ERABI EVIDENCE-BASED REVIEW of moderate to severe ACQUIRED BRAIN INJURY

13. Community Reintegration Following Acquired Brain Injury

Shannon Janzen MSc, Pavlina Faltynek MSc, Andrea Lee BSc(c), Corbin Lippert BScN, Joshua Wiener BSc, Magdalena Mirkowski MSc MScOT OT Reg.(Ont.), Robert Teasell MD FRCPC

ERABI
Parkwood Institute
550 Wellington Road, London ON

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Abbreviations

ABI	Acquired Brain Injury
ADL	Activities of Daily Living
GCS	Glasgow Coma Scale
HADS	Hospital and Anxiety Depression Scale
PCT	Prospective Controlled Trial
QoL	Quality of Life
RCT	Randomized Controlled Trial
TBI	Traumatic Brain Injury

Key Points

Group-based therapy may improve independent living and social integration post ABI.

Certain cognitive rehabilitation interventions may improve independence and social integration post ABI.
Peer mentoring may not improve social integration post ABI.

Various community-based rehabilitation programs may improve independence and social integration post ABI.

Various multimodal interventions may or may not improve independence or social integration post ABI.

Multi-faceted rehabilitation, coping skills training, and support-based interventions may improve self-efficacy and/or perceived quality of life post ABI.

Virtual reality training may not be effective in improving employment outcomes compared to conventional psychoeducation post ABI.

Cognitive rehabilitation therapy may not be effective for improving employment rates post ABI.

Simulated educational experiences may be helpful for predicting an individual's readiness to return to school post ABI.

Mentoring may be effective for improving employment and education rates post ABI.

Community-based vocational rehabilitation may improve employment rates post ABI.

Resource facilitation may improve employment rates post ABI.

Various multimodal interventions may improve employability post ABI.

Multidisciplinary neurorehabilitation may increase the number of individuals that return to driving post ABI.

Remote support groups (video or telephone) and problem-solving therapy may improve outcomes in caregivers of individuals post ABI.

Educational interventions may improve certain outcomes in caregivers of individuals post ABI.

Various multimodal interventions may benefit caregivers of individuals post ABI.

13. Community Reintegration Following Acquired Brain Injury

13.1 Introduction

Community reintegration is the ultimate goal of acquired brain injury (ABI) rehabilitation. However, contrary to expectations, community reintegration post ABI is multifaceted and can therefore be a challenging hurdle to overcome for both patients and their caregivers. The transition back into the community from acute care or post-acute rehabilitation requires diverse supports within the community, often for extended periods of time. Returning to a full range of activities in the community can prove difficult for individuals post brain injury and their families. Rehabilitation interventions primarily focus on restoring independence and social integration. While many individuals may acquire an ABI at a young age, there is also merit for a focus to be on vocational (professional and academic) rehabilitation. The impact of ABI on interpersonal relationships and leisure roles may be equally challenging, which overall is mirrored in the literature by the number of multimodal interventions for community reintegration post ABI.

Given that ABI is a relatively significant disabler of an otherwise healthy, young, and productive portion of the population, returning to independence and productivity is of utmost importance. For those individuals who had not yet developed certain skills and abilities or achieved autonomous living prior to the injury, habilitation, rather than rehabilitation, is the primary focus. Individuals may need to learn or relearn basic activities of daily living (ADL) and appropriate social behaviours, and complete primary or secondary schooling before considering vocational options.

It should be noted that the evaluation of clinical work in this area may not lend itself well to a randomized controlled trial (RCT), due to the individualized nature of community rehabilitation protocols. This module reviews the available evidence pertaining to aspects of community reintegration following ABI, and is broken down into sections focusing on interventions for either the ABI individual or the caregiver.

13.2 Independence and Social Integration

Establishing independence and strong social networks post ABI can be challenging. Independence is a broad category that includes the ability to satisfy personal needs and carry out basic ADLs. Social integration includes a broad group of experiences related to social interaction and perception. Indicators of social integration include recreational and community involvement, interpersonal interactions, and relationships. It has been reported that post ABI, a third of individuals are dissatisfied with their level of independence, social lives, and interpersonal relationships (Larsson et al., 2013).

Reduced independence can negatively impact the ability of a post-ABI individual to maintain and build relationships; persons who have experienced ABI and limited independence reported having fewer close relationships and less social contact (Johnson & Davis, 1998). Individuals with ABI often face isolation and a lack of social support, and also report lower self-esteem and perceived sex appeal (Johnson & Davis, 1998; Kreuter et al., 1998; Kreutzer & Zasler, 1989). Rehabilitation is important for improving ADL performance and social perception and interaction by targeting cognitive needs, psychosocial needs, and transitional living using diverse treatment methods. Due to the unique combination of needs each individual has, multiple interventions can be provided in combination. Individuals who engage in rehabilitation - whether it is community-based, in-home care, or a residential transitional living program

- have been found to experience improvements in productivity, social integration, and ADLs (Hopman et al., 2012).

13.2.1 Group-Based Interventions

Group-based therapy provides an opportunity for individuals to undergo rehabilitation while also integrating the individual into a social setting. Social interaction through brain injury support groups can provide individuals with a sense of belonging and reduce feelings of isolation. Social interaction within the treatment group can help prepare the individual with an ABI for social settings outside of a treatment environment.

Table 13.1 Group-Based Interventions for Independence and Social Integration Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Gerber & Gargaro (2015) Canada Pre-Post $N_{initial}$=78, N_{final}=61	**Population:** TBI=26, CVA=20, Anoxia=8, Tumor=7; Mean Age=44.97 yr; Mean Time Post Injury=7.71 yr; Severity: Mild=5, Moderate=48, Severe=9. **Intervention:** Participants entered a multi-faceted day program with their caregivers (2 d/wk, 6 mo). **Outcome Measure:** Community Integration Questionnaire (CIQ), Overt Behaviour Scale (OBS), Burden Assessment Scale (BAS), Goal Attainment Scale (GAS).	1. Mean CIQ was significantly higher after 6 mo of intervention (10.02 to 12.25, p=0.000). 2. Mean BAS was significantly lower after 6 mo of intervention (48.83 to 45.40, p=0.006). 3. Mean OBS was lower after 6 mo of intervention (7.08 to 5.66) but the difference was not significant. 4. OBS was positively correlated with BAS at baseline (r=0.381, p=0.006) and at 6 mo (r=0.391, p=0.006). 5. BAS at baseline (r=-0.409, p=0.004) and at 6 mo (r=-0.302, p=0.032) was negatively correlated with CIQ at 6 mo.
Sloan et al. (2012) Australia Cohort N=43	**Population:** TBI=29, ABI=9, Stroke=5; Mean Age=28.42 yr; Gender: Male=25, Female=18; Mean Time Post Injury=6.73 yr. **Intervention:** Participants attended the Community Approach to Participation rehabilitation program aimed at maximizing the level of participation in valued life roles. Participants were grouped by home-like (n=28) or disability-specific (n=12) accommodation setting. Outcomes were assessed at baseline, 1, 2, and 3 yr. **Outcome Measure:** Care and Needs Scale (CANS), Functional independence Measure (FIM), Community Integration Questionnaire (CIQ), Part One of the Role Checklist (RC).	1. The home-like group had significant improvement on the CANS (p=0.001), hours of gratuitous care per week (p=0.001), FIM (p=0.03), CIQ and RC (p<0.001). 2. The disability-specific group had significant improvement on the CIQ (p=0.001) and RC (p=0.02). 3. The disability specific accommodations group, compared to home-like setting, required a significantly higher level of support (CANS) at all time points (p≤0.003). A significant change was only seen in the home-like group post intervention.
Feeney et al. (2001) USA Case Series N=80	**Population:** TBI; Mean Time Post Injury=7.33 yr. **Intervention:** Participants received an intervention program designed to provide living and community support. **Outcome Measure:** Cost-Benefit Analysis, community living status.	1. Three to four years after initiation of community support services, 82% of the first cohort and 89% of second cohort were still living in the community. The majority lived in a supported apartment setting. 2. Average daily costs decreased from $208 prior to the initiation of the program to $157 after for the first cohort. The second cohort values were $215 to $153. From these 80 individuals, the program enabled a savings of $1.75 million/yr.

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Johnson & Davis (1998) USA Case Series N=3	**Population:** TBI; Mean Age=30.3 yr; Gender: Male=1, Female=2. **Intervention:** Participants were matched with community participants to increase leisure activity weekly for 4 wk (i.e. a supported relationships intervention). **Outcome Measure:** Social Contact Survey.	1. All participants increased the frequency of integrated social contact after the intervention and continued to experience integrated social contacts greater than baseline levels during the 8wk of follow-up.

Discussion

In current literature, group-based therapy has been offered in both home and assisted-living settings for individuals with ABI. Sloan et al. (2012) reported that group-based therapy resulted in improvements in community integration for individuals living in a disability-specific setting and in home-like settings, although the former group required higher levels of support. The authors explained that carers may provide more assistance than is needed and reduce the patients' level of independence.

For participants living in their home, social integration can be difficult. Johnson & Davis (1998) matched post-ABI individuals with healthy community members and found that the relationship led to increased social interaction in participants with ABI. The results of this study relied heavily on the community volunteers' ability to create a relationship with the individual who had an ABI in a short period of time, therefore careful selection of community volunteers is essential. Future studies could report different results if their selection process is altered.

Two studies used a general group-based intervention program. Gerber & Garagaro (2015) demonstrated that participants showed improved community integration, which had a positive effect on their caregiver's burden. Feeney et al. (2001) reported that most individuals provided with general community support were still living in the community three years later. Both general programs benefited the participants, but it is difficult to compare their effect due to the lack of definitive protocol.

Group-based therapies may be effective in improving social integration but there is also evidence that group therapy s in a disability specific setting may reduce independence. To better evaluate the efficacy of group-based therapy, RCTs and studies with more standardized protocols are needed.

Conclusion

There is level 4 evidence that a general group-based rehabilitation program may improve independent living and community integration post ABI.

There is level 2 evidence that the Community Approach to Participation in a home-like setting may improve independent living post ABI compared to disability-specific settings. Both settings may improve social integration.

There is level 4 evidence that pairing individuals who have ABI with community members may increase their frequency of social contact.

Group-based therapy may improve independent living and social integration post ABI.

13.2.2 Cognitive Interventions

Cognitive impairment following ABI can contribute to chronic disability (Cicerone et al., 2004). As cognitive rehabilitation can reduce functional disability and recovery time (Barman et al., 2016), it is imperative that rehabilitation effectively targets cognition to improve independence with daily functioning and social integration. Current cognitive therapies focus on behavioural retraining, self-awareness, or general cognitive function (Table 13.2).

Table 13.2 Cognitive Interventions for Independence and Social Integration Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Goverover et al. (2007) USA RCT PEDro=6 N=20	**Population:** ABI; Gender: Male=16, Female=4. *Treatment Group (n=10):* Mean Age=39.5 yr; Mean Time Post Injury=12.9 mo; Mean GCS=4.6. *Control Group (n=10)*: Mean Age=39.2 yr; Mean Time Post Injury=8.6 mo; Mean GCS=3.6. **Intervention:** The experimental group received 6 sessions of self-awareness training while they performed various instrumental activities of daily living. The control group received conventional therapeutic intervention. **Outcome Measure:** Assessment of awareness of disability (AAD), Awareness Questionnaire (AQ), Self-Regulation Skills Inventory (SRSI), Assessment of Motor and Process Skills (AMPS), Community Integration Questionnaire (CIQ).	1. The treatment group showed improvement (+2.1) in task-specific AAD while the control group worsened (-1.8), although the difference between groups was not significant (p=0.12). 2. SRSI and AMPS scores improved more in the treatment group than in the control group (p<0.001 and p<0.01, respectively). 3. No treatment effect was shown for AQ or CIQ.
Cicerone et al. (2004) USA PCT N=56	**Population:** TBI; Gender: Male=40, Female=16. *Treatment Group (n=27):* Mean Age=37.8 yr; Mean Time Post Injury=33.9 mo. *Control Group (n=29)*: Mean Age=37.1 yr, Mean Time Post Injury=4.8 mo. **Intervention:** Participants were assigned to an Intensive Cognitive Rehabilitation Program (ICRP, treatment group) or Standard Neurorehabilitation Program (SRP, control group) for 4 mo. ICRP focused on executive and metacognitive functioning, interpersonal group processes, therapeutic work trials and placement to facilitate educational or vocational readiness. **Outcome Measure:** Community Integration Questionnaire (CIQ), Quality of Community Integration Questionnaire, Trail-Making Test Parts A (TMT-A) and B (TMT-B), California Verbal Learning Test (CVLT), Rey Complex Figure (RCF).	1. Both groups showed significant improvements on the CIQ following treatment (p<0.001); although the treatment group was more than twice as likely to show clinical benefit on the CIQ as the control group. 2. The treatment group showed significant improvements on overall neuropsychological functioning following treatment (p<0.001), with significant improvements on the TMT-A (p=0.002), CVLT (p=0.007), and RCF (p=0.002). 3. Improvements on overall neuropsychological functioning were associated with improvements on total CIQ raw scores (p=0.03). 4. Within the treatment group, participants who showed a clinically significant improvement on the CIQ showed a greater improvement in overall neuropsychological functioning (p=0.045) and attention TMT-B (p=0.001).

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Giles et al. (1997) USA Case Series N=4	**Population:** TBI=3, Stroke=1; Mean Age=26.75 yr; Gender: Male=3, Female=1; Mean Time Post Injury=14 mo. **Intervention:** Participants received a behavioural retraining program targeting washing and dressing, which involved a written component to aid learning and a behavioral observation task. **Outcome Measure:** Adaptive Behavioral Scale (ABS).	1. Marked improvements were seen on the ABS for 3 participants, and 2 participants reached maximum independence on all subscales by 3 mo. 2. As treatment progressed, all 4 participants were capable of stating the order in which activities of daily living were to be performed.
Carnevale (1996) USA Case Series N=11	**Population:** ABI; Mean Age=30.5 yr; Gender: Male=7, Female=4. **Intervention:** Participants received a mobile Natural-Setting Behaviour Management Program, which consisted of education, intervention, and phase-out components. **Outcome Measure:** Attainment of target behaviours.	1. By the phase-out period, there was 82% improvement in target behaviours. 2. The greatest change (51%) occurred early on in the training program during the education component. 3. An additional 27% improvement was attained during the intervention period.

