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Factors associated with overall functional disability one year after traumatic brain injury

Factores asociados a la incapacidad funcional global luego de transcurrido un año después del traumatismo craneoencefálico

Fraga Maia, *Helena*[1]; ***Dourado***, *Inês*[2]; ***Fernandes***, *Rita de Cássia Pereira*[3]; ***Werneck***, *Guilherme Loureiro*[4]

[1]*Kinesiologist. PhD in Epidemiology. Associate Professor, Department of Ciências da Vida, Universidade do Estado da Bahia, Brazil. hmmaia@uneb.br*

[2]*Physician. PhD in Epidemiology. Associate Professor, Saúde Coletiva Institute, Universidade Federal da Bahia. I-C Researcher, Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brazil. maines@ufba.br*

[3]*Physician. PhD in Public Health. Associate Professor, Department of Social and Preventive Medicine, Faculdade de Medicina da Bahia, Universidade Federal da Bahia, Brazil. ritafernandes@ufba.br*

[4]*Physician. PhD in Epidemiology. Associate Professor, Social Medicine Institute, Universidade do Estado do Rio de Janeiro. I-B Researcher, Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brazil. gwerneck@iesc.ufrj.br*

ABSTRACT The prevalence of factors associated with functional disability was estimated six and twelve months after traumatic brain injury (TBI) in patients initially treated in the emergency unit of reference for the Metropolitan Region of Salvador, Bahia, Brazil. A prospective cohort study was performed, including 307 individuals with TBI between the ages of 15 and 65 years whose diagnosis was confirmed via neuroimaging. Using data from the period of hospitalization, 242 patients were contacted six months after the injury and 222 patients after twelve months. Functional impairment was evaluated with the Disability Rating Scale. The overall prevalence of functional disability (60.3% in the first evaluation and 40.5% in the second) was significantly associated with age, the initial gravity of the TBI and the duration of the patient's hospitalization, as well as with: fatigue; aphasia; memory, attention and concentration disorders; balance disorders; paresis; and lack of medical consultations with specialists. The high frequency of overall functional disability in the six or twelve-month follow-up period, even for patients with mild traumas, shows the relevance of TBI as a cause of disability and impairment, as well as the need for follow-up services.
KEY WORDS Traumatic Brain Injury; Disability Evaluation; Rehabilitation; Brazil.

RESUMEN Se estimó la prevalencia de los factores asociados con incapacidad funcional a los seis y doce meses en pacientes con traumatismo craneoencefálico (TCE) atendidos en una unidad de referencia en la Región Metropolitana de Salvador, Bahía, Brasil. Se realizó un estudio de cohorte prospectivo con 307 individuos con TCE de 15 a 65 años que tuvieron diagnóstico confirmado por imagen. Con los datos obtenidos durante el período de internación hospitalaria, se contactaron 242 pacientes a los seis meses del traumatismo y 222 a los 12 meses. El compromiso funcional fue evaluado con la escala de *Disability Rating Scale*. La prevalencia global de incapacidad funcional (60,3% en la primera evaluación y 40,5% en la segunda) estuvo asociada significativamente con la edad, la gravedad inicial del TCE y la duración de la internación en el hospital, con fatiga, afasia, trastornos de la memoria, atención y concentración, alteraciones del equilibrio, paresia y ausencia de consultas con especialistas. La alta frecuencia de incapacidad global a los seis y doce meses de seguimiento, aun en pacientes con traumatismos leves, denota la relevancia del TCE como productor de incapacidades y deficiencias, así como la necesidad de servicios de seguimiento.
PALABRAS CLAVES Traumatismo Craneoencefálico; Evaluación de la Discapacidad; Rehabilitación; Brasil.

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INTRODUCTION

Traumatic Brain Injury (TBI) is regarded as a serious public health problem not only because of it is widespread, but also because it primarily affects young individuals in the economically productive phase of life. Mild cases of TBI, such as concussions, can also affect the ability to perform everyday activities, as well as the ability to resume one's prior activities. According to studies conducted in countries with reliable national statistics, the occurrence of somatic, cognitive-behavioral, sensory-perceptual and sensory-motor symptoms serves as an explanatory factor of functional disability.

Different researchers have identified the existence of risk factors as well as variances in the evolution of patients with violence-related injuries versus patients with non-violent injury etiology (1-5,8). These studies conducted in the US population suggest that most patients who have experienced TBI due to violence are African American and have low educational levels, low income levels and a history of alcohol and illegal drug consumption (1-5,8). It is further stated that old age, a low educational level, a severe clinical picture at the time of hospital admittance, post-traumatic complications and delayed start of multidisciplinary rehabilitation programs are associated with negative prognoses. These studies also stress the importance of socioeconomic conditions and the access of patients to rehabilitation therapies (2,4,5,8).

