Return to work after acquired brain injury
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In the Netherlands, every year about 60,000 people – or 400 in every 100,000 citizens – are registered in hospitals due to non-progressive acquired brain injury. Acquired brain injury (ABI) is an umbrella term, encompassing a wide spectrum of brain injuries that includes traumatic and non-traumatic aetiologies. Traumatic brain injury is caused by an external mechanical force, such as in traffic accidents, falls, or assault. Non-traumatic brain injuries are the result of processes within the body, including strokes or infections. Physical, cognitive, and emotional/behavioural consequences can be the result of the ABI. If necessary, a rehabilitation training can be provided by a team of ABI professionals of a rehabilitation centre to facilitate the process of recovery.

Due to the multiple domain consequences, return to work (RTW) after ABI is not always self-evident. There are indications that special care and support, in general defined as vocational rehabilitation (VR), have a positive effect on RTW after ABI. Because specialized ABI knowledge is available from the team of professionals of a rehabilitation centre, it can be expected that part of the care and RTW support can be provided during (the early phase of) a rehabilitation process. To be able to support people with ABI as much as possible during their RTW process, it is necessary to gain insight into the return to work of people with ABI and the factors that influence this process. In addition, a VR protocol has to be available in order to provide a structured process. Therefore, the aims of the thesis were A) to provide insight into the process of RTW after ABI; and B) to study the possibilities of supporting the return to work process of people with ABI during rehabilitation.

In line with the first aim, the following research questions were formulated:

1. What is the prevalence of return to work after acquiring traumatic or non-traumatic brain injury?
2. Which factors limit or facilitate return to work of people with ABI?

In line with the second aim, the following research questions were formulated:

3. Is it possible to implement an approach of early vocational rehabilitation within the ABI unit of a rehabilitation centre in a way that it is feasible for use in the rehabilitation centre and to the satisfaction of the professionals, patients with ABI, employers, and occupational physicians?
4. What are the differences in return to work, satisfaction of the actors, and costs of Early versus Late Vocational Rehabilitation after ABI?

A. The RTW process after ABI

With regard to the first aim, it is concluded from the international literature that about 40% of the people who were working before ABI are able to return to work within two years, and that a complex interaction between different factors influences the RTW process. Support from the employer, colleagues, occupational physician, and occupational specialist is important during the RTW process. These conclusions were based on the following results per research question:
1. What is the prevalence of return to work after acquiring traumatic or non-traumatic brain injury?

A systematic review was performed including 49 studies published between 1992 and 2008 (chapter 2). Of the people with traumatic ABI, 30-65% were able to return to work. Of the people with non-traumatic ABI, 35-60% were able to return to work. All people were working before ABI. After pooling the data, about 40% of the people with traumatic or non-traumatic ABI who were working before ABI were able to return to work within two years after acquiring brain injury. However, not all these people were able to return to their former job: changes in occupation and job demands were common among people following ABI. A substantial proportion of the people with ABI who returned to work were not able to sustain their job over time.

2. Which factors limit or facilitate return to work of people with ABI?

In chapter 3, a literature review was performed to assess the limiting and facilitating factors. From this review of 22 internationally published studies (published between 1992 and 2008), strong evidence was found that a longer hospital stay is a negative prognostic indicator of RTW, and that the severity of the injury (as classified by the Glasgow Coma Scale) and suffering from a depression or anxiety were non-prognostic factors of RTW in people with traumatic ABI. In people with non-traumatic ABI, strong evidence was found that the anatomic location of the stroke (also belonging to the disease/disorder domain) and the gender of the individual (belonging to the domain of the personal factors) were not associated with RTW. Although many variables were investigated in the studies that were included in the review, strong evidence was only found on the prognostic and non-prognostic value on RTW for the few factors that were mentioned here.