Discussion

Cognitive interventions may increase independence by re-establishing pre-injury behaviours. Behavioural retraining has been shown to be effective for improving target behaviours following ABI (Carnevale, 1996; Giles et al., 1997), which includes both a specific program called the Natural-Setting Behaviour Management Program (Carnevale, 1996) and an undefined behavioural training program (Giles et al. 1997).

The effect of cognitive interventions for social integration has been evaluated by two studies. A prospective controlled trial found that intensive cognitive training was twice as likely as standard neurorehabilitation to improve social integration (Cicerone et al., 2004). Contrary to intensive cognitive training, self-awareness training did not improve social integration compared to conventional therapy (Goverover et al., 2007). This could be due to individuals becoming more aware of their social separation from the general community as a result of receiving the training. Self-awareness training did, however, improve participants' awareness of disability, motor and process skills, as well as self-regulation skills (Goverover et al., 2007). It appears that behavioural training and intensive cognitive training positively influence independence and social integration.

Conclusions

There is level 4 evidence that behavioural training programs may improve target behaviours in individuals post ABI.

There is level 1b evidence that self-awareness training may not improve social integration compared to conventional therapy in individuals post ABI.

There is level 2 evidence that intensive cognitive rehabilitation may improve social integration compared to standard neurorehabilitation in individuals post ABI.

Certain cognitive rehabilitation interventions may improve independence and social integration post ABI.

13.2.3 Mentorship

Mentorship is widely recognized as an effective approach for the rehabilitation of many sequelae arising as a result of injury (Hanks et al., 2012). Unlike support groups, mentorship provides a more personalized approach to rehabilitation (Hibbard et al., 2002). The individualized support offered by a mentor may be beneficial for helping an individual with an ABI reintegrate into the community. Relevant studies are presented in Table 13.3.

Table 13.3 Mentorship for Independence and Social Integration Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Hanks et al. (2012) USA RCT PEDro=5 N=158	**Population:** TBI=96, Caregivers=62; Gender: Male=120, Female=38. *TBI Mentored Group:* Mean Age=38.46 yr; Mean GCS=9.39. *TBI Control Group:* Mean Age=40.90 yr; Mean GCS=9.8. *Caregiver Mentored Group:* Mean Age=51.87 yr. *Caregiver Control Group:* Mean Age=50.18 yr. **Intervention:** Participants and caregivers were randomly assigned to either a peer mentoring program or to a control group. **Outcome Measure:** Community Integration Measure (CIM), Family Assessment Device (FAD), Coping Inventory for Stressful Situations (CISS), 12-Item Short-Form Health Survey (SF-12).	1. The TBI mentored group exhibited better behavioural control and less chaos in the living environment (FAD), good physical quality of life (SF-12), less emotion-focused coping (CISS; all p=0.04), less avoidance coping (CISS; p=0.03) and lower alcohol usage (p=0.01) compared to the control group. 2. The TBI mentored group did not show an improvement in task-orientated coping (CISS; p=0.61). 3. The TBI mentored group and control group were not significantly different in terms of community integration following treatment (CIM, p=0.35), however the caregiver mentored group exhibited significantly less community integration than their non-mentored counterparts (CIM, p=0.03).
Struchen et al. (2011) USA RCT PEDro=5 N=28	**Population:** TBI; Mean Age=31.7 yr; Gender: Male=24, Female=6; Mean Time Post Injury=3.5 mo; Mean GCS=6.3. **Intervention:** Participants were randomly assigned to either receive a social peer mentor (treatment group) or be waitlisted (control group). **Outcome Measure:** Craig Handicap Evaluation and Reporting Technique-Short Form, Social Activity Interview, Centre for Epidemiological Studies Depression Scale (CES-D), 6-Item Interpersonal Support Evaluation List, Weekly Social Activity Survey, UCLA Loneliness Scale-Version 3, Peer Partner Satisfaction Survey, Mentor Satisfaction Survey.	1. No significant differences were found between groups on social integration, social network size, or social activity level measures following intervention. 2. Following intervention, the treatment group reported higher perceived levels of social support than the control group (p<0.05), who showed a decline. 3. Following intervention, CES-D scores were higher for the treatment group than for the control group (p<0.01). 4. 84% of participants enjoyed spending time with their mentor but only 67% felt the mentor assisted them with decreasing loneliness and increasing social activities.
Hibbard et al. (2002) USA Post-Test N=20	**Population:** TBI=11, Caregivers=9; Age Range=19-45 yr; Gender: Male=6, Female=14. **Intervention:** Participants and caregivers received peer support from a TBI Mentoring Partnership Program.	1. Participants reported that the program had some or major impact on their ability to cope (82%), feelings of control (54%), and overall quality of life (63%); 82% reported that the program had no impact on social support (friends, family, or community).

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
	Outcome Measure: Delighted-Terrible Scale, Questionnaire adapted from the Resources and Stress-Short Form, Frequency of Family Coping Behaviors, Social Support Questionnaire Short Form and the Empowerment Scale.	2. Family members reported that the program had some impact on their ability to cope (100%) and quality of life (56%) but limited impact on social support.

Discussion

There are conflicting results regarding the effect of mentorship on the social reintegration of individuals with an ABI. Struchen et al. (2011) reported a significant improvement in perceived social support in individuals who received mentorship compared to those who did not, however no significant differences were found between groups in terms of social integration, social network size, or social activity level. Similarly, Hanks et al. (2012) also found that, compared to individuals without a mentor, mentees did not demonstrate significantly different levels of community integration following intervention.

Hibbard et al. (2002) conducted a post-test and reported that mentorship had little impact on social support, even though the majority of participants reported that the program improved their quality of life. However, there were other positive effects, including general agreement between studies that mentorship improved coping ability in individuals post ABI (Hanks et al., 2012; Hibbard et al., 2002). Struchen et al. (2011) reported a significantly higher likeliness of depression in individuals with a mentor compared to those without. Therefore, while mentorship may be effective for improving coping and quality of life following ABI, there is also the possibility that it could be associated with depression.

Conclusions

There is level 2 evidence that peer mentoring may not improve social integration compared to no mentorship in individuals post ABI.

Peer mentoring may not improve social integration post ABI.

13.2.4 Community Rehabilitation

Community rehabilitation involves the provision of rehabilitation to individuals either in their homes or communities (Hopman et al., 2012). Community rehabilitation relies on the participation of diverse services, including educational, government, non-government, vocational, and other social services. Improving the efficacy of community rehabilitation has become increasingly more important because time spent in inpatient rehabilitation programs is decreasing (Sander, 2002). Studies examining the effect of community rehabilitation for independence and social integration are presented in Table 13.4.

Table 13.4 Community Rehabilitation for Independence and Social Integration Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Hopman et al. (2012) Australia PCT	**Population:** TBI; Gender: Male=31, Female=7. *Transitional Living Unit (TLU) Group (n=20):* Mean Age=33.06 yr; Mean GCS=7.06.	1. The CR group had greater improvement in CIQ productivity scale scores than the TLU group (p=0.003).

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
N=38	*Community-Based Rehabilitation (CR) Group (n=18):* Mean Age=40.61 yr; Mean GCS=6.6. **Intervention:** Participants were assigned to either the TLU or CR program. Outcomes were assessed at baseline, 2 and 6 mo. **Outcome Measure:** Community Integration Questionnaire (CIQ), Functional Autonomy Measurement Scale (FAMS), Mayo-Portland Adaptability Inventory-4 (MPAI-4).	2. The TLU group showed a larger improvement in their mean CIQ social integration score in comparison with the CR group (p=0.007). 3. Both groups revealed significant improvements in instrumental activities of daily living (FAMS, p=0.002) and an increase in social participation (MPAI-4, p<0.05) from baseline to 6 mo.
McLean et al. (2012) Canada Case Control N=42	**Population:** TBI; *Treatment Group (n=23):* Mean Age=48.61 yr; Gender: Male=15, Female=8; Mean Time Post Injury=20.02 yr. *Control Group (n=19)*: Mean Age=41.58 yr; Gender: Male=13, Female=6; Mean Time Post Injury=12.63 yr. **Intervention:** Participants attending a brain injury drop-in centre (BIDC, treatment group) were compared to those who did not attend (control group). **Outcome Measure:** Adult Subjective Assessment of Participation (ASAP), Community Integration Questionnaire – Social Integration scale (CIQ-SI).	1. Of the participants in the treatment group, 47.8% wished to attend the BIDC more often and reported that 36.9% of all their social/leisure activities occurred at the BIDC. 2. The treatment group reported significantly higher levels of social participation on the CIQ-SI (p=0.011), and frequency (p=0.034), activities outside of the home (p=0.002), activities with others (p=0.014) and satisfaction with performance (p=0.042) on the ASAP than the control group.
Wheeler et al. (2007) USA PCT N=36	**Population:** TBI; *Treatment Group (n=18):* Mean Age=33.67 yr; Gender: Male=12, Female=6; Mean Time Post-Injury=67.22 mo. *Control Group (n=18):* Mean Age=34.83 yr; Gender: Male=12, Female=6; Mean Time Post-Injury=48.33 mo. **Intervention:** Participants attended an intensive community-based life skills training program (treatment group, 6 hr/day for 6wk). Matched community dwelling individuals served as the control group. **Outcome Measure:** Community Integration Questionnaire (CIQ), Satisfaction with Life Questionnaire (SLQ).	1. The treatment group showed significant improvement on the CIQ home integration subscale (p=0.01) and the productivity subscale (p=0.02); no significant changes were seen in the control group. 2. The treatment group showed a decrease on the SLQ, whereas the control group showed an increase; neither change was significant.
Lippert-Gruner et al. (2002) Germany Post-Test N=48	**Population:** TBI; Mean Age=31.8 yr; Gender: Male=36, Female=12; GCS Score= <8. **Intervention:** Participants were interviewed 1 yr post discharge from an early-onset continuous rehabilitation treatment program. **Outcome Measure:** Coma Remission Scale, Barthel Index, Functional Independence Measure, Disability Rating Scale.	1. At 1 yr, 35.4% were at work and 83.3% were completely independent of care. 2. Most patients were independent with activities of daily living but still had marked behavioral and speech deficits, which caused difficulty with reintegration into school/professional life. 3. Behavioural deficits (p<0.01) and speech disturbances (p<0.05) were more common in those with occupation handicaps.
Trombly et al. (1998) USA Pre-Post N=16	**Population:** TBI; Mean Age=43 yr; Gender: Male=9, Female=7; Mean Time Post Injury=22 mo. **Intervention:** Participants received occupational therapy to restore independence in the home and community.	1. Participants significantly achieved their goals (GAS) from admission to discharge and rated themselves as performing significantly better (p<0.001) and were significantly more satisfied with their performance after treatment than beforehand (p=0.001).

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
	Outcome Measure: Goal Attainment Scale (GAS), Canadian Occupational Performance Measure (COPM), Independent Living Skills Evaluation (ILSE), Reintegration to Normal Living Scale (RNL)	2. Additionally, they improved significantly on the COPM, ILSE and RNL ($p<0.001$ on all). 3. There were no significant changes in performance from discharge to follow-up on any of the scales.

Discussion

There are several different approaches to community rehabilitation. Three studies used a variety of approaches with the Community Integration Questionnaire as an outcome measure and found that transitional living compared to community-based rehabilitation, attending a brain injury drop in clinic compared to not attending, and community-based intensive life skill training, improved outcomes (social integration and productivity subscales) on the questionnaire (Hopman et al., 2012; McLean et al., 2012; Wheeler et al., 2007). While transitional living may improve community integration compared to community-based rehabilitation, Hopman et al. (2012) found that community-based rehabilitation was more effective for improving independence with performing activities than transitional-living. This difference may exist because patients in transitional living settings may become dependent on their caregiver. Occupational therapy and early-onset continuous rehabilitation were also found to improve independent living skills and ADLs in individuals with ABI (Lippert-Gruner et al., 2002; Trombly et al., 1998).

Social support is another important aspect of community reintegration. McLean et al. (2012) found that while participants attending a drop-in centre were successfully integrating into the community, they had low levels of perceived social support. Some community-based interventions may be less effective than others because they are unable to affect many personal, environmental, or social factors involved in social isolation (McLean et al., 2012). To improve research on this topic, RCTs evaluating the effectiveness of community-based rehabilitation are needed, as well as the use of standardized interventions between studies.

Conclusions

There is level 3 evidence that brain injury drop-in centres may improve social participation compared to not attending a centre in individuals post ABI.

There is level 2 evidence that transitional living may improve social integration compared to community-based rehabilitation in individuals post ABI, and community-based rehabilitation may improve independence with activities compared to transitional living. Both may improve activities of daily living and social participation.

There is level 2 evidence that intensive community-based life skills training may improve independence with activities compared to no intervention in individuals post ABI.

There is level 4 evidence that occupational therapy and early-onset continuous rehabilitation may improve independent living skills and activities of daily living in individuals post ABI.

Various community-based rehabilitation programs may improve independence and social integration post ABI.

13.2.5 Multimodal Interventions

Therapies may be evaluated in combination or comparatively to determine treatment effects. Multimodal therapies can target multiple deficits in an individual with an ABI using a single program by combining multiple interventions. This is particularly beneficial for social reintegration since there is often a compounding effect arising from multiple impairments which can prevent an individual from successfully reintegrating into the community (Powell et al., 2002).