As TBI is a heterogeneous condition, it requires different types of rehabilitation procedures to obtain the best outcome in different groups of patients in all stages of recovery. It is estimated that most patients recover quickly with a progressive and significant decrease in all somatic, cognitive-behavioral, sensory-perceptual and sensory-motor symptoms six months after injury (1,9-11). After the initial term, recovery tends to be slow and might even stop completely if a multidisciplinary rehabilitation strategy has not been administered. Nevertheless, several authors have found that many patients coexist with the TBI symptoms for much longer periods of time (12,13).

It is worth noting that most of the evidence of neuroplasticity and the capacity for recovery in patients with brain injury was produced in developed countries, where a significant improvement in rehabilitation services has taken place in the last years. In Brazil, cohort studies to estimate functional disability in TBI survivors were conducted with patients who were called in to be assessed and interviewed; as a result, these studies may suffer from selection bias (14-16). In Bahía, as well as in the rest of Brazil, the Unified Health System (SUS) [*Sistema Único de Saúde*] does not cover neurosurgical outpatient care and few facilities are available which perform multi-professional rehabilitation practices; therefore, this study aimed at describing the functional status of TBI survivors. Consequently, this study is intended to estimate the prevalence of factors associated with functional disability six and twelve months after injury, in TBI patients initially treated in the emergency unit of reference for the Metropolitan Region of Salvador, Bahia, Brazil.

METHODS

A cohort study was carried out with male patients from the state unit of reference for TBI. The study population consisted of all the individuals between the ages of 15 and 65 years who received medical care in the emergency department of the *Hospital Geral do Estado* (HGE) of Bahia from August 1, 2007 to July 31, 2008, who were diagnosed with TBI and had experienced neurological symptoms specific to this type of injury, such as loss of consciousness, disorientation, mental confusion, behavioral disorders, somnolence, dizziness, convulsions, nausea, vomiting and post-traumatic amnesia. Consequently, this study included individuals who presented cognitive disorders with a score of 14 or less in the Glasgow Coma Scale, who showed neurological symptoms, and whose TBI cases were categorized as severe to moderate or mild, that is, patients with mid to high risk. Patients with mild traumas and a Glasgow Coma Scale score higher than 14 were excluded.

Selection criteria for the sample also included place of occurrence, thus excluding patients who were not from the Metropolitan Region of Salvador. Subjects were identified as having TBI based on the presence of abnormalities in

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computerized axial tomography (CAT) scans of the cranium. Exclusion criteria were: history of intracranial tumors, strokes, multiple sclerosis, epilepsy, Parkinson's disease, meningitis, Alzheimer's disease, encephalopathy induced by HIV/AIDS, arteriovenous malformations and brain abscesses. Homeless TBI patients were not included in the study given the difficulty of gathering their data in the months after injury.

Data were collected by pre-tested questionnaires both during hospitalization and at the patient's place of residence six and twelve months after injury. During their time at the hospital, the patient's mother, wife or eldest daughter was chosen as secondary informant following that order of priority. If it was not possible to reach the secondary informant, data were collected from the family members who visited the patient frequently. Home interviews took place at the patient's place of residence and were coordinated by telephone; both patients and family members were questioned about the symptoms experienced and care measures taken. Balance tests were carried out after the interviews.

The team of interviewers was previously trained in detail about every item of the questionnaire as well as all possible answers. Simulated interview situations were carried out, as was a pilot study, performed in the emergency department and supervised by the coordinator of the research study. Data were collected by the principal researcher and two kinesiologists specialized in neurological rehabilitation.

Three different instruments were used to collect data. These instruments focused on general aspects of the patients, clinical aspects relevant to the occurrence and evolution of the TBI, all treatments or consultations undergone by the patient, and an estimate of their functional capacity. The questionnaire used at the hospitals included different aspects of socio-demographic conditions, lifestyle, history of trauma and the clinical picture of the patient.

The questionnaires implemented six and twelve months post-injury at the patient's place of residence examined the presence of somatic symptoms defined as cephalgia, dizziness and fatigue. These symptoms were regarded to be present if they interfered with the patient's everyday life; both cognitive-behavioral and sensory-perceptual symptoms were also regarded to be present using the same criteria. Cognitive-behavioral symptoms included difficulties with attention, concentration and memory; aphasia; irritability; and alterations in personality. Sensory-perceptual symptoms were defined as hearing and/or visual impairment. The presence of sensory-motor disturbances, such as the alteration of postural control, were also examined in the questionnaire. When assessing this variable, the evaluation focused on the biomechanical alignment of the body and its orientation in relation to the environment, defined as the capacity to maintain an appropriate relationship among the segments of the body in such a way as to keep a vertical orientation. For this assessment, multiple sensory references were used while the patient was on a support surface (16,17). The following tests were employed to detect alterations in postural control: the unipedal stance test, simple and sensitized Romberg test, and the posture stability of the patient without support while standing and sitting. Motor and somatosensory strategies were also taken into consideration. The positive result of any of the tests mentioned above was considered as a sign of balance alteration.

