



Outcomes of Return-to-Work after Stroke Rehabilitation: A Systematic Review

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Abstract:	<p>Introduction: The purpose of this systematic review was to identify the outcomes of return-to-work (RTW) for stroke survivors of working age after conventional stroke rehabilitation or vocational rehabilitation.</p> <p>Methods: Searches were performed using three electronic databases for literature published in English in the ten year period 2004–2014 which included a population of working age stroke survivors who had previously participated in conventional or vocational rehabilitation, and which presented the outcomes of RTW. Findings: The literature search yielded ten studies that satisfied our selection criteria. Three studies involved vocational rehabilitation. Studies illustrated and compared the vocational status at or among different stages of “pre-stroke”, “post-stroke and before rehabilitation discharge”, “rehabilitation discharge” and “follow-up”. The employment rate at follow-up ranged from 7% to 81.1%. Conclusion: Methodological variations accounted for the wide range of RTW rates. There was limited evidence to support the conclusion that rehabilitation increases RTW rates for stroke survivors of working age, but recent studies showed that improvements in fatigue and cognitive function after stroke rehabilitation were related to good RTW outcomes. Either specialized vocational rehabilitation, conventional stroke rehabilitation or their combination is needed to increase RTW rates and improve the quality of life for stroke survivors of working age.</p>

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Outcomes of Return-to-Work after Stroke Rehabilitation:
A Systematic Review

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ABSTRACT

Introduction: The purpose of this systematic review was to identify the outcomes of return-to-work (RTW) for stroke survivors of working age after conventional **stroke rehabilitation** or vocational rehabilitation. *Methods:* Searches were performed using three electronic databases for literature published in English in **the ten year period 2004–2014** which included a population of working age stroke survivors who had previously participated in conventional or vocational rehabilitation, and which presented the outcomes of RTW. *Findings:* The literature search yielded **ten** studies that satisfied our selection criteria. **Three** studies involved vocational rehabilitation. Studies illustrated and compared the vocational status at or among different stages of “pre-stroke”, “post-stroke and before rehabilitation discharge”, “rehabilitation discharge” and “follow-up”. The employment rate at follow-up ranged from 7% to 81.1%. *Conclusion:* Methodological variations accounted for the wide range of RTW rates. There was **limited** evidence to support the conclusion that rehabilitation increases RTW rates for stroke survivors of working age, but **recent** studies showed that improvements in **fatigue and cognitive function** after stroke rehabilitation were related to good RTW outcomes. **Either specialized vocational rehabilitation, conventional stroke rehabilitation or their combination** is needed to increase RTW rates and improve the quality of life for stroke survivors of working age.

Keywords: systematic review, stroke rehabilitation, return-to-work, employment rate

INTRODUCTION

Stroke survivors who **experience** a variety of impairments and dysfunctions of varying degrees will encounter barriers to participation in **work activities**. Stroke incidence increases with advancing age, but it is not uncommon among young adults. There is a trend of stroke onset occurring at younger ages (O'Brien and Wolf, 2010). Stroke survivors of working age constitute 20% to 25% of all strokes in the United Kingdom as well as 20% in the United States and Australia (Kersten et al., 2002; AIHW, 2011; Treger et al., 2007). The reported return-to-work (RTW) rate in different studies ranges from 35% to **75%** (Busch et al., 2009; Glozier et al., 2008; **Hackett et al., 2012**; Hannerz et al., 2011). It was reported to be **75% within 12 months after stroke in Australia (n=441) (Hackett et al., 2012)**; 62% for young patients two years post-stroke in Denmark (n=19,985) (Hannerz et al., 2011); 35% of those who were working pre-stroke had returned to paid work according to the South London Stroke Register (n=2,874) (Busch et al., 2009), and 53% had returned to paid work after six months in Auckland (n=1,423) (Glozier et al., 2008). In a review of 78 studies of working-age stroke **survivors**, the proportions of RTW ranged from 0% to 100%, with a mean of 44% (Daniel et al., 2009). The reported rates varied widely because of cross-study differences in demographics, sample size, and times of longitudinal follow-up. Since stroke is becoming more common in working age individuals, the burden on families and society will be heavy since younger adults are responsible for generating income and supporting family members. RTW becomes a key goal in their recovery (Arauz, 2013). For families, stroke generates direct healthcare costs arising from surgery, hospitalization and rehabilitation treatments, and indirect costs associated with lost productivity as well as welfare and compensations from the government, employer or other organizations (Saeki, 2000).

