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## Readiness to Change is Related to Real-world Walking and Depressive Symptoms in Chronic Stroke

Allison Miller, PT, DPT, NCS<sup>1</sup>, Tamara Wright, PT, DPT<sup>2</sup>, Henry Wright, PT, DPT<sup>2</sup>, Elizabeth Thompson, PT, PhD, NCS<sup>2</sup>, Ryan T. Pohlig, PhD<sup>3</sup>, Darcy S. Reisman, PT, PhD<sup>1,2</sup>

<sup>1</sup>Department of Biomechanics and Movement Science Program, University of Delaware, Newark, Delaware 19713

<sup>2</sup>Department of Physical Therapy, University of Delaware, Newark, Delaware 19713

<sup>3</sup>Department of Biostatistics Core Facility, University of Delaware, Newark, Delaware 19716

### Abstract

**Background and Purpose:** The Transtheoretical Model is a health behavior model used to understand an individual's readiness to change their behavior. This study aims to apply the Transtheoretical Model in understanding a person with stroke's readiness to change their activity level as it relates to physical capacity, physical health, depressive symptoms, self-efficacy and daily stepping activity.

**Methods:** This was a cross-sectional analysis of baseline data from a clinical trial. Participants' readiness to change their activity levels was measured via self-report and daily stepping activity was measured using a step activity monitor. Robust regression (M-estimation with robust standard errors) was used to test the relationship between readiness to change and measures of physical capacity (6-minute walk test, self-selected walking speed), physical health (body mass index, age-adjusted Charlson Comorbidity Index), depressive symptoms (Patient Health Questionnaire-9), self-efficacy (Activities Specific Balance Confidence Scale), and daily stepping (steps per day).

**Results:** 274 individuals were included in the analysis. Adjusted for age, readiness to change was positively related to daily stepping ( $\beta=0.29$ ,  $p<0.001$ ) and negatively related to depressive symptoms ( $\beta=-0.13$ ,  $p=0.01$ ). Readiness to change was not significantly associated with measures of physical capacity, physical health, or self-efficacy.

**Discussion:** These results suggest that individuals with stroke in the later stages of change may demonstrate greater daily stepping activity and lower depressive symptoms compared to those in earlier stages.

**Conclusions:** Understanding the relationship between readiness to change, daily stepping and depressive symptoms will help clinicians implement appropriate stage-specific intervention strategies and facilitate greater improvement in activity levels.

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**Corresponding Author:** Darcy S. Reisman, PT, PhD, University of Delaware, 540 South College Ave, Newark, DE 19713, PH: 302-831-0508, FAX: 302-831-4291, dreisman@udel.edu.

**Video Abstract Available** for more insights from the authors (see the Video, Supplemental Digital Content 1)

## INTRODUCTION

Improving and maintaining physical activity in healthy adults can be challenging. For persons with stroke, this can be more difficult due to sequelae including impairments in physical capacity,<sup>1</sup> self-efficacy,<sup>2</sup> and depression.<sup>3</sup> Individuals with chronic stroke (>6 months) are less active compared to otherwise healthy individuals<sup>4</sup> and often exhibit activity levels that could be considered a sedentary lifestyle.<sup>5,6</sup> This decreased activity is problematic because a sedentary lifestyle post-stroke is associated with increased risk for depressive symptoms,<sup>7</sup> reduced independence with activities of daily living,<sup>8</sup> reduced health-related quality of life,<sup>9</sup> and secondary complications, including cardiovascular events and death.<sup>10</sup> Understanding why individuals with stroke are less active will aid in the development of tailored intervention strategies to increase activity.

