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Determinants of physical activity participation following traumatic brain injury

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Abstract

Aims: The objective of the study described in this article was to establish the environmental, social, or personal determinants associated with physical activity participation in people with traumatic brain injury (TBI).

Methods: A multi-centre cross-sectional questionnaire survey using a convenience sample was used at eight community day centres for brain-injured populations. The participants were 63 individuals with traumatic brain injury (51 male, 12 female). Physical activity participation was based on the proportion of participants achieving the level of physical activity recommended for health (30 mins moderate activity, most days of the week). Standardized measures were used to assess activities of daily living (Extended Activities of Daily Living Scale), self-efficacy (Self-Efficacy for Exercise Scale), social support (Social Support for Exercise Scale) and mood (General Health Questionnaire-12).

Findings: Over half the participants were not active enough for health benefit. Active participants were more independent in activities of daily living (t=-2.21, P<0.05), had greater self-efficacy for exercise (t=-3.02, P<0.05) and were more educated (□2=5.61, P<0.05) than inactive participants. Logistic Regression showed self-efficacy for exercise to be the only significant predictor of physical activity participation (□=0.32, OR 1.03, P<0.05).

Conclusions: Self-efficacy predicted physical activity participation. Efforts to increase self-efficacy among brain injured participants may encourage activity participation in those who are able and this warrants further investigation.
Key words: barriers, brain injury, determinants, physical activity

Introduction

Promoting population physical activity is high on the public health agenda (Department of Health (DH), 2005a; DH, 2009). Currently, only 37% of men and 25% of women meet the recommended physical activity target of 30 minutes of exercise at least five days a week (DH, 2004a; 2004b; 2004c). Physical activity plays a key role in disease prevention (Knowler et al, 2002; Piperidou and Bliss, 2008), improving quality of life (Penedo and Dahn, 2005; Warburton et al, 2006) and preventing premature death (Lee and Skerrett, 2001), since mortality risk is three times greater in sedentary than regularly active individuals (Chipperfield, 2008). Promoting active lifestyles in people with long-term con- ditions is particularly important since these individuals are at increased risk of secondary disease due to deconditioning (DH, 2005b; Blake, 2009).

Exercise interventions for brain-injured individuals are on the increase (Blake and Batson, 2008). In particular, community-based physical activity interventions for people with brain injuries have been promoted and include aerobic interventions (Bateman et al, 2001; Jackson et al, 2001; Hassett et al, 2008), aquatic programmes (Driver et al, 2004; Driver et al, 2006), and mindful exercise such as Tai Chi/Qigong (Blake and Batson, 2009). While these studies suggest positive outcomes of exercise in those with traumatic brain injury (TBI), such interventions are often plagued by high attrition rates ('drop-out') (Bateman et al, 2001; Jackson et al, 2001; McMillan et al, 2002), which is a common problem in exercise research (Jones et al, 2006). Further investigation into the barriers to exercise faced by those with TBI may help to explain both this attrition and also decisions to participate, which are important in the design of interventions in practice.

Participation is defined as involvement in a 'life situation' (World Health Organization (WHO), 2001) and is used in this context to refer to engagement in physical activity to the recommended level for health benefit. Participation in physical activity by people with disabilities is already known to be a complex, multifaceted issue composed of personal, social and environmental barriers (van der Ploeg et al, 2004; Rimmer et al, 2004; Rogers et al, 2008). For healthy individuals, barriers are diverse, but commonly include lack of time, feeling tired, and lack of motivation (Lee et al, 2008).

Possible barriers to physical activity among people with disabilities have been proposed for a range of populations (Levins et al, 2004; Rimmer et al, 2004; Rogers et al, 2008; Vissers et al, 2008). However, it has been suggested that there are additional contextual, physical, social and personal factors that affect participation in exercise for people with neurological conditions (Dawes, 2009). These may specifically include concern regarding appropriate facilities, embarrassment issues when using community venues, perceived lack of knowledge of fitness or of health professionals about their neurological disease, and the impact of the condition on exercise prescription (Dawes, 2009; Elsworth et al, 2009a; 2009b; in press).