Table 13.5 Multimodal Interventions for Independence and Social Integration Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Schmidt et al. (2013) Australia RCT PEDro=8 $N_{initial}$=54, N_{final}=32 *Follow-up study by Schmidt et al. (2015)	**Population:** TBI. *Group 1 (G1, n=18):* Mean Age=42.7 yr; Gender: Male=14, Female=4; Mean Time Post Injury=1.5 yr; Mean GCS=8.1. *Group 2 (G2, n=18):* Mean Age=41.6 yr; Gender: Male=14, Female=4; Mean Time Post Injury=4.7 yr; Mean GCS=7.1. *Group 3 (G3, n=18):* Mean Age=37.5 yr; Gender: Male=18, Female=0; Mean Time Post Injury=5.8 yr; Mean GCS=7.0. **Intervention:** Participants were randomly allocated to receive self-awareness training with verbal plus video (G1), verbal (G2), or experiential (G3) feedback on functional task performance before task repetition. Outcomes were assessed before and after intervention, and then at 8-10 wk follow-up. **Outcome Measure:** Online Awareness (OA, error frequency), Awareness Questionnaire (AQ), Self-perceptions in Rehabilitation Questionnaire (SPIRQ), Depression Anxiety Stress Scale (DASS).	1. All groups showed significant improvement on OA and AQ after treatment, which were maintained at follow-up. 2. G1 showed significantly greater improvement on OA and AQ compared to G2 and G3 after treatment (p<0.001) and at follow-up (p<0.01). There was no significant difference in OA or AQ between G2 and G3. 3. G1 significantly improved on AQ (p<0.01) compared to G2 (MD=4.9) and G3 (MD=7.3). There was no significant difference in AQ between G2 and G3 (MD=2.4). 4. There was no significant difference in SPIRQ or DASS between groups after treatment or at follow-up. 5. All groups maintained a significant improvement in OA through the maintenance of a similar number of errors as initial follow-up. 6. The G1 group continued to improve in OA in comparison to G2 (MD=20.6) and G3 (MD=14.4). There was no significant difference in OA between G2 and G3.
Bell et al. (2011) USA RCT PEDro=4 N=433	**Population:** TBI; Mean Age=39 yr; Gender: Male=323, Female=110; Mean GCS=9.7 **Intervention:** Participants were randomly assigned to either scheduled telephone intervention (treatment group; n=210) or usual care (control group; n=223) in the community. The treatment group received telephone calls over 21 mo consisting of education, problem-solving, and referrals. Outcomes were assessed at 1 and 2 yr. **Outcome Measure:** Functional Independence Measure, Disability Rating Scale, Participation Assessment with Recombined Tools-Objective, Glasgow Outcome Scale-Extended, 12-Item Short Form Health Survey, Brief Symptom	1. There were no significant differences between groups on any of the outcome measures at 1 or 2 yr.

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
	Inventory-18, EuroQOL, Perceived Quality of Life.	
Powell et al. (2002) USA RCT PEDro=4 $N_{initial}$=110, N_{final}=94	**Population:** TBI; Gender: Male=71, Female=23. *Outreach Group (n=48):* Mean Age=34 yr; Mean Time Post Injury=4 yr. *Information Group (n=46):* Mean Age=35 yr; Mean Time Post Injury=2.7 yr. **Intervention:** Participants were randomly allocated to either an outreach treatment group provided by a multidisciplinary team (2-6 hr/wk, 6-12 wk) or an information treatment group (n=46) which involved a therapist providing a booklet of resources in single home visit. **Outcome Measure:** Barthel Index (BI), Brain Injury Community Rehabilitation Outcome-39 scale (BICRO-39).	1. The outreach group had greater change scores on the self-organization (p<0.025) and psychological wellbeing (p<0.05) subscales of the BICRO-39 than the information group. 2. The outreach group showed significantly greater change scores on the BI (p<0.05) and BICRO-39 (p<0.05) in comparison with the information group.
Waehrens & Fisher (2007) Denmark Pre-Post N=36	**Population:** ABI=22, Stroke=14; Age=48.1 yr; Gender: Male=24, Female=12; Mean Time Post Injury=6.9 mo. **Intervention:** A retrospective pre-post of patients attending an inpatient neuro-rehabilitation program. The program combined Affolter, Bobath, and Coombes approaches. **Outcome Measure:** The assessment of motor and process skills (AMPS) tool.	Following rehabilitation individuals showed improvement in their ability to perform motor activities of daily living (ADLs) and Process ADLs (p<0.001 for both) from baseline.
Goranson et al. (2003) Canada Cohort N=42	**Population:** TBI; Gender: Male=21, Female=21; *Treatment Group (n=21):* TBI; Mean Age=34.71 yr; Mean Time Post Injury=12.1 mo. *Control Group (n=21):* TBI; Mean Age=36.57 yr; Mean Time Post Injury=13.48 mo. **Intervention:** Participants attended an intensive outpatient rehabilitation program from a multidisciplinary team focusing on cognition, attention, listening, and transitioning (treatment group, 5.5 hr/d, 4 d/wk, 4mo). Matched community dwelling individuals served as the control group. **Outcome Measure:** Community Integration Questionnaire (CIQ).	1. The treatment group showed significant improvement in home integration (p=0.035) and non-significant improvement on the social integration (p=0.28) and productive (p=0.09) scales of the CIQ. 2. Participation in rehabilitation, age at Injury, level of education, length of post-traumatic amnesia, and gender (female) were all predictors of better outcome.

Discussion

Multidisciplinary rehabilitation was found to be effective for improving home integration, but not social integration or independence with performing activities, compared to those not receiving the intervention (Goranson et al., 2003). Multidisciplinary rehabilitation, including a combination of cognitive and physical training, in comparison to an information treatment (a booklet of resources) resulted in significantly higher Barthel Index scores, indicating improved ADL performance (Powell et al., 2002; Waehrens & Fisher, 2007). Waehrens & Fisher (2007) also found improved ADL performance in patients receiving inpatient neurorehabilitation.

A single RCT evaluated the use of telephone-delivered cognitive and educational training. The authors found that there was no improvement in mental and physical well-being or independence compared to usual care (Bell et al., 2011). The authors identified that there were baseline differences between the participants at different sites, but despite initial differences, improvement did not differ between sites. A potential reason contributing to the lack of effectiveness of this treatment is that participants did not feel comfortable receiving counselling using a telephone (Bell et al., 2011).

Lastly, one high level RCT examined if the delivery of feedback on functional task performance could influence self-awareness and other outcomes (Schmidt et al., 2013). The authors found that delivering feedback via video and verbally significantly improved self-awareness compared to verbal or experiential feedback alone. However, there were no significant differences between groups regarding measures of depression (Schmidt et al., 2013).

Conclusions

There is level 2 evidence that a multimodal telephone intervention may not improve independence with activities of daily living in comparison to usual care in individuals post ABI.

There is level 2 evidence that multidisciplinary rehabilitation may improve performance on activities of daily living compared to an information treatment in individuals post ABI.

There is level 2 evidence that multidisciplinary rehabilitation may not improve social integration and independence with activities compared to no multidisciplinary rehabilitation in individuals post ABI.

Various multimodal interventions may or may not improve independence or social integration post ABI.

13.3 Life Satisfaction and Quality of Life

Life satisfaction is regarded as an important indicator of the efficacy of a rehabilitative intervention. Compared to healthy individuals, those with ABI have reported less satisfaction in multiple aspects of life (Atay et al., 2016; Jacobsson & Lexell, 2013b). Quality of life (QoL) is a subjective measure that takes many factors into account, including but not restricted to: health and functioning, psychological and material well-being, and social functioning (Mailhan et al., 2005). Other factors such as cognitive functioning, physical functioning, sexual functioning, vocational outcomes, and perception have been related to QoL outcomes (Esbjörnsson et al., 2013; Forslund et al., 2013; Jacobsson & Lexell, 2013b; Sander et al., 2013). As perception influences health related QoL, some individuals may have greater awareness of their obstacles and less denial of their limitations based on their level of impairment. This awareness may influence their anxiety, depression, and life satisfaction. Satisfaction with QoL is a complex concept and its definition and validity can vary due to its subjectivity. Studies examining life satisfaction in ABI populations are presented in Table 13.6.

Table 13.6 Interventions for Life Satisfaction Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Backhaus et al. (2010) USA RCT	**Population:** ABI=20, Caregivers=20; Gender: Male=14, Female=26. **Intervention:** Each group had 10 caregivers and 10 individuals with ABI. Those in the treatment group	1. There was no difference found between the two groups in relation to psychological distress (p>0.10).

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
PEDro=4 N=40	received Brain Injury Coping Skills (BICS) training. The control group was waitlisted. BICS training involved psychotherapy, stress management training, problem solving skills, and group discussion (12-2 hr sessions). **Outcome Measure:** Brief Symptoms Inventory-18 (BSI-18), Brain Injury Coping Skills Questionnaire.	2. The control group showed more emotional distress at 3mo by elevations on the BSI-18 subscales (p<0.05). 3. Greater perceived self-efficacy was associated with less emotional distress (p=0.007).
Cicerone et al. (2008) USA RCT PEDro=6 N=68	**Population:** TBI; Gender: Male=46, Female=22; Severity: Severe=40, Moderate=16, Mild=9, Unknown=3. *Treatment Group (n=34):* Mean Age=38.7 yr; Mean Time Post Injury=49.6mo. *Control Group (n=34):* Mean Age=34.5 yr; Mean Time Post Injury=37 mo. **Intervention:** Patients were randomly assigned to an Intensive Cognitive Rehabilitation Program (ICRP, treatment) or a standard neurorehabilitation program (control). ICRP received holistic neuropsychological rehabilitation in cognitive, emotional, interpersonal, and functional interventions, and controls received discipline-specific therapies. All participants received 15 hr/wk for 16 wk. **Outcome Measure:** Community Integration Question (CIQ), Perceived Quality of Life Scale (PQOL), Self-efficacy Scale (SES), Employment.	1. The treatment group had significant increases on CIQ total (p=0.004), PQOL (p=0.004) and SES (p=0.024) compared to controls post treatment. 2. Employment post treatment was acquired by 47% of the treatment group compared to 21% of controls. 3. Controls were more likely to receive continued comprehensive treatment after the study than the treatment group (p=0.001).
Heinemann et al. (2004) USA PCT N=319	**Population:** TBI; Mean Age=36 yr; Gender: Male=246, Female=73; Mean Time Post Injury=1.4 yr. **Intervention:** Patients with substance abuse problems received comprehensive case management treatment (treatment, n=217) or standard care (control, n=102). **Outcome Measure:** Community Integration Questionnaire (CIQ), Satisfaction With Life Scale (SWLS).	1. The treatment group received more total hours of case management than the control group (p<0.01). 2. Both groups experienced equivalent gains on CIQ (p=0.001). 3. The treatment group experienced greater gains on SWLS than the control group at 9mo.
Cusick et al. (2003) USA Case Control N=132	**Population:** TBI; Gender: Male=84, Female=48; Time Post Injury=1-3 yr; Severity: Moderate=14, Severe=119. **Intervention:** Patients received post-injury care through the Colorado Medicaid Programme (CMP; n=66) and were compared to a matched sample who did not receive this service (control group, n=66). Patients were interviewed after treatment. **Outcome Measure:** Craig Handicap Evaluation and Reporting Technique-Short Form (CHART-SF), Sickness Impact Profile-Alertness Behaviour, Satisfaction with Life Scale (SWLS), Short-Form Health Survey – Short Form (SF-12).	1. The CMP group showed significantly fewer problems in terms of SF-12 mental health (p=0.006), alcohol use (p=0.003), and risk of using alcohol (p<0.001) compared to controls. 2. The CMP group used significantly more case management (p=0.005), physical therapy (p=0.038), second rehabilitation admission (p=0.013), and group home stay (p=0.008) compared with the controls. 3. The CMP group had poorer outcomes on the total CHART-SF (p<0.01) and on the physical independence, cognitive independence, mobility, and occupational subscales. 4. No significant differences were found on SWLS (p=0.771).

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Vandiver & Christofero-Snider (2000) USA Case Series $N_{initial}$=49, N_{final}=15	**Population:** TBI; Gender: Male=34, Female=15. **Intervention:** Patients attended a community psychosocial support program (2x/mo). **Outcome Measure:** Self-Efficacy Scale, Quality of Life interview.	1. At follow-up, self-efficacy scores increased from 3.36 to 3.61 ($p<0.05$). 2. Participants perceived social relations, leisure and finances as important variables contributing to quality of life.
Armengol (1999) USA Pre-Post N=6	**Population:** TBI, Mean Age=30.33 yr; Gender: Male=3, Female=3; Mean Time Post Injury=22.16 mo. **Intervention**: Patients attended a support group focused on education, coping skills, and goal setting (2.5 hr/wk for 10 wk). Outcomes were assessed before and after treatment and at 1 yr follow-up. **Outcome Measure:** Beck Hopelessness Scale (BHS), Purpose In Life test (PIL), Perceived Self-Regulatory Ability Inventory (PSRA).	1. Significant reduction in hopelessness and improvement in feelings of control and destiny were found on BHS, PIL and PSRA ($p<0.05$). 2. At 1 yr follow-up, all patients had maintained a positive attitude and 5 patients had returned to work or education.

Discussion

Having a social support group is an important component in improving an individual's life satisfaction after ABI (Atay et al., 2016; Jacobsson & Lexell, 2013a; Vandiver & Christofero-Snider, 2000). Armengol (1999) demonstrated that social support groups focusing on education, coping training, and goal setting resulted in positive changes to measures of hopelessness, which can lead to a greater sense of control and empowerment. Vandiver and Christofero-Snider (2000) found similar results in individuals who actively participated in a brain injury club; participants' self-efficacy and sense of personal competency improved as a result of planning, organizing, and implementing club events (Vandiver & Christofero-Snider, 2000). Self-efficacy was also improved by participating in a Brain Injury Coping Skills training program, based on cognitive behavioural therapy principles, compared to individuals who did not receive training (Backhaus et al., 2010). Additionally, this training was found to reduce feelings of emotional distress (Backhaus et al., 2010).

After an intensive cognitive rehabilitation program involving cognitive, emotional, interpersonal, and functional interventions, Cicerone et al. (2008) found that participants had higher self-efficacy and perceived QoL than those receiving standard neurorehabilitation. Similarly, a comprehensive case management program for substance abuse and ABI was compared to standard care, with the case management group demonstrating significantly higher satisfaction with life scores following treatment(Heinemann et al., 2004). Cusick et al. (2003) evaluated whether services provided through Colorado's Medicaid Programme improved psychosocial outcomes, and reported that individuals receiving services compared to those who did not had significantly reduced mental health problems, but there were no significant differences between groups in terms of satisfaction with life (Cusick et al., 2003).

