

1 Title: Stroke rehabilitation use and caregiver psychosocial health profiles in Singapore: A
2 latent profile transition analysis

3 **Abstract**

4 Objectives: To identify and describe the transition of latent profiles characterized by
5 caregiver psychosocial health characteristics over a 12-month period, to determine if stroke
6 rehabilitation use at 12-month post-stroke differed by profile transition patterns, and to
7 investigate if the identified profiles at 3-month post-stroke influence the explanation of stroke
8 rehabilitation use at 12-month post-stroke by stroke rehabilitation use at 3-month post-stroke,
9 with covariates.

10 Design: Latent profile transition analysis of caregiver psychosocial health with stroke
11 rehabilitation use at 12-month post-stroke as outcome.

12 Setting and Participants: 149 stroke patient-caregiver dyads from the Singapore Stroke Study.

13 Methods: Cross-sectional latent profile analyses were conducted on caregiver psychosocial
14 health indicators of burden, depression, health status, quality of relationship with patient, and
15 social support. Changes in latent profile classification over three time points (baseline, 3-
16 month, and 12-month post-stroke) were analysed using latent transition analysis. A transition
17 model with stroke rehabilitation use at 12-month post-stroke as the outcome was tested after
18 accounting for covariates.

19 Results: Two distinct caregiver psychosocial health latent profiles were found across time:
20 non-distressed and distressed. Most caregivers were classified as non-distressed and remained
21 non-distressed over time. Distressed caregivers at baseline were 76% likely to become non-
22 distressed at 12-month post-stroke. Regardless of profile transition patterns, non-distressed

23 caregivers at 12-month post-stroke tended to have cared for stroke rehabilitation non-users at
24 12-month post-stroke. Patient depression explained profile classification at 3-month and 12-
25 month post-stroke. After accounting for covariates, rehabilitation users at 3-month post-
26 stroke tended to continue using rehabilitation at 12-month post-stroke only when they had
27 non-distressed caregivers at 3-month post-stroke.

28 Conclusions and Implications: Whether caregiver adaptation explains the associations
29 between the latent profile transition patterns and rehabilitation use at 12-month post-stroke
30 should be examined. Early psychosocial health assessment and sustained support should be
31 made available to stroke caregivers to enhance their well-being and subsequent patient
32 rehabilitation participation.

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Introduction

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Stroke is the main reason for disability in Singapore. 63% of stroke patients report disabilities within three months.¹ Informal caregivers not only have to deal with stroke patient's physical limitations in mobility, self-care, and communication, but also changes in cognitive function, depression, and personality.² While it is established that informal caregiving can affect one's psychosocial health adversely and that more support than currently available is needed,^{3,4} less is known about the specific timing of these caregivers' experiences.⁵⁻⁷ Stroke caregiving demands may vary according to a stroke patient's recovery journey.^{8,9}

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Outpatient stroke rehabilitation is important in postponing institutionalization of stroke patients and in assisting caregivers with the difficulties of providing care.¹⁰ Despite the beneficial effects of stroke rehabilitation, its use remains low with only 33.3% of Singapore stroke patients recommended for rehabilitation treatment, utilizing outpatient rehabilitation services.¹¹ Two studies showed that outpatient rehabilitation, a year after patients were released from community hospitals, garnered only 28% and 4.3% participation.^{11,12}

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Outpatient rehabilitation facilities in Singapore, which offers universal health coverage to citizens, are situated within a 15-minute drive away from home. Rehabilitation users who pass a means test are subsidised. A local study found that participation in centre-based rehabilitation at 1-month post-stroke was strongly predictive of participation in supervised rehabilitation at 12-month post-stroke.¹³

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While patient and caregiver factors are known to explain stroke rehabilitation use,^{14,15} emerging evidence suggest that caregiver psychosocial health factors (e.g., burden and depression) also prospectively and concurrently influence stroke rehabilitation use and long-

24 term care services (LTCS).^{16,17} These factors are based on an emerging concept, that one's
25 health is a result of one's ability to adapt to and self-manage the difficulties and life changes
26 that disease creates.¹⁸ In clinical practice, some combinations of these factors could classify
27 caregivers into profiles to facilitate the design of caregiver psychosocial education, support
28 and intervention, which may increase stroke rehabilitation use. Unfortunately, we know of
29 only one previous study that examined the associations of underlying caregiver profiles with
30 patient attributes such as quality of life and depressive symptoms.¹⁹ Little is known about the
31 profiles' relation with service use by stroke patients.

