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ORIGINAL REPORT

FACTORS ASSOCIATED WITH LIVING SETTING AT DISCHARGE FROM INPATIENT REHABILITATION AFTER ACQUIRED BRAIN INJURY IN ONTARIO, CANADA

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Objective: **This study examined factors associated with living setting of patients with acquired brain injury at discharge from inpatient rehabilitation.**

Design: **Retrospective cohort design.**

Subjects/Patients: **Cohort of patients first identified in acute care with a diagnostic code of traumatic or non-traumatic brain injury who also subsequently received inpatient rehabilitation in Ontario, Canada for fiscal years 2003/2004 to 2005/2006.**

Methods: **Using logistic regression, we examined predisposing, need and enabling factors associated with living settings at discharge from inpatient rehabilitation (home/other versus residential care). Acute care and inpatient rehabilitation data were used.**

Results: **The majority of patients (83%) were discharged home after inpatient rehabilitation. Among ABI patients, those with longer lengths of stay and patients living alone and in non-home settings at admission were significantly more likely to be living in a residential care setting at discharge. Conversely, patients with higher total function scores from the FIM™ Instrument and those receiving informal support at discharge were significantly less likely to be living in a residential care setting at discharge.**

Conclusion: **Our findings suggest that informal support influences service utilization and provide evidence for its importance at discharge with respect to living in the community. Prior living arrangement and functional outcome at discharge significantly predicted discharge destination. Improving physical function and providing needed supports at discharge may be factors important to reduce the demand for residential care facilities.**

Key words: acquired brain injury; Andersen behavioral model; inpatient rehabilitation; International Classification of Diseases.

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INTRODUCTION

Acquired brain injury (ABI) is a leading cause of death and disability worldwide (1, 2). ABI has been defined as damage to the brain, which occurs no fewer than 7 days after birth and can occur as a result of traumatic and non-traumatic causes (3). ABIs are categorized as traumatic brain injuries (TBI) and non-traumatic brain injuries (nTBI) based on etiology. Estimates from a publicly insured population showed that 5%–10% of persons with an ABI diagnosis are discharged to inpatient rehabilitation from acute care (4). A primary goal of rehabilitation is to improve the physical, social, emotional, community and vocational functions providing the highest quality of life attainable (5). Due to the complex nature of brain injuries, it is challenging to address all disabilities that affect quality of life. Currently, there are few population based studies of ABI patients examining predictors of living setting at discharge from inpatient rehabilitation as an outcome measure across adult age groups (6–11), and none in a Canadian context that includes all forms of ABI.

This study addresses the gaps of previous studies by using comprehensive administrative data from all patients admitted to inpatient rehabilitation from acute care in Ontario, Canada. It compares discharge home to a specific non-home setting: residential care. Reporting of emergency room, hospitalization and inpatient rehabilitation data is mandatory in the province of Ontario, thus providing a comprehensive database for analysis. This study looks at a variety of factors that may affect inpatient rehabilitation, as framed by the Andersen Behavioral Model. The Andersen Behavioral Model has been used to study predisposing, need and enabling factors associated with overall health care utilization (12). The primary objective of this study was to examine factors associated with living setting at discharge from inpatient rehabilitation for both TBI and nTBI patients using the Andersen Behavioral Model.

METHODS

Study design and case definition

This was a retrospective cohort study in an ABI population in Ontario, Canada. ABI patients discharged alive were identified in the Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD) by the presence of an ICD-10 code for TBI and nTBI in any diagnosis field (up to 25) (13). NTBI included brain infections, brain tumours, anoxia, metabolic encephalopathy, toxic effects, and vascular insults excluding stroke (Table I). Only patients discharged alive from an acute care facility between April 1, 2003–October 31, 2006 and then admitted to inpatient rehabilitation as identified by CIHI National Rehabilitation Reporting System (NRS) (14) within 365 days were included in our sample. Both datasets record all hospital or inpatient rehabilitation admissions, respectively, in Ontario. TBI and nTBI patients with a stroke diagnosis in the most responsible diagnosis position (MRDx; i.e., the condition most responsible for the length of stay) were excluded from this study. However, patients identified in the DAD that were in a subsequent Rehabilitation Client Group (RCG 1 in NRS for stroke) were included in our sample, since some of these patients are treated in stroke units. Thus, this paper examined RCGs for stroke and for brain dysfunction. Hospitalization data were linked to inpatient rehabilitation records using encrypted health card numbers. DAD and NRS data were provided by the Ontario Ministry of Health and Long-Term Care (MOHLTC) based on data from CIHI. Patients with TBI and nTBI were analyzed separately due to the differences in mechanism of injury, demographics, and the way they utilize health care. They are often treated in similar or identical rehabilitation programs and facilities (15, 16); however, little is known about their profiles, how they differ in outcomes, and how these differences affect the use of resources. Analyses would be more difficult if TBI and nTBI patients were grouped together, controlling for the type of brain injury. Previous literature focuses on TBI only; thus, it is easier to compare and contrast findings with previous work.