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4 Work has been identified as a meaningful occupation that fulfills human beings' spiritual and basic
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6 physical needs, and improves psychological well-being. It plays an important role in developing a
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8 person's values, self-esteem, self-identity and social status, as well as in facilitating the pursuit of
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10 interests, achievement and happiness (Baldwin and Brusco, 2011). Studies have reported that RTW
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12 after a stroke depends on age, gender, occupation, type of stroke and stroke severity (Hannerz et al.,
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14 2011; Varona et al., 2004), **independence in activities of daily living (Hackett et al., 2012)**, and that
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16 disabilities and functional deficits are more important than stroke location in predicting RTW (Saeki
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18 and Hachisuka, 2004). Cognitive deficits (Arauz, 2013) and early psychiatric morbidity (Glozier et
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20 al., 2008) may prevent RTW after a stroke. **However, a recent study found that early depression after**
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22 **stroke is not associated with an inability to RTW (Hackett et al, 2012)**. Although RTW is regarded as
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24 an important rehabilitation outcome post-stroke (Arauz, 2013; Daniel et al., 2009), research evidence
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26 in this area is lacking (Saltychev et al., 2013; AIHW, 2011). Some studies had been conducted to
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28 address the effect of vocational rehabilitation programmes on RTW rates post-stroke, but the
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30 randomized controlled trials were not of a high quality and could not prove whether specific
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32 vocational rehabilitation programmes were beneficial in increasing RTW rates following stroke
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34 (Baldwin and Brusco, 2011).

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36 Therefore, our purpose in conducting this systematic review was to identify the outcomes of RTW
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38 after rehabilitation, conventional stroke rehabilitation or vocational rehabilitation, for stroke
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40 survivors of working age.
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44 **METHODS**

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46 Search strategy
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4 A systematic review was conducted in June, 2015 to search for English-language studies with full
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6 text published in **the ten year period 2004-2014** that investigated the outcomes of RTW after
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8 rehabilitation for stroke survivors of working age in randomized control trials, case control studies,
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10 and cohort studies per se. Searches were performed using electronic databases (Medline, CINAHL
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12 and PubMed) as well as hand search with a limited publication period of the decade between January
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14 2004 and December 2014. The search terms “stroke” or “post-stroke”, “CVA” or “cerebrovascular
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16 accident”, or “hemiplegia” were combined with the operator “and” with the terms “return-to-work”,
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18 “back to work” and “work outcome” to identify relevant articles. A search of the reference lists for
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20 relevant studies was also undertaken.
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29 Selection criteria

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31 All the studies yielded in response to the search terms were identified against the inclusion and
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33 exclusion criteria. **The inclusion criteria were that** they should be published in English and include a
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35 population of subjects that **were stroke survivors of** working age (15–65 years old) who had
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37 participated in rehabilitation before, and one of the **primary** outcomes of rehabilitation should be
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39 RTW. The rehabilitation programmes in which the subjects **had participated included** conventional
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41 stroke rehabilitation, vocational rehabilitation, and comprehensive rehabilitation programmes
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43 integrating the two.
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49 Studies not eligible included those containing other diagnostic groups and where the stroke group
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51 results were not reported independently; surveys or studies that primarily investigated the factors that
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53 influence RTW after stroke, vocational outcomes of caregivers, and studies in which work outcomes
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55 **of stroke survivors** are not sufficiently detailed. Qualitative studies and previous systematic reviews
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4 were also excluded.
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8 9 Study selection

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11 After the electronic database search, studies were identified using the selection criteria above. Each
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13 title was read and references that were clearly irrelevant were eliminated. Abstracts or even the full
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15 text for the remaining references was obtained and reviewed based on the selection criteria, and
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17 finally the closely relevant references were picked out and included in our review with other studies
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19 from electronic databases.
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24 25 26 Data extraction and analysis

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28 Relevant data were extracted and recorded from the included studies. Data extraction included the
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30 characteristics of the subjects, a brief description of the rehabilitation programme, follow-up time,
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32 and vocational status pre-stroke, at rehabilitation admission and discharge, and at follow-up time.
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36 Data were **systematised** in tables to illustrate and compare the characteristics of the included studies.
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39 **To evaluate the quality of methods of both randomized and non-randomized clinical trials, the**
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41 **Downs and Black Checklist was used (Downs and Black, 1998). The checklist consisted of 4**
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43 **domains including 10 items in reporting domain, 3 items in external validity, 13 items in internal**
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45 **validity, and 1 item in power of study (Downs and Black, 1998).**
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50 51 **RESULTS**

52 53 54 Study selection

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56 Figure 1 shows the flowchart of the literature search and recruitment process. Our search yielded **246**
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4 potentially relevant articles after removing duplicates, 236 articles were excluded after application of
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6 the selection criteria, leaving the final ten articles used for our review.
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10 11 Study design

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13 In the ten articles included in our review, there are: one randomized controlled trial (Ntsiea et al.,
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15 2015), one single group clinical trial (Adams et al., 2004), four retrospective single cohort studies
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17 (Chan, 2008; Doucet et al., 2012; O'Brien and Wolf, 2010; Varona et al., 2004) and four prospective
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19 single cohort studies (Busch et al., 2009; Hofgren et al., 2007; Saeki and Toyonaga, 2010; Tanaka et
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21 al., 2011). The details of the study designs are illustrated in Table 1.
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29 Participants