Conclusions

There is level 3 evidence that the Colorado Medicaid Programme may reduce mental health problems compared to individuals not receiving this service, but may not improve life satisfaction, in individuals post ABI.

There is level 2 evidence that a Brain Injury Coping Skills training program may improve perceived self-efficacy and reduce emotional distress compared to no training in individuals post ABI.

There is level 1b evidence that intensive cognitive rehabilitation therapy may improve self-efficacy and perceived quality of life compared to standard neurorehabilitation in individuals post ABI.

There is level 2 evidence that comprehensive case management may improve life satisfaction compared to standard care for individuals with substance abuse problems post ABI.

There is level 4 evidence that support group programs may improve self-efficacy and feelings of hopelessness in individuals post ABI.

Multi-faceted rehabilitation, coping skills training, and support-based interventions may improve self-efficacy and/or perceived quality of life post ABI.

13.4 Vocational Rehabilitation and Productivity

Vocational rehabilitation and productivity following ABI includes paid employment, educational pursuits, and volunteer work. Many studies on community reintegration are focused on vocation given that patients tend to be of employment age, the data is accessible, and the costs are tangible. A focus on vocational goals is also usually desired by the participating individual, facilitated by the consulting clinicians, and promoted by the funding body/payer. Unlike several other outcomes used for community reintegration, vocational outcomes are clearly linked to financial indices and vulnerable to financial pressures.

Vocational success has significant implications for life satisfaction following ABI. Decreased life satisfaction has been associated with unemployment and passive uninvolved lifestyles (Melamed et al., 1992). Brain injury can deprive individuals from participating in gainful and challenging employment and achieving social and financial stability. Both depression and anxiety are more common among individuals who are unable to return to work or who cannot find work post ABI (McCrimmon & Oddy, 2006; Ponsford & Spitz, 2015). This section will discuss studies examining methods of vocational rehabilitation for individuals with ABI including technology, cognitive training, mentorship, community rehabilitation, resource facilitation, and multimodal therapies.

13.4.1 Technology

Although technology may be beneficial to the rehabilitation process, few studies currently exist which examine technological interventions for vocational rehabilitation following ABI (Table 13.7).

Table 13.7 Technology for Vocational Rehabilitation and Productivity Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Man et al. (2013) Hong Kong RCT PEDro=5 N=40	**Population:** TBI; *Artificial Intelligence Group (n=20):* Mean GCS=10.25. *Psychoeducational Group (n=20):* Mean GCS=10.05. **Intervention:** Patients were randomly assigned to 12 sessions of Artificial Intelligence Virtual	1. Participants in the treatment group performed better across all measures, but only WCST-errors (p=0.02) and WCST-conceptual level response (p<0.01) were significant.

	Reality training (treatment) or a conventional psychoeducational programme (control). Outcomes were assessed at 1, 3 and 6 mo. **Outcome Measure:** Wisconsin Card Sorting Test–computer version 4 (WCST), Tower of London Test, Vocational Cognitive Rating Scale, Employment status.	2. Both groups showed significant improvements in employment outcomes (p=0.04 and p=0.018, respectively), but there were no significant differences between groups. 3. The treatment group showed significant improvement in self-efficacy (p=0.018) from pre- to post-test but the control group did not. However, there was no significant difference between the two groups.

Discussion

Unfortunately, studies evaluating the effect of technology on vocational rehabilitation to date are limited. Man et al. (2013) reported greater improvements in employment outcomes in participants receiving artificial intelligence virtual reality training compared to individuals receiving a conventional psychoeducational programme, although this difference was not statistically significant.(Man et al., 2013). It is difficult to make any definitive conclusions regarding the effect of technology for improving vocational outcomes in ABI populations due to the limited number of studies examining this topic.

Conclusions

There is level 2 evidence that virtual reality training may not improve employment outcomes compared to a conventional psychoeducational programme in individuals post ABI, although both interventions may improve employment outcomes.

Virtual reality training may not be effective in improving employment outcomes compared to conventional psychoeducation post ABI.

13.4.2 Cognitive Interventions

Cognitive interventions are some of the most commonly studied rehabilitative interventions for individuals with ABI due to the high prevalence of cognitive impairments within this clinical population (Vanderploeg et al., 2008). Cognitive impairments can reduce or eliminate vocational options that an individual with an ABI has depending on severity, therefore it is imperative that vocational rehabilitation includes a cognitive rehabilitation component.

Table 13.8 Cognitive Interventions for Vocational Rehabilitation and Productivity Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Vanderploeg et al. (2008) USA RCT PEDro=7 N=360	**Population:** TBI; Mean Age=32.4 yr; Gender: Male=335, Female=25. **Intervention:** Patients were randomly assigned to specific cognitive-didactic therapy (n=180) or functional-experiential rehabilitation therapy (n=180) for 1.5-2.5 hr over 20-60 days. **Outcome Measure:** Return to work/school.	1. Return to work at 1 yr for the cognitive group and functional group was 38.9% and 35.4%, respectively. The difference between groups was not significant (p=0.50).
Salazar et al. (2000) USA	**Population:** *Hospital Group:* Mean Age=25 yr; Gender: Male=62, Female=5; Mean Time Post	1. Return to work was achieved by 90% of the hospital group and 94% of the home

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
RCT PEDro=6 N=120	Injury=38 days; Mean GCS=9.4. *Home Group:* Mean Age=26 yr; Gender: Male=51, Female=2; Mean Time Post Injury=39 days; Mean GCS=9.5. **Intervention:** Patients were randomly assigned to intensive in-hospital cognitive rehabilitation (8 wk) or limited home rehabilitation. **Outcome Measure:** Return to work and/or military duty.	group; there was no significant difference between groups (p=0.51). 2. After the intervention, 73% of the hospital group and 66% of the home group were fit for active military duty; there was no significant difference between groups (p=0.43).

Discussion

Vanderploeg et al. (2008) compared two different treatment approaches for vocational rehabilitation, cognitive-didactic therapy and functional-experiential rehabilitation therapy. After one year of cognitive-didactic therapy, over one third of participants had returned to work, but this was similar to participants in the functional treatment arm (Vanderploeg et al., 2008). Salazar et al. (2000) evaluated the effect of an in-hospital cognitive rehabilitation program compared to a limited home rehabilitation program on return to employment and fitness for military duty. There were no significant differences between groups in terms of the number of participants who returned to work or were fit for active duty (Salazar et al., 2000). Although there was no difference between the treatment and control groups, Salazar et al. (2000) reported high employment rates (90% and 94%, respectively); this was likely due to the study having been conducted during the acute phase of recovery, which may have reduced the potential impact that the intervention could have had due to spontaneous recovery. While more research is needed to confirm this, based on current research, cognitive training does not seem effective for improving rates of employment compared to conventional therapies.

Conclusions

There is level 1b evidence that cognitive-didactic therapy may not be more effective than functional-experiential rehabilitation therapy for return to work in individuals post ABI.

There is level 1b evidence that intensive hospital-based cognitive rehabilitation may not improve return to work compared to limited home-based rehabilitation in individuals post ABI.

Cognitive rehabilitation therapy may not be effective for improving employment rates post ABI.

13.4.3 Educational Interventions

Educational interventions provide individuals with an ABI an opportunity to learn more about the potential challenges encountered following a brain injury, as well as resources that are available to them. Few studies currently exist which examine educational interventions for vocational rehabilitation following ABI (Table 13.9).

Table 13.9 Education for Vocational Rehabilitation and Productivity Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
MacLennan & MacLennan (2008) USA Case-Series N=3	**Population:** TBI; Gender: Male=3, Female=0; Mean Age=23.6 yr. **Intervention:** Individuals participated in a simulated college experience: 16 sessions (1 hr), 12 lectures, and 4 exams testing their ability to learn. **Outcome Measure:** Return to work/school.	1. Performance in the college simulation was helpful in predicting success and challenges in college performance.

Discussion

Individuals interested in returning to post-secondary education following ABI can face many potential challenges. MacLennan & MacLennan (2008) assessed a simulated college experience and its ability to predict college performance and success. Both participants who performed poorly did not return to school, while one participant who was successful in the program did return to school. One participant specifically chose not to return to school after the simulated lectures despite initially insisting that he would. The experience may have reduced his unawareness or denial of impairment. Exposing individuals with ABI to a simulated college experience may help the individual in making a more informed decision about pursuing further education, however more higher-level and larger studies are needed to evaluate the effectiveness of this program as well as other educational interventions.

Conclusions

There is level 4 evidence that a stimulated college experience may predict readiness for post-secondary education in individuals post ABI.

Simulated educational experiences may be helpful for predicting an individual's readiness to return to school post ABI.

13.4.4 Mentorship

Mentorship provides an individual with a trained mentor or peer to help with the transition to living with an ABI. Mentorship has been effective in people with an ABI, particularly in terms of educating the individual about the resources and methods available to assist them in pursuing their vocational goals (Kolakowsky-Hayner et al., 2012). Mentorship is also useful for providing an individualized approach to achieve the desired employment outcomes.

Table 13.10 Mentorship for Vocational Rehabilitation and Productivity Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Kolakowsky-Hayner et al. (2012) USA Pre-Post $N_{initial}$=131, N_{final}=77	**Population:** TBI=80, Spinal Cord Injury=39, Other=12; Mean Age=20.3 yr; Gender: Male=89, Female=42; Mean Time Post Injury=503 days. **Intervention:** Patients were matched with a trained mentor (>2 yr post injury) and met with them 3x/mo for the Back on Track to Success Mentoring Program.	1. 30 of 57 TBI participants were considered a program success (i.e. returned to school/work). 2. Of the 42 total program successes, 29 (69.0%) had returned to school and 13 (31.0%) returned to work.

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
	Outcome Measure: Return to work/school, Disability Rating Scale (DRS), Participation Index of the Mayo-Portland Adaptability Inventory (M2PI), Supervision Rating Scale (SRS), Craig Handicap Assessment and Reporting Technique-Short Form (CHART).	3. There were significant improvements seen in the M2PI (p=0.007), the DRS (p<0.001), and SRS (p<0.001) in program successes. For program failures, there was a significant improvement seen in the DRS (p<0.001) but not the other two measures. 4. For participants who were successful in the program, CHART subscale increases were shown for cognitive independence (p=0.001) and mobility (p<0.001), as well as improvements on M2PI (p=0.0007), DRS (p<0.001) and SRS (p<0.001).

Discussion

Kolakowsky-Hayner et al. (2012) evaluated a community-based mentoring program using a sample of participants mostly comprised of individuals with TBI. The authors reported that trained mentors helped most of the program participants return to work or school. . Of the 35 individuals who did not complete the program, more than half dropped out because they were not interested in pursuing an educational or vocational goal through the program. The mentorship also increased participants' community integration and independence, functional performance, and adaptability (Kolakowsky-Hayner et al., 2012). Mentorship may be effective for increasing post-ABI vocational performance, but supporting research is currently limited.

Conclusions

There is level 4 evidence that a community-based mentoring program may be beneficial for helping individuals with ABI return to work or school.

Mentoring may be effective for improving employment and education rates post ABI.

13.4.5 Community Rehabilitation

Community rehabilitation involves the provision of rehabilitation to individuals either in their homes or communities (Hopman et al., 2012). Community rehabilitation relies on the participation of diverse services, including educational, government, non-government, vocational, and other social services. Improving the efficacy of community rehabilitation has become increasingly more important because time spent in inpatient rehabilitation programs is decreasing (Sander, 2002). Studies examining the effect of community rehabilitation for vocational rehabilitation are presented in Table 13.11.

Table 13.11 Community Rehabilitation for Vocational Rehabilitation and Productivity Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Gamble & Moore (2003)	**Population:** TBI; Mean Age=35.4 yr; Gender: Male=800, Female=345.	1. There was a significant difference between the number of individuals who

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
USA Cohort N=1073	**Intervention:** Patients from a public vocational rehabilitation service provider were compared: those with supported employment services (treatment) and those without (control). **Outcome Measure:** Vocational status.	were competitively employed at time of case closure between those who were and those who weren't provided with support (67.9% vs. 47%, respectively, p<0.003). 2. Controls had significantly higher earnings per week (p<0.05), worked more hr/wk (p<0.001) and had fewer rehabilitation expenditures (p<0.001) than those who had employment services.
Klonoff et al. (2001) USA Case Series N=164	**Population:** TBI=113, Stroke=38, Other=13; Mean Age=33.6 yr; Gender: Male=108, Female=56; Mean Time Post Injury=13.9 mo. **Intervention:** Follow up of participants in a work/school re-entry program at the Adult Day Hospital for Neurological Rehabilitation (ADHNR). **Outcome Measure:** Rates of productivity depending on return to work/school.	1. Of the participants who were productive pre-injury, 25.3% were engaged in the same line of work/school at the same capacity. 2. Eleven percent returned to the same job as pre-injury with modifications and 38.3% returned to a different job or school level (mostly lower) or in volunteer or homemaker positions. 3. Those working/in school at follow-up were significantly younger than the non-productive group (p=0.009).
Malec & Moessner (2000) USA Post-Test N=62	**Population:** TBI=48, ABI=14; Mean Age=34.8 yr; Gender: Male=48, Female=14; Severity: Mild=2, Moderate=1, Severe=37, Undetermined=22; Median Time Post Injury=679 days. **Intervention:** Patients completed a brain injury comprehensive day treatment program. Outcomes were evaluated at the end of the program and at 1 yr follow-up. **Outcome Measure:** Mayo-Portland Adaptability Inventory (MPAI), Vocational Independence Scale (VIS), Independent Living Scale (ILS), Goal Attainment Scaling (GAS).	1. Those with mild impaired self-awareness (ISA) showed a decline in ISA on the MPAI from 37% to 29%, and those with moderate to severe ISA declined from 58% to 29%. Overall change after 1 yr was found to be significant (p<0.001). 2. ISA accounted for 23.7% of the variance in GAS scores (p<0.00). 3. ISA contributed significantly to the prediction of ILS (p<0.01). 4. There was no significant difference in VIS outcome at 1 yr.
Klonoff et al. (1998) USA Pre-Post N=64	**Population:** TBI=37, Stroke=19, Other=8; Mean Age=35 yr; Gender: Male=44, Female=20. **Intervention:** Patients attended a work/school re-entry program (6 hr/day, 5 day/wk). **Outcome Measure:** Adjusted outcome scores (productivity at discharge vs impairment at admission), Working alliance ratings, Work eagerness, Work readiness.	1. At discharge, 89.5% showed a fair or good adjusted outcome, 62% were gainfully employed or full-time students, with 15.6% returning to the same level of work or school as before the injury. 2. Patient and family working alliance during treatment correlated with level of successful adjusted outcome (p<0.01). 3. Work eagerness was found to be significantly related to productivity (p<0.001). 4. Patients seeking compensation had lower work eagerness (p<0.01) but not lower work readiness. 5. Those with more severe injuries had better adjusted outcomes than those with less severe injuries.
Wall et al. (1998) USA	**Population:** TBI=31, Stroke=3, Other=4; Mean Age=35.38 yr; Gender: Male=28, Female=10;	1. Fifty-eight percent of patients completed the program. Those who completed the

