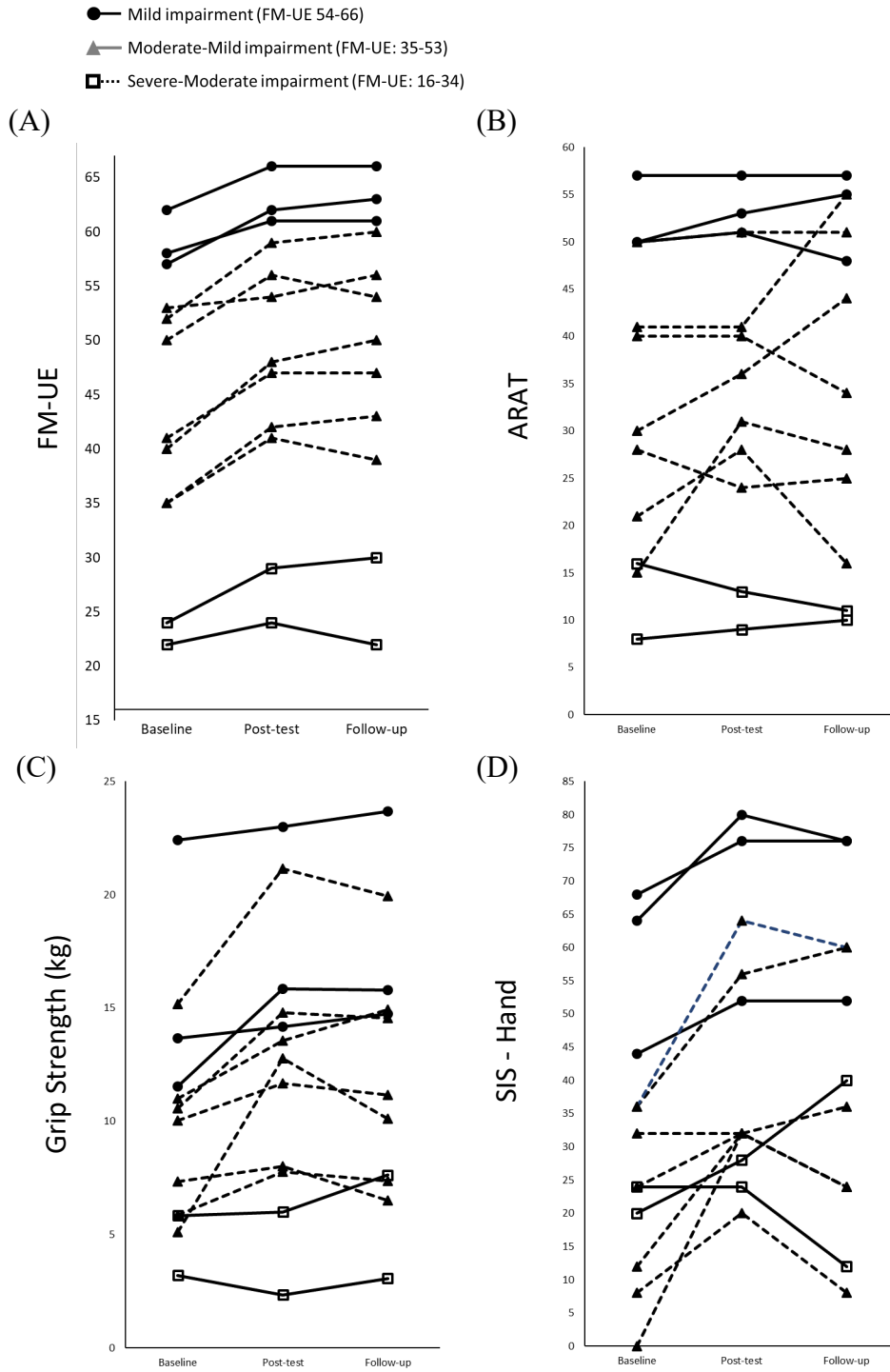


Figure 2.

489 **Appendixes**

490 **Appendix 1: GRASP practice time log sheet**

491 Write the number of minutes you did GRASP exercise each day.

492 **\*\*Note unusual events such as flu or surgery that may have prevented GRASP practice. Also**  
 493 **note if pain or excessive fatigue.**

494 **Month:** \_\_\_\_\_

	<b>Mon</b>	<b>Tues</b>	<b>Wed</b>	<b>Thur</b>	<b>Fri</b>	<b>Sat</b>	<b>Sun</b>
GRASP minutes	_____	_____	_____	_____	_____	_____	_____
GRASP minutes	_____	_____	_____	_____	_____	_____	_____
GRASP minutes	_____	_____	_____	_____	_____	_____	_____
GRASP minutes	_____	_____	_____	_____	_____	_____	_____
GRASP minutes	_____	_____	_____	_____	_____	_____	_____
GRASP minutes	_____	_____	_____	_____	_____	_____	_____

495

496 **Appendix 2.** Typical class agenda and components

<b>Time</b>	<b>Agenda</b>	<b>Components</b>
15 mins	Experience sharing and discussion	<p>The instructor led discussions on how participants used their affected arms in the previous week</p> <hr/> <p>The instructor reviewed weekly log sheets.</p> <hr/> <p>The instructor led discussions on facilitators and barriers to doing the GRASP exercises at home.</p>
35 mins	Exercises progression and modification	Exercises are progressed and modified by the instructor and volunteers if needed.
10 mins	Goal setting and wrap-up	Participants named new things that they would do with their affected arms and hands in the coming week.

497