Chapter 4 described the qualitative study used to investigate which factors were experienced as limiting or facilitating during the RTW process of Dutch individuals (n=12) with ABI. All participants were working full-time before acquiring traumatic or non-traumatic brain injury (two to three years earlier). After injury, three participants were working full-time, four participants were working part-time in paid jobs, two participants were working part-time as volunteers, and three participants were not working at all. The experiences were gathered through semi-structured interviews. The most important limiting factors were: physical and/or cognitive tiredness, a number of physical and cognitive consequences of ABI (problems with vision or hearing, feeling pressure in the head, a loss of muscle strength, limited balance, limited energy and physical fitness, impairments of the lower and/or upper extremities, aphasia, and problems in concentrating), a long duration and incompleteness of recovery from the results of ABI, acquired serious diseases that were not related to ABI, regulations concerning eligibility to drive a car after ABI, and a lack of knowledge about ABI and/or RTW after ABI and support from employers, colleagues, and specialists like occupational specialists or occupational physicians. The most important facilitating factors were a strong will and
motivation to return to work, the kind of job tasks, not being impaired in using the upper extremities, an ongoing recovery of the results of ABI over time, humour, and support from colleagues, employers, occupational physicians, occupation specialists, and relatives.

B. The possibilities of supporting the RTW process of people with ABI during rehabilitation

In the current thesis, two interventions of vocational rehabilitation (VR) were described: the Early Vocational Rehabilitation (EVR) intervention and the Late Vocational Rehabilitation (LVR) intervention. The LVR intervention had already been implemented in one Dutch rehabilitation centre. The EVR intervention was newly developed. A description of the EVR protocol and its development was given in chapter 5. The main purpose of the EVR and LVR interventions is to support people with ABI during their rehabilitation process to return to work in a sustainable way. The VR intervention is started early (from the first day of the standard rehabilitation treatment) or later (after inpatient rehabilitation has ended and one is living at home independently), respectively, during a standard rehabilitation process. Work training is started at the rehabilitation centre or at the workplace of the patient, and is provided by the rehabilitation professionals (EVR) or by a co-worker (usually a colleague of the patient), who is also supported by rehabilitation professionals (LVR), respectively. In addition to the person with ABI, other stakeholders like the employer and occupational physician are involved in both processes in order to facilitate a smooth continuation of the support of the person with ABI after rehabilitation has ended. The cooperation also guarantees that the VR treatment is maximally adapted to the individual (work) situation of the person with ABI. With regard to the second aim of the thesis, it is concluded that it is possible to implement the EVR intervention in an existing rehabilitation process. Both the EVR intervention and the LVR intervention are suitable for supporting people with ABI during their RTW process. The differences between the interventions do not lead to differences in RTW outcome, the satisfaction of the actors, or costs. These conclusions were based on the following results per research question:

3. Is it possible to implement an approach of Early Vocational Rehabilitation within the ABI unit of a rehabilitation centre in a way that it is feasible for use in the rehabilitation centre and to the satisfaction of the professionals, patients with ABI, employers, and occupational physicians?

After the development of the EVR intervention, it was implemented as a pilot study in the inpatient and outpatient rehabilitation process of people with ABI at a Dutch rehabilitation centre in order to test the feasibility of the EVR protocol. A pre- and post-process evaluation was performed in chapter 6. Outcome measures were usability, promoting factors and barriers, and perceived effectiveness of the protocol. Usability on the process
level (defined by 13 goals set on performance and timing of the protocol’s steps) was 
evaluated using existing forms and registrations. Questionnaires were used to investigate 
the fulfillment of usability expectations, perceived promoting factors and barriers, and 
perceived effectiveness.
Data of 23 patients were available for process evaluation. Nine rehabilitation 
professionals, ten patients with ABI, nine employers, and six occupational physicians 
completed the questionnaires. With regard to usability, the results showed that eight of 
the 13 goals that were set on performance by the rehabilitation management team of the 
ABI unit were achieved. Some difficulties occurred in complying with the timing of the 
protocol: only three of the 13 goals set on the timing of the steps were achieved. This 
was in line with the expectations of the rehabilitation professionals who were working 
according the EVR protocol. Almost 95% of the participants perceived the protocol as 
being suitable for facilitating RTW after ABI. The contact between the actors was cited as 
a promoting factor by all responders. Barriers that were reported by the rehabilitation 
professionals included insufficient time, unfamiliarity with the EVR protocol, and practical 
problems. Barriers concerning the quality and quantity of the contact between the 
rehabilitation professionals and the other actors, and the connection with the patient’s job 
were encountered as barriers by patients, employers, and occupational physicians. It was 
concluded that although some adaptations have to be made, the EVR intervention can be 
implemented successfully in a standard rehabilitation process.