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Post-Test N=38	Mean Time Post Injury=8.91 yr; Severity: Severe=90%. **Intervention:** Patients attended a 16 wk Community Based Training Program (CBTP) that combined work adjustment and supported employment concepts. Outcomes were assessed after treatment and at follow-up. **Outcome Measure:** Employment status, Modified Job Diagnostic Survey (mJDS).	program had a longer length of disability and longer pre-injury work histories than those who did not complete it (p<0.05). 2. Mean time from program completion to follow-up was 18.67mo, at which point 38% were employed. 3. More than one placement was required by 14% of the sample to secure employment and 14% were still in the placement process. 4. Of those who completed the program, 59% were competitively employed, 24% were unemployed, and 18% were still in the placement process. 5. For those employed, the mean mJDS score was 25.18 (i.e. they were satisfied with their positions as persons without disabilities).
Buffington & Malec (1997) USA Pre-Post N=80	**Population:** TBI=52, ABI=27; Median Age=37 yr; Gender: Males=50, Females=30; Mean Time Post Injury=64 mo; Severity: Mild=10, Moderate-Severe=35, Unknown=7. **Intervention:** Patients received vocational services and assistance through inpatient or outpatient rehabilitation with follow-up 90 days after occupational placement. **Outcome Measure:** Vocational Outcome Scale (VOS).	1. At 3 mo, almost 40% were placed, with the majority placed in independent competitive work (VOS level 5). 2. At 1 yr, about 70% of all participants were placed. 3. Of those placed by 1 yr, 74% were in community-based employment (VOS levels 3-5), of which 41% were placed into independent work (VOS level 5). 4. Of all placements made, 37% were returning to work with the same employer as pre injury, but not necessarily the same job. 5. Those entering the program at <12 mo post injury had significantly faster (3.68 vs. 6.0 mo) and better (VOS score of 4.48 vs. 3.74) job placements than those entering the program >12 mo post injury (p<0.05).

Discussion

Community rehabilitation provides an opportunity for individuals to reintegrate themselves gradually into the community. Two studies looked at the effectiveness of a work/school re-entry program. The first study by Klonoff et al. (1998) found that more than half of the participants were employed after the program, although a minority of participants returned to the same pre-injury level of work or school. Individuals with strong patient and family working alliance, work eagerness, and more severe injuries were found to have favourable outcomes. Subsequently, Klonoff et al. (2001) again reported that at 20 week follow-up, a minority of individuals returned to work in the same field and at the same pre-injury capacity.

The Community Based Training Program was evaluated in a single study. The program was completed by 58% of participants, and of those, more than half were competitively employed. Those who completed the program often had a longer length of disability and longer employment pre-injury (Wall et al., 1998).

Longer employment prior to injury may be associated with an older population in the study, indicating that younger individuals with a shorter pre-injury employment history may have recovered more quickly. In a different study, the effect of a comprehensive brain injury day treatment program was evaluated, which showed no significant improvement in vocational independence at one year follow-up compared to at the end of the program (Malec & Moessner, 2000).

To meet vocational goals post ABI, access to employment services may be essential. In a study by Gamble & Moore (2003), significantly more individuals who received supported employment services were employed compared to those who did not receive support. The authors also observed that those who did not have access to employment services had a higher average income and worked more hours each week. Buffington & Malec (1997) saw 40% of their participants placed in jobs at 3 months, and at 1 year 70% of the participants were placed. The authors also reported that early onset vocational training (<12 mo) is more effective than later onset training. Community-based rehabilitation may be effective in improving vocational outcomes post ABI stroke, but a lack of control groups in most studies to date makes it difficult to accurately determine treatment effects.

Conclusions

There is level 4 evidence that community-based programs may improve return to work in individuals post ABI.

There is level 2 evidence that supported employment services may improve return to work compared to not receiving these services in individuals post ABI.

Community-based vocational rehabilitation may improve employment rates post ABI.

13.4.6 Resource Facilitation

Resource facilitators provide support for transitioning back into the community for individuals with an ABI. They provide a comprehensive explanation of available resources for individuals with an ABI, as well as how to access them (Trexler et al., 2010). Part of their focus is to assist with vocational goals when desired by the individual.

Table 13.12 Resource Facilitation for Vocational Rehabilitation and Productivity Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Trexler et al. (2010) USA RCT PEDro=5 $N_{Initial}$=22, N_{Final}=20	**Population:** TBI=7, ABI=7, Stroke=6, Other=2; Gender: Male=14, Female=8. **Intervention:** Patients were randomly assigned to a resource facilitation program (treatment, n=9) or standard care (control, n=11). The treatment group was assigned a resource facilitator with the goal of returning to work. **Outcome Measure:** Return to work, Participation Index of the Mayo Portland Adaptability Inventory (M2PI), Patient Health Questionnaire (PHQ-9).	1. Participation increased for both groups over the course of treatment (p<0.0001). 2. The interaction between group and time indicated greater improvement in the treatment group (p=0.007), showing a strong impact on return to work and community participation. 3. Employment was achieved by 64% of the treatment group compared to 36% of controls (p<0.0001). 4. No significant differences between groups were found on the PHQ-9.

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Radford et al. (2013) United Kingdom PCT $N_{initial}$=94, N_{final}=79	**Population:** TBI; Mean Age=34.3 yr; Gender: Male=63, Female=16; Severity: Mild=40, Moderate=16, Severe=38. **Intervention:** Patients were assigned to vocational rehabilitation with a resource facilitator (treatment, n=34) or usual care (control; n=45). Outcomes were assessed at 3, 6, and 12 mo. **Outcome Measure:** Return to work.	1. At each time point, a greater percentage of the treatment group returned to work or school compared to the controls. 2. At 1yr, 75% of the treatment group returned to work compared to 60% of the controls. 3. 13 of 14 patients with 'minor' TBI in the treatment group returned to work by 3mo compared to 14 of 25 in the control group (p=0.03).

Discussion

Currently, there remains limited research focused on resource facilitation in the ABI population. However, two studies have found that substantially more participants who received aid from a resource facilitator returned to work compared to standard care (Radford et al., 2013; Trexler et al., 2010). Trexler et al. (2010) also found that community participation increased when employment increased, potentially because work increases one's motivation to become involved in the community again. Alternatively, it may be that individuals who return to work are more independent and therefore better able to participate in the community than those who are not employed. Resource facilitation appears to have a positive impact on achieving vocational goals for individuals with an ABI.

Conclusions

There is level 2 evidence that a resource facilitator may improve return to work compared to standard care in individuals post ABI.

Resource facilitation may improve employment rates post ABI.

13.4.7 Multimodal Interventions

Individuals with an ABI often experience multiple challenges, including psychological and physiological, that may prevent them from returning to work. Multimodal therapies provide an opportunity for individuals with an ABI to receive therapy for multiple areas of need in a single program. Targeting multiple problems with a single program could assist individuals return to their vocation sooner than if receiving singular therapies.

Table 13.13 Multimodal Interventions for Vocational Rehabilitation and Productivity Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Trexler et al. (2016) USA RCT PEDro=8 $N_{initial}$=44, N_{final}=42	**Population:** ABI. *Treatment Group (TG, n=22):* Mean Age=33.0 yr; Mean Time Post Injury=63.2 daya. *Control Group (CG, n=22):* Mean Age=39.5 yr; Mean Time Post Injury=64.4 days. **Treatment:** Participants were randomized to receive services from an outpatient multidisciplinary resource facilitation team (TG)	1. RTW was 69% in TG and 50% in CG. 2. Both groups improved on VIS at follow-up, but TG showed significantly greater improvement than CG (p=0.027). 3. Both groups returned to productive activity (VIS≥2) at follow-up, but TG was

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
	or standard outpatient care (CG). Outcomes were assessed at baseline and after 15 mo of treatment. **Outcome Measures:** Return to Work (RTW), Vocational Independence Scale (VIS), Mayo-Portland Adaptability Inventory (MPAI).	significantly more likely than CG (p=0.027). 4. There was no statistically significant effect of time (p=0.139) and group (p=0.813) on MPAI Participation Index, nor interaction between group and time (p=735).
Cogne et al. (2017) USA Cohort N=57	**Population:** TBI=39, Other=18; Mean Age=34.7 yr; Gender: Male=38, Female=19; Mean Time Post Injury=9-247 mo. **Intervention:** Patients were recruited from those who completed the 2008 French evaluation, retraining, social and vocational unit (UEROS) program for 5 yr follow-up to assess family and vocational status, autonomy and life satisfaction. **Outcome Measure:** Health, return to work, life satisfaction, activities of daily living, psychosocial and community integration.	1. At 5 yr follow-up, 56% reported having a health problem, mainly pain, epilepsy, and asthenia. 2. Participants were 33% more independent when completing activities of daily living than at inclusion. 3. At 5 yr follow-up, 47% were working compared with 11% when the cohort first entered the program. 4. Approximately half of those surveyed reported being satisfied or very satisfied with their quality of life. 5. More persons lived with a partner (+23%) or in their own home (+21%) at 5 yr follow-up compared with entry rates of the program.
Bonneterre et al. (2013) France Pre-Post N=100	**Population:** TBI; Gender: Male=80, Female=20. **Intervention:** Patients attended a personalized service of accompaniment and follow-up to employment (SPASE) program. Two interviews were conducted: one over the phone and one with a vocational rehabilitation specialist from the SPASE workplace reintegration programme. **Outcome Measure:** Return to work.	1. Compared to preinjury, significantly more individuals were at work after treatment (p=0.001). 2. Workplace support was a highly significant factor in returning to work in the short term (<3 yr; p<0.001) and in the medium term (>3 yr; p=0.01). 3. Regularity of assistance (p=0.05) and physical disabilities (p=0.05) both affected workplace reintegration in the short term.
Watanabe (2013) Japan Pre-Post N=300	**Population:** TBI; Mean Age=36.7 yr; Gender: Male=247, Female=53; Severity: Moderate=48, Severe=247, Unavailable=5. **Intervention:** Patients attended an inpatient rehabilitation program with supported employment. Participants were grouped based on their Barthel Index (BI) score. **Outcome Measure:** Employment status, Activities of Daily Living (ADL).	1. Group A (BI score <20) and Group B (20<BI score<80) displayed significant gains in ADL (p>0.05), but Group A was not fully independent in ADL. 2. No members of Group A returned to work, but 35.7% of Group C (BI score of >80) and 10.7% of Group B did return to work.
Bergquist et al. (2012) USA Pre-Post N=154	**Population:** TBI=96, Stroke=15, Other=43; Mean Age=35.5 yr; Gender: Male=108, Female=46. **Intervention:** Participants attended the Mayo Clinic Comprehensive Day Treatment Programme and identified goals at three levels: personal, short-term, and graduation. Goals consisted of social awareness, cognitive, and communication improvements. Goal attainment was recorded, and follow-up was completed at 1 yr.	1. Patients living independently (ILS) in the community were significantly more likely to meet their graduation goals (GAS, p<0.02). 2. At 1 yr, more of the 'goals met' group were living independently compared to the 'goals unmet' group (72% vs. 56%, p<0.05). 3. At discharge, 62% of the 'goals met' group were in community-based employment (VIS) compared to 46% of

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
	Outcome Measure: Goal Attainment Scale (GAS), Independent Living Scale (ILS), Vocational Independence Scale (VIS).	the 'goals unmet' group (p<0.05); at 1 yr follow-up the rates were 73% and 51%, respectively (p<0.01).
Geurtsen et al. (2008) Netherlands Pre-Post N=24 *Follow-up study by Geurtsen et al. (2012)	**Population:** TBI=18, Stroke=3, Other=3; Mean Age=28.5 yr; Gender: Male=18, Female=6; Mean Time Post Injury=5.4 yr; Mean GCS=5.9. **Intervention:** Patients attended the Brain Integration Programme with 3 educational modules: independent living, work, and social-emotional. Outcomes were assessed before and after treatment, with follow-up at 1 yr and 3 yr. **Outcome Measure:** Community Integration Questionnaire (CIQ), Centre for Epidemiological Studies-Depression (CES-D), Quality of Life, Employability Rating Scale (ERS), Employment status.	1. There was an increase in community integration (p=0.001), a decrease in depression (p=0.004), and improvement in their quality of life (p=0.000). 2. The increase in employability was only significant between discharge and 1 yr (p=0.03). 3. Following the program, patients felt a greater sense of independence, with those living independently rising (41.6% to 71%). 4. Patients working increased from 38% to 58%, with mean hours worked per week increasing from 8 to 15.5. 5. There were no significant improvements from 1-3 yr for community integration (CIQ), employability (ERS), work hours (ERS), emotional well-being (CES-D), and QoL. 6. From 1-3 yr, the number of patients working slightly increased (33 vs. 41) but the number of patients living independently decreased (42 vs. 37).
Walker et al. (2006) USA Cohort N=1341	**Population:** TBI; Mean Age=35 yr; Gender: Male=1033, Female=308; Mean GCS=8. **Intervention:** Individuals participated in an individualized comprehensive inpatient rehabilitation program. **Outcome Measure:** Category of Productive Activity, Census Occupational Category, Occupation Group, Functional Independence Measure, Duration of Unconsciousness.	1. Fifty-five percent held skilled positions pre-injury. 2. Overall 39% returned to competitive employment in any occupation 1 yr post injury, 9% were students/retired/ or homemakers, and roughly half were unemployed. 3. Participants in professional/managerial jobs pre-injury showed 56% return to work compared to those in skilled trades (40%) and manual labour (32%). 4. Those scoring at the 75% level on the FIM were 3.33 times more likely to return to work than those at the 25% level.
O'Neill et al. (2004) USA Case Control N=42	**Population:** TBI; Gender: Male=34, Female=8. **Intervention:** Patients who attended the Program Without Walls (PWW; n=21) participants were compared to those receiving traditional vocational rehabilitation services (n=21). **Outcome Measure:** Case status at closure, weekly earnings at closure, hours working at closure, cost of case services.	1. More cases in the intervention group were successfully closed (57% vs. 24%; p=0.03), had higher mean earnings ($328.70 vs. $124.00; p=0.03), and worked more hours on average (32.08 vs. 17.8; p=0.04) compared to controls. 2. The average cost of case services per PWW consumer was $3586.10 vs. $3326.00 for non-PWW consumers, although this difference was not statistically significant (p=0.43).