Outcome measure

Living setting at discharge from inpatient rehabilitation was ascertained by the "discharge living setting" variable in NRS. Two main categories were created for the outcome variable:

1) Home/other: home with paid services, home without paid services, boarding house, shelter, public place, and other. To avoid excluding a small number of patients that were discharged to destinations such as boarding house, shelter, public place, or other settings, they were placed into the home category.
2) Residential care: residential care and assisted living.

Table I. *International Classification of Diseases-10 definitions used for traumatic brain injuries (TBI) and non-traumatic brain injuries (NTBI)*

TBI codes	
Fracture of the skull	S02 [0.0, 0.1, 0.7–0.9]
Intracranial injury	S06 [0.0–0.6, 0.8, 0.9]
Sequelae of head injury	T90 [0.2, 0.5, 0.8, 0.9]
nTBI Codes[a]	
Brain infections	A81.1, A83.0, A83.2, A87 [0.0–0.2, 0.8, 0.9], B00.4, B01.0, B01.1, B02.0, B05.0, B37.5, G00 [0.0–0.3, 0.8, 0.9], G01.0, G02 [0.0, 0.1, 0.8], G03 [0.0–0.2, 0.8, 0.9], G04 [0.0, 0.8, 0.9], G05 [0.0–0.2, 0.8], G06 [0.0– 0.2], G93.0
Encephalopathy	E10.0, E11 [0.0, 0.1], E13 [0.0, 0.1], E14 [0.0, 0.1], E15
Toxic effects	T51 [0.0–0.3, 0.8–0.9], T56 [0.0, 0.1, 0.4, 0.5, 0.8, 0.9], T58
Anoxia	G93.1, T75.1, T71
Vascular insults	I62.0, I62.9
Brain neoplasms	C70 [0.0, 0.1, 0.9], C71 [0.0–0.9], C79.3, D32.0, D33 [0.0–0.3], D42.0, D43 [0.0–0.4, 0.7, 0.9]

[a]Patients were excluded with stroke codes (I60, I61, I63, and I64) in the most responsible position.

Need, predisposing and enabling variables

Variables abstracted were selected based on the framework set by the Andersen Behavioral Model. Predisposing factors identified in the DAD included age at discharge and sex. Need factors identified included the Charlson Comorbidity Index, length of stay (LOS) in acute care, LOS in inpatient rehabilitation, total function score at discharge as measured by the FIM™ instrument, living setting at admission, and living arrangement at admission. Enabling factors identified included whether the brain injury was a result of a motor vehicle collision (for TBI patients), urban versus rural residence, and level of informal support at discharge.

Age at discharge and sex of patients with ABI were abstracted from the DAD record of each patient. Demographic and diagnostic variables have proven to be very accurate, with 100% agreement in reabstraction studies (17).

Comorbidities

The Charlson Comorbidity Index was calculated as an indicator of the need of patients with ABI (18). The Charlson Comorbidity Index has been accepted as a useful tool to measure comorbid disease status and has a consistent correlation with in-hospital mortality (19).

Length of stay

LOS measured cumulative number of days spent in inpatient acute care and inpatient rehabilitation. LOS was also measured as the number of days spent in both acute care and inpatient rehabilitation. We defined extended period of stay as the top quartile in this cumulative LOS measure. LOS was included as an indicator of the severity of disease, a measure of need.

FIM™ total function score at discharge

The FIM™ instrument was used to assess level of disability. This 18-item measure assesses the cognitive and physical domains of a patient. The cognitive FIM subscale has 5 items and the physical FIM subscale has 13. Each item is scored on a 7-point Likert scale, with 1 indicating total assistance and 7 total independence (20). In this study, the total score at discharge was generated and was included in the logistic regression model; FIM ratings are shown to be a predictor of discharge destination from inpatient rehabilitation (9).