4. **What are the differences in return to work, satisfaction of the actors, and costs of Early versus Late Vocational Rehabilitation after ABI?**

An evaluation study was performed in which the EVR intervention and the LVR 
intervention were compared with respect to RTW, satisfaction, and costs (chapter 7). A 
longitudinal prospective study was conducted in which 22 patients treated according to 
the EVR intervention and 11 patients treated according to the LVR intervention 
participated. All patients had been working before acquiring brain injury and were 
included in the study at the start of their rehabilitation process (between July 18th, 2011 
and September 1st, 2012) and were followed for 18 months. In addition to the patient, 
their employer and occupational physicians were also asked to participate.
The main outcome measure was the time between ABI and performing useful tasks as 
defined by the employer. The Kaplan-Meier analysis showed that no statistical significant 
differences between the interventions existed (p=0.82). The median time from ABI till 
being able to perform useful tasks was 206 (range 59-509) days in the EVR group and 
190 (range 66-446) in the LVR group.
Secondary outcome measures were the percentage of people that returned (partly or 
fully) to work at 3, 6, 9, and 12 months after the start of the rehabilitation, satisfaction with 
the support provided during the intervention, satisfaction with the result of the intervention 
for the patient, intervention costs, and costs from the societal, healthcare, employer’s,
and patient’s perspective. Concerning the percentage of people that achieved RTW, no statistically significant differences between the groups were found (p=0.48-0.66): three months after the start of the rehabilitation process, 32% of the people in the EVR group and 40% of the people in the LVR group were working. After six months the percentages were respectively 58% and 67%, after nine months 79% and 89%, and after 12 months 88% and 78%. A mean score for satisfaction with the vocational rehabilitation process and a mean score for satisfaction with the outcome for the patient of the intervention was computed for each individual VR process, including the available scores from the patient, employer, and occupational physician. Overall, the actors were satisfied with the EVR and LVR processes (scores were 8 (range 6-9) points versus 7 (range 5-9) points out of 10 points; p=0.84) and with the outcomes of the interventions for the patients (scores were 8 (range 6-9) points versus 8 (range 7-9) points out of 10 points in both groups; p=0.08).

The mean number of patient-related VR intervention hours was 43 (SD 38.7) hours in the EVR group and 43 (SD 22.9) hours in the LVR group, resulting in mean intervention costs of €2108 (SEM 401) in the EVR group and €2165 (SEM 338) in the LVR group per patient. These costs did not differ statistically significantly (95%CI -972 to 1069). Finally, a cost-benefit analysis was performed from a societal perspective in which all relevant costs were measured 18 months after the start of the rehabilitation, regardless of who pays or benefits. In the EVR group, the costs were €28,947 (SEM €2194) on average per patient and in the LVR group the costs were €33,263 (SEM €2840). The differences in costs did not differ statistically significantly (95%CI -10,432 to 3923). In addition, no statistically significant differences between the groups were found in the analyses performed from the healthcare perspective (EVR: €3691 (SEM €580); LVR: €4264 (SEM €529); 95%CI -2012 to 1034), the employer’s perspective (EVR: €37,819 (SEM €4136); LVR: €39,988 (SEM €4948); 95%CI -15,343 to 9630), or the patient’s perspective (EVR: €1213 (SEM €319); LVR: €881 (SEM €319); 95%CI -309 to 1291).

**Conclusion and recommendations**

The outcomes of the interventions are promising and, taking all the results into account, it can be concluded that it is worth the effort to implement the EVR and/or LVR intervention in an existing rehabilitation setting. Essential elements of the interventions are the cooperation between the actors from inside and outside the rehabilitation institute, providing insight into the job requirements and the individual’s capabilities, an early start of the intervention, and work training.

For future research it is recommended that the long-term effects on outcome and costs of the EVR and the LVR interventions are evaluated and that an investigation is performed into which intervention works best for whom. For practice it is recommended that the EVR and the LVR interventions are implemented in other rehabilitation settings, and that RTW support is organized in a cross-discipline manner and easily accessible for people with
ABI during their whole working life. Such an interdisciplinary organization of RTW support should guarantee that the balance in the working life of people with ABI is maintained and that people are able to continue working, performing tasks adapted to their capabilities.