Physical independence, social support and psychological factors such as self-efficacy and mood have all been shown to influence physical activity participation in a healthy population (Simonavice and Wiggins, 2008; Sharpe et al, 2008) and also in sedentary populations (Steptoe et al, 2000). However, there remains little published evidence about why individuals with TBI specifically engage in physical activity, and what barriers they face in participation (Hellweg and Johannes, 2008; Blake and Batson, 2009). This is important since the TBI population is predominantly young and male (Yates et al, 2006) and so may not be directly comparable to other neurological populations, such as stroke, for which information about barriers to exercise is more readily available. The aim of this study was to determine the environmental, social and personal determinants associated with physical activity participation in people with TBI.

METHODS

This was a multi-centre cross-sectional questionnaire study using a convenience sample. Approval was granted by a local ethics committee in July 2008. Participants living in the community with TBI were identified through the registered charity 'Headway' – the national brain injury association – at eight Headway day centres across the Midlands region. Headway managers identified participants who met the study inclusion criteria.

Participants were invited to take part in the study if they were 18 years or older, had a diagnosis of TBI, were fluent in English language and had a level of cognitive ability such that they were able to comprehend the participant information sheet. Data were collected by a trained researcher, at each centre, on one designated day per centre between July 2008 and January 2009. Individuals with TBI attending on that day were provided with a letter of invitation and a study information sheet. The information sheet provided detail as to the purpose of the study and the voluntary nature of participation, and ensured participants that their choice to participate or not would have no impact on their care.

All those recruited agreed to take part and completed a questionnaire. Completion of the form was taken as informed consent. The researcher was available on request to assist with questionnaire completion for participants with reading or writing difficulties that prevented them completing the form themselves. Only the study team had access to the data. Names and contact details of participants were recorded separately to the questionnaire, using unique identifier numbers, in accordance with the Data Protection Act (1998), to maintain anonymity. A total of 207 individuals with TBI were registered at the centres, and 63 (30%) were present on the data collection days and invited to participate.

MEASURES

Demographic data were collected, since research shows that variables such as age, gender and ethnicity influence trends seen nationally in the uptake of physical activity (Casperson et al, 2000; Trost et al, 2002; Emmons et al, 2006; Joshi et al, 2007). Participants were asked to provide their age, gender, ethnic origin, marital status, level of education (no qualifications/O-level or GCSE passes or higher), length of time since injury, and cause of injury.

Based on a conceptual model for physical activity for people with disabilities (van der Ploeg, 2004), personal, social and environmental factors were assessed.

Personal and social factors were assessed using standardized questionnaire measures of physical activity participation, activities of daily living, self-efficacy, social support and mood. The six-part Stages of Exercise Behaviour Change Model (Marcus et al, 1992) was used to identify current self- reported physical activity participation. This measure is extensively used as an epidemiological tool, and has been tested for validity using objective measuring of exercise behaviour (Bulley et al, 2008). Original scoring was (0–5) from pre-contemplation stage to maintenance stage, which was collapsed to a bimodal response (0–1) for no/yes respectively, referred to in the text as 'inactive' and 'active'. For the purpose of this study, 'active' was determined by whether or not participants reported that they engaged in 30 minutes of physical activity per day, for a minimum of 5 days a week (DH, 2004). Those who did not meet these criteria were classed as 'inactive'.

