J Occup Rehabil (2014) 24:533–542
DOI 10.1007/s10926-013-9488-z

Long Term Efficacy of an Integrated Neurological and Vocational Rehabilitation Programme for Young Adults with Acquired Brain Injury

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Published online: 18 December 2013

Abstract *Purpose* To characterise and determine the pre-injury, injury and post-injury factors associated with vocational outcome 1–9 years post-discharge from a mixed therapy/educational/vocational rehabilitation (VR) residential programme. *Methods* 119 clients of working age when they acquired their brain injury and who had attended the centre between 2002 and 2011 were followed up at least 1 year post-discharge to determine their vocational outcome as part of an ongoing review/audit of the service. All clients had had a severe/very severe brain injury. Clients were classified as having a positive vocational outcome (working—paid/voluntary, full/part-time or undertaking full or part-time vocationally related education) or negative vocational outcome (undertaking neither work nor education). *Results* Over half of the clients attained a positive vocational outcome. Length of time since discharge did not differ between those clients with a positive or negative vocational outcome. Vocational outcome was predicted by cognitive and motor ability at discharge, and gender. Together these variables correctly classified the vocational outcome of 76 % of the clients. *Conclusion* Clients with severe/very severe brain injury can attain a positive vocational outcome following intensive neurorehabilitation consisting of traditional therapies in addition to educational and VR.

Keywords Brain injuries · Traumatic brain injury · Rehabilitation, vocational · Return to work

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Introduction

In the UK it is estimated that the yearly incidence of severe brain injury is 10–15 per 100,000, moderate brain injury 15–20 per 100,000 and mild brain injury 100–150 per 100,000. This means that the prevalence of long term disability related to brain injury is 228 per 100,000 adults in the UK. These figures exclude those people who have an acquired brain injury from a brain tumour (20 per 100,000) and stroke (240 per 100,000) [1]. As advances are made in medicine the survival rate of people with acquired brain injury (ABI) has significantly increased. As a result more people are living with permanent disabilities affecting their cognition, emotional, behavioural and physical functioning, with subsequent effect on their ability to live independently, engage in relationships and undertake educational studies and vocational options [2]. These difficulties are not confined to those who have sustained a moderate to severe brain injury; Thornhill found that people who have sustained a mild brain injury also experience difficulties in returning to work a year after their brain injury [3].

Traditionally neurorehabilitation has functioned on increasing independent living skills within the home and social settings of people who have had a brain injury [4]. In the UK the NICE guidelines [5] state that people with a moderate to severe brain injury should be offered acute, specialised medical treatment for their ABI. However, provision of vocational rehabilitation (VR) is less available [6], only 8 % of neurorehabilitation centres offering a specialised VR programme catering for fewer than 10 % of people with ABI.

Returning to work following an ABI is recognised as a primary goal for many people and a major marker of how effective neurorehabilitation has been. The benefits of

returning to work are well documented both for the individual and also for society. Returning to work is associated with a greater quality of life [7] giving structure and purpose to everyday life, a chance to engage in meaningful social relationships and confers on life a sense of "normality" [8]. Conversely failure to return to work is associated with isolation and depression, loss of income and subsequently increased carer and patient stress [9].

It is well recognised that the number of people with an ABI returning to work is low, reported to be about 40 % at one to 2 years post injury [10], compared to 61–75 % being employed before injury [11]. It is also recognised that individuals with ABI experience difficulty in entering and sustaining work [12].

It is estimated that 75 % of people with an ABI are of working age [13] and for those who survive the first 6 months their working life expectancy is near normal [14, 15]. Therefore if a person fails to return to work the cost to society is high, both in lost taxes on salaries and increased social benefits including increased health costs due to depression and stress.

Different models of VR have been reported [16, 17]. A comparative study has concluded that there are insufficient studies of a high enough quality to assess the benefits of specialised VR as opposed to not receiving VR or the benefits of one model of VR (programme-based VR; individual placement model of supported employment; or a case co-ordinated approach) as opposed to another [18]. However, a study of specialist VR comparing people who received usual care with those who received no specialist VR demonstrated that 27 % more people receiving specialist VR returned to work [19]. VR has also been demonstrated to be cost effective, the cost of the programme being exceeded by the salaries that participants go on to secure [20, 21].