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31 Table 1 provides characteristics of the subjects who participated in stroke rehabilitation in the
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33 included studies. Selection criteria for subject recruitment were written explicitly in some studies,
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35 such as “experienced first ever stroke” (Busch et al., 2009; Doucet et al., 2012; Hofgren et al., 2007;
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37 Saeki and Toyonaga, 2010; Tanaka et al., 2011; Varona et al., 2004), “experienced a mild to moderate
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39 stroke” (O'Brien and Wolf, 2010), “pre-stroke employment” (Adams et al., 2004; Busch et al., 2009;
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41 O'Brien and Wolf, 2010; Ntsiea et al., 2015) and “working age (ranged from 15 to 65)” (Hannerz et
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43 al., 2011; Ntsiea et al., 2015; O'Brien and Wolf, 2010; Saeki and Toyonaga, 2010; Tanaka et al.,
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45 2011). The total number of subjects included in these ten studies is 1,780. Sample size of the
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47 included studies ranged from 29 to 400, and five of the ten studies had a population larger than 200
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49 (Busch et al., 2009; Saeki and Toyonaga, 2010; Tanaka et al., 2011; Varona et al., 2004; Adams et al.,
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51 2004). Only one study had less than 50 subjects (Chan, 2008), the remaining four studies had
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4 between 50 and 100 (Busch et al., 2009; Doucet et al., 2012; Hofgren et al., 2007; Ntsiea et al., 2015;
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6 O'Brien and Wolf, 2010). Gender ratio was identified in **nine studies**, except the study conducted by
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8 Chan et al. (2008). The mean age of the subjects was reported in **eight studies**, and ranged from **45**
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10 **years (Ntsiea et al., 2015)** to 55.2 years (Tanaka et al., 2011). One study reported that the median age
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12 was 48 (Adams et al., 2004) and one study had not reported the age of the recruited subjects (Chan,
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14 2008). Most of the studies also reported additional information such as **time since onset of stroke or**
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16 **follow-up period post-stroke, etc.** for the purpose of identifying the relationship with RTW rate.
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24 Interventions

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26 Before identifying the outcomes of RTW, all recruited subjects had participated in **different kinds** of
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28 rehabilitation programmes, but only **three studies** introduced the rehabilitation programmes in which
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30 subjects had participated. Adams et al. (2004) provided a brief description of the intervention, which
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32 included conventional rehabilitation and vocational rehabilitation, while Chan (2008) and Ntsiea et al.
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34 (2015) mentioned their vocational programmes for stroke explicitly (Table 2). The schedule and
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36 duration of rehabilitation programmes were diverse and some programmes were not described
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38 properly. None of the studies stated the period between stroke onset and rehabilitation admission.
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40 Only Doucet et al. (2012) mentioned that it took an average of 19.2 months post-stroke for subjects
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42 to be able to go back to work in their study. Follow-up time is closely related to the employment
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44 rates, and different follow-up periods reported different employment rates within the same group of
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46 subjects (AIHW, 2011; Mennemeyer et al., 2006). With the exception of Chan (2008), every study
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48 reported clearly on the follow-up period. In conclusion, it is not easy to compare the follow-up
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50 period in our review due to different definitions – some are post-stroke periods while the others are
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4 post-rehabilitation periods (Table 2).
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8 Outcomes 9

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11 There are four potential stages that could be addressed to better illustrate and contrast the
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13 employment rate: (1) pre-stroke; (2) post-stroke and before rehabilitation discharge (at rehabilitation
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15 admission); (3) the time of rehabilitation discharge; (4) certain follow-up points after rehabilitation
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17 discharge. **Seven studies** established their measurements as described above, and their pre-stroke
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19 employment rates were 100% (Adams et al., 2004; Busch et al., 2009; Doucet et al., 2012; **Ntsiea et**
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21 **al., 2015**; O'Brien and Wolf, 2010; Saeki and Toyonaga, 2010; Tanaka et al., 2011). Pre-stroke
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23 vocational status was reported in **eight studies** and the corresponding employment rates ranged from
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25 93% to 100% (Adams et al., 2004; Busch et al., 2009; Doucet et al., 2012; Hofgren et al., 2007;
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27 **Ntsiea et al., 2015**; O'Brien and Wolf, 2010; Saeki and Toyonaga, 2010; Tanaka et al., 2011). The
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29 follow-up vocational status was reported in all **ten studies** and the employment rates ranged from 7%
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31 (Hofgren et al., 2007) to 75.6% (Adams et al., 2004) (Table 2).
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39 Adam et al. (2004) made an overall contrast of the four different stages and the results showed that
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41 the vocational status remained relatively stable between the two stages from rehabilitation discharge
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43 to 1-year follow-up due to minor changes in the productive rate. O'Brien & Wolf (2010) compared
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45 the stages of "pre-stroke", "at rehabilitation discharge" and "follow-up time", and the employment
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47 rate dropped a little from "after discharge" to "follow-up", but was still relatively steady, between 63%
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49 and 54.1%, during the period. **Six studies** compared the stage of "pre-stroke" with "follow-up"
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51 (Busch et al., 2009; Doucet et al., 2012; Hofgren et al., 2007; **Ntsiea et al., 2015**; Saeki and Toyonaga,
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53 2010; Tanaka et al., 2011), and two reported follow-up vocational status only (Chan, 2008; Varona et
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4 al., 2004). Table 2 summarizes the characteristics and results of rehabilitation.