The 22-item Extended Activities of Daily Living Scale (EADL) (Nouri and Lincoln, 1987) was used to assess self-reported independence in activities of daily living. The scale is scored (0-0-1-1), indicating participants' level of independence. Higher scores therefore show increased independence in extended activities of daily living. The scale has been used in other chronic populations including stroke, arthritis of the hip and coronary obstructive pulmonary disease (Gladman et al, 1993; Gompertz et al, 1994; Okubadejo et al, 1997; Harwood and Ebrahim, 2002). The EADL and its four subscales have demonstrated high internal consistency (0.72–0.94) and satisfactory test-retest reliability (rs 0.81–0.90) in a neurological population (Nicholl et al, 2002).

The 9-item Self-Efficacy for Exercise Scale (Resnick and Jenkins, 2000) was used as a self- report measure to assess perceived self-efficacy or confidence to

participate in exercise. Scoring ranged from 0–10 where 0='not very confident'; 10='very confident'. Total scores were used in data analysis. The scale has been used with older adults, disability and chronic disease populations (Resnick et al, 2004; Harnirattisai and Johnson, 2005; Gleeson-Kreig, 2006). Studies with older adults have shown evidence of internal consistency ($\alpha = 0.89$ and 0.90; 0.92) with evidence of validity based on confirmatory factor analysis and hypothesis testing (Resnick and Jenkins, 2000; Resnick et al, 2004). λX estimates (all estimates ≥ 0.81) provided further evidence of validity (Resnick and Jenkins, 2000).
The 13-item Social Support and Exercise Scale (Sallis et al, 1987) was used to measure the perceived influence of family and friends in physical activity participation. A Likert-type scale scoring system was used (1'none'/'does not apply'; 2 'rarely'; 3 'a few times'; 4 'often'; 5 'very often') and separate scores obtained for the two sub-scales, family and friends. Higher scores indicate greater perceived support. In healthy populations, test-retest and internal consistency reliabilities were acceptable (Sallis et al, 1987). The scale has been used previously with a brain-injured population (Driver, 2005).

The General Health Questionnaire-12 item (Goldberg and Williams, 1988) was used to assess participant mood. Likert-type scoring (0–3) was used and higher scores indicate lower mood. The scale is well-validated with recent studies showing reliability to be adequate ($\alpha = 0.73$) with discrimination highest with Likert scoring method ($\delta = 0.94$) (Hankins, 2008). High sensitivity and specificity has been shown in other clinical populations (Jacob et al, 1997; Donath, 2001). The scale has been used previously in TBI research (Hawley et al, 2003).

A list of environmental barriers was developed from the published evidence on barriers to exercise in long-term conditions. Participants were asked to select the barriers relevant to them and were given opportunity for further comment. Data were analysed using SPSS version 15.0. All variables were checked for normality using PP-Plot and normal distribution was observed. Univariate and multivariate analyses were conducted to determine which factors predicted participation in physical activity. Univariate analysis included T-Tests to compare physical activity participation on the continuous variables (age, time since injury), and chi-square tests to compare physical activity participation on categorical variables (gender, marital status, ethnic origin, level of education, cause of injury). Variables that were significant in the univariate analyses (Extended Activities of Daily Living score, Self-efficacy for Exercise score, educated yes/no and road traffic accident yes/no as the cause of injury) were then entered into a Logistic Regression model.

RESULTS

Recruitment and completion rates for questionnaires was 100% (n = 63). Age ranged from 19–67 years (mean 43.89 years, SD 13.42 years). Almost one third (31.7%) were married or cohabiting, with the remainder reporting that they were single or lived alone (68.3%). The majority of participants were male. More than half of the participants reported that they did not meet current recommendations for physical activity (30 mins/most days of the week). Demographic variables were compared between active and inactive participants. Results are shown in Table 1.