Multiple factors have been identified as prognostic indicators for successful/unsuccessful return to work following an ABI: pre-injury (including age, educational level, premorbid vocational status and personality), injury (including severity measures, location and type of injury) and post-injury factors (including level of functional independence, severity of cognition, emotional, behavioural and physical disabilities). However, differing models of VR delivery [16, 21] in addition to methodological heterogeneity in defining "return to work" (e.g. return to competitive work vs. increased productivity including paid work, voluntary work, and education) and the inclusion of different severities of brain injury have led to different conclusions. Different factors have been identified as positively, negatively and not predictive of return to work in different studies, including severity of injury, cognitive and physical sequelae, premorbid education and gender [22, 23]. However a meta-analysis by Crepeau and Scherzer [24] found that most factors were only weakly or moderately associated with returning to work. Shames et al., [25] considered the influence of VR on returning to work and concluded that the pre-injury, injury, post injury and environmental factors all interact in a complex and interrelated way and are further impacted by the availability of neurorehabilitation services, which are limited by geographical location, financial resources and the availability of skilled practitioners.

Therefore, it is important to determine which clients with a brain injury could enter work or education so that the necessary support can be implemented. For those clients who are identified as not being able to enter work or education, support can be put in place to identify other day time activities that they would like to pursue so that they still have a structure and purpose to their life, are able to develop social relationships with others and have a positive quality of life.

This study seeks to build on previous research observations and address the following objectives:

1. To determine the vocational outcome of young adults with ABI who have attended a mixed residential neurorehabilitation programme between 2002 and 2011 and who have been discharged for at least 1 year prior to follow up; and
2. To determine the pre-injury, injury and post-injury variables that predict a positive vocational outcome at follow up for this cohort.

Methodology

Setting

QEF Neuro Rehabilitation Services (QEF Neuro Rehab) provides a residential intensive neurorehabilitation, education and VR for young adults with severe disabilities resulting from an ABI, including traumatic brain injuries (TBI) (injuries resulting from road traffic accidents, falls, assault or projectile) and non TBI (injuries resulting from infection, stroke or tumour). Clients are admitted from regional rehabilitation centres or community, following failure to reach their vocational or educational potential post injury. This includes clients admitted from more acute neurorehabilitation centres for further rehabilitation.

Clients receive up to 5 h of integrated therapy (occupational therapy, physiotherapy, speech and language therapy or psychology), education and/or VR daily which is tailored to meet their specific needs and stage of recovery.

Rehabilitation focuses on optimising their level of independence in functional activities, by regaining and

applying skills as well as learning compensatory strategies in the domains of self-care, independent living skills, physical and mobility skills, cognitive functioning, communication, social integration and vocational productivity, thus enabling them to live more independently.

In VR sessions clients are supported to develop a greater understanding of the impact of their acquired brain injury in a working or learning environment and to consider and explore realistic vocational and educational options, focusing on their awareness and insight into how their strengths and difficulties are likely to impact upon their future life.

Clients are supported with all aspects of returning to work or, as many of the clients due to their age might not have been in employment before, choosing a realistic career path including analysis of work place/study demands in relation to clients' skills and abilities, interview skills, self advocacy, work experience placements and job search skills.

Clients are supported within work experience placements which vary from a half to one day per week over an extended period of time, to a block of time over a period of a week. Work experience providers are offered training about the impact of ABI and how best to support clients. Support is tailored to the client's needs and is graded off as appropriate. All clients receive weekly vocational counselling while undertaking their placements to review their performance and to address any areas that they, or the placement provider, may highlight.

For clients who are interested in returning to or entering education, VR addresses many of the same skills, including enabling the client to search for a suitable college and course, organising meetings, interviews and arranging appropriate support.

Clients also attend education sessions where they are supported to undertake qualifications in literacy, numeracy and information and communications technology. Clients are also assisted to develop their study skills and, where appropriate, are supported to access formal learning at local colleges. Clients are either taught individually or in small groups of three of four.

Historically criteria for admission to the service include clients with ABI who are aged between 16 and 36 (although since 2012 clients up to the age of 65 are accepted), are medically stable, who are perceived to have potential to benefit from the services offered by the programme and also the ability to participate actively in the intensive neuro rehab, educational and/or VR programmes offered.