Living setting at admission

Living settings at admission included (1) home (home with and without paid services), and (2) other (boarding home, shelter, public place, residential care, assisted living, and other).

Living arrangement at admission

Living arrangement at admission included (1) living with someone (spouse/partner, family, non-family unpaid), (2) living alone, (3) living with paid attendant or at a hospital, long term care, residential care and home care, and (4) other.

English language

English language was categorized into "yes" and "no" based on the language primarily spoken and understood on a regular basis. It was added to capture the diversity of Canada, as measures of race are not routinely collected.

Motor vehicle collision

The external cause of injury for TBIs was based on the International Classification for Diseases-10 (ICD-10) codes in the DAD. Motor ve-

hicle collisions (MVCs) may result in access to additional funding for associated medical costs from insurance companies. Previous studies in Ontario have examined MVC as a proxy for the availability of additional resources through supplemental insurance, which was found to be associated with more discharges home (21). As a result, MVCs are considered as an enabling factor for TBI cases.

Rurality

Individual postal codes were designated as being rural by the Canadian Postal Service. Living in rural areas may affect access to services and, as a result, urban setting was examined as an enabling factor in our analysis.

Level of informal support at discharge

Informal support has been shown to be important in the outcome of patients with chronic diseases (22, 23). In the NRS, this variable "describes the unpaid assistance provided to the person from any individual including family, friend, or neighbour. It excludes formal services, or persons arranged by formal service providers such as volunteers" (14). The categories at discharge were "not required", "received", "received with restrictions", and "not received". Not required was defined as "the client was able to care for self and/or all services required were provided by formal service providers". Received is defined as "client required informal support services and all the informal support service requirements were met". Received with restrictions was defined as "client required informal support services and not all the informal support services were provided". Not received was defined as "client required informal support services and none of the required informal support was provided".

Statistical analysis

Frequency distributions and measures of central tendency were generated for all variables and were stratified by TBI and nTBI patient groups and by the dependent variable, living in residential care at discharge. Risk factor variables were categorized according to standard intervals (e.g., Charlson Comorbidity Index) and percentiles (LOS). A two stage model selection technique was employed where variables significant at alpha < 0.10 in a bivariate logistic regression model were entered in a second multivariable model (i.e., full fitted) without further variable reduction. Multicollinearity was assessed using variance inflation factor>5 and model fit with Hosmer and Lemeshow's goodness-of-fit test.

RESULTS

Characteristics of patients with TBI living at home and in a residential care setting at discharge from inpatient rehabilitation are presented in Table II. The majority of TBI patients were living at home (83%), and the remaining 17% were living in a residential care setting. In both discharge locations, most were male. A larger proportion of those discharged to a residential care setting were older adults (61% vs. 41%), had a Charlson Comorbidity Index score of 2 or higher (16% vs. ~10%), had a LOS in the 75th+ percentile in acute care and inpatient rehabilitation (36% vs. 21% and 45% vs. 21%). A smaller proportion of those living in a residential care setting at

Table II. *Characteristics of patients with traumatic brain injuries in inpatient rehabilitation by living setting at discharge*