The number of steps an individual takes per day is a valid proxy for physical activity in healthy individuals and persons with stroke and is often measured using step activity monitors.<sup>6,11–14</sup> While 10,000 steps/day is a common threshold recommended for health promotion in adults,<sup>15</sup> people with stroke are representative of a special population in which this activity level may not be realistic. An average of 8,000 steps/day in an individual post-stroke may provide a more appropriate threshold in this population.<sup>6</sup> However, promoting and maintaining changes in daily stepping activity in persons with stroke may be difficult without the individual showing a readiness to make a lifestyle change to increase their activity. An individual with stroke may demonstrate the physical ability to walk enough to maintain an adequate activity level; however, without readiness to change their behavior, their activity can remain stagnant or decline. Thus, an individual's readiness to change their activity behavior reflects their perceived ability to adopt a permanent lifestyle change and is therefore a different construct from objectively-measured activity levels. This may explain why some clinical trials in stroke have resulted in only minimal changes in activity levels post intervention.<sup>16,17</sup>

The Transtheoretical Model (TTM) is a behavior change model that involves 10 processes of change including: consciousness raising, self-liberation, social liberation, self-reevaluation, environmental reevaluation, counterconditioning, stimulus control, reinforcement management, dramatic relief, and helping relationships.<sup>18–20</sup> The TTM posits that these processes of change are utilized differently across five stages of change: Precontemplation, Contemplation, Action, Maintenance, and Relapse.<sup>18–20</sup> Individuals in the Precontemplation stage are either unaware of the consequences of their behavior or are resistant to making a behavior change.<sup>18</sup> Individuals may then progress through the various stages of change until reaching the Maintenance stage where a more permanent change in behavior has occurred. During the Maintenance stage, the individual may also be actively working to prevent a regression into a Relapse state where the undesirable behavior returns.<sup>18</sup> Similarly, individuals may get “stuck” or go backwards at any time. For example, individuals in the contemplation stages may not have strategies in place to successfully change their behavior and advance to the next stage.

In their seminal work, Prochaska and DiClemente utilized a self-report questionnaire to understand how the processes of change varied across the stages of change in the context of

smoking cessation.<sup>19</sup> In accordance with the TTM, individuals utilized the processes of change differently across the stages of change.<sup>19</sup> For example, consciousness raising (where an individual seeks out information related to the negative effects of smoking) was found to be emphasized the most by individuals in the Contemplation stage. This further suggests that because individuals within each stage of change utilize unique processes to facilitate behavior change, they may also require stage-specific intervention approaches. Thus, understanding the stage an individual is in may aid in the development of stage-specific interventions that can result in behavioral change success.

The TTM has since evolved and been adapted to contexts related to exercise adherence<sup>21</sup> and steps per day in healthy individuals.<sup>22</sup> Rosenkranz and colleagues found that in a sample of healthy individuals, those in the later stages (e.g. Action and/or Maintenance) were more likely to achieve 10,000 steps/day, had better general health and lower body mass index (BMI) and higher self-efficacy compared to those in earlier stages.<sup>22</sup> Similar results have been found in the context of exercise adherence such that those in the later stages of change tended to have greater exercise self-efficacy compared to those in earlier stages.<sup>21</sup> While the TTM has been applied in stroke to capture readiness to begin motor-based therapies,<sup>23</sup> it has not been applied in the context of daily stepping activity in individuals with stroke. Additionally, since stroke often results in residual impairments,<sup>1</sup> findings in healthy populations may not translate to persons with stroke. For example, impairments in gait speed<sup>24,25</sup> and aerobic conditioning<sup>5</sup> that often occur in individuals post-stroke limit the ability to extrapolate findings from healthy individuals to persons with stroke.

As prior work suggests that outcomes of behavior change programs are associated with readiness to change,<sup>26</sup> we sought to understand the role of readiness to change activity levels as it relates to daily stepping activity and other health and clinical measures in individuals with stroke. Evidence in stroke suggests that multiple factors influence activity levels, including measures of physical capacity,<sup>27,28</sup> self-efficacy,<sup>29,30</sup> and depression.<sup>31–33</sup> Thus, we posit that these factors may be related to a stroke survivor's readiness to change their activity behavior.