Exclusion criteria include clients who are not medically stable, have previous diagnoses of severe psychological disorders or who have a current severe substance abuse problem as this would negatively affect their ability to engage with the rehabilitation programme.

Prospective clients attend the centre for assessment by therapy, education and VR departments after which a case conference is held to discuss their suitability for the programme. This decision is based on clinical judgement by the interdisciplinary team.

Funding for clients to participate in such a programme comes from a variety of sources including health, social services, education and private sources. Clients are discharged when they are judged to have made a maximal functional recovery within the residential intensive neurorehabilitation setting, as expressed by the reduction of their disability and handicap. This decision is made through consultation with the team, client and client's family and use of objective outcomes measures, such as the FIM + FAM [26].

Participants

All consecutively admitted clients who were of working age when they acquired their brain injury (aged 16 or over), had had a severe or very severe brain injury, had attended the centre for neurorehabilitation between 2002 and 2011 and who had left the centre for at least 1 year were followed up via postal questionnaire or telephone to ascertain whether they were working (either full or part time, voluntarily or paid) or were in vocationally directed further or higher education, as part of an ongoing review/audit of the service. Of the 119 clients contacted 97 responded, 4 declined to participate, 1 had died and 17 were not contactable, equating to an 82 % response rate. Severity of BI was determined using Glasgow coma Scale (GCS) and duration of post traumatic amnesia (PTA).

Data Analysis

Variables were analysed using independent samples *t* test and Chi square as appropriate, comparing the clients who had a positive vocational outcome at follow up (were working or in education) and those who did not. Variables were also compared for men versus women. Further analysis was conducted using stepwise discriminant function analysis to predict whether a client had a positive vocational outcome or not. Variables examined were age at injury, injury type (TBI vs. non TBI), gender, premorbid level of education [less than general certificate of secondary education (GCSE), GCSEs, A Levels, trade/technical, college but not graduated, college graduate], duration of sub acute/post acute rehabilitation at QEF Neuro Rehab, motor and cognitive subsections of the FIM + FAM at admission and discharge and years since discharge from QEF Neuro Rehab. Discriminating variables were further investigated using one-way between-groups analysis of

Table 1 Mean admission demographic, clinical and functional data for clients who had a positive and negative vocational outcome at follow up

	Positive vocational outcome	Negative vocational outcome	Significance
Number of clients	51 (53 %)	46 (47 %)	
Age at injury (years)	21.07 (4.22)	20.65 (4.80)	$p = 0.647$
Injury			
TBI (%)	36 (70.59)	37 (80.44)	$p = 0.262$
Severity of TBI			
Severe	6	5	$p = 0.672$
Very severe	30	33	
Gender			
Male (%)	32 (43.84)	41 (56.16)	$p = 0.003$
Female (%)	19 (79.17)	5 (20.83)	
Education (%)			
<GCSE	5 (9.80)	9 (19.57)	$p = 0.522$
GCSEs	23 (45.10)	20 (43.48)	
A levels	7 (13.73)	7 (15.21)	
Trade	5 (9.80)	4 (8.70)	
Some college	10 (19.61)	4 (8.70)	
College graduate	1 (1.96)	2 (4.35)	
Pre injury status			
Fulltime working	20	27	$p = 0.093$
Fulltime education	29	16	
Unemployed	2	3	
Length of QEF Neuro Rehab rehabilitation (years)	1.07 (0.57)	1.43 (0.77)	$p = 0.010$
FIM + FAM motor section at admission	78.91 (25.65)	95.42 (17.77)	$p = 0.001$
FIM + FAM cognitive section at admission	55.77 (16.59)	64.94 (16.99)	$p = 0.011$
FIM + FAM motor section at discharge	91.20 (23.14)	107.37 (7.70)	$p < 0.0005$
FIM + FAM cognitive section at discharge	67.17 (16.30)	80.61 (12.21)	$p < 0.0005$
Years since discharge from QEF Neuro Rehab (years)	3.11 (2.15)	3.39 (2.28)	$p = 0.535$

variance (ANOVA). Data were collected and analysed using SPSS 18.0 (SPSS Inc, Chicago, IL, USA).