Concurrent limb fractures were also taken into account in this study. Therapeutic support consults or treatments were regarded as present when the patient or a family member informed having attended a medical consultation or examination with the neurological and/or neurosurgical, orthopedic or clinical specialties, or if the patient had attended at least five sessions of kinesiology. Paresis or plegia of the hemibody or limbs were other sensory-motor disorders included in this study, and were defined as total or partial loss of voluntary movement as a result of sensory, neuromotor, neurocognitive or muscoskeletal alterations (18).

The Disability Rating Scale was used to evaluate the overall functional disability of all patients in their place of residence. Functional disability was categorized as mild or absent if they scored between 0 and 1.5, or as moderate or severe if they scored above 2 (19).

For the purpose of data analysis, variables were redefined taking into consideration the need for stratification. Accordingly, *age* was defined in complete years. *Skin color* was defined by the interviewer and classified as white or non-white.

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Educational level was divided into two categories: one category included the subcategories unable to read, able to read and write, and up to first grade of primary education; the other category included those with at least a second-grade education. *Household income* was categorized in Brazilian currency (*reales*): R$ 0-450, R$ 451-900, and R$ 901-5000 (2008 USD value: $0-245, $246-491, from $492-2,732). *Social support* was assessed using the variables of marital status and the presence of other residents at the patients' homes who were willing to look after them; patients were considered to have *social support* if four or more people at the home were able to assist the patient if the event that he needed to travel to receive treatment. The marital status variable was divided into two categories: "single," which also included those separated or divorced as well as widowers, and "married or in a stable relationship" for the rest of the possibilities. *Lifestyle* was assessed using the variables of alcohol and drug abuse, which were considered dichotomous variables according to the information provided by the family members.

The cause of the injury was defined based on the intentionality of the event: it was regarded as violent TBI when the injury was a result of interpersonal violence and accidental TBI when the injury was a result of a fall, the practice of a sport or a traffic accident. The seriousness of the injury was assessed upon admittance and during hospitalization using the Glasgow Coma Scale (GCS) variables. Alterations in the level of consciousness were categorized as mild if the patient scored 13 to 15 points, as moderate if the patient scored 9 to 12 points, and as severe if the patient scored 3 to 8 points. An examination performed by a neurologist or a neurosurgeon was used as the gold standard test. The length of the hospital stay was categorized into two strata (20); severe cases included hospitalizations lasting over fifteen days.

A bivariate analysis was performed with the aim of identifying the set of variables that most contributed to the explanation of the level of functional disability six and twelve months post-injury. Then, a multivariate analysis was performed using an unconditional logistic regression model. Using the logistic regression parameters, specific measures were estimated and crude and adjusted 95% confidence intervals were calculated using the Delta Method (21).

The multivariate analysis was developed based on a theoretical model defined *a priori*, with associated factors organized in blocks of variables according to the existing hierarchy between the levels of determination of overall functional disability. The strategy used to enter the blocks of variables was that of forward selection (anterograde process) in the following steps: first block-suprahierarchical (age); second block (sociodemographics); third block (social support); forth block (lifestyles); fifth block (cause of injury); sixth block (seriousness of injury); seventh block (symptoms) and eighth block (supplementary therapy). Variables showing statistical significance of $p < 0.20$ were kept in the model. The significance level chosen for the study was 0.05. EpiInfo (version 6.0) (19) and Stata (version 10.0) were the statistical software packages used in this study.

The research project was approved by the Research Ethics Committee of the *Instituto de Saúde Coletiva* of the *Universidade Federal da Bahia* (No. 054-06/06). During both hospitalization and the home visits stages, all participants were guaranteed the right to not participate in this study as well as to interrupt their contribution at any time. The objectives, methodology and expected findings of the research were explained to the family member that was closest to the subject who had agreed to participate in this study. Then, this relative was asked to sign the Free and Informed Consent Form to guarantee the autonomy of everyone involved. Anonymity and confidentiality of the collected data was also guaranteed.

The study involved no potential risk to the patients. No inclusion criteria were set based on race, religious beliefs, educational levels or household income. Additionally, the relevance of this study presents important advantages to all subjects involved according to the principles of justice, equality and beneficence. Patients with functional disability were referred to neurologists who provided free treatment and to kinesiologists from physiotherapy teaching clinics of higher education that provided rehabilitation treatment. No patient refused to share data, and no family members refused to participate in this study.

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FINDINGS

The study sample was composed of 307 men between the ages of 15 and 65 years, of which 108 (35.2%) were between 15 and 25 years old, 96 (31.3%) were between 26 and 35 years old, and 103 (33.5%) between 36 and 65 years old. None refused to participate. Subjects were mainly non-white (92.2%), single, separated or widowers (58.0%) and lived alone or with up to three other people at their place of residence. Household income was stated to be less than R$ 450 in 104 cases (33.9%) and R$ 451-900 in 107 cases (34.8%). Among those included in the sample, 76 (30.3%) had a habit of consuming alcohol and 37 (12.0%) had a habit of drug use. The cause of injury was, in most cases, due to violence (58.0%). Upon admittance, 136 cases (44.3%) were categorized as mild and 107 (34.9%), as severe, according to the Glasgow Coma Scale (GCS) (Table 1). All subjects were previously in good health and carried out productive activities pre-injury.