	Living setting at discharge		
Characteristics	Total *n* (column %)	Home/other *n* (column %, row %)	Residential care *n* (column %, row %)
Overall	840 (100.0)	700 (100.0, 83.3)	140 (100.0, 16.7)
Sex			
Female	266 (31.7)	209 (29.9, 78.6)	57 (40.7, 21.4)
Male	574 (68.3)	491 (70.1, 85.5)	83 (59.3, 14.5)
Age at discharge			
25–34 years	99 (11.8)	89 (12.7, 89.9)	10 (7.1, 10.1)
35–44 years	123 (14.6)	113 (16.1, 91.9)	10 (7.1, 8.1)
45–54 years	134 (16.0)	112 (16.0, 83.6)	22 (15.7, 16.4)
55–64 years	109 (13.0)	96 (13.7, 88.1)	13 (9.3, 11.9)
65–74 years	127 (15.1)	105 (15.0, 82.7)	22 (15.7, 17.3)
≥75 years	248 (29.5)	185 (26.4, 74.6)	63 (45.0, 25.4)
Language			
English	734 (87.4)	611 (87.3, 83.2)	123 (87.9, 16.8)
Other	106 (12.6)	89 (12.7, 84.0)	17 (12.1, 16.0)
Charlson comorbidity index score			
0–1 (low)	747 (88.9)	629 (89.9, 84.2)	118 (84.3, 15.8)
2–3	84 (10.0)	NR	NR
≥4 (high)	9 (1.1)	<5	NR
Length of stay in acute care			
<25th%	226 (26.9)	193 (27.6, 85.4)	33 (23.6, 14.6)
25–49th%	203 (24.2)	180 (25.7, 88.7)	23 (16.4, 11.3)
50–74th%	212 (25.2)	179 (25.6, 84.4)	33 (23.6, 15.6)
75–89th%	118 (14.0)	101 (14.4, 85.6)	17 (12.1, 14.4)
≥90%	81 (9.6)	47 (6.7, 58.0)	34 (24.3, 42.0)
Length of stay in inpatient rehabilitation			
<25th%	213 (25.4)	183 (26.1, 85.9)	30 (21.4, 14.1)
25–49th%	212 (25.2)	191 (27.3, 90.1)	21 (15.0, 9.9)
50–74th%	205 (24.4)	179 (25.6, 87.3)	26 (18.6, 12.7)
75–89th%	131 (15.6)	107 (15.3, 81.7)	24 (17.1, 18.3)
≥90%	79 (9.4)	40 (5.7, 50.6)	39 (27.9, 49.4)

Table II. *Contd.*

Characteristics	Living setting at discharge		
	Total *n* (column %)	Home/other *n* (column %, row %)	Residential care *n* (column %, row %)
Total length of stay			
<25th %	205 (24.4)	176 (25.1, 85.9)	29 (20.7, 14.1)
25–49th %	221 (26.3)	202 (28.9, 91.4)	19 (13.6, 8.6)
50–74th %	210 (25.0)	184 (26.3, 87.6)	26 (18.6, 12.4)
75–89th %	124 (14.8)	96 (13.7, 77.4)	28 (20.0, 22.6)
≥90 %	80 (9.5)	42 (6.0, 52.5)	38 (27.1, 47.5)
FIM total function score at discharge[a]			
0–50	45 (5.4)	20 (2.9, 44.4)	25 (17.9, 55.6)
51–100	183 (21.8)	123 (17.6, 67.2)	60 (42.9, 32.8)
101–151	605 (72.0)	552 (78.9, 91.2)	53 (37.9, 8.8)
Living arrangement at admission[a]			
Alone	209 (24.9)	159 (22.7, 76.1)	50 (35.7, 23.9)
With paid attendant	37 (4.4)	NR	NR
With someone	587 (69.9)	524 (74.9, 89.3)	63 (45.0, 10.7)
Other	6 (0.7)	NR	<5
Living setting at admission[a]			
Home	782 (93.1)	676 (96.6, 86.4)	106 (75.7, 13.6)
Other	56 (6.7)	23 (3.3, 41.1)	33 (23.6, 58.9)
Level of informal support at discharge			
Not required	144 (17.1)	110 (15.7, 76.4)	34 (24.3, 23.6)
Required	696 (82.9)	590 (84.3)	106 (75.7)
Received	605 (86.9)	516 (87.5, 85.3)	89 (84.0, 14.7)
Received with restrictions	77 (11.1)	NR	NR
Not received	14 (2.0)	NR	<5
Motor vehicle collision			
Yes	216 (25.7)	182 (26.0, 84.3)	34 (24.3, 15.7)
No	624 (74.3)	518 (74.0, 83.0)	106 (75.7, 17.0)
Geographic location			
Non-rural	698 (83.1)	571 (81.6, 81.8)	127 (90.7, 18.2)
Rural	142 (16.9)	129 (18.4, 90.8)	13 (9.3, 9.2)

[a]Missing data were excluded from this table. Therefore, column percentages may not add up to 100%.
NR: not reportable due to small cell size.

discharge were from a rural setting (8% vs. 18%), and received informal support at discharge (84% vs. 88%).

Among all TBI patients, the median LOS in acute care was 20 days (mean 27.5 [standard deviation; SD 26.2]), the median LOS in inpatient rehabilitation was 37 days (mean 44.9 [SD 35.9]), and the median total LOS was 58 days (mean 72.4 [SD 52.9]) (results not shown).