Results

At follow up 51 clients (53 %) had a positive vocational outcome (10 in full-time education, 8 in part time education, 8 in fulltime paid employment, 9 in part time paid employment and 16 undertaking unpaid, voluntary work).

Demographics

Those clients with a positive or negative vocational outcome did not differ with respect to the age at which they acquired their brain injury ($t_{(95)} = 0.459, p = 0.647$), the proportion of the group with a TBI versus a non TBI ($\chi^2_{(1)} = 1.259$, $p = 0.262$) and their level of education ($\chi^2_{(5)} = 4.193$, $p = 0.522$). The clients with a positive vocational outcome did have a lower proportion of men ($\chi^2_{(1)} = 9.043, p = 0.003$) and there was a trend towards a higher proportion of clients who were in fulltime education, as opposed to working, at the time of their injury ($\chi^2_{(2)} = 4.753$, $p = 0.093$) (see Table 1).

Acute Hospitalisation and Neurorehabilitation

The clients with a positive vocational outcome spent a shorter amount of time receiving neurorehabilitation from QEF Neuro Rehab ($t_{(95)=}2.637$, $p = 0.010$) (see Table 1).

Severity of Disability on Admission to QEF Neuro Rehab

The majority of clients had sustained a TBI. Of these 85 % had sustained a severe (GCS = 6–8, PTA = 1–7 days) or very severe (GCS 3–5; PTA of 1–4 weeks) brain injury (85 and 15 % respectively). There was no difference in the severity of TBI sustained between the clients who attained a negative or positive vocational outcome ($\chi^2_{(1)} = 0.180$, $p = 0.672$). The severity of injury of those clients with a non

Table 2 Cross-validated classification results

Actual group membership	Number of clients	Predicted group membership	
		Positive vocational outcome	Negative vocational outcome
Positive vocational outcome	46	40 (87 %)	6 (13 %)
Negative vocational outcome	41	15 (36.6 %)	26 (63.4 %)

Table 3 Mean admission and discharge FIM + FAM scores for clients who were correctly and incorrectly predicted to have a positive and negative vocational outcome at follow up

	Positive vocational outcome		Negative vocational outcome	
	Correctly predicted	Incorrectly predicted	Correctly predicted	Incorrectly predicted
Number of clients	40	6	26	15
FIM + FAM motor section at admission				
Mean (SD)	108.98 (3.16)	96.67 (17.25)$^{+}$	84.23 (25.45)	103.27 (11.30)*$^{+}$
FIM + FAM cognitive section at admission				
Mean (SD)	83.45 (9.95)	61.67 (8.62)*$^{+}$	59.38 (12.83)	80.67 (12.53)*$^{+}$

* $p < 0.05$ = difference between clients correctly predicted to have a positive vocational outcome and those correctly predicted to have a negative vocational outcome for motor and cognitive FIM + FAM scores respectively

$^{+}$ $p > 0.1$ = no difference between clients who had a negative vocational outcome (those correctly identified as having a negative vocational outcome and those incorrectly classified as having a positive vocational outcome) for motor and cognitive FIM + FAM scores respectively

TBI was judged to be very severe as each had resulted in prolonged hospitalisation (mean of 10.8 months). Functional independence, as measured using the FIM + FAM, was used as an indicator of current injury severity on admission to QEF Neuro Rehab. The clients who achieved a positive vocational outcome on discharge had a higher total motor and cognition score on the FIM + FAM at admission, reflecting their higher level of functional independence than those clients with a negative vocational outcome ($t_{(89)} = -2.599$, $p = 0.011$; $t_{(47.866)} = -4.270$, $p < 0.0005$) (see Table 1). Six clients were missing a FIM + FAM assessment at admission.

Post Rehabilitation Scores

The clients with a positive vocational outcome were more functionally independent, as measured by the motor and cognitive subsections of the FIM + FAM at discharge ($t_{(47.866)} = -4.270$, $p < 0.0005$; $t_{(73.655)} = -4.311$, $p < 0.0005$).

There was no difference between the clients with a positive or negative vocational outcome with regards to the amount of time since they were discharged QEF Neuro Rehab ($t_{(95)} = -0.623$, $p = 0.535$) (see Table 1). Ten clients were missing a FIM + FAM assessment at discharge.