Loss to follow-up between time of TBI and the six-month post-TBI assessment was mainly due to the seriousness of injury: a loss of 61.7% was observed in the sample of patients with severe cases of TBI and of 12.5% in the sample of patients with mild to moderate cases. Death was the main reason for these losses to follow-up. In the period of time between hospital admittance and the first home visit, 62 subjects (79.8%) died from TBI-related causes, and 4 patients (6.5%), victims of violent TBI, were murdered after hospital discharge. Among those with mild or moderate TBI cases (136 patients), only 17 died during this period from TBI-related causes. However, there were no differences between individuals that left the study and those that remained and were evaluated six and twelve months post-injury in terms of age, race, household income, marital status, number of people living at the home, or cause and seriousness of injury. Therefore, there is only a minimum possibility that the final results were biased by differential losses to follow-up.

Table 1 provides information on socio-demographic aspects, social support, lifestyles, etiology and seriousness of injury as well as the prevalence of functional disability, categorized as "mild or absent" or as "moderate or severe", both six and twelve months post-injury. The prevalence of functional disability was significantly higher in patients over 35 years of age during the first six months and in severe TBI cases. Six months post-injury, the prevalence of overall functional disability was 49.6% in mild TBI cases, 63.2% in moderate cases, and 77.3% in severe cases. Twelve months post-injury, the prevalence of functional disability was 31.8%, 33.3% and 62.3% respectively. Moderate or severe disability was more prevalent in patients with longer hospitalizations, both six months (68.5%) and twelve months (73.3%) post-injury.

Table 2 provides the characteristics of the signs and symptoms present and of the treatments carried out six and twelve months post-injury. There was a prevalence of moderate to severe functional disability six months post-injury (60.3%), as well as twelve months post-injury (40.5%). The presence of somatic, cognitive-behavioral, sensory-perceptual and sensory-motor symptoms was associated to a higher prevalence of moderate or severe overall functional disability, both six and twelve months post-injury. The presence of locomotor disorders was also significantly associated to moderate or severe functional disability twelve months post-injury. Moderate or severe functional disability was associated to the administration of treatment after hospital discharge, specifically, kinesiology and clinical medicine six and twelve months post-injury, and neurologic and orthopedic care twelve months post-injury.

In the first stage of the logistic regression analysis, it was identified that age, household income, skin color and seriousness of injury complied with the criteria previously established for remaining in the model (Table 3). Furthermore, it was verified that that the variables related to the seriousness of the injury, such as the Glasgow Coma Scale score upon hospital admittance and the duration of hospitalization, were significantly associated with functional disability, even after adjusting for age and socio-demographic variables. This was so both six and twelve months post-injury.

The findings of the second stage of the logistic regression analysis are shown in Table 4a and Table 4b. Six months after the injury, the following variables were significantly associated with functional disability and remained in the model: fatigue (PR = 1.4; 95%CI [1.1; 1.9]), difficulties in attention

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Table 1. Socio-demographic and injury etiology variables upon hospital admittance and prevalence of overall functional disability six and twelve months post-injury in patients with traumatic brain injury treated/not treated at the unit of reference. Salvador, Bahia 2007-2008.