32 Latent profile analysis (LPA) classifies individuals into mutually exclusive latent
33 profiles based on indicators – observed variables of interest. Each latent profile is a typology
34 describing heterogeneity in a population concerning a phenomenon. Each indicator is
35 assumed to follow a normal distribution within a latent profile and each individual is assumed
36 to belong to one of the latent profiles. The probability of being classified in a particular latent
37 profile are estimated in each model. Latent transition analysis (LTA) examines longitudinal
38 movements of latent profiles by estimating them at multiple time points.

39 **Study Goals**

40 We had five main goals: (1) identify latent profiles characterized by caregiver
41 psychosocial health characteristics through LPA; (2) describe the profile stability and
42 movement between profiles across three time points: baseline (T0), 3-month (T1) and 12-
43 month post-stroke (T2); (3) determine if stroke rehabilitation use at T2 differed by the profile
44 transition patterns; (4) explore if patient and caregiver characteristics explain the profile
45 classification at each time point; and (5) investigate if the identified profiles at T1 influences
46 the explanation of stroke rehabilitation use at T2 by stroke rehabilitation use at T1, after
47 accounting for the effects of patient and caregiver characteristics.

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Methods

49 Data Source

50 We analysed data from the Singapore Stroke Study (S3), which recruited participants
51 from all five public tertiary hospitals in Singapore from December 2010 to September 2013.
52 Stroke patients were older than 40 years and had a recent diagnosis. Primary caregivers were
53 family members or friends who provided unpaid care to the patient. Of the 482 stroke patient-
54 caregiver dyads, usable data were obtained from 378, 331 and 278 patient-caregiver dyads at
55 T0, T1 and T2, respectively. Given the largely exploratory nature of our analyses, these
56 sample sizes were sufficient for the commonly used fit indices to function adequately.²⁰
57 Detailed descriptions of the background and methods of the S3 and participants'
58 characteristics have been reported elsewhere.^{14,15} Ethics approval was obtained from hospital
59 and university institutional review boards. All patients and caregivers provided written
60 informed consent.

61 Latent Profile Indicators and Outcome

62 Caregiver burden,²¹ depression,²² health status,²³ quality of care relationship with
63 patient,²⁴ and social support²⁵ were used to characterize the caregiver psychosocial health
64 latent profiles, based on an emerging concept of health.¹⁸ T2 stroke rehabilitation use was the
65 outcome variable,^{11,12} and was dichotomized as “1” – users and “0” – non-users.

66 Covariates

67 Predictors of rehabilitation use (T2) - T1 stroke rehabilitation use,¹⁶ stroke type^{26,27}
68 and stroke severity²⁸ – were selected based on past research. We also explored if caregiver
69 characteristics, namely relationship with patient and marital status, and patient characteristics,
70 namely patient depression,²² disability level,²⁹ activities of daily living independence,³⁰

71 cognitive status,³¹ availability of domestic maid at patient's home, housework as main
72 responsibility of domestic maid, stroke care as main responsibility of domestic maid and
73 discharge destination, influenced the latent profile classification at each time point.

74 **Statistical Analyses Plan**

75 First, cross-sectional LPAs were conducted on the latent profile indicators to
76 determine the number of profiles at T0, T1 and T2. The interpretability of profile solutions
77 (separation and homogeneity), and statistical indicators of Akaike's Information Criteria
78 (AIC), Bayesian Information Criteria (BIC), adjusted Bayesian Information Criteria (ABIC),
79 Lo-Mendell-Rubin Adjusted Likelihood Ratio Test (LMR) and entropy were employed to
80 determine the model of best fit. The latent profile models were implemented with 1000
81 random sets of starting values and 50 final stage optimizations to obtain the best eventual
82 model.³² Solutions with less than ten percent of starting values identified across different
83 random sets of starting values were considered as inadequate.³³ Names of the profiles were
84 interpreted based on the conditional means of the latent profile indicators. Second, LTA was
85 conducted using a manual three-step approach³⁴ to characterize the movements of each latent
86 profile over time. Third, measurement invariance, stationary transitions and higher order
87 effects over time were tested using a likelihood-ratio test. Last, the associations between the
88 outcome variable, initial latent profile classification and the latent profile transition patterns
89 were examined. Covariates were manually fitted into the latent transition model. Exploratory
90 variables associated with the estimated latent profiles and established predictors of
91 rehabilitation use were included in the eventual model. All models in this study were
92 constructed using Mplus version 7.³⁵