TABLE 1.
Comparison of demographic variables between active and inactive participants

		Participant Activity Level		
	Full sample	Active $n = 30$	Inactive $n = 33$	P value
Gender				
Male	51 (81%)	25 (83.8%)	26 (78.8%)	
Female	12 (19%)	5 (16.7%)	7 (21.2%)	0.67
Ethnicity				
White	56 (89%)	26 (86.7%)	30 (90.9%)	
Non-white	7 (11%)	4 (13.3%)	3 (9.1%)	0.60
Qualifications				
Yes	41 (65%)	24 (80.0%)	17 (51.5%)	
No	22 (35%)	6 (20.0%)	16 (48.5%)	0.02*
Cause of Injury				
RTA	47(74.6%)	26 (86.7%)	21 (63.6%)	
Other	16 (25.4%)	4 (13.3%)	12 (36.4%)	0.04*
Time since injury (days)	M = 5675.75 (SD = 3978.5)	M = 5586.00 (SD = 3715.95)	M = 5764.73 (SD = 4282.84)	0.86

*significant at $P < 0.05$; RTA = Road Traffic Accident; SD = Standard Deviation

Scores for independence in extended activities of daily living, self-efficacy, social support and mood were compared between active and inactive participants. Results are shown in Table 2.

TABLE 2.
Comparison of questionnaire measures between active and inactive participants

	Participant Activity Level			
	Active $n = 30$	Inactive $n = 33$	Diff (95%CI)	*P* value
EADL scale	15.33 (SD=4.07)	12.82 (SD=4.88)	1.14 (-4.79, -0.24)	0.03*
Self-efficacy score	53.03 (SD=21.72)	36.85 (SD=20.78)	5.36 (-26.90, -5.47)	0.004**
GHQ-12 score	16.87 (SD=3.81)	18.09 (SD=4.07)	1.00 (-0.77, 3.22)	0.22
SS family participation score	21.87 (SD=8.39)	20.18 (SD=10.17)	2.36 (-6.41, 3.04)	0.48
SS family punishment and reward score	4.47 (SD=2.13)	4.33 (SD=2.01)	0.52 (-1.18, 0.91)	0.80
SS friend participation score	20.67 (SD=9.66)	17.36 (SD=8.43)	2.28 (-7.86, 1.26)	0.15

CI = confidence interval; EADL = Extended Activities of Daily Living Scale; GHQ-12 = General Health Questionnaire-12; SS = Social Support; *significant at $P<0.05$; **significant at $P<0.01$

Active participants reported significantly greater independence in activities of daily living than those who were inactive. Self-efficacy was significantly greater in those who were active compared with those who were inactive. Active participants were more likely to have formal educational qualifications that those who were inactive. Those who had suffered TBI as a result of a road traffic accident were more likely to be active than those who had suffered TBI as a result of another cause, such as violent attack. No significant difference was found between active and inactive participants on other demographic variables, or on measures of mood and social support.

Only those variables which showed significant differences in univariate analyses were entered into a forward-Wald Logistic Regression equation. These included Extended Activities of Daily Living score, Self-efficacy for Exercise score, whether the participant had qualifications (yes/no), and road traffic accident as the cause of injury (yes/no). Results are presented in Table 3.

Table 3.
Logistic Regression model

		Odds ratio (95% CI)	*P* value
EADL scale		1.05 (0.91, 1.21)	0.46
Self-efficacy Score		1.03 (1.00-1.06)	0.03*
Qualifications	No	1	
	Yes	2.23 (0.63, 7.87)	0.21
Cause of Injury	Other	1	
	RTA	2.96 (0.68, 12.95)	0.15

CI = confidence interva; EADL = Extended Activities of Daily Living; *significant at $P<0.05$

Results from the Logistic Regression analysis showed that the overall model was significant, [χ 2(4) = 15.59, P < 0.01] and accounted for 29.3% of the total variance in exercise participation. Self-efficacy significantly predicted exercise participation [χ2=0.32, P<0.05], in that those who reported higher self-efficacy were more likely to exercise than those who had lower self- efficacy. No other variables were significant in the model.

Participants identified a wide range of additional barriers to participating in physical activity and the most commonly selected are presented in Table 4.