Discriminating Between Clients Who Have a Positive Vocational Outcome at Follow up and Those Who Do Not

A stepwise discriminant function analysis was conducted to predict whether a client had a positive or negative vocational outcome at follow up. A model comprising total cognitive and motor subsection of the FIM + FAM at discharge (structure matrix function 0.705; 0.680), and gender (structure matrix function = −0.434) accounted for 31.6 % of the between-group variability (Wilks' Lambda = 0.68, $\chi^2_{(5)} = 30.625$). The cross-validated classification showed that 75.9 % of the clients were correctly classified; 87 % of the clients who had had a positive vocational outcome and 63.4 % of the clients who had had a negative vocational outcome (see Table 2). The sensitivity, specificity, positive predictive value, negative predictive value of the model were calculated (see Table 3).

This equated to a sensitivity (true positive rate) of 87 %, a positive predictive value (proportion of clients with a positive result who did had a positive vocational outcome of 73 %, specificity (true negative rate) of 63 % and a negative predictive value (proportion of clients with a negative result who did had a negative vocational outcome) of 81 %.

Further Investigation of Functional Independence for Clients Correctly and Incorrectly Predicted to Have a Positive and Negative Vocational Outcome at Follow up

A one way ANOVA was conducted to compare the discharge FIM + FAM motor and cognitive scores for the clients who were correctly and incorrectly identified as having a positive vocational outcome or negative vocational outcome.

There was a statistical difference between the discharge FIM + FAM motor and cognitive scores for the clients who were correctly and incorrectly identified as having a positive and negative vocational outcome ($F(3, 83) = 13.811$, $MSE = 3{,}302.86$, $p < 0.0005$ and $F(3,83) = 28.07$, $MSE = 3{,}566.22$, $p < 0.0005$ respectively).

Post hoc analysis using the Tukey HSD test indicated that the mean discharge motor and cognitive FIM + FAM for the clients who were correctly predicted to have a positive vocational outcome differed from those who were predicted to have a negative vocational outcome as predicted by the stepwise discriminant function analysis.

However, significant differences in the motor and cognitive FIM + FAM scores at discharge were also found between the clients who were correctly and incorrectly predicted to have a negative vocational outcome. Similarly significant differences in the cognitive FIM + FAM scores at discharge were also found between the clients who were correctly and incorrectly predicted to have a positive vocational outcome. However, no differences were found between the motor FIM + FAM score at discharge between these two groups.

It is hypothesized that the clients who had a positive vocational outcome (those correctly identified as having a positive vocational outcome and those wrongly classified as having a negative vocational outcome) would not differ on FIM + FAM change in motor and cognitive score. No difference was found between these two groups for either FIM + FAM measure.

Similarly it is hypothesized that the clients who had a negative vocational outcome (those correctly identified as having a negative vocational outcome and those wrongly classified as having a positive vocational outcome) would not differ on FIM + FAM change in motor and cognitive score. Again no difference was found between these two groups for either FIM + FAM measure (see Table 3).

Discussion

We examined the vocational outcomes of 97 clients admitted to a residential intensive neurorehabilitation and education centre for young adults with disabilities following an acquired brain injury to determine which demographic, injury and post injury factors differed between those with a positive and negative vocational outcome and whether these variables could predict what outcome the clients would have at follow up. The majority of clients had sustained a severe or very severe brain injury and had been discharged from QEF Neuro Rehab 1–9 years previously.

We chose to consider positive vocational outcome, encompassing paid and non paid work and education rather than just considering paid employment. Waddell and Burton [27] define work as "not only 'a job' or paid employment, but includes unpaid or voluntary work, education and training, family responsibilities and caring." Returning to vocationally orientated education and voluntary work are both important settings for acquiring and developing work preparation skills and have associated benefits, including giving structure and purpose to everyday life, allowing the adult a setting in which to engage in meaningful social relationships and giving the client's life a sense of "normality" [8]. As many of our clients entered education rather than the work place and because of the relatively young adult age at which they sustained their BI, the use of such a definition of vocational outcome was more ecologically valid. As different studies examining vocational outcomes following brain injury consider different definitions of a positive outcome (returning to the participants' pre morbid paid employment position versus returning to any fulltime employment versus returning to part or fulltime employment versus returning to employment or education versus returning to paid or voluntary employment or education) caution is needed when comparing the different rates of returning to work reported.