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Results

94 **Latent Profile Analysis**

95 First, we estimated models with one to six latent profiles based on the latent profile
96 indicators measured at each time point. Missing values on these indicators were missing
97 completely at random (Little's $\chi^2 = 480.74, p = .20$), and maximum likelihood estimates were
98 obtained. Table 1 compares the fit indices of the estimated models. AIC, BIC and ABIC
99 values decreased when the number of profiles increased. Entropy values indicate a good
100 separation of latent classes ($> .80$) for all models. LMR statistics at each time point suggested
101 that the two-profile model was better than the one-profile model.

102 The two-profile models at T0, T1 and T2 were selected based on the latent profiles'
103 interpretability. Standardized conditional mean plots of the two-profile models are provided
104 in Supplementary Figures 1 to 3. The mean values of these models showed a more defined
105 pattern of latent profiles than those of other profile models. Clearer distinctions on burden,
106 depression, and health status between caregiver groups were observed in the two-profile
107 models. Higher homogeneity was also observed in the two-profile models, as there is a
108 stronger correspondence between the latent profiles and their indicators. Profiles were similar
109 across time points.

110 The plots suggested that the caregiver psychosocial health profiles could be labelled –
111 “Non-distressed” and “Distressed”. The former accounted for most of the sample at T0
112 (81.2%), T1 (79.5%) and T2 (87.8%). This profile comprises caregivers with indicators that
113 approximate the standardized conditional mean. The second profile comprises caregivers
114 with higher levels of burden and depression, and poorer health status. Table 2 shows the
115 indicators that characterize these two latent profiles.

116 **Latent Transition Analysis**

117 Next, LTA was conducted to explore profile movements over time. Full measurement
118 invariance was used in our subsequent analyses, as latent profile plots were similar across the

119 time points which allowed a more straightforward interpretation of transition
120 probabilities.^{36,37} Non-stationary transitions were chosen as covariates would be added later
121 into the transition model, and stationary transitions do not allow meaningful interpretations to
122 be made.³⁶ Results suggested the presence of a second-order effect, as likelihood ratio test
123 indicated significant differences in model fit, Santorra-Bentler $\chi^2(1) = 10.00, p < .01$.

124 Last, a latent transition model with covariates was constructed. The covariates were
125 assessed on their ability to explain the latent profiles and outcome variable. For parsimony,²⁰
126 statistically non-significant pathways from the exploratory covariates were removed from the
127 model. Listwise deletion removed dyads with missing values on the outcome or covariates,
128 resulting in a final analytic sample of 140 in the eventual model.

129 Table 3 shows the transition probabilities of the latent profiles in the eventual model.
130 Distressed caregivers at T0 were 24% likely to remain distressed at T2. Non-distressed
131 caregivers at T0 were 97% likely to remain non-distressed at T2. Further analyses revealed
132 that distressed caregivers of stroke rehabilitation non-users at T0 had an 80% likelihood of
133 becoming non-distressed while their patients remained rehabilitation non-users at T2.

134 Table 4 and Figure 1 show the results and structure of the eventual latent profile
135 transition model, respectively. Notably, the second-order effect of the T0 latent profile on the
136 T2 latent profile was statistically significant, [$\text{logit}(B) = 2.21, 95\% \text{ confidence interval (CI)}$
137 $0.20, 4.23]$, after considering the effects of T0 patient depression ($B = -2.91, 95\% \text{ CI } -4.84, -$
138 0.99) and T1 patient depression ($B = -2.14, 95\% \text{ CI } -3.26, -1.01$), on the T0 and T1 latent
139 profiles, respectively. Non-distressed caregivers at T0 were more likely to remain non-
140 distressed at T2. Patients who were less depressed tended to have non-distressed caregivers at
141 T0 and T1.

