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REVIEW ARTICLE (META-ANALYSIS)

# Factors Associated With Post-Stroke Physical Activity: A Systematic Review and Meta-Analysis

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**Abstract**

**Objective:** To integrate the literature investigating factors associated with post-stroke physical activity.

**Data Sources:** A search was conducted from database inception to June 2016 across 9 databases: Cochrane, MEDLINE, ProQuest, Web of Science, PsycINFO, Scopus, Embase, CINAHL, and Allied and Complementary Medicine Database. The reference lists of included articles were screened for secondary literature.

**Study Selection:** Cohort and cross-sectional studies were included if they recruited community-dwelling stroke survivors and measured factors associated with physical activity.

**Data Extraction:** Risk of bias was evaluated using the Quality in Prognosis Studies checklist. A meta-analysis was conducted for correlates where there were at least 2 studies that reported a correlation value. Correlation values were used in an effect size measure and converted to a standardized unit with Fisher $r$ to $z$ transformation and conversion back to $r$ method. Results were described qualitatively for studies that could not be pooled.

**Data Synthesis:** There were 2161 studies screened and 26 studies included. Age (meta $r=-.17$; $P\leq.001$) and sex (meta $r=-.01$; $P=.02$) were the nonmodifiable factors that were found to be associated with post-stroke physical activity. The modifiable factors were physical function (meta $r=.68-.73$; $P<.001$), cardiorespiratory fitness (meta $r=.35$; $P\leq.001$), fatigue (meta $r=-.22$; $P=.01$), falls self-efficacy (meta $r=-.33$; $P<.001$), balance self-efficacy (meta $r=.37$; $P<.001$), depression (meta $r=-.58$ to $.48$; $P<.001$), and health-related quality of life (meta $r=.38-.43$; $P<.001$). The effect of side of infarct, neglect, and cognition on post-stroke physical activity was inconclusive.

**Conclusions:** Age, sex, physical function, depression, fatigue, self-efficacy, and quality of life were factors associated with post-stroke physical activity. The cause and effect of these relations are unclear, and the possibility of reverse causality needs to be addressed.

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Stroke is a leading cause of disability worldwide.[1] Sufficient physical activity can reduce detrimental secondary changes after stroke (eg, skeletal muscle loss,[2] muscle structure change,[3] bone mass loss,[4] reduced cardiorespiratory fitness[5]). Physical activity may also aid in preventing recurrent strokes by improving control of stroke risk factors (eg, diabetes, hypertension, dyslipidemia).[6] Apart from medical benefits, stroke survivors also consider physical activity to be an important vehicle in adjusting to life after stroke and to achieving one's physical and social goals.[7] Despite the known benefits of post-stroke physical activity, several studies have demonstrated that stroke survivors have low levels of physical activity and are even less active than older adults with nonneurologic chronic conditions.[8,9] However, it is unclear which factors are most strongly associated with post-stroke physical activity.

Physical activity is defined as any physical movement that causes energy expenditure because of skeletal muscle

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contraction.[10] This includes energy expenditure involved in exercise and household, occupational, and leisure activities. Several studies have investigated factors that may be related to physical activity levels among stroke survivors. To date, there have been 2 systematic reviews that have explored physical activity after stroke.[11,12] The results of these studies demonstrated that physical function was a positive correlate, whereas low mood and poorer quality of life were negatively correlated with steps per day and activity counts.[11,12] However, the studies were diverse in the measurement of independent variables and physical activity outcomes used. A mix of direct and self-reported measures were also used, which made comparison across different studies challenging. Both reviews reported the correlates of physical activity as a secondary aim, and neither provided a detailed appraisal of the research in this area or a quantitative synthesis of the strength of the associations.

A comprehensive synthesis and appraisal of existing literature will allow a better understanding of the factors which could influence post-stroke physical activity levels. Therefore, the aim of this systematic review with meta-analysis was to investigate the factors associated with physical activity among community-dwelling stroke survivors.