This study aims to understand the relationship between readiness to change activity levels and measures of physical capacity, physical health, self-efficacy, depressive symptoms, and daily stepping activity in individuals with stroke. In order to develop a Readiness to Change (RTC) scale for persons with stroke in the context of daily stepping activity, we adapted the Stages of Change in Steps (SoC-Step) categories developed by Rosenkranz and colleagues<sup>22</sup> that includes a Preparation stage<sup>21,34</sup> and defined “normal” activity as completing 3 or more days per week of at least 8000 steps/day.<sup>6</sup> We hypothesize that RTC will be significantly related to daily stepping activity, with those in the Action/Maintenance stages having greater steps/day. In accordance with previous evidence using the Transtheoretical Model in healthy individuals<sup>22</sup> as well as other evidence in stroke,<sup>27–33,35,36</sup> we also hypothesize that RTC will be significantly related to measures of physical capacity,<sup>27,28</sup> self-efficacy,<sup>29,30</sup> depressive symptoms,<sup>31–33</sup> and physical health.<sup>22</sup>

## METHODS

### Study Design and Participants

This investigation was a cross-sectional analysis using baseline data from a clinical trial (NCT02835313).<sup>37</sup> In this study, participants were recruited across four sites (University of Delaware, Christiana Care Health System, University of Pennsylvania, and Indiana University). Recruitment methods included advertisements in newspapers and websites, leveraging existing clinical databases, local support groups, and local physical therapy clinics and physician offices. All participants signed informed consent approved by the Human Subjects Review Board at the University of Delaware or their respective institution prior to participation. Inclusion criteria included: 1) 6 months post stroke, 2) Age 21–85, 3) Self-selected walking speed  $\geq 0.3$  m/s, 4) Resting heart rate between 40–100 beats per minute, and 5) Resting blood pressure between 90/60 to 170/90. Exclusion criteria included: 1) Evidence of cerebellar stroke, 2) Secondary neurological conditions, 3) Lower extremity Botox injections <4 months prior, 4) Cardiac event within 3 months, 5) Pain that limited walking activity, 6) Inability to communicate with investigators, and 7) Score  $> 1$  on question 1b and  $> 0$  on question 1c on the NIH Stroke Scale.

### Clinical Examination

Participants completed a baseline clinical evaluation that included demographic information and measures of physical health, physical capacity, self-efficacy, and depressive symptoms.<sup>37</sup> Demographic information included age, sex, and time since stroke. Measures of physical health included BMI and comorbidities (Charlson Comorbidity Index, age-adjusted).<sup>38</sup> Measures of physical capacity included 10-meter self-selected (SSWS) and fast walking speeds (FWS)<sup>39</sup> as well as the 6-minute walk test (6MWT).<sup>39,40</sup> The Activities-Specific Balance Scale (ABC) was measured to capture the construct of balance self-efficacy,<sup>41</sup> and the Patient Health Questionnaire (PHQ-9) was used to screen for depressive symptoms.<sup>42</sup> These measures were included in the statistical analysis to represent the constructs of interest: physical health, physical capacity, self-efficacy, and depressive symptoms. All measures have been shown to have acceptable psychometric properties in individuals with stroke.<sup>38–42</sup>

### Readiness to Change

During the baseline evaluation, participants chose a statement that best described their current and intended activity level and was considered to be reflective of a specific stage of the TTM. Each statement included a descriptor of current stepping activity in conjunction with intended step activity: 1) I am currently not active, and do not intend on becoming active in the next 6 months (Precontemplation), 2) I am currently not active, but am thinking about starting to become active in the next 6 months (Contemplation), 3) I am currently active sometimes, but not regularly (Preparation), 4) I am currently active regularly, but have only begun doing so within the last 6 months (Action), or 5) I am currently active regularly, and have done so for longer than 6 months (Maintenance). For this study, Relapse was not conceptualized as a distinct stage, and participants endorsed a response to the Readiness to Change scale and answered a question to measure Relapse separately. To measure Relapse, the participant was asked to respond “yes” or “no” to the following statement: I have been

regularly active in the past, but I am not doing so currently. Prior to selecting a statement for both scales, a research physical therapist defined “regular activity” and informed the participant of the approximate number of steps accumulated through participating in numerous activities throughout the day (see Appendix A).<sup>22</sup> For this study, regular activity was defined as completing 3 or more days per week of at least 8,000 steps per day.