Variables	Upon Admittance (N=307)		Six months after traumatic brain injury (N=242)							Twelve months after traumatic brain injury (N=222)						
	n	%	n	%	Prevalence of functional disability				*p*-value	n	%	Prevalence of functional disability				*p*-value
					Mild or absent		Moderate or severe					Mild or absent		Moderate or severe		
					n	%	n	%				n	%	n	%	
Age																
15 to 25	108	35.2	88	36.4	43	48.9	45	51.1		82	36.9	52	63.4	30	36.6	
26 to 35	96	31.3	75	31.0	29	38.7	46	61.3	0.05	69	31.1	41	59.4	28	40.6	0.56
36 to 65	103	33.5	79	32.6	24	30.4	55	69.6		71	32.0	39	54.9	32	45.1	
Socio-demographic aspects																
Skin color																
White	24	7.8	20	8.3	11	55.0	9	45.0	0.14	18	8.1	12	66.7	6	33.3	0.51
Non-white	283	92.2	222	91.7	85	38.3	137	61.7		204	91.9	120	58.8	84	41.2	
Household income (in Brazilian *reales*)																
0 to 450	104	33.9	79	32.6	38	48.1	41	51.9		73	32.8	47	64.4	26	35.6	
451 to 900	107	34.8	80	33.1	28	35.0	52	65.0	0,17	73	32.8	39	53.4	34	46.6	0.39
901 to 5.000	96	31.3	83	34.3	30	36.1	53	63.9		76	34.2	46	60.5	30	39.5	
Social Support																
Marital Status																
Single. separated or widower	178	58.0	143	59.1	58	40.6	85	59.4	0.73	135	60.8	83	61.5	52	38.5	0.44
Married or in a stable relationship	129	42.0	99	40.9	38	38.4	61	61.6		87	39.2	49	56.3	38	43.7	
Number of residents in the patient's home																
0 to 3	183	63.1	147	60.7	59	40.1	88	59.9	0,85	136	61.3	87	64.0	49	36.0	0.08
4 or more	107	36.9	95	39.3	37	38.0	58	61.0		86	38.7	45	52.3	41	47.7	
Lifestyle																
Alcohol consumption																
Yes	93	30.3	76	31.4	28	36.8	48	63.2	0,54	71	32.0	43	60.6	28	39.4	0.81
No	214	69.7	166	68.6	68	41.0	98	59.0		151	68.0	89	59.0	62	41.0	
Drug use																
Yes	37	12.0	27	11.2	8	29.6	19	70.4	0.25	23	10.4	12	52.2	11	47.8	0.45
No	270	88.0	215	88.8	88	41.0	127	59.0		199	89.6	120	60.3	79	39.7	
Etiology of injury																
Violent	178	58.0	156	64.5	65	41.7	91	58.3	0.39	147	66.2	91	61.9	56	38.1	0.29
Accidental	129	42.0	86	35.5	31	36.0	55	64.0		75	33.8	41	54.7	34	45.3	
Seriousness of injury																
Glasgow Coma Scale (upon admittance)																
Severe	107	34.9	66	27.3	15	22.7	51	77.3		61	27.5	23	37.7	38	62.3	
Moderate	64	20.8	57	23.5	21	36.8	36	63.2	0,00	51	23.0	34	66.7	17	33.3	0.00
Mild	136	44.3	119	49.2	60	50.4	59	49.6		110	49.5	75	68.2	35	31.8	
Duration of hospitalization (in days)																
≥15	-	-	138	57.0	38	27.5	100	72.5	0.00	125	56.3	59	47.2	66	52.8	0.00
0 to 14	-	-	104	43.0	58	55.7	46	44.3		97	43.7	73	75.3	24	24.7	

Source: Own elaboration based on primary data.

Table 2. Characteristics related to signs and symptoms present and treatments carried out six and twelve months post-discharge in relation to overall functional disability in patients with traumatic brain injuries treated/not treated at the unit of reference. Salvador, Bahia, 2007-2008.

Characteristics	Six months after traumatic brain injury (N=242)							Twelve months after traumatic brain injury (N=222)						
	n	%	Prevalence of functional disability				*p*-value	n	%	Prevalence of functional disability				*p*-value
			Mild or absent		Moderate or severe					Mild or absent		Moderate or severe		
			n	%	n	%				n	%	n	%	
Prevalence of overall disability	242	100,0	96	39,7	146	60,3		222	100,0	132	59,5	90	40,5	
Somatic symptoms														
Cephalgia														
No	112	46,3	54	48,2	58	51,8	0,01	111	50,0	79	71,2	32	28,8	0,00
Yes	130	53,7	42	32,3	88	67,7		111	50,0	53	47,7	58	53,3	
Dizziness														
No	131	54,1	67	51,2	64	48,8	0,00	125	56,3	87	69,6	38	30,4	0,00
Yes	111	45,9	29	26,1	82	73,9		97	43,7	45	46,4	52	53,6	
Fatigue														
No	144	59,5	72	50,0	72	50,0	0,00	139	62,6	89	64,0	50	36,0	0,07
Yes	98	40,5	24	24,5	74	75,5		97	37,4	43	51,8	40	48,2	
Cognitive-behavioral symptoms														
Memory disorders														
No	102	42,2	59	57,8	43	42,2	0,00	77	34,7	63	81,8	14	18,2	0,00
Yes	140	57,8	37	26,4	10	73,6		145	65,3	69	47,6	76	52,4	
Attention and concentration difficulties														
No	164	67,8	88	53,7	76	46,3	0,00	191	86,4	124	64,9	67	35,1	0,00
Yes	78	32,2	8	10,3	70	89,7		30	13,6	8	26,7	22	73,3	
Aphasia														
No	198	81,8	92	46,5	106	53,5	0,00	198	81,8	121	67,6	58	32,4	0,00
Yes	44	18,2	4	9,1	39	90,9		44	18,2	11	25,6	31	74,4	
Irritability														
No	96	39,7	55	57,3	41	42,7	0,00	66	29,7	53	80,3	13	19,7	0,00
Yes	146	60,3	41	28,1	105	71,9		156	70,3	79	50,6	77	49,4	
Alterations in personality														
No	129	53,3	71	55,0	58	45,0	0,00	143	64,4	104	72,7	39	27,3	0,00
Yes	113	46,7	25	22,1	88	79,9		79	35,6	28	35,4	51	64,6	
Sensory-perceptive symptoms														
Hearing impairment														
No	184	76,1	80	43,5	104	56,5	0,03	171	77,0	110	64,3	61	35,7	0,07
Yes	58	23,9	16	27,6	42	72,4		51	23,0	22	43,1	29	56,9	
Visual impairment														
No	177	73,4	80	45,2	97	54,8	0,00	180	81,1	113	62,8	67	37,2	0,03
Yes	64	26,6	16	25,0	48	75,0		42	18,9	19	45,2	23	54,8	
Sensory-motor disorders														
Alterations in postural control														
No	133	55,0	30	22,6	103	74,4	0,00	121	54,5	56	46,3	65	53,7	0,00
Yes	109	45,0	66	60,5	43	39,5		101	45,5	76	75,3	25	24,7	
Paresis or plegia of the limbs														
No	191	78,9	87	90,6	104	71,2	0,00	174	78,4	117	67,2	57	32,8	0,00
Yes	51	21,1	9	9,4	42	28,8		48	21,6	15	31,2	33	68,8	
Locomotor disorders														
Limb fractures														
No	196	81,0	82	41,8	114	58,2	0,15	178	80,1	114	64,4	64	36,0	0,00
Yes	46	19,0	14	30,4	32	69,6		44	19,8	18	41,0	26	59,0	
Therapeutic support														
Neurological care														
No	131	54,1	53	40,5	78	59,5	0,78	103	46,4	66	67,0	34	33,0	0,05
Yes	111	45,9	43	38,7	68	61,3		119	53,6	63	52,9	56	47,1	
Physiotherapeutic care														
No	200	82,6	91	45,5	109	54,5	0,00	182	82,0	124	68,1	58	31,9	0,00
Yes	42	17,4	5	11,9	37	88,1		40	18,0	8	20,0	32	80,0	
Orthopedic care														
No	201	83,1	85	42,3	116	57,7	0,06	190	85,6	125	65,8	65	34,2	0,00
Yes	41	16,9	11	26,8	30	73,2		32	14,4	7	21,9	25	78,1	
Clinical care														
No	160	66,1	77	48,1	83	51,9	0,00	145	65,3	94	64,8	51	35,2	0,02
Yes	82	33,9	19	23,2	63	76,8		77	34,7	38	49,3	39	50,7	