## Methods

This review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement guidelines,[13] and was registered on PROSPERO (registration no. CRD42015019097).[14]

### Literature search

A systematic search was conducted from database inception to June 2016 across 9 databases: Cochrane, MEDLINE, ProQuest, Web of Science, PsycINFO, Scopus, Embase, CINAHL, and Allied and Complementary Medicine Database. Reference lists of included articles were screened for secondary literature. Search terms were customized to each database with no language restriction. An example search using MEDLINE is provided in box 1.

### Selection criteria

Original quantitative and observational research articles that recruited community-dwelling adults with stroke and explored associations with physical activity levels were included. Studies involving physical activity measurement in hospital, during therapy sessions, or where the setting of measurement of physical activity was ambiguous or inconsistent were excluded. Studies exploring community ambulation post-stroke were included if frequency, duration, or intensity of outdoor activity was measured. Studies where physical ability or function was measured instead, or where physical activity was not the dependent variable, were excluded. Abstracts and gray literature (eg, reports, conference proceedings, doctoral theses, dissertations) were also excluded.

*List of abbreviations:*

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| 6MWT | 6-minute walk test |
| BBS | Berg Balance Scale |
| CI | confidence interval |
| ES | effect size |
| FSS | Fatigue Severity Scale |
| HRQOL | health-related quality of life |
| MMSE | Mini-Mental State Examination |
| MoCA | Montreal Cognitive Assessment |

### Screening process and data extraction

The first author (S.T.) conducted the searches and completed the initial screening from the titles and abstracts. The full texts of all potential titles were independently reviewed by 2 authors (S.T. and B.F.M.), with a decision made regarding article selection based on the inclusion criteria. The reasons for article exclusion were recorded. Any disagreements between the 2 reviewers regarding the inclusion of an article were settled by a third reviewer (K.J.B.). Data extraction was independently conducted by the 2 reviewers using a customized database. Data such as study design, methods, participant characteristics, type of physical activity measurement, duration of activity monitoring, independent and dependent variables investigated, statistical tests used in analysis, and correlational values were extracted.

### Risk of bias assessment

Selected articles were assessed for bias using the Quality in Prognosis Studies checklist.[15] The Quality in Prognosis Studies tool provides a framework to assess quality of reporting and risk of bias in 6 domains: study participation, study attrition, prognostic factor measurement, confounders' measurement and adjustment, outcome measurement, and statistical analysis. Each domain is scored either as low, moderate, or high risk of bias. The tool was customized so that within each domain the specific issues pertaining to physical activity post-stroke were defined (appendix 1). For example, the confounding domain was irrelevant in studies that examined the combined influence of multiple possible factors on physical activity. However, this domain would be relevant in studies that examine (1 or 2) specific factors. Reporting quality for each domain was scored as yes, no, partly, or unsure using customized definitions. A final score for the risk of bias was allocated based on the overall reporting quality in each domain. If a study scored a high risk of bias in any 1 of the 6 domains, it scored an overall rating of high risk.[15] If a study did not score a high risk in any domain and scored a low risk in at least 4 of the 6 domains (66%), it was given an overall rating of low risk.[15] This percentage rule was also applied to studies that had 1 or 2 domains that were not applicable, based on the number of domains that were scored. Any cases in between these 2 rules were rated as an overall moderate risk of bias. Risk of bias assessment was rated independently by 2 authors (S.T. and B.F.M.), followed by a consensus meeting with a third author (P.Y.H.), which included a discussion of the individual ratings.

### Data synthesis and meta-analyses

A meta-analysis was conducted for studies that reported a correlation value and at least 2 studies that examined the same construct. Multiple values were extracted from the same study if the study used a combination of direct and self-report measures of physical activity. Correlation values were used in an effect size (ES) measure and converted to a standardized unit with Fisher $r$ to $z$ transformation and conversion back to $r$ method.[16,17]