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6 Additional information was also reported and analyzed in the **ten studies**, including factors and
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8 determinants influencing RTW (Adams et al., 2004; Busch et al., 2009; Doucet et al., 2012; **Ntsiea et**
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10 **al., 2015**; Saeki and Toyonaga, 2010; Tanaka et al., 2011), however, only one study mentioned the
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12 mortality rate and recurrence rate after stroke (Varona et al., 2004). These data were seldom reported
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14 and discussed in the other studies in this review.
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17 18 19 20 21 **Methodological quality**

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23 **All articles were scored in the Downs and Black Checklist (Table 3). Among the four domains,**
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25 **external validity, which reflected the representativeness of findings, was found as having high quality**
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27 **with a mean score of 2.40±0.70 (80% of the total score). However, four out of ten studies did not**
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29 **meet the criteria of confounding in internal validity which indicated the bias in subject recruitment.**
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31 **The mean score was 1.40±1.35 (23% of the total score) and a range from 0 to 4 only.**
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38 39 **DISCUSSION**

40 41 **Effects of rehabilitation on RTW**

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43 This review aimed to demonstrate what has been reported in recent studies on the outcomes of RTW
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45 after rehabilitation for stroke survivors of working age **and concentrated on studies of both**
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47 **conventional stroke programmes and vocational rehabilitation programmes with the outcomes of**
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49 **RTW since 2009 which might not have been examined by previous systematic reviews (Baldwin and**
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51 **Brusco, 2011; Daniel et al., 2009).** Although the ten studies included used different study designs and
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60 methodologies, and certain findings may have suggested that **conventional stroke rehabilitation** is

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4 helpful to RTW, this review provided inconclusive evidence for the conclusion that **vocational**
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6 **rehabilitation programme is superior than conventional stroke programme to increase** the post-stroke
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8 employment rates for stroke survivors of working age.

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11 The ten studies included were either single cohort studies or single group clinical trials where the
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13 subjects participating in the rehabilitation programmes were not compared with any control groups
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15 (Adams et al., 2004; Busch et al., 2009; Chan, 2008; Doucet et al., 2012; Hofgren et al., 2007;
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17 O'Brien and Wolf, 2010; Saeki and Toyonaga, 2010; Tanaka et al., 2011; Varona et al., 2004), **except**
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19 **that there has been one recent randomised controlled trial evaluating a RTW workplace intervention**
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21 **with usual stroke care in South Africa.** It is impossible to follow one model or programme and apply
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23 it fully to other clients since rehabilitation programmes are very individualized as different clients
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25 need different programmes. This makes it difficult to compare the effectiveness of rehabilitation
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27 programmes on RTW. However, some indirect factors identified could potentially address the
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29 mechanisms affecting RTW. Many studies found that RTW was related to functional independence: a
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31 higher level of independence was associated with greater productivity (Adams et al., 2004; Ergeletzis
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33 et al., 2002; Inouye et al., 2000; Kendall et al., 2007). Hofgen et al. (2007) also found that
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35 neurological status and cognition status were strongly related to RTW. **The majority of stroke**
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37 **survivors with left hemiplegia had greater chance of RTW than those with right hemiplegia which**
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39 **might possibly associate with a higher likelihood to suffer speech problems in those with left**
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41 **hemiplegia (Ntsiea et al., 2015).** **These findings** may indicate that stroke rehabilitation should focus
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43 on the factors that critically influence RTW and intervene accordingly with appropriate rehabilitation
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45 strategies.
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Outcomes of RTW

The wide range of RTW rates among the **ten studies** could be accounted for by the differences in the definition of work, the subject inclusion criteria, follow-up periods and study design, as well as the methods of data collection, which makes a comparison difficult (Daniel et al., 2009).

Each article regards vocational status differently. Most did not offer clear definitions of work, employment and RTW. Adams et al. (Adams et al., 2004), for instance, divided vocational status into the categories productive or non-productive work. Productive work includes competitive employment, modified employment, supported employment and sheltered workshops, as well as educational programmes, homemaker and volunteer work. Saeki's study gave a definition of RTW as active employment in the former or a new occupation (full-time or part-time competitive or self-employment) (Saeki and Toyonaga, 2010), but without considering the work of housewives and students. Some studies did not define "work" at all (Hofgren et al., 2007). Tanaka et al. (2011) regarded work outcome as a very early RTW within one month post-discharge. The variance in the definitions of vocational status in the studies' inclusion criteria makes comparison of rates of RTW difficult. Several articles established selection criteria for subject recruitment, but without a unified standard; fortunately, their baselines are comparable, with 100% "employment" before stroke onset (Adams et al., 2004; Busch et al., 2009; Doucet et al., 2012; **Ntsiea et al., 2015**; O'Brien and Wolf, 2010; Saeki and Toyonaga, 2010; Tanaka et al., 2011).