Source: Own elaboration based on primary data.

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Table 3. Association between overall functional disability estimated six and twelve months post-injury and socio-demographic factors, intentionality and seriousness of injury in patients with traumatic brain injury treated/not treated at the unit of reference. Salvador, Bahia, 2007-2008.

Variables	Six months after traumatic brain injury (N=242)					Six months after traumatic brain injury (N=242)				
	PR	95%CI	APR	95%CI	*p*-value	PR	95%CI	APR	95%CI	*p*-value
Age										
36 to 65	1.3	1.1; 1.5	-	-	0.01*	1.2	0.9; 1.7	-	-	0.28
26 to 35	1.1	1.0; 1.3	-	-	0.19	1.1	0.8; 1.5	-	-	0.61
15 to 25[a]	-	-	-	-		-	-	-	-	
Socio-demographic aspects										
Household income (in Brazilian reales)										
0 to 450	1.2	1.0; 1.4	1.2[b]	0.9; 1.6	0.07	1.3	0.9; 1.8	1.3[b]	0.7; 2.5	0.15
451 to 900	1.2	0.9; 1.4	1.1[b]	0.8; 1.6	0.14	1.1	0.8; 1.5	1.1[b]	0.6; 1.9	0.68
901 to 5.000[a]	-	-	-	-		-	-	-	-	
Skin color										
White	1.4	0.8; 2.3	1.3[b]	0.08; 2.2	0.19	1.2	0.6; 2.4	1.2[b]	0.6; 2.4	0.57
Non-white[a]	-	-	-	-		-	-	-	-	
Social Support										
Marital Status										
Single. separated or widower	1.0	0.8; 1.2	1.0[c]	0.8; 1.3	0.66	0.9	0.2; 1.2	0.9[c]	0.6; 1.3	0.58
Married or in a stable relationship[a]	-	-	-	-		-	-	-	-	
Number of residents in the patient's home										
0 to 3	1.0	0.8; 1.3	1.0[c]	0.8; 1.2	0.94	1.1	0.8; 1.6	1.1[c]	0.8; 1.6	0.46
4 or more[a]	-	-	-	-		-	-	-	-	
Lifestyle										
Alcohol consumption										
Yes	1.1	0.9; 1.3	0.9[d]	0.7; 1.2	0.78	1.0	0.7; 1.4	0.9[d]	0.6; 1.3	0.53
No[a]	-	-	-	-		-	-	-	-	
Drug use										
Yes	1.2	0.9; 1.6	1.2[d]	0.9; 1.6	0.53	1.2	0.8; 1.9	1.2[d]	0.7; 1.9	0.55
No[a]	-	-	-	-		-	-	-	-	
Etiology of injury										
Violent	1.1	0.9; 1.3	1.1[e]	0.9; 1.4	0.29	1.2	0.9; 1.6	1.2[e]	0.9; 1.7	0.29
Accidental[a]	-	-	-	-		-	-	-	-	
Seriousness of injury										
Glasgow Coma Scale (upon admittance)										
Severe	1.4	1.2; 1.6	1.4[e]	1.2; 1.7	0.00*	1.9	1.4; 2.6	2.1[e]	1.5; 2.9	0.00*
Moderate	1.1	1.0; 1.2	1.1[e]	1.0; 1.2	0.07	1.0	0.8; 1.3	1.0[e]	0.8; 1.3	0.97
Mild[a]	-	-	-	-		-	-	-	-	
Duration of hospitalization (stated in days)										
≥15	1.6	1.3; 2.1	1.6[f]	1.3; 20	0.00*	2.1	1.5; 3,1	2.1[f]	1.4; 3.1	0.00*
0 to 14[a]	-	-	-	-		-	-	-	-	