Table III presents the characteristics of patients with nTBI by living setting at discharge from inpatient rehabilitation. Similar to the TBI group, the majority of nTBI patients were living at home (83%), and 17% were living in a residential care setting. There were approximately equal numbers of females and males among those living in residential care (51%). A larger proportion of those discharged to residential care setting were older adults (73% vs. 52%), had a Charlson Comorbidity Index score of 2 or higher (43% vs. 41%), and had a LOS in the 75th+ percentile in acute care and inpatient rehabilitation (31% vs. 21% and 38% vs. 24%). A smaller proportion of those living in a residential care setting at discharge were from a rural setting (11% vs. 17%), and received informal support at discharge (83% vs. 87%).

Among all nTBI patients, the median LOS in acute care was 16 days (mean 23.4 [SD 23.4]), the median LOS in inpatient rehabilitation was 37 days (mean 42.7 [SD 29.4]), and the median total LOS was 57 days (mean 66.1 [SD 42.8]) (results not shown).

Logistic regression revealed that TBI patients who required and received informal support at discharge (OR = 0.40) and patients aged 35 to 44 years (OR = 0.29) were significantly less likely to be living at a residential care setting at discharge from inpatient rehabilitation. Conversely those living alone at admission (OR = 3.02) were significantly more likely to be living in a residential care setting at discharge and patients with a total LOS in the 75th+ percentile (OR = 3.21) were also significantly more likely to be living in a residential care setting at discharge. Patients living in "other" living settings at admission, which included boarding home, shelter, public place, residential care, and assisted living, were significantly more likely to be living in residential care at discharge (OR = 4.55). Finally, a one point increase in total function score significantly reduced the odds of living in residential care by 3% (OR = 0.97) (Table IV).

Logistic regression for nTBI patients showed that patients that received informal support at discharge (OR = 0.64) and those living in a rural residence (OR = 0.60), were significantly less likely to be living in a residential care setting at discharge from inpatient rehabilitation. Those living alone (OR = 4.63)

Table III. *Characteristics of patients with non–traumatic brain injuries in inpatient rehabilitation by living setting at discharge*

	Living setting at discharge		
Characteristics	Total *n* (column %)	Home/other *n* (column %, row %)	Residential care *n* (column %, row %)
Overall	1,848 (100.0)	1,527 (100.0, 82.6)	321 (100.0, 17.4)
Sex			
Female	849 (45.9)	686 (44.9, 80.8)	163 (50.8, 19.2)
Male	999 (54.1)	841 (55.1, 84.2)	158 (49.2, 15.8)
Age at discharge			
25–34 years	84 (4.5)	79 (5.2, 94.0)	5 (1.6, 6.0)
35–44 years	151 (8.2)	132 (8.6, 87.4)	19 (5.9, 12.6)
45–54 years	229 (12.4)	200 (13.1, 87.3)	29 (9.0, 12.7)
55–64 years	362 (19.6)	328 (21.5, 90.6)	34 (10.6, 9.4)
65–74 years	442 (23.9)	374 (24.5, 84.6)	68 (21.2, 15.4)
≥75 years	580 (31.4)	414 (27.1, 71.4)	166 (51.7, 28.6)
Language			
English	1,634 (88.4)	1,344 (88.0, 82.3)	290 (90.3, 17.7)
Other	214 (11.6)	183 (12.0, 85.5)	31 (9.7, 14.5)
Charlson comorbidity index score			
0–1 (low)	1,082 (58.5)	900 (58.9, 83.2)	182 (56.7, 16.8)
2–3	554 (30.0)	451 (29.5, 81.4)	103 (32.1, 18.6)
≥4 (high)	212 (11.5)	176 (11.5, 83.0)	36 (11.2, 17.0)
Length of stay in acute care			
<25th%	481 (26.0)	402 (26.3, 83.6)	79 (24.6, 16.4)
25–49th%	496 (26.8)	418 (27.4, 84.3)	78 (24.3, 15.7)
50–74th%	446 (24.1)	382 (25.0, 85.7)	64 (19.9, 14.3)
75–89th%	260 (14.1)	207 (13.6, 79.6)	53 (16.5, 20.4)
≥90%	165 (8.9)	118 (7.7, 71.5)	47 (14.6, 28.5)
Length of stay in inpatient rehabilitation			
<25th%	436 (23.6)	384 (25.1, 88.1)	52 (16.2, 11.9)
25–49th%	472 (25.5)	407 (26.7, 86.2)	65 (20.2, 13.8)
50–74th%	459 (24.8)	377 (24.7, 82.1)	82 (25.5, 17.9)
75–89th%	300 (16.2)	238 (15.6, 79.3)	62 (19.3, 20.7)
≥90%	181 (9.8)	121 (7.9, 66.9)	60 (18.7, 33.1)
Total length of stay			
<25th%	447 (24.2)	386 (25.3,86.4)	61 (19.0, 13.6)
25–49th%	466 (25.2)	410 (26.9, 88.0)	56 (17.4, 12.0)
50–74th%	473 (25.6)	389 (25.5, 82.2)	84 (26.2, 17.8)
75–89th%	278 (15.0)	219 (14.3, 78.8)	59 (18.4, 21.2)
≥90%	184 (10.0)	123 (8.1, 66.8)	61 (19.0, 33.2)
FIM total function score at discharge[a]			
0–50	102 (5.5)	55 (3.6, 53.9)	46 (14.6, 46.1)
51–100	540 (29.2)	383 (25.1, 70.9)	157 (48.9, 29.1)
101–151	1,170 (63.3)	1,065 (69.8, 91.0)	105 (32.7, 9.0)
Living arrangement at admission[a]			
Alone	447 (24.2)	308 (20.2, 68.9)	139 (43.3, 31.1)
With paid attendant	54 (2.9)	NR	NR
With someone	1,338 (72.4)	1,206 (79.0, 90.1)	132 (41.1, 9.9)
Other	7 (0.4)	<5	<5
Living setting at admission[a]			
Home	1,752 (94.8)	1,502 (98.4, 85.7)	250 (77.9, 14.3)
Other	90 (4.9)	20 (1.3, 22.2)	70 (21.8, 77.8)
Level of informal support at discharge[a]			
Not required	299 (16.2)	231 (15.1, 77.3)	68 (21.2, 22.7)
Required	1,546 (83.8)	1,295 (84.9, 83.8)	251 (78.8, 16.2)
Received	1,330 (86.0)	1,122 (86.6, 84.4)	208 (82.9, 15.6)
Received with restrictions	194 (12.5)	158 (12.2, 81.4)	36 (14.3, 18.6)
Not received	22 (1.5)	15 (1.2, 68.2)	7 (2.8, 31.8)
Geographic location			
Non-rural	1,551 (83.9)	1,266 (82.9, 81.6)	285 (88.8, 18.4)
Rural	297 (16.1)	261 (17.1, 87.9)	36 (11.2, 12.1)