142 The profile transition patterns with non-distressed caregivers at T2 had a high
143 probability (92%) of stroke rehabilitation non-use at T2 ($B = 2.38, 95\% \text{ CI } 0.46, 4.30$) after

144 considering the effects of T1 rehabilitation use, stroke type and severity. No associations
145 were observed between patterns with distressed caregivers at T2 and stroke rehabilitation use
146 at T2 ($B = 0.41$, 95% CI -1.42, 2.25).

147 T1 rehabilitation use predicted T2 rehabilitation use in profile transition patterns with
148 non-distressed caregivers at T1 ($B = 2.34$, 95% CI 0.54, 4.14), but not in patterns with
149 distressed caregivers at T1 ($B = 1.50$, 95% CI -2.31, 5.31). Patients with non-ischemic stroke
150 types tended to have used rehabilitation at T2 ($B = -2.30$, 95% CI -3.80, -0.80). Stroke
151 severity was not associated with T2 rehabilitation use ($B = 0.06$, 95% CI -0.02, 0.15).
152 Sensitivity analyses showed that between the cases that were included in the final analytic
153 sample and those that were excluded from it due to missingness on the outcome or covariates,
154 the mean values on the indicators at each time point were largely comparable (see
155 Supplementary Table 1), and the two-profile solutions were replicated with the final sample.

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Discussion

157 To our knowledge, this was the first study that sought to understand psychosocial
158 health profiles of informal stroke caregivers using LPA, track changes in these profiles using
159 LTA, and test associations of these profiles transition patterns with stroke rehabilitation use
160 over a 12-month duration.

161 Latent profile characterization and classification

162 Results showed two distinctive profiles across time, labelled as distressed and non-
163 distressed, which were characterized by caregiver burden, depression and health status.³⁸ The
164 proportion of distressed caregivers was 19%, 21% and 12% at T0, T1 and T2 respectively.

165 The characterization of the caregiver profiles highlights the importance of caregiver
166 psychosocial health on longer term management of degenerative conditions, such as stroke.

167 The larger mean differences observed for intrapersonal factors (i.e. caregiver burden,

168 depression, and health status) as compared to interpersonal factors (i.e. relationship quality
169 and social support) could be because intrapersonal factors are more important than
170 interpersonal factors in caregiver distress. Future research should further clarify the
171 characterization of the latent caregiver psychosocial health profiles.

172 That greater proportions of distressed caregivers at T0 and T1 were found may be
173 explained by the *Timing It Right* framework.³⁹ This framework informs when caregivers
174 ought to be supported as they accompany stroke survivors across care environments.³⁹ This
175 framework describes five phases experienced in a stroke survivor's recovery journey: (1)
176 acute care admission (event/diagnosis); (2) medical stabilization (stabilization); (3)
177 preparation for discharge (preparation); (4) initial adjustment to community or home living
178 (implementation), and (5) longer-term adjustment to community living (adaptation).³⁹ Family
179 caregivers' needs for support change in tandem with stroke survivors' functional recovery
180 and community reintegration.⁴⁰ In this study, T0, T1 and T2 were arguably the preparation,
181 implementation and adaptation phases of the stroke patients respectively. Family caregivers'
182 needs are maximal in the preparation phase for home discharge, and in the implementation
183 phase of the initial months at home. Caregivers in the adaptation phase may face greater
184 distress and require support over the longer term due to greater disabilities or communication
185 challenges in their care recipients.

186 **Latent profile stability**

187 We found some profile stability in the classification results and the transition
188 probabilities across the three time points. Firstly, independent LPA results indicated that the
189 caregiver psychosocial health profiles were similar over time. The caregivers were classified
190 into two distinctive profiles across the time points: a profile with high burden and depression
191 and poor health status, and another profile with moderate overall indicator scores. Secondly,
192 the LTA results indicated that the non-distressed profile was stable across the time points.

193 Among the non-distressed caregivers, the probabilities of profile stability exceeded .90 at
194 each transition and across transitions.