Before injury the majority of clients had been in fulltime work or education (95 %) compared to 53 % following rehabilitation at QEF Neuro Rehab (19 % in full-time work or education, 18 % in part-time work or education, 16 % undertaking voluntary work). Studies examining return to work after a similar amount of time post injury in clients with a similar level of injury have reported rates of return to work/education. Cattelani et al. [28] found, in a small sample of adults (35), that 54 % of clients with severe BI returned to competitive paid employment or education 20 months after their injury. Similarly, Fleming et al. [29] found that 46.5 % of a larger sample of 208 adults who had sustained a severe BI remained employed or were undertaking education/training 3.5 years after their BI. Little research has focused on vocational outcomes of adults following a very severe BI.

There was no difference in the time from discharge from QEF Neuro Rehab to follow up for the clients with a positive (in full or part time paid work, vocationally orientated education or voluntary work) or negative outcome.

This suggests that returning to work does not just take longer for our clients. Studies looking at return to work in the longer term have found that the proportion of clients in employment remains stable. Franulic et al. [30] found that the number of clients with a moderate or severe BI increased at longer time points, 53.5 % were employed at 2 years compared to 69 % at 10 years post BI. Wood and Rutterford [31] have reported rates of employment in patients with a severe brain injury at a mean time to 17 years post injury as being 28.7 %. In contrast, Ashley et al. [32] found that vocational status post TBI decreased the longer people had been discharged from post acute neurorehabilitation.

Thirty percent of the clients who had a positive vocational outcome following rehabilitation at QEF Neuro Rehab were undertaking unpaid voluntary work. Ouellet et al. [33] has demonstrated that adults who have sustained a TBI and who undertake voluntary work have a higher level of psychological adjustment, including being less depressed and anxious, less fatigued and more motivated. They argue that this is in part because these adults are receiving social recognition for fulfilling a role, are engaged in a meaningful productive activity outside of the home, and are able to build a social network.

Many studies exclude adults who were unemployed at the time of the brain injury from research looking at vocational outcomes. We have included these clients as all clients who are admitted to the centre receive VR, regardless of their premorbid employment history. Of the five clients we included who were unemployed at the time of their BI, following rehabilitation three remained unemployed (all males) and two were undertaking vocationally orientated education (both females). However, this sample size is too small from which to draw any conclusions. Of the clients who were contacted and did not participate 12 (57 %) were in fulltime education, 8 (38 %) were working fulltime and 1 (5 %) was unemployed, prior to their BI. When compared to the clients who did respond—45 (46 %) having been in fulltime education prior to their BI, 47 (49 %) in fulltime work and 5 (5 %) unemployed—a larger proportion of clients who were in education prior to their BI were not contactable at follow up.

The age at which the clients acquired their BI did not differ between the clients with a positive or negative vocational outcome. This is most likely due to the narrow age range of the clients attending the centre (16–36 years) for neurorehabilitation and the inclusion in this study of adults injured at an age where they could have been working (16 years and above). QEF Neuro Rehab is a specialist college for people with ABI and as such attracts clients of college age. This failure to find a difference in age of injury between the clients with a positive and negative vocational outcome is in line with other studies that only found an adverse effect of age on returning to work when adults were aged 40 [34, 35] or 45 [36] at the time of their injury.

Studies have defined the lowest age of inclusion of their cohorts differently. Some have chosen to include those of working age at the time the study was conducted and who might have been injured during childhood (16 years old [33]; 17 years old [37] or 18 years old [38; 12; 21]). Others have chosen to limit the lower age of inclusion as the age of injury (15 years [28]; 16 years old [39]; 17 years [36] or 18 years [40]. We chose to include clients who were injured at an age where they could have been working in the UK (16 years) although the youngest person at the time they were approached was 18.23 years old. Therefore, although the average age of our cohort is younger than many reported the age of our youngest participant is comparable with other studies.