[a]Missing data were excluded from this table. Therefore, column percentages may not add up to 100%.
NR: not reportable due to small cell size.

and those living with a paid attendant or in a hospital, long term care facility, residential care, or home care (OR = 4.47) at admission were significantly more likely to be living in residential care at discharge. Also, older adults (OR = 3.43) were significantly more likely to be living in a residential care setting and nTBI patients with total LOS in the 75th+ percentile (OR = 2.04) were also significantly more likely to be living in a residential care setting at discharge. Patients living in settings other than home at admission were significantly more likely to be living in residential care at discharge (OR = 9.43). Finally, a one point increase in FIM score significantly reduced the odds of living in residential care by 3% (OR = 0.97) (Table V).

All models were adjusted for Charlson Comorbidity Index score, acute care LOS, inpatient rehabilitation LOS, and total LOS with referent group of the lower quartile. However, these variables did not meet the model selection criteria and thus were excluded from the final model. The final logistic regression model controlled for sex, age, English language, total extended LOS, FIM score at discharge, living setting at admission, living arrangement at discharge, informal support, and rural residence, using the following reference groups: male, 25–34 years old, non-English speaking, no extended LOS, home, living with someone, support not required and non-rural residence.

DISCUSSION

To our knowledge, this is the first population based Canadian study that describes the living setting at discharge from inpatient rehabilitation among patients with TBI and nTBI and that models factors that are significantly associated with living in a residential care setting at discharge. Multivariate logistic regression revealed that longer lengths of stay, liv-

Table IV. *Multivariate logistic regression model predicting living setting at discharge from inpatient rehabilitation among patients with traumatic brain injuries (*n = *840).*