### Step Activity Monitoring

Participants were given a FitBit™ One or Fitbit™ Zip at the end of the clinical evaluation to wear on their non-paretic leg. While the FitBit™ has demonstrated acceptable accuracy in detecting steps in individuals with stroke,<sup>12,43–45</sup> it may be less accurate in detecting steps in individuals with stroke with gait speeds of <0.3 m/s.<sup>46</sup> Therefore, participants were required to have a self-selected gait speed of at least 0.3 m/s to be eligible for participation in the clinical trial. The monitor was placed such that the face of the monitor could not be seen. Participants were instructed to begin wearing the FitBit™ the next morning and wear for at least 3 full days (preferably for at least 7 days). They were instructed to go about their normal routine while wearing the monitor and to remove it for bathing, swimming, and sleep. Participants returned the FitBit™ at their next study visit or by mail if they were determined ineligible for study participation. Once returned, the research PT ensured that there were at least 3 valid days of activity and then averaged the steps per day (SPD) over the number of valid recording days. To be considered a valid recording day, times of donning/doffing were considered, and participants were questioned about their activity if there were any inconsistencies or irregularities. For example, if the stepping activity for a particular recording day appeared out-of-the-ordinary for a particular participant, they were shown the stepping data and queried to understand what factors resulted in such irregularities to determine if the day should be counted as a valid recording day. If there were not enough valid stepping days, the participant was asked to wear it again to obtain the required number of days.

### Statistical Analysis:

Robust regression (using M-estimation with robust standard errors) was used to test the relationship between RTC and measures of physical capacity (6MWT, SSWS), physical health (BMI, age-adjusted Charlson Comorbidity Index), depressive symptoms (PHQ-9), self-efficacy (ABC), and daily stepping activity (steps per day, SPD). The data were checked for assumptions of normality and homogeneity of variance and for outliers using Cook’s distance and leverage. Using these outlier metrics, it was determined that there were no outliers present. Initial inspection of the data revealed non-normality and heteroskedasticity present in most of the variables of interest. Thus, a square root and log transformation were applied, and the assumptions were retested. The assumption of normality was still violated; therefore, robust regression in Mplus<sup>47</sup> was used. This method calculates maximum likelihood parameter estimates and standard errors are found using a sandwich estimator, which are robust to non-normality and heteroskedasticity.<sup>47,48</sup> Potential confounders of age, gender, and stroke chronicity were compared across RTC stages using a Kruskal-Wallis test. Age was significantly different among RTC stages ( $p < 0.001$ ) and was therefore included as a covariate in the regression models. In order to answer our research question regarding the relationship between RTC and the outcomes of interest, the standardized coefficients were

evaluated as these coefficients represent the strength of the relationship between the independent and dependent variable in a regression model. However, we also report the model fit statistics for completeness. Descriptive analyses were conducted using SPSS (Version 25.0; Armonk, NY, USA) with  $p < 0.05$  considered statistically significant.

## RESULTS

At the time this analysis occurred, 283 individuals were available in the dataset from the clinical trial. In total, 2 individuals were in the Precontemplation Stage, 187 in the Contemplation Stage, 52 in the Preparation Stage, 6 in the Action Stage, 35 in the Maintenance Stage, and one individual with missing data. Based on the very small number of individuals who reported being in the Precontemplation and Action Stages, these stages were removed from the main analysis. Thus, our sample size was 274 and reflected only the stages of Contemplation, Preparation, and Maintenance. The median number of SPD for the total sample was 4133.5 (IQR 3237.8, range 76 – 18166), and the median number of valid stepping days was 8 (IQR 6, range 3 – 27). Table 1 displays the descriptive statistics of our sample. Table 2 displays the variables of interest across RTC stages along with age, stroke chronicity, and gender.