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
De Kort et al. (2002) Netherlands Post-Test $N_{Initial}$=25, N_{Final}=20	**Population:** ABI; Mean Age=29 yr. **Intervention:** Patients attended the Come Back Programme (CBP) aimed at regaining maximal independence in work and leisure activities. Participants received aid from social workers, a neuropsychologist, and a physician. Outcomes were assessed by a chart review and at a mean of 3 yr after the program. **Outcome Measure:** Employment status, Living situation.	1. At the start of the study, 11 patients lived independently, and at the end of the program 13 patients were living independently. 2. Fourteen patients had a job pre injury, and 4 patients within 3 mo before CBP. 3. For those with a pre-injury job, 10 of 14 achieved employment after CBP, but only 7 were paid and only 3 did the same work as pre-injury. 4. Ten patients were in a relationship pre injury, all of which were terminated post injury. 5 patients were in a relationship within 3 mo before CBP and 10 after CBP. 5. There were no significant changes to the number of patients having friends at any point in the study. 6. The two main goals expressed by patients were solving problems in living and work-related problems, 9 of 11 were satisfied with their result of the first goal, and 12 of 15 were satisfied with the second goal.
Malec and Degiorgio (2002) USA Cohort N=114	**Population:** TBI=73, ABI=41; Mean Age=37.4 yr; Gender: Male=70, Female=44; Mean Time Post Injury=65.5 mo. **Intervention:** Patients in 3 different rehabilitation pathways were compared at 1 yr: (1) Specialized vocational services (SVS); (2) SVS and community reintegration (1 hr/day, 3 days/wk); and (3) SVS and comprehensive day treatment (6 hr/day, 5 days/wk). **Outcome Measure:** Mayo-Portland Adaptability Inventory-4 (MPAI-4), Vocational-Independence Scale (VIS), Community-Based Employment (CBE).	1. VIS outcomes differed significantly between groups at placement (p=0.01) but not at 1 yr (p=0.06). 2. CBE success rates for group 1, 2, and 3 were 77%, 85%, and 84%, respectively (p>0.10). 3. The number of individuals returning to work for a pre-injury employer did not differ significantly between groups. 4. In group 3, MPAI-4 scores did not significantly differ between those who were successful and those who were not.

Discussion

Most multimodal studies have evaluated the effect of combining multiple interventions rather than comparing different interventions. There was, however, one study that compared and combined three different rehabilitation approaches (Malec & Degiorgio, 2002). Vocational services were provided either alone, with community reintegration, or with comprehensive day treatment. Employment rates were 77% or higher in each group, but none of the treatments were found to be more effective than the others (Malec & Degiorgio, 2002).

There are several multimodal rehabilitation programs available for people with an ABI. The service of accompaniment and follow-up to employment (SPASE) program, the French evaluation, retraining, social and vocational unit (UEROS) program, Mayo Clinic Comprehensive Day Treatment Programme, Brain Integration Programme, Come Back Programme, and Program Without Walls all reported favourable improvements in vocational outcomes following program completion, though conclusions cannot be made regarding which one is most effective as no studies have compared one to another (Bergquist et al., 2012; Bonneterre et al., 2013; Cogné et al., 2017; De Kort et al., 2002; Geurtsen et al., 2008; O'Neill et al., 2004). In addition to improved vocational outcomes, the UEROS and Come Back Programme improved independence (Cogné et al., 2017; De Kort et al., 2002). The Brain Integration Programme also reported increased independence, as well as less depressive symptoms a year after treatment (Geurtsen et al., 2008). Though it has been thought that increased independence and societal awareness post ABI may lead to increased emotional burden, the decrease in depressive symptoms along with an increase in independence suggest otherwise. However, a follow-up study of the Brain Integration Programme reported that from 1-3 years post discharge, more individuals were employed, but less were living independently (Geurtsen et al., 2008). Though this program is effective in increasing employability, it may not have lasting effects on independence.

General inpatient or outpatient rehabilitation programs may also be effective for improving employment outcomes. Trexler et al. (2016) reported that access to a multidisciplinary team led to an increase in employment and independence compared to standard outpatient care. Similarly, inpatient rehabilitation may also improve return to work post ABI; Walker et al. (2006) found that 39% of individuals were employed at 1-year post injury following rehabilitation. Though there is less research on general multidisciplinary rehabilitation programs, it seems that they also have a positive effect on employability post ABI.

Some factors that increase whether an individual has a successful return to work trajectory include independence, workplace support, and higher Functional Independence Measure and Barthel Index scores (Bergquist et al., 2012; Bonneterre et al., 2013; Walker et al., 2006; Watanabe, 2013). Walker et al. (2006) also found that type of occupation may influence employment outcomes; participants who worked in professional or management roles were more likely to return to work compared to skilled trade or manual workers.

Conclusions

There is level 2 evidence that the Evaluation, Retraining, Social, and Vocational Unit (UEROS) program may improve return to work in individuals post ABI.

There is level 3 evidence that the Program Without Walls may improve employment rates and incomes compared to traditional vocational rehabilitation in individuals post ABI.

There is level 4 evidence that the Come Back Programme, Brain Integration Programme, Mayo Clinic Comprehensive Day Treatment Program, and service of accompaniment and follow-up to employment may improve return to work post ABI.

There is level 1b evidence that multidisciplinary outpatient rehabilitation may improve return to work and vocational independence in individuals post ABI.

There is level 2 evidence that inpatient rehabilitation may improve return to work in individuals post ABI.

There is level 2 evidence that vocational services alone may not be more effective than vocational services paired with either community reintegration or comprehensive day treatment for return to work in individuals post ABI.

Various multimodal interventions may improve employability post ABI.

13.5 Return to Driving

For those who have an ABI, the inability to drive is one of the most challenging consequences because it is often seen as a key determinant of an individual's level of social engagement and general independence (Lane & Benoit, 2011). Individuals with an ABI often return to driving in an effort to feel independent, even if they are not fit to do so (Leon-Carrion et al., 2005; Liddle et al., 2011, 2012). Driving a motor vehicle requires good functionality across multiple domains which may have been impaired by the injury, including perception, cognition, communication, and coordination. In particular, driving depends on functional vision, rapid reliable responses, attentiveness despite distractions, and quick decision making. Individuals with an ABI may have difficulty driving due to deficits in monitoring simultaneous inputs (Formisano et al., 2005; Masson et al., 2013; Ortoleva et al., 2012) and anticipating dangerous situations (van Zomeren et al., 1987). Adjusting to post-injury abilities can also be an issue among returning drivers, as some individuals are less likely to modify their driving style and behaviour following ABI, particularly younger male drivers (Labbe et al., 2014). All of these factors contribute to the increased likelihood that individuals with an ABI will be involved in more accidents than the general population (Bivona et al., 2012; Formisano et al., 2005), reinforcing the need for effective driver rehabilitation therapies.

Table 13.14 Interventions for Return to Driving Post ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Perumparaichallai et al. (2014) USA Case Series N=128	**Population:** TBI=75, Stroke=36, non-TBI=17; Mean Age=34.7 yr; Gender: Male=76, Female=52; Mean Time Post Injury=10.42 mo. **Intervention:** Patients attended a milieu-oriented neurorehabilitation program consisting of clinic-based therapies (6 hr/day, 4 days/wk). Neuropsychological evaluations were done before and after treatment to assess fitness to drive. **Outcome Measure:** Return to driving, Trail Making Test A and B (TMT-A/B), Wechsler Adult Intelligence Scale (WAIS-III): Arithmetic (ART), Letter Numbering Sequencing (LNS), Symbol Search, Digit Symbol Coding, Block Design, Matrix Reasoning (MR).	1. Following a neurorehabilitation program, 54% of participants returned to driving. 2. There was a significant difference between the driving and non-driving groups on LNS (p<0.004), Digit span coding (p<0.0001), Symbol Search (p<0.0001), Block Design (p<0.001), TMT-A (p<0.0001), and TMT-B (p<0.001) after treatment. 3. There was no significant difference between groups on MR (p=0.01) or ART (p=0.15) after treatment.
Leon-Carrion et al. (2005) Spain Pre-Post N=17	**Population:** TBI; Mean Age=22.94 yr; Mean GCS=6; Mean Time Post Injury= 10.94 mo. **Intervention:** Patients attended a neurorehabilitation program. Patients were assessed based on return to driving at the start of rehabilitation despite recommendations otherwise.	1. Those who returned to driving had significantly higher mean total FIM+FAM scores at admission (p=0.000) and discharge (p=0.001) compared to non-drivers. 2. At discharge, FIM+FAM-R for all participants raised to 80% from 42.5%.

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
	Outcome Measure: Functional Independence Measure + Functional Assessment Measure-Revised Scale (FIM+FAM-R).	3. At admission, 35.3% were driving despite not being fit to do so; 70.6% were driving at discharge.

Discussion

Participation in a multidisciplinary neurorehabilitation program has been shown to improve driving as well as driving-related impairments, and thus may increase the rate of individuals returning to driving following ABI (Leon-Carrion et al., 2005; Perumparaichallai et al., 2014). After treatment, 54% to 71% of participants returned to driving, though one study found that 30% were driving upon admission to rehabilitation despite not being fit to do so (Leon-Carrion et al., 2005). Performance on tests of visual attention, working memory, processing speed, and task switching were correlated with return to driving (Perumparaichallai et al., 2014). Specifically, those who resumed driving scored higher on the Functional Independence and Assessment Measures than those who did not resume (Cullen et al., 2014; Hawley, 2001; Leon-Carrion et al., 2005).

Conclusions

There is level 4 evidence that multidisciplinary neurorehabilitation may improve return to driving in individuals post ABI.

Multidisciplinary neurorehabilitation may increase the number of individuals that return to driving post ABI.

13.6 Caregiving and Caregiver Burden

Following ABI, someone often takes on the responsibility of ensuring that the injured individual receives proper care. The role may be taken on by a "primary caregiver", often a family member, or distributed among a larger network of individuals. The caregiver role can be both physically and emotionally challenging. Caregiver burden is the term used to broadly encompass all of the responsibilities and overall impact faced by those who assume the caregiver role. Challenges associated with caring for someone with ABI are influenced by changes in the injured individual's emotional control, personality, behaviour, physical abilities, and cognitive abilities (Brooks et al., 1986; Hall et al., 1994; Jacobs, 1988; Kreutzer et al., 1994; McKinlay et al., 1981; Oddy et al., 1978; Thomsen, 1984; Willer et al., 1991). The situation may be compounded by loss of income and/or transportation, increased care and medication costs, ongoing therapy demands, and a lack of community-based services.

The responsibility of providing care for individuals with ABI can lead to increased levels of stress. Caregiver characteristics, such as coping strategies, can also influence the level of stress experienced by caregivers (Chronister et al., 2016; Davis et al., 2009; Katz et al., 2005). Caregiving can increase the risk of depression, which may be greater in ABI caregivers compared to non-ABI caregivers (Warren et al., 2016). Caregiver depression is significantly correlated with burden, life satisfaction, and coping strategies (Gulin et al., 2014). Fortunately, caregiver burden has been found to decrease over time (Bayen et al., 2016; Dillahunt-Aspillaga et al., 2013), as the individual's outcome improves and the caregiver becomes accustomed to providing care. The caregiver experience can be broken down into three categories: burden, satisfaction, and mastery (Albert et al., 2002). Common indicators of each of these categories can be found in Table 13.15.

Table 13.15 Common Indicators of Caregiver Burden, Satisfaction, and Mastery (Albert et al., 2002)

Caregiver Burden	Caregiver Satisfaction	Caregiver Mastery
• Not enough time • Anxiety • Not enough sleep • Not enough privacy • Strain on personal relationships • Depression • Interruptions at work • Low energy • Inability to get outside the home • Use of alcohol or drugs • Feeling overwhelmed • Isolation • Uncomfortable having visitors • Caregiver gets needed support	• Patients appreciate caregiver • Caregivers feel close to patients • Caregivers enjoy helping patient • Caregiving adds meaning to life	• Feeling that one is a good care manager • Feeling that one understands patient problems • Knowing where to go for help • Confidence handling caregiving challenges • Having a reasonable plan for the future • Effective handling of benefits and insurance

Despite caregiver burden being well described in the literature, there is limited research evaluating interventions for caregivers. Caregiver burnout and overall health is a significant issue (Saban et al., 2013), therefore it is important to evaluate the long-term impact of these variables and provide educational and support services to help caregivers effectively cope.