Source: Own elaboration based on primary data.

PR = Prevalence ratio. APR = Adjusted prevalence ratio. 95% CI = 95% confidence interval.

a Reference value.
b Adjusted for age and socio-demographic variables.
c Adjusted for age, socio-demographic and social support variables.
d Adjusted for age, socio-demographic and lifestyle variables.
e Adjusted for age and socio-demographic variables.
f Adjusted for age and variables of the socio-demographic and seriousness of injury blocks.
*Statistically significant value.

and concentration (PR = 1.6; 95%CI [1.2; 2.1]), alteration in postural control (PR = 1.9; 95%CI [1.4; 2.5]), paresis or limb paralysis (PR = 1.4; 95%CI [1.1; 1.7]), cephalalgia, aphasia, alterations in personality and visual impairment. All the variables related to post-hospitalization therapeutic support also remained in the model – even in those cases in which clinical care was not received – and were associated with functional disability (PR = 1.5; 95%CI [1.2; 1.9]). It was also observed that

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Table 4a. Association between overall functional ability and symptoms reported six and twelve months post-injury in patients with traumatic brain injuries treated at the unit of reference. Salvador, Bahia, 2007- 2008.

Variables	Six months after traumatic brain injury (N=242)					Twelve months after traumatic brain injury (N=222)				
	PR	95%CI	APR	95%CI	*p*-value	PR	95%CI	APR	95%CI	*p*-value
Somatic symptoms										
Cephalgia										
Yes	1.3	1.1; 1.6	0.8[b]	0.6; 1.1	0.16	1.8	1.3; 2.6	0.8[b]	0.6; 1.1	0.26
No[a]	-	-	-	-		-	-	-	-	
Dizziness										
Yes	1.5	1.2; 1.9	1.2[b]	0.9; 1.6	0.29	1.8	1.3; 2.4	0.8[b]	0.6; 1.1	0.22
No[a]	-	-	-	-		-	-	-	-	
Fatigue										
Yes	1.5	1.2; 1.8	1.4[b]	1.1; 1.9	0.02*	1.3	1.0; 1.8	1.1[b]	0.9; 1.4	0.39
No[a]	-	-	-	-		-	-	-	-	
Cognitive-behavioral symptoms										
Memory Loss										
Yes	1.7	1.4; 2.2	0.9[c]	0.7; 1.3	0.73	2.9	1.8; 4.7	1.5[d]	1.1; 2.1	0.02*
No[a]	-	-	-	-		-	-	-	-	
Attention and concentration difficulties										
Yes	1.9	1.6; 2.3	1.6[c]	1.2; 2.1	0.01*	2.1	1.6; 2.8	0.9[d]	0.5; 1.4	0.50
No[a]	-	-	-	-		-	-	-	-	
Aphasia										
Yes	1.7	1.4; 2.0	1.3[c]	0.9; 1.8	0.19	2.3	1.7; 3.0	1.4[d]	1.2; 1.8	0.01*
No[a]	-	-	-	-		-	-	-	-	
Irritability										
Yes	1.7	1.3; 2.2	1.2[c]	0.8; 1.7	0.29	2.5	1.5; 4.2	1.5[d]	1.0; 2.2	0.03*
No[a]	-	-	-	-		-	-	-	-	
Alterations in personality										
Yes	1.7	1.4; 2.1	1.3[c]	0.9; 1.7	0.15	2.4	1.7; 3.2	1.2[d]	0.9; 1.5	0.27
No[a]	-	-	-	-		-	-	-	-	
Sensory-perceptual symptoms										
Hearing impairment										
Yes	1.3	1.0; 1.6	1.0[e]	0.7; 1.4	0.91	1.6	1.2; 2.2	1.3[f]	1.0; 1.6	0.07
No[a]	-	-	-	-		-	-	-	-	
Visual impairment										
Yes	1.4	1.1; 1.7	1.3[e]	1.0; 1.6	0.11	1.5	1.1; 2.1	0.8[f]	0.6; 1.2	0.24
No[a]	-	-	-	-		-	-	-	-	

Source: Own elaboration based on primary data.