Table 3 displays the results of the regression models for the variables of interest. After adjusting for age, Readiness to Change was significantly associated with SPD ( $\beta=0.29$ ,  $p<0.001$ ;  $R^2=0.08$ ,  $SE=0.04$ ,  $p=0.04$ ) and PHQ-9 ( $\beta= -0.13$ ,  $p=0.01$ ;  $R^2=0.04$ ,  $SE=0.02$ ,  $p=0.08$ ). After adjusting for age, RTC was not significantly associated with measures of physical capacity (6MWT:  $\beta= -0.003$ ,  $p=0.96$ ;  $R^2=0.002$ ,  $SE=0.01$ ,  $p=0.70$ ; SSWS:  $\beta=0.02$ ,  $p=0.78$ ;  $R^2=0.003$ ,  $SE=0.01$ ,  $p=0.66$ ), physical health (Charlson Comorbidity Index:  $\beta=0.02$ ,  $p=0.74$ ;  $R^2=0.23$ ,  $SE=0.04$ ,  $p<0.001$ ; BMI:  $\beta= -0.11$ ,  $p=0.08$ ;  $R^2=0.03$ ,  $SE=0.02$ ,  $p=0.18$ ), or self-efficacy (ABC:  $\beta=0.03$ ,  $p=0.63$ ;  $R^2=0.002$ ,  $SE=0.01$ ,  $p=0.73$ ).

In our sample, 207 (75.5%) participants indicated that they had experienced a relapse in their stepping activity levels (i.e. they were regularly active in the past but not currently).

## DISCUSSION

As hypothesized, readiness to change activity levels in participants with stroke was positively related to their daily stepping activity and negatively related to depressive symptoms. This suggests that as a person post-stroke progresses from Contemplation through Maintenance, an increase in their daily stepping activity and lower levels of depressive symptoms may be observed. These results further suggest that measuring readiness to change activity level in someone after stroke may provide insight into their daily stepping activity as well as their level of depressive symptoms. Ultimately, understanding an individual's readiness to change their activity levels will enable clinicians to provide stage-specific intervention strategies to improve daily walking activity.

The results of this study align with findings from healthy individuals in that individuals in the Maintenance stage had greater daily stepping activity compared to those in earlier stages.<sup>22</sup> In other words, individuals with stroke who self-reported being currently active and having done so for greater than 6 months were indeed taking more steps per day measured

objectively compared to those in the Contemplation and Preparation stages. Interestingly, however, those in the Contemplation and Preparation stages appeared similar in their stepping activity (Table 2). Since our measure of readiness to change was specific to the construct of physical activity, we expected to see increases in daily stepping activity with stage progression. Previous evidence suggests, however, that discrepancies may exist between self-reported and objectively-measured activity levels in adults<sup>49</sup> and individuals with stroke,<sup>50</sup> and this may be one possible reason for this finding. Specifically, the data in Table 2 suggests that individuals in the Preparation stage who reported being active sometimes but not regularly, were often not achieving daily step counts that met the definition of regular activity that was provided to them. In parallel, as we defined regular physical activity as 3 or more days/week of at least 8,000 steps/day, not all participants who identified with being in the Maintenance stage met this criterion (Table 2). These results support the notion that self-reported and objectively measured levels of physical activity do not always agree in individuals with stroke. This could have occurred because participants may have had difficulty with accurately estimating their daily stepping activity. Although we did ask the participants if they had ever used a device to track their daily stepping and provided examples of how steps can be accumulated throughout the day, some participants may have not been able to accurately estimate their daily activity. In addition, other factors such as fatigue<sup>33</sup> and energy cost of walking<sup>51</sup> may affect activity levels in individuals with stroke and were not measured in this study. Thus, we cannot rule out the possibility that these unmeasured confounders may have affected our results. Nonetheless, individuals in the Maintenance stage who reported being active for a longer period of time did indeed take greater steps per day on average compared to individuals in earlier stages.