The narrow age range of when the clients acquired their brain injuries in addition to the lack of difference in age of injury between the clients with a positive and negative vocational outcome probably also explains why no difference in premorbid education level was found between the two groups. The majority of our clients (74 %) had not completed their formal education (GCSEs completed at age 16 and A-Levels completed at age 18). Lower levels of education prior to injury are associated with a reduced rate of returning to work in cohorts that contain adults who have attained higher educational levels [39, 40]. However, the clients who had attained higher levels of education were also older. Gollaher et al. [41] found that education was one of the strongest predictors of adults with a mild to severe BI returning to work, those with higher levels of education more likely to have a positive vocational outcome. Those with higher levels of education have also been shown to sustain work better [31] and enter work at a similar level to their pre morbid level [30]. We also found that clients who had been in fulltime education at the time of their BI were more likely to have a positive vocational outcome. This may be because these clients had not entered a profession prior to their BI and so after their neurorehabilitation are entering the workplace rather than seeking to return to a profession at which they might now not be able to succeed.

Clients with a positive vocational outcome had a shorter duration of rehabilitation at QEF Neuro Rehab than those clients with a negative vocational outcome. The clients with a positive vocational outcome also had a higher level of functional independence, as measured by the FIM + FAM on admission and discharge from QEF Neuro Rehab. This demonstrates that although the majority of clients had sustained a severe or very severe BI those who had a positive vocational outcome had possibly made a better early recovery during their initial hospitalisation/acute

neurorehabilitation compared to those clients with a negative vocational outcome.

No differences were found between the clients with positive and negative outcomes with regard to whether they had sustained a TBI or a non TBI. This finding suggests that the programme was equally effective facilitating the return to work/education for both aetiologies of BI. Treger et al. [43] reviewed the return to work rates of people post stroke and found a similar rate as those reported for people following TBI. He also found that positive predictive factors were being aged less than 65 years, higher education level and employment levels; severity of stroke was a negative predictive factor.

Prediction of Outcome

The impact of pre-injury, injury and post injury variables on vocational outcome were investigated using stepwise discriminant function analysis. We found that a model containing total cognitive subsection of the FIM + FAM at discharge, length of neurorehabilitation at QEF Neuro Rehab, gender, preinjury occupation and years since discharge from QEF Neuro Rehab accounted for 31.6 % of the between-group variability. This model correctly classified 87 % of the clients who had had a positive vocational outcome and 63.4 % of the clients who had had a negative vocational outcome, meaning that 75.9 % of the clients were correctly classified.

Firstly, we found that whether a client returns to work or education following neurorehabilitation is predicted by their gender, a variable that cannot be influenced by neurorehabilitation. Gender has been identified by other studies as being predictive of returning to work or education [42].

Three demographic factors that other studies have found to be predictive of whether a person returns to work, but which we did not detect, include level of education [34, 40, 42, 44], preinjury occupation [29, 41] and age [34, 42]. Our failure to find an effect of these factors is most likely due to the narrow range of both in our cohort. Again, due to the age of our cohort very few were married so this factor was not examined. Other studies looking at a wider age range of clients have found an effect of marital status on returning to work [40, 42].

Secondly we found that two post injury factors were also predictive of whether a person returned to work/education. Functional independence on the cognitive and motor subsections of the FIM + FAM at discharge also predicted whether a client returns to work or education. This finding is intuitive as the more motorically and cognitively able a client the more likely they would be to return to paid work, education or voluntary work. The use of the FIM or FIM + FAM to examine motor and cognitive functioning at discharge can be argued to be more ecologically valid than considering performance on different neuropsychological tests because the FIM and FIM + FAM consider how people function in their everyday life, rather than on an assessment which is removed from everyday functioning. Functional limitations encompassing both cognitive and motor disabilities have been found to predict return to work [29, 40, 42, 44]. Injury severity, as measured by the DRS has also been identified as being predictive of returning to work [34, 38, 41]. Further exploration of the data showed that the clients who were correctly predicted to have a positive vocational outcome had a greater level of cognitive and motor functional independence than those correctly predicted to have a negative vocational outcome. Similarly, clients who were incorrectly predicted to have negative vocational outcome (i.e. had a positive vocational outcome) had a greater level of cognitive and motor functional independence than those correctly predicted to have a negative vocational outcome. However, clients who were correctly predicted to have a positive vocational outcome had only a greater level of cognitive functional independence than clients incorrectly predicted to have a positive vocational outcome (i.e. had a negative vocational outcome). This finding is supported by the observations of Greenspan et al. [40] who found that for clients with a severe brain injury it was rare to find motor deficits and no cognitive deficits, so concluding that for a given level of cognitive deficit it is the addition of a motor deficit that further increases the clients' failure to return to work.