A major methodological problem encountered in many studies, identified by Wozniak and Kittner (2002), is that the follow-up period varied among different subjects. Saeki et al. (1995) found that two periods of time showed dramatic increases in the RTW rates in Japan. The first referred to the

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4 first six months after admission due to early discharge from hospital; the second period was 12–18
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6 months post-admission, probably due to the expiration of patients' sickness benefits (AIHW, 2011;
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8 Saeki et al., 1995). A longer period would render follow-up difficult, but a shorter follow-up period
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10 might not allow identification of suitable data. As follow-up time is rather important to the
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12 employment rates, an appropriate uniform follow-up period is recommended in our review – 12
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14 months, with consideration of different cultural environments.
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19 Rehabilitation programmes in stroke care units should be directed towards RTW preparation in order
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21 to facilitate RTW for younger adults (Arauz, 2013; Roding et al., 2003). The vocational rehabilitation
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23 programmes of Adams et al. (2004), Chan (2008) and Ntsiea et al. (2015) shared few common
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25 elements; the former mainly focused on counseling and compensatory strategy education, while the
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27 latter two mainly focused on job placement and skills training. A previous systematic review reported
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29 that social consequences such as support from family and co-workers enable post-stroke RTW
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31 (Daniel et al., 2009). Some studies suggested that the patient-centered principle should be adopted in
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33 vocational rehabilitation as evidence shows that RTW was influenced by individuals' perceived
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35 self-efficacy as well as external support from family, employers and society (Hartman-Maeir et al.,
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37 2007; Kersten et al., 2002; Medin et al., 2006). One recent qualitative study found that employers
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39 faced complex emotional and practical issues when helping an employee return-to-work after a
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41 stroke (Coole et al., 2013). Attention should also be paid to the range and quality of support networks,
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43 including those provided by clinicians (Coole et al., 2013). Moreover, precautions regarding
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45 hypertension, work tolerance, fatigue and fall risk should be considered when patients participate in
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47 vocational rehabilitation, especially work hardening, although none of the studies mentioned the
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49 precautions of work hardening for stroke survivors. The results of two studies found that fatigue and
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4 its consequences was the main reason precluding return-to-work full-time (Ntsiea et al., 2015;
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6 Roding et al., 2003). Most stroke survivors in the intervention group of a recent randomised
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8 controlled trial had work adaptations and job description changes following communication and
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10 contract between employers and therapist (Ntsiea et al., 2015). Another study reported that every
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12 cognitive deficit doubled a patient's risk of subsequent inability to RTW compared with a patient
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14 with no cognitive deficits, and executive functions and processing speed deficits were the most
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16 prevalent deficits both initially and at six months (Kauranen et al., 2013). Recent findings also
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18 indicated that for every unit increase in a cognitive assessment score in the six month, the likelihood
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20 of RTW increased by 1.3 and the factors that had an influence was possibly associated with speech
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22 impairment in stroke survivors with right hemiplegia (Ntsiea et al., 2015). Therefore, there might be
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24 a need to design rehabilitation programmes involving treatment of cognitive deficits and fatigue to
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26 facilitate post-stroke RTW.
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34 The results of quality evaluation suggested that studies on the outcomes of RTW after rehabilitation
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36 for stroke survivors of working age show on average a moderate methodological quality (50% of the
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38 total score). It is noteworthy that the reported quality may differ from the true methodological quality,
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40 because different designs of studies - single group clinical trial, retrospective single cohort studies,
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42 prospective single cohort studies, and a randomised controlled trial were used.
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48 49 Limitations

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51 The limitations of the studies in our review included a lack of randomised controlled trials, a lack of
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53 uniform definitions of "work", "return-to-work" and "employment", as well as difficulties in
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55 comparing vocational status at different time points among different studies. These issues should be
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4 addressed by future research. Although systematic reviews are becoming increasingly
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6 mixed-methods, studies with pure qualitative designs were excluded in our review because of the
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8 difficulty in comparing results for the conduct of unbiased systematic reviews.
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10 11 12 13 **CONCLUSION**

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16 Work is essential for people and post-stroke employment promotes well-being and life satisfaction
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18 for stroke survivors. Although RTW has been recognized as an important rehabilitation goal among
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20 stroke survivors, further research is still required in order to understand the relationship between
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22 conventional stroke rehabilitation and vocational rehabilitation programmes, and RTW. More
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24 randomised controlled trials focusing on vocational rehabilitation for stroke survivors of working age
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26 should be conducted in the future.
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34 **Key findings**

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36 • Functional independence, neurological status and cognition status were strongly related to
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38 return-to-work in stroke survivors of working age.
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40 • Return-to-work percentages reported in various studies are extremely variable.
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42 • Limited evidence was found to support vocational rehabilitation alone in facilitating
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44 return-to-work for stroke survivors.
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46 • Conventional stroke rehabilitation is also helpful to RTW for stroke survivors of working age.
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54 **What the study has added**

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56 Limited evidence was found to support vocational rehabilitation in facilitating return-to-work for
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stroke survivors. Further randomized controlled studies should well control baseline comparable between groups, define clearly return-to-work, elements and medical precautions in the rehabilitation programmes.