We found a negative relationship between readiness to change and depressive symptoms implying that as readiness levels progress, depressive symptoms may reduce. However, as data for this study were collected at a single point in time, we cannot infer the causal direction between these variables, and it could be that having lower levels of depressive symptoms facilitates advancement along the stages of change. The negative relationship observed between readiness to change and depressive symptoms is also in line with previous work demonstrating that depressive symptoms can negatively impact participation in stroke survivors.<sup>31,32,52,53</sup> Thus, clinicians treating individuals post stroke may consider referral to other health care providers if the presence of depressive symptoms is interfering with readiness to change activity behavior.

Contrary to previous evidence in healthy individuals,<sup>22</sup> we found that readiness to change activity levels in individuals with stroke was not significantly related to their balance self-efficacy and physical health. This suggests that individuals with stroke in the later stages of change may not necessarily have greater balance self-efficacy or better physical health and that potentially other variables are important for progressing along the continuum of change for physical activity. This may be because having a high BMI<sup>54,55</sup> and the presence of other comorbidities<sup>56</sup> are risk factors for stroke and possibly more prevalent in a sample of persons with stroke compared to a sample of otherwise healthy individuals such as that in Rosenkranz et al.<sup>22</sup> In addition, our measure of self-efficacy was specific to balance self-efficacy and not self-efficacy as it relates to physical activity and this may be one reason why we did not find a relationship between readiness to change and self-efficacy. We also

considered the possibility that there may be a relationship between assistive device use and perceived self-efficacy,<sup>57</sup> however, we did not observe any statistically significant differences or observable trends in the use of an assistive or orthotic device among individuals in the Contemplation, Preparation, and Maintenance stages. Similarly, we found that physical activity readiness to change was not associated with measures of physical capacity. As previous evidence suggests that measures of physical capacity are related to daily stepping activity,<sup>27,28,33,58</sup> one might have expected to observe a significant relationship between walking activity readiness to change and SSWS and 6MWT. However, the Readiness to Change scale used in this study required participants to globally reflect on their levels of walking activity and did not include requirements related to how fast or far participants could walk. In addition, previous work suggests that measures of physical capacity, specifically the 6MWT, only account for ~37% of the variance in physical activity in individuals post stroke.<sup>33</sup>

Relapse has been observed in other behavioral change contexts, such as smoking cessation<sup>19</sup> and physical activity after weight loss.<sup>59</sup> In our study, ~75% of participants reported to have relapsed, indicating they were regularly active in the past but not currently. This suggests that relapse in activity levels may be common during recovery from stroke and that strategies to prevent relapse should be implemented to prevent individuals from regressing. Such strategies may include education on the continued use of a step activity monitor to encourage daily stepping and encouraging social support during exercise through group exercise sessions or virtual apps.<sup>60</sup> However, it is important to acknowledge that we did not specifically define the time frame for this question and thus cannot conclude when relapses in activity occurred. Thus, further work is needed to understand how and when individuals post-stroke relapse to enable clinicians to intervene at these time points.

This study has several limitations. First, we had few participants in the Precontemplation and Action stages and thus did not have representation from the full continuum of stages. As data from this study was obtained from a clinical trial aiming to increase walking activity in individuals after stroke, we suspect that those who volunteered for the study were likely motivated to change their behavior and were therefore not likely in the Precontemplation stage. Second, as this is the first study to examine the relationship between readiness to change and daily stepping activity in individuals with stroke, these results should be interpreted as preliminary and further work is needed to fully understand these relationships and causal directions. Third, we cannot infer causality in the relationships observed due to the cross-sectional nature of this study. Consequently, it remains unknown if an individual's readiness to change their activity behavior causes a reduction in depressive symptoms and improvement in daily stepping activity or if the counterfactual occurs. Finally, the availability of measures that more specifically capture the construct of walking activity (i.e. walking activity self-efficacy), may be better equipped to detect relationships with walking activity readiness to change.