Table 4.
Most commonly reported barriers to physical activity

Reason	*n*	%
No motivation	26	41.2%
My health is not good enough	18	28.6%
I'm too tired	16	25.4%
I am active enough already	16	25.4%
I don't have transport to get to facilities	15	23.8%
There is no one to do it with	14	22.2%
There are no suitable facilities (e.g. leisure centres, day centre classes)	13	20.6%

Although the most commonly reported barrier was a personal concern, many other barriers were environmental concerns, such as accessibility of services and lack of transport. No significant differences were found between active and inactive participants on these items and so they were not included in the multivariate analysis.

The most commonly selected barriers to participation were lack of motivation and personal health. Free responses identified further barriers to physical activity and factors which encouraged them to take part. These additional barriers included cognitive problems, most specifically with memory, concern about seizures or epilepsy, physical problems associated with pain and seasonal distresses, such as children using physical activity facilities during the school holiday periods. Additional encouraging factors to participation in physical activity included enjoyment of physical activities, exercise gained through caring for pets, and encouragement provided by day centres in providing services specifically for them.

DISCUSSION

More than half the participants reported that they were not active enough for health benefit, in that they did not engage in 30 minutes of moderate activity on most days of the week (DH, 2004a). Active participants were more independent in activities of daily living, had greater self-efficacy for exercise and more likely to be educated than those who were inactive.

The aim of this study was to identify the key personal, social and environmental determinants associated with physical activity participation following traumatic brain injury. The main finding was that high self-efficacy significantly predicted physical activity participation. Although findings should be interpreted with caution due to study limitations, previous work is supported which identifies self-efficacy as an important factor in physical activity participation in healthy populations (Sternfeld et al, 1999; Wallace et al, 2000; Sharpe et al, 2008; Simonavice and Wiggins, 2008), for individuals with TBI and in those with other long-term conditions or disabilities (Steptoe et al, 2000; Rimmer et al, 2008; Williams et al, 2008).

For individuals with high self-efficacy this has positive implications, as other research has shown that those who rate their confidence higher perceive fewer barriers to physical activity participation, and are more likely to maintain their physical activity levels over time (Simonovace and Wiggins, 2008; Williams et al, 2008). For those with low self-efficacy, it may be that interventions to improve confidence to be active may help to increase their physical activity levels. Indeed, pilot work has suggested that mindful exercise intervention such as Tai Chi/Qigong may itself lead to improvements in psychological outcomes (Blake and Batson, 2009) although this requires further investigation.

Despite evidence suggesting that social support exerts a significant effect on physical activity participation (Heller et al, 2002; Levins et al, 2004), this was not supported in this study. In this instance, social support from friends and family did not appear to influence physical activity in the brain injured individual, although positive views were expressed towards day centre staff in providing the physical activity intervention and supporting participation.

Gender and ethnicity have been associated with exercise participation in other populations (Trost et al, 2002; Emmons et al, 2006), but the sample here was predominantly white male making meaningful gender and ethnicity comparisons difficult to achieve. Given the male:female ratio in the TBI population, gender comparisons require larger sample sizes and to the authors' knowledge there is no existing data on ethnicity profile and the influence of different ethnic groups on exercise participation in TBI.

Participants frequently identified lack of motivation, their personal health and tiredness as important barriers to physical activity. While motivational issues are evident also in healthy populations, concerns relating to personal health may potentially be associated with lack of knowledge about the health benefits of an active lifestyle. These factors may also be related to fear of the unknown, failure and injury (Rimmer et al, 2004; Rogers et al, 2008) all of which may affect the person's confidence to be physically active (Sternfeld et al, 1999).

Encouragement, tailored education and support from health care professionals regarding safety and appropriateness of physical activities could help in addressing such barriers directly, and this in turn may increase confidence to be more active for those who are physically able.

Other important issues raised included availability of services, transport and the social aspects of physical activity, and this information is relevant to service providers who can invest in appropriate services and group physical activity, or provide information on accessing existing facilities.