Length of time since the client had been discharged from QEF Neuro Rehab was also included in the model of whether a client would have a positive vocational outcome or not at follow up. However, those clients with a positive or negative vocational outcome did not differ with respect to this variable.

The number of clients correctly classified by our model was comparable to other studies. Ponsford [34] correctly classified 68 % of adults returning to work 2 years after a TBI; Kreutzer [38] correctly classified 70 % of adults as to whether they were stably or unstably employed or unemployed a year after TBI; Gollaher [41] correctly classified 75 % of adults as to whether they were employed or not 1-3 years post TBI. The time that had passed since our clients had acquired their BI was significantly longer at about 6 years. Our clients were also more severely injured than those reported by Ponsford [34], Kreutzer [38] and Gollaher [41] whose cohorts comprised 61-83 % adults with a severe BI, the brain injuries of the rest being mild or moderate.

Study Limitations

The limitations of our study need to be considered. Firstly, our cohort of clients is not representative of the wider

population with BI due to their limited age range with resultant narrow educational attainment, low proportion of premorbid employment and low likelihood of being married. The age of our clients also meant that the goal for many clients was to return to or enter education. Many of our clients had no work history so were undertaking voluntary work to develop their work skills. For this reason we considered vocational outcome, rather than those who were in paid employment. Also, the majority of our clients had sustained very severe brain injuries. Secondly, our clients were not admitted solely to receive VR and for many clients the addition of VR and education as a part of their neurorehabilitation was a secondary provision. This meant that decisions on funding were based on functional gains rather than on whether the client needed more VR and as such the duration of neurorehabilitation/VR differed between the clients. In addition, as our clients were admitted for VR in addition to neurorehabilitation it is impossible to determine whether their return to work or education was because of one or other of both parts of the programme. Thirdly, about half of the clients attended the centre straight after their acute rehabilitation whereas the remaining half undertook their neurorehabilitation about 2 years after their acute neurorehabilitation had finished. Whether clients would benefit more from VR immediately following more acute neurorehabilitation or after a stay in the community was not determined. Fourthly, many studies looking at vocational outcomes have considered job stability and retention as being more important that examining vocational outcome at one point in time. Unfortunately this information was not available for us to examine. Fifthly, whether an adult has a positive or negative vocational outcome is also dependent on support received post discharge from QEF Neuro Rehab, information that was not available for use to include in this analysis. A lack of such support may explain the failure of 15 clients to attain a positive vocational outcome as predicted by our findings. Equally, that 8 clients attained a positive vocational outcome that was not predicted might reflect a greater level of vocational support post discharge.

Conclusion

In conclusion we have demonstrated that over half of young adults who undertake intensive neurorehabilitation programme containing traditional therapies (physiotherapy, occupational therapy, speech and language therapy and psychology) in addition to education and VR following a severe/very severe brain injury attain a positive vocational outcome when followed up 1–9 years following discharge from the programme.

A greater proportion of women achieved a positive vocational outcome. There was also a trend towards clients who were in education rather than those who were working at the time of their injury achieving a positive vocational outcome. In addition gender predicted who would have a positive or negative vocational outcome at follow up, a factor that cannot be altered by rehabilitation. However, this knowledge may enable VR for male clients to be tailored more specifically. Greater functional motor and cognitive abilities at discharge were predictive of who would have a positive vocational outcome. This finding suggests that greater ongoing vocational support might enable those more impaired to achieve a positive vocational outcome.

Further research is needed to identify the reasons why those clients predicted to have achieved a positive vocational outcome did not and further support that would have enabled them to do so. Also of interest is what factors enabled those clients that were predicted to have a negative vocational outcome to achieve a positive outcome. Stability and retention of vocational outcome is another area that deserves further exploration within our cohort.

Acknowledgments There are no conflicts of interest including financial, consultant, institutional, and other relationships that might lead to bias or a conflict of interest. Although the author is employed by QEF Neuro Rehabilitation Services this research is funded externally by three charitable trusts (The Wates Foundation, the Wates Family Enterprise Trust and the PF Charitable Trust).

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