	Residential care setting	
Variable	OR	95% CI
Sex		
Female	1.00	
Male	0.82	0.51–1.34
Age		
25–34 years	1.00	
35–44 years	0.29*	0.09–0.94
45–54 years	1.18	0.47–2.98
55–64 years	0.65	0.22–1.87
≥65 years	1.79	0.78–4.11
Language		
Other	1.00	
English	0.97	0.53–1.86
Total extended LOS		
No	1.00	
Yes	3.21***	1.97–5.22
FIM total function score at discharge	0.97***	0.96–0.98
Living arrangement at admission		
With someone	1.00	
Alone	3.02***	1.83–4.99
With paid attendant	3.65	0.89–14.90
Other	0.88	0.05–14.51
Living setting at admission		
Home	1.00	
Other	4.55*	1.40–14.81
Informal support at discharge		
Not required	1.00	
Received	0.40**	0.23–0.70
Received with restrictions	0.56	0.24–1.33
Not received	0.55	0.10–3.11
Rural residence		
No	1.00	
Yes	0.50	0.23–1.08

*p < 0.05; **p < 0.01; ***p < 0.001.
All models considered Charlson Comorbidity Index score and motor vehicle collision, however these variables did not meet model selection criteria.
LOS: length of stay; CI: confidence interval.

Table V. *Multivariate logistic regression model predicting living setting at discharge from inpatient rehabilitation among non-traumatic brain injury patients (*n = *1,845)*

	Residential care setting	
Variable	OR	95% CI
Sex		
Female	1.00	
Male	1.04	0.77–1.41
Age		
25–34 years	1.00	
35–44 years	1.18	0.33–4.17
45–54 years	2.09	0.64–6.80
55–64 years	1.52	0.48–4.86
≥65 years	3.43*	1.13–10.36
Language		
Other	1.00	
English	1.39	0.87–2.23
Total extended LOS		
No	1.00	
Yes	2.04***	1.46–2.84
FIM total function score at discharge	0.97***	0.97–0.98
Living arrangement at admission		
With someone	1.00	
Alone	4.63***	3.36–6.36
With paid attendant	4.47**	1.53–13.03
Other	2.08	0.25–17.47
Living setting at admission		
Home	1.00	
Other	9.43***	4.34–20.47
Informal support at discharge		
Not required	1.00	
Received	0.64**	0.43–0.93
Received with restrictions	0.75	0.43–1.30
Not received	0.86	0.28–0.70
Rural residence		
No	1.00	
Yes	0.60*	0.39–0.94

*p < 0.05; **p < 0.01; ***p < 0.001.
All models considered Charlson Comorbidity Index score, however this variables did not meet model selection criteria.
LOS: length of stay; CI: confidence interval.

ing alone and in non-home settings at admission (residential care, assisted living, boarding home, shelter, and public place) significantly increased the odds of living in a residential care setting at discharge from inpatient rehabilitation. Patients receiving informal support and who had a higher FIM score at discharge significantly decreased the odds of living in a residential care setting.

These findings have implications for the planning of health-care services for ABI patients. First, the odds of an older adult with nTBI living at a residential care setting at discharge from inpatient rehabilitation were 3.43 times higher than the odds of patients aged 25 to 34 years. However, the finding from the multivariate analyses that older adults with TBI were not significantly more likely to be living in residential care suggests that discharge to residential care is a function of outcome from inpatient rehabilitation and level of disability rather than age. As of July 1, 2011, 14% of Ontario's residents are older adults aged 65 years and older, and it is estimated that by the year 2036, older adults will make up a quarter of Canada's population (24). As the Canadian population continues to age, a significant need for residential care facilities will emerge, particularly among the nTBI population.

Second, the odds of TBI and nTBI patients with extended LOS living at a residential care facility were 3.21 and 2.04 times higher than those with shorter total LOS. This finding corroborates previous research (6,11). Longer lengths of stay are an indicator of "need" of rehabilitation services during recovery and likely a proxy indicator of severity of injury. This result suggests that health care planners can anticipate ABI patients with longer total LOS to be more likely to live in residential care settings at discharge from inpatient rehabilitation.

Third, nTBI patients living in a rural area were significantly less likely to be living at a residential care facility. This may be a reflection of a lack of availability of this care option in rural areas, as these locations may not have the same options. It may suggest that rural communities have better support networks that can assist individuals at home. However, a previous paper showed that rural location was an independent predictor of institutionalized care at discharge from acute care (25) and as such, the most likely candidates for this destination in rural settings were possibly discharged there after inpatient care. Rural/urban differences in accessing health care services have been established (6, 26, 27), thus additional research into how rurality affects discharge destination among patients with brain injury is required.