195 The consistency of caregivers' profiles across time is supported.^{41,42} Caregivers'
196 distress may be affected by their experiences at stroke onset, including appraisal or
197 acceptance of situation, rather than merely a process of attrition.^{43,44} While there exist
198 longitudinal studies that evaluate caregivers' distress or well-being across time based on
199 observed measures, further research on the transitional probabilities of such combined latent
200 psychosocial health characteristics over time may be required to confirm the findings from
201 this research.⁴⁵

202 On the other hand, among the distressed caregivers, the probabilities of profile
203 stability did not exceed 28% at each transition and across transitions. Most distressed
204 caregivers at T0 are likely to become non-distressed by T2 although some may remain
205 distressed. This heartening finding may be explained by caregivers' adaptation to caregiving
206 demands over time,^{16,46} their acceptance of the caregiver role, and/or the support and training
207 that some of them may have received. It is plausible that distressed caregivers who would
208 remain distressed cared for patients with greater disabilities, or communication challenges
209 hampering reintegration.⁴⁰

210 Future research should explain the temporal stability of the non-distressed caregivers
211 and the recovery of the distressed caregivers, and examine the contribution of patient
212 rehabilitative improvement to the probability of distressed caregivers remaining distressed.

213 **Caregiver profile transition pattern and rehabilitation use**

214 Stroke rehabilitation use at T2 differed by the caregiver profile transition patterns.
215 The transition patterns with non-distressed caregivers at T2 were associated with stroke
216 rehabilitation non-use at T2, but no associations were found between patterns with distressed
217 caregivers at T2 and stroke rehabilitation use at T2. Caregiver adaptation³⁹ and patient

218 functional recovery may explain the former associations and should be investigated in future
219 research. Whether rehabilitation use is distressing to some caregivers but not others should
220 also be examined in future studies.

221 **Explanation of caregiver profiles**

222 Among the covariates, patient depression was found to explain the caregiver
223 psychosocial health profile classifications at T0 and T1. This finding is supported by previous
224 research that showed positive associations between patient depression, and caregiver strain
225 and depression in stroke rehabilitation.^{47,48} The predictive ability of the baseline latent
226 profiles on those profiles at T2 suggested that identification of at-risk caregivers,
227 psychoeducation of and psychosocial interventions for distressed caregivers should be
228 provided early – at patient discharge from acute hospital.

229 **Moderating effect of caregiver profiles**

230 Caregiver profiles at T1 moderated the association between stroke rehabilitation use
231 at T1 and T2. Although stroke rehabilitation use at T1 predicted stroke rehabilitation use at
232 T2, this association was present only when caregivers were not distressed at T1. To enhance
233 rehabilitation participation at 12-month post-stroke via earlier participation, assessing,
234 identifying, psycho-educating, and intervening on caregivers early in a stroke patient's
235 recovery journey are necessary.

236 **Limitations**

237 This study used only five indicators of caregiver psychosocial health because
238 operational definitions of the emerging concept of health was still being developed.¹⁸
239 Increasing the number of indicators will increase robustness of the statistical models. We
240 found less than 10 dyads in six of the eight profile transition patterns indicating possible lack
241 of power, unstable solution and masked effects in the latent transition model.⁴⁹ Our analyses
242 should be replicated with a larger sample. The possibility of endogeneity bias is reduced by

243 our use of latent transition analysis that estimated the rehabilitation use and latent profile
244 models simultaneously,⁵⁰ and by the inclusion of known predictors as covariates of the
245 outcome. Nonetheless, causal interpretations cannot be made because the data is
246 observational in nature. To shed light on potential longer-term effects of caregiver profiles,
247 future studies could explore distal outcomes over a longer period, such as rehabilitation use at
248 24- and 36-month post-stroke.

249 **Conclusions and Implications**

250 This was the first study in stroke rehabilitation literature that generated underlying
251 informal caregiver profiles from observed psychosocial health attributes, and examined each
252 profile transition pattern's association with stroke rehabilitation use at 12-month post-stroke.
253 Our findings are supported by recent reports that caregiver psychosocial health attributes are
254 prospectively and concurrently associated with stroke rehabilitation and LTCS use.^{16,17}

255 We found distinct distressed and non-distressed caregiver profiles, with the latter
256 associated with stroke rehabilitation non-use at 12-month post-stroke regardless of profile
257 transition patterns. Whether caregiver adaptation and patient functional recovery explain this
258 result should be examined.