Conflict of interest: None

Research ethics: Not applicable for systematic review

For Peer Review

Figure 1. Extraction of articles based on the framework of PRISMA (Moher et al., 2009)

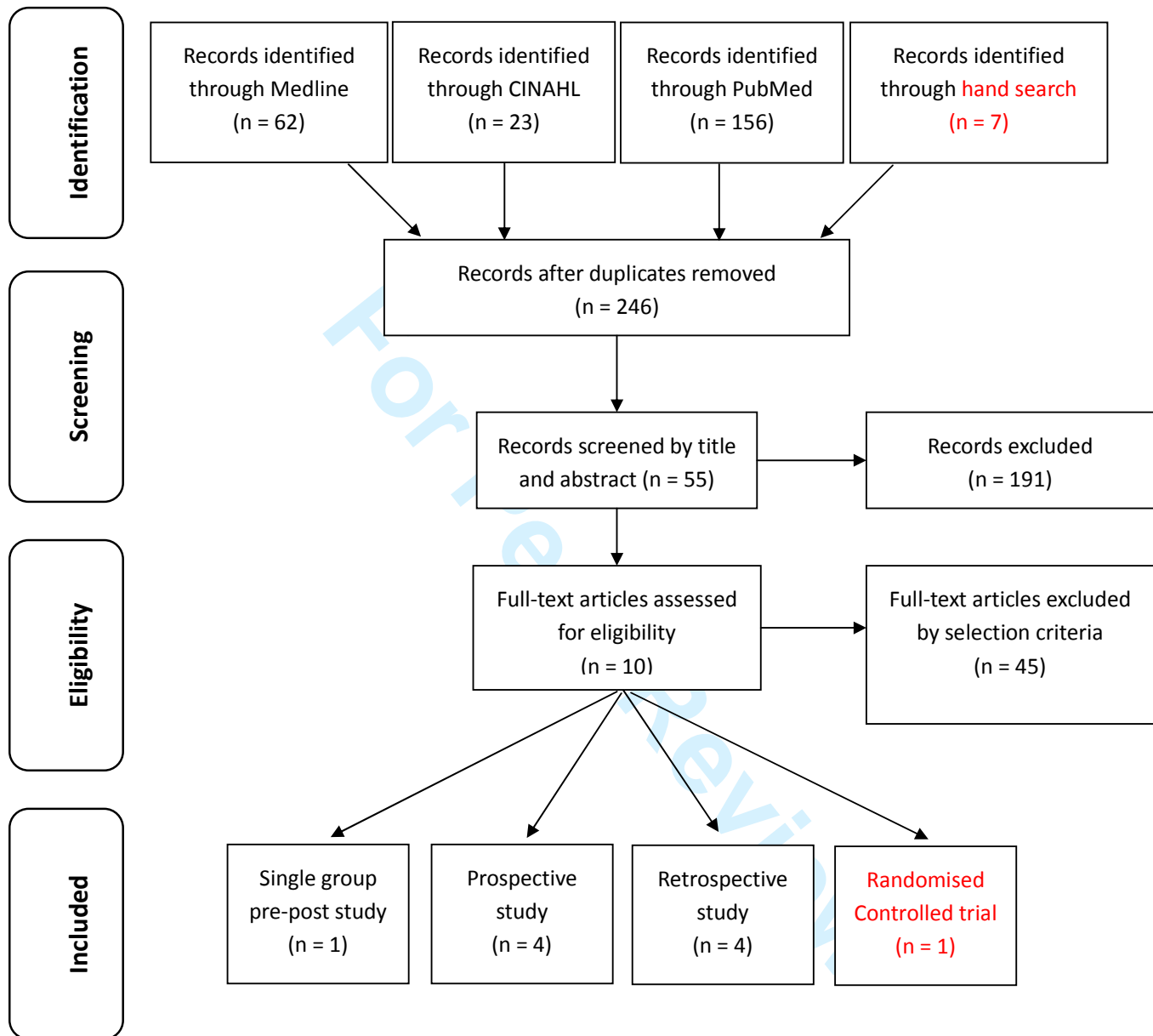


Table 1. Characteristics of studies and basic information of the stroke survivors recruited