13.6.1 Interventions of Support or Cognitive-Behavioural Interventions

The need for social relationships and support systems for caregivers has been reported in many studies. Caregivers who receive less social support typically feel more burdened and isolated (Chronister et al., 2016; Coy et al., 2013; Davis et al., 2009; Liu et al., 2015; Manskow et al., 2015; Stevens et al., 2013). Interventions of support directly address this need by providing group or individual support sessions.

Table 13.16 Interventions of Emotional Support or Cognitive-Behavioural Interventions for Caregivers of Individuals with an ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Rivera et al. (2008) USA RCT PEDro=5 N=67	**Population:** Caregiver of individuals with TBI; Gender: Male=4, Female=63. *Problem Solving Group (n=33):* Mean Age=51.3 yr. *Education-only Group (n=34):* Mean Age=50.8 yr. **Intervention:** Caregivers were randomly assigned to a problem-solving therapy group that received 4 home visits with a staff member (at 1, 4, 8 and 12 mo) or an education-only group that received brief monthly calls. **Outcome Measure:** Centre for Epidemiologic Studies Depression Scale, Satisfaction With Life Scale, Pennebaker Inventory of Limbic Languidness, Caregiver Burden Scale, and Social problem solving ability.	1. A significant linear increase in depression over time was observed among the education-only group ($p<0.05$) but a significant decrease was seen in the problem-solving group ($p<0.01$). 2. Both groups had a significant linear increase in well-being ($p<0.005$). 3. There was no statistically significant interaction between treatment and time for caregiver well-being or caregiver burden. 4. There was a significant decrease in health complaints by those in the problem-solving group ($p<0.05$).

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
		4. There was a decline in dysfunctional problem solving for the problem-solving group (p<0.01).
Brown et al. (1999) Canada PCT N=91	**Population:** Caregivers of individuals with ABI; Mean Age=47.9 yr; Gender: Male=11, Female=80; Relation: Spouse=46, Parent=35, Child=5, Unknown=5. **Intervention:** Caregivers were assigned to a traditional face-to-face on-site support group (control, n=39) or a telephone support group using teleconference technology (treatment, n=52). Sessions were 1.5-2 hr/wk for 9-10 wk. **Outcome Measure:** Family Assessment Device, Caregiver Burden Inventory (CBI), Profile of Mood States (POMS).	1. The treatment group reported less burden than the control group on total CBI and on each subscale except social burden (all p<0.001). 2. On the POMS, the control group reported more distress than those in the treatment group (p<0.05). 3. For both groups, there was significant improvement in mood scores (POMS, p<0.05).
Acorn (1995) Canada Pre-Post N=19	**Population:** Caregivers of individuals with head injury; Mean Age=50 yr; Gender: Male=5, Female=14. **Treatment:** Caregivers attended a weekly group-support program (5 hr/day for 3 wk). **Outcome Measure:** Dupuy General Well-Being Scale, 13-item Life Satisfaction Index Z, Rosenberg's 10-item Self-esteem Scale, Jalowiec Coping Scale Revised.	1. There were no statistically significant differences between pre- and post-intervention in coping, self-esteem, life satisfaction or well-being. 2. However, participants significantly increased their use of supportive coping styles after attending the program (p<0.05).

Discussion

Support groups provide an opportunity for caregivers to learn from and converse with other caregivers. Acorn (1995) found that weekly support groups did not aid in improving mental well-being, including coping, self-esteem, and life satisfaction. However, in another study it was found that participants of a videoconferencing support group program, assessed through a qualitative study, reported that the sessions were helpful for managing emotions (Damianakis et al., 2016). Additionally, caregivers attending a telephone support program reported less burden and distress than those attending an on-site support group (Brown et al., 1999). Current literature suggests that remote support groups – via video or telephone – can have a positive influence on caregivers of individuals with an ABI.

Rivera et al. (2008) compared caregivers who received problem-solving therapy or education to those who received only education. The treatment group showed significant decreases in depression, health complaints, and dysfunctional problem solving, but no treatment and time interactions were found for caregiver well-being or burden (Rivera et al., 2008). Problem solving therapy training may be a beneficial intervention for improving certain caregiver outcomes.

Conclusions

There is level 2 evidence that problem-solving therapy may improve depression, health complaints, and dysfunctional problem solving, but not well-being or burden, compared to an educational program in caregivers of individuals with ABI.

There is level 2 evidence that telephone support groups may reduce burden and distress compared to traditional on-site support groups in caregivers of individuals with ABI.

There is level 4 evidence that on-site support groups may not improve well-being in caregivers of individuals post ABI.

Remote support groups (video or telephone) and problem-solving therapy may improve outcomes in caregivers of individuals post ABI.

13.6.2 Educational Interventions

Education and access to information have been found to have a positive effect on caregiver burden. Caregivers regard health information support as a valuable resource, particularly in the early stages of TBI care (Calvete & de Arroyabe, 2012; Liu et al., 2015). When these resources are unavailable or inaccessible, it can negatively impact caregiver mental health. Doyle et al. (2013) revealed that most unmet caregiver needs - resulting in anxiety and depression - revolved around a lack of health information regarding the patient and ABI.

Table 13.17 Educational Interventions for Caregivers of Individuals with an ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Sinnakaruppan et al. (2005) Scotland RCT PEDro=5 N=83	**Population:** Head Injury=41, Caregivers=42; Gender: Male=41, Female=42. *Participants with head injuries (n=41):* Age Range=21-63 yr; Range of Time Post Injury=2-94 mo; Severity: Moderate=22, Severe=19. **Intervention:** Caregivers and patients were randomly assigned to an educational training program covering memory, executive function and emotions led by a neuropsychologist (treatment, 8 2.5 hr sessions) or a waitlist (control). **Outcome Measure:** Hospital Anxiety and Depression Scale (HADS), General Health Questionnaire-28 (GHQ), Rosenberg Self-Esteem Scale, COPE Scale, Functional Independence Measure (FIM), Rivermead Behavioural Memory Test (RBMT), Behavioural Assessment of Dysexecutive Syndrome (BADS), Weschler Adult Intelligence Scale-Third Edition (WAIS).	1. For caregivers, the treatment group had significantly decreased GHQ-Depression scores than controls (p=0.044), but no significant differences were found on the HADS. 2. For patients, the mean change improvements were significant in only the treatment group for HADS anxiety (p=0.008) and depression (p=0.017). On all GHQ subscales, the treatment group had significantly greater mean changes than the controls (p<0.05). 3. Total FIM mean differences were greater for carers in the treatment group than in the control group (p=0.036). 4. Caregivers in the treatment group had greater improvements in seeking instrumental social support (p=0.04) and behavioural disengagement (p=0.016) than controls. 5. Patients in the treatment group showed greater mean score changes on the WAIS vocabulary (p=0.02), RBMT profile (p=0.04) and screening (p=0.034), and BADS (p=0.043) than controls.
Carnevale et al. (2002) USA RCT PEDro=5 N=27	**Population:** Caregivers of individuals with ABI; Mean Age=47.5 yr. **Intervention:** Participants and their caregiver (27 pairs) were randomly assigned to the control group (n=10), education group (2 hr/wk, 4 wk; n=8) or education plus behavioral management	1. **Limited statistics provided in study.* After adjustment for baseline burden and stress ratings, an analysis of covariance found that there were no significant differences after treatment on the QRS and MBI.

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
	group (n=9). The intervention (8 wk) was the development and implementation of individualized treatment plans. **Outcome Measure:** Questionnaire on Resources and Stress for Families with Chronically Ill or Handicapped Members (QRS), Adapted Version of the Maslach Burnout Inventory (MBI).	
Fortune et al. (2016) Ireland PCT $N_{initial}$=113, N_{final}=76 $N_{follow\text{-}up}$=61	**Population:** Caregivers for patients with ABI. *Treatment Group (n=75):* Mean Age=52.08 yr; Gender: Male=11, Female=64; Relation: Parent=33, Spouse/Partner=35, Child=5, Sibling=2. *Control Group (n=38):* Mean Age=52.68 yr; Gender: Male=8, Female=30; Relation: Parent=19, Spouse/Partner=15, Child=1, Sibling=3. **Intervention:** Caregivers were allocated to a receive educational training sessions on a variety of subjects pertaining to caring for an individual with an ABI (treatment) or a wait-list (control). Outcomes were assessed before and after intervention, and at 3 mo follow-up. **Outcome Measure:** Caregiver Strain Index (CSI), Perceived Criticism Scale (PCS), Hospital Anxiety & Depression Scale (HADS).	1. The treatment group showed significant improvement in CSI (F=3.97, p=0.02), PCS-Caregiver (F=9.54, p=0.001), and PCS-Patient (F=6.02, p=0.003) compared to controls after treatment and at follow-up. 2. No significant difference in HADS was found between groups after treatment or at follow-up.
Goodwin et al. (2016) United Kingdom Pre-Post N=66	**Population:** ABI; Mean Age=40 yr; Gender: Male=41, Female=25; Mean Time Post Injury=3 yr. **Intervention:** Patients and caregivers were recruited and assessed before and after rehabilitation. Caregivers were provided with education on the consequences of ABI. **Outcome Measure:** Dysexecutive Questionnaire (DEX), Carer Strain Index (CSI).	1. Participants showed significant improvement on all DEX subscales after rehabilitation (p<0.05): Behavioural/Emotional (t=4.63), Executive Function (t=4.14), and Metacognitive (t=5.74). 2. Caregivers showed significant improvement on two CSI subscales after rehabilitation of participants (p<0.05): Time/Practical (t=3.85) and Personal/Emotional (t=3.82). Improvement on the Personal/Role subscale was not statistically significant (t=1.90, p=0.63).
Morris (2001) United Kingdom Pre-Post $N_{initial}$=33, N_{final}=27	**Population:** Caregivers of individuals with head injury; Age Range=16-65 yr; Gender: Male=6, Female=27; Relation: Parent=20, Spouse=12, Sibling=1. **Intervention:** Caregivers were provided with an information booklet and completed questionnaires at 2 time points 4 wk apart. Participants divided into group 1 (n=11, caring for someone 2-9 mo post injury), or group 2 (n=22; ≥1 yr). **Outcome Measure:** General Health Questionnaire (GHQ), Hospital Anxiety and Depression Scale (HADS).	1. Changes in scores on the GHQ and HADS were not statistically significant when data for both groups were analyzed together or separately. 2. Group 1 showed a statistically significant reduction on the GHQ social dysfunction subscale (p<0.05).

Discussion

Several studies examined whether an educational intervention was effective for reducing caregiver depression. Fortune et al. (2016) provided educational modules on a variety of different topics for caregivers of individuals with ABI and reported that it did not improve caregiver depression or anxiety in comparison to wait-list control participants, but there were significant improvements in caregiver strain and perceived criticism. Morris (2001) found that providing educational material to caregivers did not impact caregiver depression or anxiety. From these two studies educational interventions do not appear to have a beneficial impact on caregiver depression, although they may have positive impacts on other caregiver outcomes. Contrary to this one study (Sinnakaruppan et al., 2005) did show that education can have a positive effect on one measure of depression (General Health Questionnaire), however, these effects were not seen on the HADS measure within the same study and should be interpreted with caution.

Two studies provided rehabilitation to the individual with an ABI as well as educational intervention for the caregiver. Goodwin et al. (2016) reported that caregiver strain improved following intervention, as demonstrated by improved scores on two subscales on the carer strain index. However, Carnevale et al. (2002) found that there was no difference in family stress or potential burnout post education and behavioral management training compared to caregivers just receiving education.

The method of education delivery is also important to consider. It has been reported that the distribution of educational material alone may not have as significant an impact as educational programs (Morris, 2001).

Conclusions

There is level 2 evidence that educational training programs may improve strain and perceived criticism compared to wait-list controls in caregivers of individuals post ABI.

There is level 2 evidence that providing education to a caregiver as well as rehabilitation for the individual with an ABI may not be more effective for improving family stress or burnout risk compared to education alone in caregivers of individuals post ABI.

There is level 2 evidence that educational training programs may not improve depression and anxiety compared to wait-list controls in caregivers of individuals post ABI.

Educational interventions may improve certain outcomes in caregivers of individuals post ABI.

13.6.3 Multimodal Interventions

Therapies may be evaluated in combination or comparatively to determine treatment effects. Commonly, studies combine educational and support interventions into a single treatment program to improve caregiver outcomes. This is particularly beneficial because caregivers face diverse challenges, and a multimodal intervention can target more areas than a singular intervention program.