FIM total function score at discharge was predictive of living in residential care while controlling for all other factors. This illustrates the importance of assessing functional outcome in other care settings, which was also stated by Peek and colleagues (28). Currently in the Canadian setting there is no indicator of functional outcome in our acute care administrative data sources such as the DAD. As such, future revisions to acute care outcome measures in the DAD should include measures of functional outcome.

The odds of living in a residential care setting at discharge among TBI and nTBI patients receiving informal support was significantly lower than among those who did not require informal support at discharge. This may be because patients who did not require informal support may be living in assisted living settings and may already be receiving formal support. Also, there is the possibility that these patients do not realize that they may need informal support or reject support when offered. Previous research has demonstrated that informal support plays a critical role in the outcome of a condition; one of the most common reasons for delayed discharge from inpatient rehabilitation was the lack of ongoing support (22, 29). Given that social support is a main predictor of psychological and physical well being of patients with chronic diseases (22), it is critical that research on living setting at discharge among patients with brain injury take into account the role of informal support. This variable is included in the NRS dataset but it is typically missing in large administrative acute care data files; perhaps it should be included in acute care databases as well. Although it is unclear whether the association found in this study is causal, the results suggest that with more community-based informal support, potentially more institutionalized forms of care may be averted. It should be noted that the sample size for patients not receiving informal support is very small. Therefore, although the odds ratio indicating that these patients were more likely than those who did not require informal support to be living in residential care at discharge was not significant, the small sample size of this group could have affected the significance.

Finally, this study revealed some differences in the factors influencing discharge destination of patients with TBI and nTBI, despite similar descriptive profiles. This suggests that patients with TBI and nTBI discharged from inpatient rehabilitation are distinct populations and require specific discharge planning. In particular, the finding of increased odds of living in residential care among older nTBI patients suggests that older adults with nTBI have higher care needs, which could result in need for more intensive post-discharge care. Patients with nTBI living in rural areas were significantly less likely to be living in residential care at discharge from inpatient rehabilitation; however, the finding for TBI patients was not significant. Previous research on TBI and nTBI patients supports a differential profile of patients by type of brain injury (30). Studies in Canada (15, 16, 30), United States (31), and in Europe (32) comparing TBI patients with a specific nTBI population – survivors of anoxic brain injury – also revealed differences in functional outcome, rate of recovery, and length of stay. As such, this study provides support for a more detailed examination of differences between and within TBI and nTBI populations in order to provide appropriate discharge planning from rehabilitation.

Limitations

The predictors that could be included in our model were limited by the data elements available in administrative data. Other studies have found that environmental and individual factors, including race and marital status, are significant predictors; however, these data elements are not recorded in the NRS database. The variable "language" was added in our analysis given the linguistic diversity of Canada.

In addition, the variables identified are not necessarily the best measures of the factors identified in the Andersen Behavioral Model. In particular, length of stay in rehabilitation may be due to a combination of factors that are of interest in program planning, including severity of injury, type of intervention used, age of patient, and available funding. In this study, length of stay was identified as an indicator of severity; however, it is likely more of an indicator of a combination of these factors. As a result, further studies looking at the duration of inpatient rehabilitation are needed to evaluate effectiveness.

The NRS is also limited in the identification of patients with acquired brain injury because patients are categorized by broad rehabilitation client groups (RCGs). This study only includes patients in RCG 1 (stroke) and RCG 2 (brain dysfunction) that have an acute care stay with at least one TBI or nTBI ICD-10 code in the DAD database. We did not capture individuals who had an ABI code in acute care and potentially may be included in other diagnostic groupings. We did not include patients who were admitted directly through long-term care facilities, the community, or other locations. As such, our results are generalizable to persons who were admitted to inpatient rehabilitation from acute care.

Strengths and conclusions

Despite limitations, this is the first study to our knowledge in Canada to describe and model characteristics of patients with ABI by their living setting at discharge from inpatient rehabilitation. By using administrative data, this study included all patients in Ontario who are treated in a publicly funded inpatient rehabilitation facility. As of July 1, 2011, Ontario is home to almost 40% of all Canadians. It is highly generalizable and findings can be used to guide research in other provinces. In addition, this study looks at predisposing, need and enabling factors that may be related to living setting at discharge. This study demonstrates the need for investigation into informal support for the ABI population. Findings suggest that providing community support as well as improving functional status may reduce institutionalization, which is important as our society ages.

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