Authors	Countries	Studies' design	Sample size	Gender (Male:Female)	Age (years)	Time since onset of stroke or follow-up period post-stroke	Education	
(Ntsiea et al., 2015)	South Africa	RCT	80	41:39	45±8.7	4.6±1.8 weeks	Degree	6
							>Grade12	16
							Grade 12	24
							Grade 11	27
							≤Grade 7	7
(Adams et al., 2004)	USA	Single group pre-post	127	77:50	median=48 25 th , 75 th percentile= (38, 54)	83 days (40-222)	<High school	9
							High school	35
							Some college	29
							College degree	54
(Varona et al., 2004)	Spain	Retrospective	272	177:95	36.6±7.2	11.7±7.9 years (mean follow-up period)	Not stated	
(Hofgren et al., 2007)	Sweden	Prospective	58	44:14	52±7.9	Not stated	Not stated	
(Chan, 2008)	Singapore	Retrospective	29	Not stated	Not stated	Not stated	Not stated	
(Busch et al., 2009)	UK	Prospective	400	261:139	53.8±12.9	Not stated	Not stated	
(O'Brien and Wolf, 2010)	USA	Retrospective	98	54:44	51.53±7.74	6-18 months (follow-up post stroke)	>high school	
(Saeki and Toyonaga, 2010)	Japan	Prospective	325	264:61	55.1±7.4	Not stated	<High school	56
							High school	170
							College graduate	54
(Tanaka et al., 2011)	Japan	Prospective	335	267:68	55.2±7.2	Not stated	<High school	59
							High school	159
							Junior college	25
							College	54

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(Doucet et al., 2012)	France	Retrospective	56	35:21	48.3±10.1	Not stated	Junior high	13
							Vocational	22
							High school	21

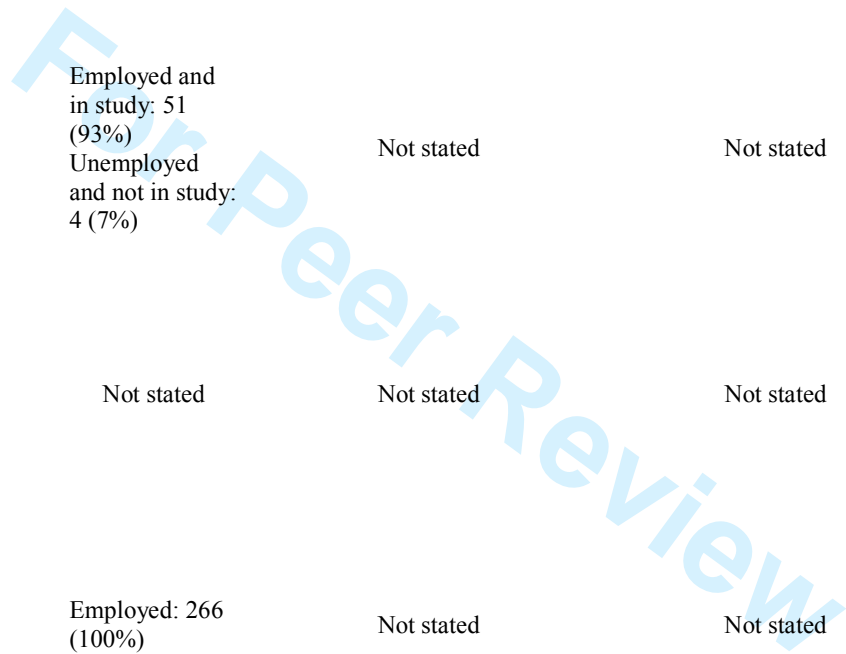
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Table 2. Interventions and primary findings of the studies included in this systematic review

Studies	Interventions	Treatment duration	Vocational status, n (%)			
			Pre-stroke	Admission	Discharge	Follow-up
(Ntsiea et al., 2015)	WIP vs Usual stroke care	Not stated	Employed: 80 (100%)	Not stated	Not stated	3-month: Intervention (27%) Control (12%) 6-month: Intervention (60%) Control (20%)
(Adams et al., 2004)	VR	Not stated	Employed: 90 (100%)	Productive: 4 (4.4%) i. Competitive employment: 0 (0%); ii. Modified employment: 2 (2.2%); iii. Supported employment: 1 (1.1%); iv. Education programme: 1 (1.1%); v. Homemaker: 0 (0.0%); vi. Volunteer: 0 (0.0%); Non-productive: 86 (95.6%)	Productive: 73 (81.1%) i. Competitive employment: 33 (36.7%); ii. Modified employment: 15 (16.7%); iii. Supported employment: 2 (2.2%); iv. Education programme: 2 (2.2%); v. Homemaker: 2 (2.2%); vi. Volunteer: 19 (21.1%); Non-productive: 17 (18.9%)	Productive: 68 (75.6%) i. Competitive employment: 35 (38.9%); ii. Modified employment: 9 (10.0%); iii. Supported employment: 0 (0.0%); iv. Education programme: 3 (3.3%); v. Homemaker: 9 (10%); vi. Volunteer: 12 (13.3%); Non-productive: 22 (24.4%)