Table 13.18 Multimodal Interventions for Caregivers of Individuals with an ABI

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
Powell et al. (2016) USA RCT N=153 PEDro=6	**Population:** TBI Caregivers; *Control Group (n=76)*: Mean Age=51.1 yr; Gender: Male=14, Female=62; Relationship to Patient: Spouse/Partner=36, Child=31, Other=9. *Intervention Group (n=77):* Mean Age=48.2 yr; Gender: Male=13, Female=64; Relationship to Patient: Spouse/Partner=46, Child=23, Other=8. **Intervention:** TBI caregivers in the intervention group received a maximum of 10 telephone calls at 2 wk intervals after discharge of the TBI patient in addition to usual care. The telephone calls combined education and mentored problem-solving on topics relevant to caregiving associated with TBI recovery and management. Participants in the control condition received usual care. **Outcome Measure:** Bakas Caregiving Outcome Scale (BCOS), Brief Symptom Inventory (BSI-18), Participation Assessment with Recombined Tool-Objective (PART-O), Modified Caregiver Appraisal Scale (MCAS), TBI survivor measures, Other Prespecified Caregiver Outcomes.	1. A composite outcome measure of BCOS and BSI-18 showed a significant between-group difference in favour of the intervention group at 6 mo (p=0.032). For the BSI-18 alone, emotional well-being was significantly better in the treatment group compared to controls at 6 mo (p=0.031). Between-group differences for the BCOS assessment were non-significant. 2. There were no significant between group differences in PART-O or MCAS scores. 3. None of the TBI survivor measures tested (BSI, Life Satisfaction Scale) were significantly different between groups. 4. For other pre-specified caregiver outcomes, the intervention group differed significantly from the control group in feelings that they can get support from friends and family (p=0.019), and healthcare providers (p=0.027), taking care of their own health (p=0.046), receiving help with caregiving from more people (p=0.015), more active coping (p=0.020), less emotional venting (p=0.028), and less use of humor (p=0.011).
Secondary Analysis Powell et al. (2017) USA Post-Hoc Analysis N=153 PEDro=6	**Outcome Measures:** Caregiver-survivor relationship characteristics, Caregiver activity changes, caregiver educational concerns.	1. Sixty-five percent of caregivers lived in the same house as the TBI survivor before the injury occurred, while 86% of caregivers were in touch with the patient daily to several times per wk. 2. Caregivers were able to increase their participation in a number of areas where they had experienced reduced activity/participation over the past 6 mo. This included increasing leisure activities, making fewer financial sacrifices, increasing work/school hours, and taking fewer extended (≥1 mo) breaks from school/work. 3. Concerns voiced by more than 33% of caregivers were related to the following topics: managing their emotional adjustment, strategies for getting things done, managing survivor emotions and behaviours, and engaging in healthful habits.
Kreutzer et al. (2015) USA RCT PEDro=4 $N_{initial}$=137, N_{final}=104	**Population:** Caregivers of individuals with TBI; Median Age=51.4 yr; Gender: Male=38, Female=99; Relation: Parents=51, Spouses=56, Other=30. **Intervention:** Caregivers of individuals with TBI were randomized into the Brain Injury Family	1. There was a significant improvement in Health Information (p=0.003), Emotional Support (p=0.0001), Professional Support (p=<0.0001) and Community Support (p=0.0179) subscales of the FNQ from baseline to 10 wk for the treatment

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
	Intervention (BIFI) program which includes family education, skill building, and psychosocial support (treatment, n=80) or a waitlist (control, n=24). BIFI group completed 5 sessions over 10 wk. Assessments took place at baseline, 10 wk and 3 mo. **Outcome Measure:** Family Needs Questionnaire (FNQ), Service Obstacles Scale (SOS), Zarit Burden Inventory (ZBI).	group; however, there was no significant difference in Instrumental Support (p=0.5292) or Care Involvement (p=0.0646). 2. Only Emotional Support (p=0.0184) and Professional Support (p=0.0022) subscales of the FNQ remained significant at 3mo follow-up for the treatment group. 3. Both SOS and ZBI scores improved in the treatment group from baseline to 10 wk (p=0.0036 and p=0.0007, respectively). 4. There was no significant difference in FNQ, SOS or ZBI scores in the control group from baseline to 10 wk (all p>0.05).
Kreutzer et al. (2009) USA Pre-Post N=53	**Population:** Caregivers of individuals with ABI; Mean Age=50.22 yr; Gender: Male=18, Female=35; Relation: Spouse=29, Parent=15, Other=9. **Intervention:** Caregivers and patients participated together in the Brain Injury Family Intervention program (2 hr sessions 5x/wk over 10 wk) based on family systems theory and cognitive behavioural therapy. The program consists of education, skill building, and psychosocial support. **Outcome Measure:** Family Needs Questionnaire (FNQ), Service Obstacles Scale (SOS), Family Assessment Device (FAD), Brief Symptom Inventory (BSI), Satisfaction with Life Scale (SWLS).	1. Scores on all FNQ subscales changed significantly from pre to post (p≤0.0346) and pre to 3 mo follow-up (p≤0.0024). 2. Scores on the FAD assessment tool did not change over time, whereas scores on the SOS did change significantly over time (p=0.0004). 3. Results of the BSI and the SWLS did not show any significant changes over time.
Smith et al. (2006) United Kingdom Case Control N=41	**Population:** Caregivers for individuals with ABI; Relation: Parent=18, Partner=23; Gender: Male=9, Female=32. *Community Group (n=17):* Mean Age=48.3 yr; *Outpatient Group (n=24):* Mean Age=49.3 yr. **Intervention:** Caregivers of individuals who attended a community rehabilitation service were compared to caregivers whose individual with ABI attended a traditional outpatient service. **Outcome Measure:** Family Assessment Device-General Functioning (FAD-GF), Family Needs Questionnaire, General Health Questionnaire, Acceptance and Action Questionnaire.	1. The mean proportion of met family needs was significantly different between the outpatient group (30.63) and the community group (61.12, p=0.02). 2. The mean FAD-GF score for the outpatient group was significantly higher than the community group (2.03 vs. 1.74; p=0.04), indicating higher levels of maladaptive familial interaction in the outpatient group.
Bowen et al. (2001) United Kingdom PCT N=96	**Population:** Caregivers of individuals with TBI; Age Range=26-50 yr; Gender: Male=14, Female=82; Relation: Partner=45, Parent=36, Other=15. **Intervention:** Caregivers received early (pre-discharge, n=41), or late (post-discharge, n=28) head injury team (HINT) intervention, or no intervention (control, n=27). The HINT was composed of health professionals, an administrative assistant and a clinical	1. At 6mo post injury, 63-89% of controls felt poorly informed compared to 46-64% of the early group, and 46-81% of the late group (p≥0.01). 2. A clinically significant level of distress was reported by 52% of controls, compared to 29% of the early group and 18% of late group (p<0.01). 3. Compared to controls, the early group was more prepared for caring after

Author/ Year/ Country/ Study Design/ N	Methods	Outcomes
	coordinator. Outcomes were assessed at 6 and 12 mo. Existing services were offered to all participants. **Outcome Measure:** Wimbledon Self-Report Scale.	discharge (p=0.02), had more resources available at discharge (p=0.03), and felt better equipped to adjust to long term outcomes (p=0.03) and personality changes (p=0.01). 4. Compared to controls, the late group felt more informed on personality changes (p=0.03).

Discussion

Smith et al. (2006) found that home-based community rehabilitation services for the individual with an ABI resulted in more favourable outcomes for carers in terms of fulfilled family needs and family functioning when compared to traditional outpatient services. Bowen et al. (2001) compared timing of intervention and found that early access to a multidisciplinary team was more effective for informing caregivers but did not reduce levels of distress compared to late access. However, both late and early access were significantly more effective than no access to the support team. It is imperative that caregivers be made aware of available services, as it has been shown to help caregivers feel better prepared for the future and feel less distressed (Bowen et al., 2001).

Kreutzer et al. (2009) studied families who participated in a Brain Injury Family Intervention program that focused on cognitive behavioural therapy and education on family dynamics (e.g., managing stress). The authors found that family members benefited in terms of meeting needs and overcoming service obstacles, although the program did not strongly improve their family functioning, life satisfaction, or psychological well-being. In a more recent study of the same intervention, Kreutzer et al. (2015) reported that the program significantly reduced caregiver burden and improved met family needs and satisfaction with services relative to pre-treatment.

Powell et al. (2016) reported that caregivers receiving a telehealth self-management intervention, comprised of education and mentored problem-solving, showed improved coping ability and psychological well-being, when compared to usual care. In a follow-up to this study, Powell et al. (2017) reported that 6 months post ABI, caregivers were able to increase their involvement in recreational and professional endeavors. At this time, continuing concerns presented by caregivers included emotional adjustment, time management, and creating healthy habits (Powell et al., 2017).

Conclusions

There is level 4 evidence that the Brain Injury Family Intervention may improve met family needs and satisfaction with services and reduce burden in caregivers of individuals post ABI.

There is level 1b evidence that a telehealth self-management program combining education and mentored problem-solving may improve coping and psychological well-being compared to usual care in caregivers of individuals post ABI.

There is level 3 evidence that community-based rehabilitation for the individual with an ABI may be more effective than traditional outpatient services in benefiting caregivers of individuals post ABI by improving levels of met family needs and family dysfunction.

There is level 2 evidence that early or late access to a head injury team intervention may reduce distress compared to no intervention in caregivers of individuals post ABI.

Various multimodal interventions may benefit caregivers of individuals post ABI.

13.7 Conclusions

Based on the studies above, multimodal interventions appear to have the strongest evidence for community reintegration post ABI. As social integration encompasses many different aspects of life and functioning, multimodal interventions can provide the broadest support for these components. A multitude of studies comprised of having a diverse care team to address both physical and psychological needs when re-entering the community. Newer areas of interest and research included topics such as mentorship and resource facilitation.

With regards to caregiver burden, many studies were added for ERABI Version 12. These studies examined the effects of care giving for those with ABI on their support team. The majority of interventions involved psychological support and access to resources.

13.8 Summary

There is level 4 evidence that a general group-based rehabilitation program may improve independent living and community integration post ABI.

There is level 2 evidence that the Community Approach to Participation in a home-like setting may improve independent living post ABI compared to disability-specific settings. Both settings may improve social integration.

There is level 4 evidence that pairing individuals who have ABI with community members may increase their frequency of social contact.

There is level 4 evidence that behavioural training programs may improve target behaviours in individuals post ABI.

There is level 1b evidence that self-awareness training may not improve social integration compared to conventional therapy in individuals post ABI.

There is level 2 evidence that intensive cognitive rehabilitation may improve social integration compared to standard neurorehabilitation in individuals post ABI.

There is level 2 evidence that peer mentoring may not improve social integration compared to no mentorship in individuals post ABI.
There is level 3 evidence that brain injury drop-in centres may improve social participation compared to not attending a centre in individuals post ABI.

There is level 2 evidence that transitional living may improve social integration compared to community-based rehabilitation in individuals post ABI, and community-based rehabilitation may improve independence with activities compared to transitional living. Both may improve activities of daily living and social participation.

There is level 2 evidence that intensive community-based life skills training may improve independence with activities compared to no intervention in individuals post ABI.

There is level 4 evidence that occupational therapy and early-onset continuous rehabilitation may improve independent living skills and activities of daily living in individuals post ABI.

There is level 2 evidence that a multimodal telephone intervention may not improve independence with activities of daily living in comparison to usual care in individuals post ABI.

There is level 2 evidence that multidisciplinary rehabilitation may improve performance on activities of daily living compared to an information treatment in individuals post ABI.

There is level 2 evidence that multidisciplinary rehabilitation may not improve social integration and independence with activities compared to no multidisciplinary rehabilitation in individuals post ABI.

There is level 3 evidence that the Colorado Medicaid Programme may reduce mental health problems compared to individuals not receiving this service, but may not improve life satisfaction, in individuals post ABI.

There is level 2 evidence that a Brain Injury Coping Skills training program may improve perceived self-efficacy and reduce emotional distress compared to no training in individuals post ABI.

There is level 1b evidence that intensive cognitive rehabilitation therapy may improve self-efficacy and perceived quality of life compared to standard neurorehabilitation in individuals post ABI.

There is level 2 evidence that comprehensive case management may improve life satisfaction compared to standard care for individuals with substance abuse problems post ABI.

There is level 4 evidence that support group programs may improve self-efficacy and feelings of hopelessness in individuals post ABI.

There is level 2 evidence that virtual reality training may not improve employment outcomes compared to a conventional psychoeducational programme in individuals post ABI, although both interventions may improve employment outcomes.

There is level 1b evidence that cognitive-didactic therapy may not be more effective than functional-experiential rehabilitation therapy for return to work in individuals post ABI.

There is level 1b evidence that intensive hospital-based cognitive rehabilitation may not improve return to work compared to limited home-based rehabilitation in individuals post ABI.

There is level 4 evidence that a stimulated college experience may predict readiness for post-secondary education in individuals post ABI.

There is level 4 evidence that a community-based mentoring program may be beneficial for helping individuals with ABI return to work or school.

There is level 4 evidence that community-based programs may improve return to work in individuals post ABI.

There is level 2 evidence that supported employment services may improve return to work compared to not receiving these services in individuals post ABI.

There is level 2 evidence that a resource facilitator may improve return to work compared to standard care in individuals post ABI.

There is level 2 evidence that the Evaluation, Retraining, Social, and Vocational Unit (UEROS) program may improve return to work in individuals post ABI.

There is level 3 evidence that the Program Without Walls may improve employment rates and incomes compared to traditional vocational rehabilitation in individuals post ABI.

There is level 4 evidence that the Come Back Programme, Brain Integration Programme, Mayo Clinic Comprehensive Day Treatment Program, and SPASE may improve return to work post ABI.

There is level 1b evidence that multidisciplinary outpatient rehabilitation may improve return to work and vocational independence in individuals post ABI.

There is level 2 evidence that inpatient rehabilitation may improve return to work in individuals post ABI.

There is level 2 evidence that vocational services alone may not be more effective than vocational services paired with either community reintegration or comprehensive day treatment for return to work in individuals post ABI.

There is level 4 evidence that multidisciplinary neurorehabilitation may improve return to driving in individuals post ABI.

There is level 2 evidence that problem-solving therapy may improve depression, health complaints, and dysfunctional problem solving, but not well-being or burden, compared to an educational program in caregivers of individuals with ABI.

There is level 2 evidence that telephone support groups may reduce burden and distress compared to traditional on-site support groups in caregivers of individuals with ABI.

There is level 4 evidence that on-site support groups may not improve well-being in caregivers of individuals post ABI.

There is level 2 evidence that educational training programs may improve strain and perceived criticism compared to wait-list controls in caregivers of individuals post ABI.

There is level 2 evidence that providing education to a caregiver as well as rehabilitation for the individual with an ABI may not be more effective for improving family stress or burnout risk compared to education alone in caregivers of individuals post ABI.

There is level 2 evidence that educational training programs may not improve depression and anxiety compared to wait-list controls in caregivers of individuals post ABI.

There is level 4 evidence that the Brain Injury Family Intervention may improve met family needs and satisfaction with services and reduce burden in caregivers of individuals post ABI.

There is level 1b evidence that a telehealth self-management program combining education and mentored problem-solving may improve coping and psychological well-being compared to usual care in caregivers of individuals post ABI.

There is level 3 evidence that community-based rehabilitation for the individual with an ABI may be more effective than traditional outpatient services in benefiting caregivers of individuals post ABI by improving levels of met family needs and family dysfunction.

There is level 2 evidence that early or late access to a head injury team intervention may reduce distress compared to no intervention in caregivers of individuals post ABI.

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