Understanding readiness to change activity behavior following stroke has important implications for future studies. Importantly, the TTM assumes that the behavioral change approach will vary from person to person, depending on the unique aspects of the individual and their current stage of change.<sup>18</sup> This philosophy may explain why some studies have



found minimal improvements in daily stepping post intervention<sup>16,17</sup> and why some individuals demonstrate an improvement in their daily stepping whereas others do not.<sup>61</sup> It is possible that the individuals who demonstrate the greatest sustaining improvements post intervention are further along in the continuum of change; however, further work is needed to explore this potential hypothesis and understand the causal relationships between these variables. In addition, understanding an individual's readiness to change their activity levels will enable clinicians to provide stage-specific intervention strategies. For example, an individual in the contemplation stages would likely benefit from receiving information about the importance of improving their activity levels; however, providing this information to an individual in the Action or Maintenance stage will likely be ineffective as these individuals have already taken action towards changing this behavior. We found that participants' readiness to change their activity levels was significantly related to their daily stepping activity, therefore, future studies in stroke measuring physical activity should consider assessing participants' readiness to change this behavior to understand how this affects outcomes.

## CONCLUSIONS:

In individuals with chronic stroke, readiness to change their activity levels was significantly associated with daily stepping activity and depressive symptoms. Understanding the relationship between readiness to change, daily stepping and depressive symptoms may help clinicians implement appropriate stage-specific intervention strategies that can facilitate greater improvement in activity levels.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## APPENDIX A: Instructions for Administering Readiness to Change Questionnaire

**INSTRUCTIONS:** Before completing the questionnaire, please read the following information on the number of steps adults take each day.

Both men and women can accumulate steps throughout the day in a number of ways:

- doing chores or working around the house
- running errands or going to the shops
- walking from place to place
- doing exercise or playing sports

- doing things such as going up the stairs, walking to the car, walking from one room to another, and so on.

We might not know it, but large contributions to daily steps come from:

- having an active job (4000 to 9000 steps at work)
- having an inactive or office job (1000 to 4000 steps at work)
- a session of moderate-intensity walking or exercise (3000–4000 steps in 30 minutes of walking, which is more than 100 steps per minute)

Studies have shown that:

- for healthy adults, jobs and the activities of daily living typically result in about 6000–7000 steps/day.
- adults who do 30 minutes of walking or other exercise may attain an additional 3000– 4000 steps/day.
- most healthy adults accumulate between 3000 and 9000 steps per day.

<b>Less than 5000steps/day:</b> typically minimal activities of daily living and inactive work, likely no sports/exercise	<b>5000–7499 steps/day:</b> typically some physical activity from activities of daily living on a work day, excluding sports/exercise	<b>7500–9999 steps/day:</b> likely to have additional activity beyond activities of daily living from sports/exercise or active job	<b>10,000–12,499 steps/day:</b> likely to have substantial additional physical activity beyond activities of daily living from sports/exercise or active job
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**Definition of Regular Activity** = completing 3 or more days per week of at least 8,000 steps per day

Please choose the category (check the box) that best describes you:

Stage	Item
<b>Precontemplation</b>	I am currently not active, and I do not intend on becoming active in the next 6 months.
<b>Contemplation</b>	I am currently not active, but I am thinking about starting to become active in the next 6 months.
<b>Preparation</b>	I am currently active sometimes, but not regularly.
<b>Action</b>	I am currently active regularly, but I have only begun doing so within the last 6 months.
<b>Maintenance</b>	I am currently active regularly and have done so for longer than 6 months.

Does this category apply to you, if so please also check this box?