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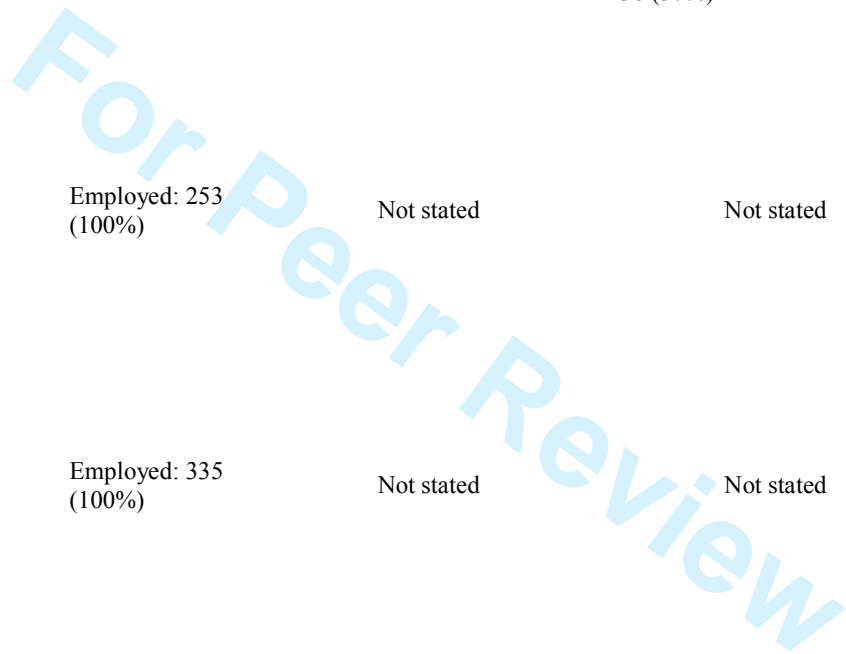
(Varona et al., 2004)	Not stated	Not stated	Not stated	Not stated	Not stated	Employed: 128 (53%); Unemployed: 84 (35%); Other (student, house wife or unemployed before): 28 (12%)
(Hofgren et al., 2007)	Not stated	3 weeks	Employed and in study: 51 (93%) Unemployed and not in study: 4 (7%)	Not stated	Not stated	1-year post-rehabilitation: 4 (7%); 3-year post-rehabilitation: 11 (20%)
(Chan, 2008)	VR	Not stated	Not stated	Not stated	Not stated	Employed: 16 (55%) i. Open employed: 10 (34%); ii Sheltered workshop: 6 (21%) Remain unfit for work, need further surgery or rehabilitation etc..
(Busch et al., 2009)	Not stated	Not stated	Employed: 266 (100%)	Not stated	Not stated	Employed: 94 (35%); i. Full-time: 61 (23%); ii Part-time: 33 (12%)



(O'Brien and Wolf, 2010) (Saeiki and Toyonaga, 2010) (Tanaka et al., 2011) (Doucet et al., 2012)	Not stated	Not stated	Employed: 98 (100%)	Not stated	After discharge: Employed: 62 (63%); Never employed: 36 (37%)	Still employed: 44 (44.9%); Employed in different jobs or in a modified capacity: 9 (9.2%); Never employed: 45 (45.9%)
	Not stated	Not stated	Employed: 253 (100%)	Not stated	Not stated	Employed: 138 (55%)
	Not stated	Not stated	Employed: 335 (100%)	Not stated	Not stated	Employed: 102 (30.4%); i. Male: 85 (25.4%); ii. Female: 17 (5.0%)
	Not stated	195.7 ± 162.5 days (Mean ± SD)	Employed: 56 (100%)	Not stated	Not stated	Employed: 18 (32.1%); i. Same work: 9 (16.0%); ii. New work: 9 (16.0%) Unemployed: 38 (67.9%)

VR-Vocational rehabilitation

WIP-Workplace intervention programme



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Table 3. Scores of the Downs and Black Checklist for each study

Studies	Reporting (11)	External validity (3)	Internal validity (13)		Power (5)	Total score (32)
			Bias (7)	Confounding (6)		
(Ntsiea et al., 2015)	10	2	3	4	3	22
(Adams et al., 2004)	9	2	5	2	3	21
(Varona et al., 2004)	6	2	4	2	3	17
(Hofgren et al., 2007)	7	3	4	0	3	17
(Chan, 2008)	4	1	2	2	0	9
(Busch et al., 2009)	7	2	2	2	3	16
(O'Brien and Wolf, 2010)	5	3	2	0	0	10
(Saeki and Toyonaga, 2010)	8	3	2	0	3	16
(Tanaka et al., 2011)	7	3	3	0	3	16
(Doucet et al., 2012)	6	3	2	2	3	16
Mean score (mean ± SD)	6.90±1.79	2.40±0.70	2.90±1.10	1.40±1.35	2.40±1.26	16.00±4.06
(Percentage of gained score)	(63%)	(80%)	(41%)	(23%)	(48%)	(50%)

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