LIMITATIONS

This study has a number of limitations. Only individuals with TBI were included, although the findings may also be relevant to individuals with other types of acquired brain injury and other neurological populations, such as stroke. The researchers only accessed individuals who were registered with the day centres, and so the barriers and determinants to physical activity for those who were not in attendance at the day centres on the specified visit days is unknown. Baseline data on the physical and cognitive ability of participants in our sample was not collected and therefore it was not possible to determine individual capacity for physical activity.

Future studies should include assessment of physical function by use of, for example, 6-Minute Walk Test (6MWT), Functional Independence Measure-Locomotor (FIM-L), or 10-Meter Walk Test (10MWT). Assessment of cognitive function should be undertaken on a global measure of cognitive function such as the Mini-Mental State Examination (Folstein et al, 1975) or Montreal Cognitive Assessment (Nasreddine et al, 2005).

The findings of this study were based solely on self-report questionnaire measures, which relied on individual's ability to define their current level of physical activity correctly. Nevertheless, the presence of the researcher at the time of completion meant that all instructions were delivered in the same way, by the same researcher, and any queries were dealt with at the time. Including objective measures of participation in physical activities may have strengthened the findings and this is an area for further development.

The questionnaire measures included had established reliability and validity and, where possible, this was evidenced in chronic and neurological populations, although the measures had not been validated for TBI specifically. Nevertheless, where possible, measures were included that had been used in TBI populations previously. Future testing of the scales used should be carried out among the TBI population specifically for a wider use of the instruments. A valid and reliable measure of participation in physical activities specific to the brain injured population is lacking. Participation in this instance was based on a dichotomous measure, which was sufficient for the purpose of this study. However, future research may consider the use of a continuous measure of physical activity to gather information on intensity of physical activity participation.

Given time limitations, data collection spanned several months (July 2008-January 2009) and therefore it is possible that there may have been differences in activity levels with seasonal change, since physical activity participation is generally higher in the summer (Plasqui et al, 2004).

Due to the limitations of the study design these findings should be interpreted cautiously. However, there may be practice implications for TBI rehabilitation. It seems plausible that interventions to improve self-efficacy in TBI may influence participation in physical activities for those who are able. Previous interventions designed for increasing self-efficacy have promoted physical activity using behavioural changes (King et al, 1995), which has been reasonably effective since psychosocial factors are more easily modifiable compared with most demographic factors (Sternfeld et al, 1999). While this study estimates the proportion of individuals with TBI participating in physical activity, further research might include investigation into intensity of physical activity for those who are able to participate, and potential differences in barriers between individuals who vary in their capacity for participation in physical activities (affected by cognitive function and mobility).

CONCLUSION

More than half of individuals with TBI attending community day centres in this study were not active enough for health benefit, and may therefore be at risk of deconditioning and secondary disease. Despite study limitations, self- efficacy emerged as the strongest predictor of participation in physical activities for this population. Interventions to improve self-efficacy may encourage individuals with TBI to engage in physical activities.

Educating brain injured individuals about the benefits of physical activity may increase their motivation to be more active, alleviate their concerns regarding their own physical health and highlight the forms of activity that may be suitable and any long-term benefits of participation, and this warrants further investigation. Informing service providers about the barriers and determinants specific to TBI may assist in the development of community physical activity interventions. This way, rehabilitation professionals such as physiotherapists and community support workers may encourage participants who have the potential to be physically active, while providing a safe environment to exercise to maintain high self-efficacy.

Conflict of interest: none

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KEY POINTS

- The recommended physical activity target is 30 minutes of exercise at least five days a week.
- Over half the participants in this study were not active enough for health benefit.
- Self-efficacy ('confidence') for exercise predicts physical activity participation in individuals with traumatic brain injury.
- Interventions to improve self-efficacy may influence physical activity levels in those who are able and this needs to be tested in a large-scale study.

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