<b>Relapse*</b>	I have been regularly active in the past, but I am not doing so currently.
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**Table 1.**

Characteristics of Study Sample (n = 274)

<b>Age (years)</b>	65 (17)
<b>Gender</b>	Male: 144 (52.6%)
<b>Time Since Initial Stroke (months)</b>	23 (41)
<b>Hemiparesis</b>	Left: 145 (52.9%) Right: 123 (44.9%) Bilateral: 6 (2.2%)
<b>SSWS (m/s)</b>	0.75 (0.33)
<b>Assistive Device Use (yes/no)</b>	Yes: 129 (47.1%)
<b>Orthotic Device Use (yes/no)</b>	Yes: 64 (23.4%)

Continuous variables are presented as median, IQR. *Abbreviations: SSWS- Self-selected Walking Speed*

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**Table 2.**

Variables of Interest by Readiness to Change Stage

	Precontemplation* (n = 2)	Contemplation (n = 187)	Preparation (n = 52)	Action* (n = 6)	Maintenance (n = 35)
<b>SPD</b>	2824, 7958	3988 (2867)	4039.5 (4169.3)	5521 (6171)	5766 (5264)
<b>SSWS (m/s)</b>	0.66, 0.90	0.75 (0.33)	0.76 (0.31)	0.72 (0.48)	0.80 (0.39)
<b>6MWT (m)</b>	251.71, 341.76	312.5 (188.1)	273.5 (167.55)	358.02 (220.19)	315.93 (226.39)
<b>BMI (kg/m<sup>2</sup>)</b>	28.13, 43.45	29.8 (7.58)	30.4 (7.22)	26.8 (4.94)	28.82 (11.29)
<b>CCI</b>	6, 4	6 (2)	5 (3)	5.5 (1)	5 (3)
<b>ABC</b>	67.19, 23.13	79.54 (23.91)	77.5 (22.42)	89.47 (21.55)	79 (27.5)
<b>PHQ-9</b>	2, 10	3 (6)	4 (7)	1.5 (2)	3 (3)
<b>Age (years)</b>	75, 52	68 (17)	58 (16)	57.5 (16)	60 (22)
<b>Time Since Initial Stroke (months)</b>	71, 101	21 (34)	22 (53)	49 (83)	36 (63)
<b>Gender</b>	Male 0 (0%) Female 2 (100%)	Male 91 (48.7%) Female 96 (51.3%)	Male 29 (55.8%) Female 23 (44.2%)	Male 2 (33.3%) Female 4 (66.7%)	Male 24 (68.6%) Female 11 (31.4%)

Continuous variables are presented as median, IQR (Precontemplation expressed as participant 1, participant 2 for that stage).

\* Stage not included in main statistical analysis.

Abbreviations: SPD- Steps per Day; SSWS- Self-selected Walking Speed; 6MWT- Six Minute Walk Test; BMI- Body Mass Index; CCI- Charlson Comorbidity Index (age-adjusted); ABC- Activities Specific Balance Confidence Scale; PHQ-9- Patient Health Questionnaire-9



**Table 3.**

Robust Regression Models with Readiness to Change and Age as Independent Variables

	$\beta$	Standard Error	p
<b>Dependent Variable: SPD</b>			
Age	0.04	0.05	0.51
RTC Stage	0.29	0.07	<0.001
<b>Dependent Variable: 6MWT</b>			
Age	-0.05	0.06	0.44
RTC Stage	-0.003	0.07	0.96
<b>Dependent Variable: SSWS</b>			
Age	-0.05	0.06	0.46
RTC Stage	0.02	0.06	0.78
<b>Dependent Variable: Charlson Comorbidity Index</b>			
Age	0.48	0.05	<0.001
RTC Stage	0.02	0.05	0.74
<b>Dependent Variable: BMI</b>			
Age	-0.16	0.06	0.02
RTC Stage	-0.11	0.06	0.08
<b>Dependent Variable: PHQ-9</b>			
Age	-0.18	0.06	0.003
RTC Stage	-0.13	0.05	0.01
<b>Dependent Variable: ABC</b>			
Age	0.04	0.06	0.56
RTC Stage	0.03	0.06	0.63

Abbreviations: SPD- Steps per Day; 6MWT- Six-minute Walk Test; SSWS- Self-selected Walking Speed; BMI- Body Mass Index; PHQ-9- Patient Health Questionnaire-9; ABC- Activities Specific Balance Confidence Scale; RTC- Readiness to Change