259 Distressed caregivers at baseline were 24% likely to remain distressed at 12-month
260 post-stroke. Rehabilitation use at 3-month post-stroke predicted rehabilitation use at 12-
261 month post-stroke only among non-distressed caregivers at 3-month post-stroke. Early
262 psychosocial health assessment and sustained support should be made available to stroke
263 caregivers to enhance their well-being and subsequent patient rehabilitation participation.

264

Conflicts of Interest

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No conflicts of interest.

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391

392

Figure Legend

393 **Figure 1.** Structure of the Eventual Latent Profile Transition Model ($N = 140$).

394 *Notes.* Dotted lines represent profile-specific conditional means rather than *bona fide*
395 regressive paths. T0: Baseline; T1: 3-month post-stroke; T2: 12-month post-stroke.

396

397 **Table 1**

398 Model Fit Indices Derived from Latent Profile Analyses With 1 – 6 Profiles at Each Time
 399 Point.

Model fit indices	Solutions					
	1-profile	2-profile	3-profile	4-profile	5-profile	6-profile
T0 Log Likelihood value	-5526.41	-5422.33	-5323.67	-5247.09	-5191.94	-5142.07
Free parameters (#)	10	16	22	28	34	40
Entropy	NA	.809	.994	.938	-	.945
AIC	11072.81	10876.65	10691.35	10550.17	-	10364.13
BIC	11112.16	10939.61	10777.91	10660.35	-	10521.53
ABIC	11080.43	10888.84	10708.11	10571.51	-	10394.62
Solution %	100.0	100.0	12.0	100.0	4.0	14.0
LMR	NA	202.48***	239.16	148.99***	-	172.13*
T1 Log Likelihood value	-4944.14	-4806.73	-4716.19	-4643.73	-4588.24	-4556.66
Free parameters (#)	10	16	22	28	34	40
Entropy	NA	.860	-	.948	.949	-
AIC	9908.28	9645.46	-	9343.45	9244.48	-
BIC	9946.30	9706.29	-	9449.91	9373.76	-
ABIC	9914.58	9655.54	-	9361.10	9265.91	-
Solution %	100.0	100.0	6.0	84.0	42.0	2.0
LMR	NA	267.15**	-	224.11	107.87	-
T2 Log Likelihood value	-4006.95	-3902.26	-3734.73	-3689.68	-3642.61	-3611.40
Free parameters (#)	10	16	22	28	34	40
Entropy	NA	.946	-	.971	.961	.956
AIC	8033.91	7836.52	-	7453.35	7353.23	7302.81
BIC	8070.18	7894.56	-	7536.93	7476.57	7447.91
ABIC	8038.47	7843.83	-	7448.14	7368.76	7321.08
Solution %	100.0	100.0	2.0	16.0	16.0	10.0
LMR	NA	203.37***	-	87.51	97.10	127.35

400

401 *Notes.* AIC: Akaike's Information Criteria; BIC: Bayesian Information Criteria; ABIC:
 402 sample-size Adjusted Bayesian Information Criteria; LMR: Lo-Mendell-Rubin Adjusted
 403 Likelihood Ratio Test. T0: Baseline; T1: 3-month post-stroke; T2: 12-month post-stroke.

404 * $p < .05$. ** $p < .01$. *** $p < .001$.

405

406

407 **Table 2**

408 Indicators that Characterize Latent Profiles at Each Time Point.

Indicators	Latent profiles				<i>t</i>
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	
T0	Non-distressed (<i>n</i> = 307)		Distressed (<i>n</i> = 71)		
Caregiver burden	22.20	0.55	36.83	1.36	-18.34***
Caregiver depression	14.69	0.23	20.16	0.74	-13.59***
Caregiver health status	80.89	0.87	65.14	2.43	9.47***
Caregiver-patient relationship quality	11.25	0.09	10.50	0.26	2.67*
Caregiver social support	27.18	0.27	23.71	0.63	6.16***
T1	Non-distressed (<i>n</i> = 263)		Distressed (<i>n</i> = 68)		
Caregiver burden	18.06	0.43	28.88	2.00	-10.17***
Caregiver depression	12.55	0.24	19.22	0.76	-18.33***
Caregiver health status	80.44	0.98	68.08	2.58	6.35***
Caregiver-patient relationship quality	11.06	0.11	10.13	0.29	3.89***
Caregiver social support	26.85	0.35	23.15	0.62	5.62***
T2	Non-distressed (<i>n</i> = 244)		Distressed (<i>n</i> = 34)		
Caregiver burden	17.46	0.45	24.99	1.67	-4.57***
Caregiver depression	12.63	0.12	20.15	0.74	-15.26***
Caregiver health status	81.81	0.77	66.28	2.50	7.51***
Caregiver-patient relationship quality	10.43	0.11	9.72	0.39	2.00
Caregiver social support	25.59	0.23	22.31	0.81	4.19***

409

410 *Notes.* T0: Baseline; T1: 3-month post-stroke; T2: 12-month post-stroke.411 * $p < .05$. ** $p < .01$. *** $p < .001$.

412

413 **Table 3**

414 Transition Probabilities of Distressed and Non-Distressed Profiles in the Eventual Latent

415 Profile Transition Model ($N = 140$).

Transition Probabilities		
T0	T1	
	Non-distressed	Distressed
Non-distressed	.91	.09
Distressed	.80	.20
T1	T2	
	Non-distressed	Distressed
Non-distressed	.92	.08
Distressed	.72	.28
T0	T2	
	Non-distressed	Distressed
Non-distressed	.97	.03
Distressed	.76	.24

416

417 *Notes.* T0: Baseline; T1: 3-month post-stroke; T2: 12-month post-stroke.

418

419 **Table 4**

420 Parameter Estimates and Odds Ratios of the Eventual Latent Profile Transition Model ($N =$
 421 140).

Variables	Logit B (95% CI) [^]	Standard Error	P value	Odds Ratio (95% CI)
Latent profiles [#]				
Non-distressed (T0)				
Patient depression (T0)	-2.91 (-4.84, -0.99)	0.97	.003	0.05 (0.01, 0.37)
Non-distressed (T1)				
Non-distressed (T0)	0.33 (-1.94, 2.61)	1.15	.77	1.40 (0.14, 13.61)
Patient depression (T1)	-2.14 (-3.26, -1.01)	0.57	< .001	0.12 (0.04, 0.36)
Non-distressed (T2)				
Non-distressed (T0)	2.21 (0.20, 4.23)	1.02	.030	9.14 (1.21, 68.77)
Non-distressed (T1)	1.59 (-0.41, 3.58)	1.01	.12	4.89 (0.66, 35.98)
Outcome				
Rehabilitation use (T2) (thresholds)				
Non-distressed at T2	2.38 (0.46, 4.30)	0.97	.014	-
Distressed at T2	0.41 (-1.42, 2.25)	0.93	.66	-
Latent profile transition patterns				
Non-distressed at T1				
Rehabilitation use (T2)				
Rehabilitation use (T1)	2.34 (0.54, 4.14)	0.91	.010	10.39 (1.72, 62.71)
Stroke type	-2.30 (-3.80, -0.80)	0.76	.002	0.10 (0.02, 0.45)
Stroke severity	0.06 (-0.02, 0.15)	0.04	.15	1.06 (0.98, 1.16)
Distressed at T1				
Rehabilitation use (T2)				
Rehabilitation use (T1)	1.50 (-2.31, 5.31)	1.92	.44	4.48 (0.10, 201.60)
Stroke type	-2.30 (-3.80, -0.80)	0.76	.002	0.10 (0.02, 0.45)
Stroke severity	0.06 (-0.02, 0.15)	0.04	.15	1.06 (0.98, 1.16)

422

423 *Notes.* T0: Baseline; T1: 3-month post-stroke; T2: 12-month post-stroke. [#] The distressed
 424 profile was taken as reference.

425 [^] Upper limit for logits (95% CI) were calculated based on the formula: $\text{logit} +$

426 $1.984 \times \text{standard error}$, and lower limit for logits (95% CI) were calculated based on the

427 formula: $\text{logit} - 1.984 \times \text{standard error}$.