PR = Prevalence ratio. APR = Adjusted prevalence ratio. 95%CI = 95% confidence interval.
[A] Reference value.
[b]Adjusted for age, household income, skin color, seriousness of injury, and somatic symptoms.
[c]Adjusted for age, household income, skin color, seriousness of injury, somatic symptoms six months post-injury and variables of the same block.
[d]Adjusted for age, household income, skin color, seriousness of injury, symptoms twelve months post-injury (cognitive-behavioral) and variables of the same block.
[e]Adjusted for age, household income, skin color, seriousness of injury, symptoms six months post-injury (somatic, cognitive-behavioral) and variables of the same block.
[f]Adjusted for age, household income, skin color, seriousness of injury, symptoms twelve months post-injury (cognitive-behavioral) and variables of the same block
*Statistically significant value.

orthopedic and kinesiological therapeutic treatments (respectively, PR = 1.2; 95%CI [1.0; 1.5] and PR = 1.3; 95%CI [1.0; 1.6]) were associated with the prevalence of functional disability, albeit with borderline statistical significance. In the case of the twelve-month model, the appearance of memory disorders (PR = 1.5; 95%CI [1.1; 2.1]), aphasia (PR = 1.4; 95%CI [1.2; 2.2]), alteration in postural control (PR = 1.8; 95%CI [1.2; 2.8]), paresis or limb paralysis (PR = 1.9; 95%CI [1.3; 2.7]) and limb fractures (PR = 1.5; 95%CI [1.1; 2.2]) were significantly associated with functional disability. A positive association between disability and irritability (PR = 1.5; 95%CI [1.0; 2.2]) as well as hearing

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Table 4b. Association between overall functional ability and symptoms reported six and twelve months post-injury in patients with traumatic brain injury treated at the unit of reference. Salvador, Bahia, 2007-2008.

Variables	Six months after traumatic brain injury (N=242)					Twelve months after traumatic brain injury (N=222)				
	PR	95%CI	APR	95%CI	*p-value*	PR	95%CI	APR	95%CI	*p-value*
Sensory-motor disorder										
Balance alteration										
Yes	2.1	1.6; 2.7	1.9[b]	1.4; 2.5	0.00*	2.1	1.5; 3.2	1.8[c]	1.2; 2.8	0.01*
No[a]	-	-	-	-		-	-	-	-	
Paresis or limb paralysis										
Yes	1.5	1.3; 1.8	1.4[b]	1.1; 1.7	0.01*	2.1	1.6; 2.8	1.9[c]	1.3; 2.7	0.01*
No[a]	-	-	-	-		-	-	-	-	
Locomotor disorder										
Limb fractures										
Yes	1.2	0.9; 1.5	1.2[d]	0.9; 1.5	0.28	1.6	1.2; 2.6	1.5[e]	1.1; 2.2	0.03*
No[a]	-	-	-	-		-	-	-	-	
Therapeutic support										
Neurological care										
No	1.0	0.8; 1.3	0.8[f]	0.6; 1.5	0.11	1.4	0.9; 1.9	0.9[g]	0.8; 1.0	0.76
Yes[a]	-	-	-	-		-	-	-	-	
Physiotherapeutic care										
No	1.6	1.4; 1.9	1.3[f]	1.0; 1.6	0.12	2.5	1.9; 3.2	2.2[g]	1.6; 3.2	0.01*
Yes[a]	-	-	-	-		-	-	-	-	
Orthopedic care										
No	1.3	1.0; 1.6	1.2[f]	1.0; 1.5	0.15	2.2	1.7; 2.9	2.8[g]	1.5; 5.0	0.00*
Yes[a]	-	-	-	-		-	-	-	-	
Clinical care										
No	1.5	1.2; 1.8	1.5[f]	1.2; 1.9	0.00*	1.4	1.0; 1.9	0.9[g]	0.8; 1.0	0.65
Yes[a]	-	-	-	-		-	-	-	-	

Source: Own elaboration based on primary data..

PR = Prevalence ratio. APR = Adjusted prevalence ratio. 95%CI = 95% confidence interval.
[a]Reference value
[b]Adjusted for age, household income, skin color, seriousness of injury, symptoms six months post-injury (somatic, cognitive-behavioral, sensory-perceptual) and variables of the same block.
[c]Adjusted for age, household income, skin color, seriousness of injury, symptoms twelve months post-injury (cognitive-behavioral, sensory-perceptual) and variables of the same block.
[d]Adjusted for age, household income, skin color, seriousness of injury, symptoms six months post-injury (somatic, cognitive-behavioral, sensory-perceptual and sensory-motor).
[e]Adjusted by age, household income, skin color, seriousness of injury, symptoms twelve months post-injury (cognitive-behavioral, sensory-perceptual and sensory-motor).
[f] Adjusted for age, household income, skin color, seriousness of injury, symptoms six months post-injury (cognitive-behavioral, sensory-perceptual and sensory-motor) and variables of the same block.
[g] Adjusted for age, household income, skin color, seriousness of injury, symptoms twelve months post-injury (cognitive-behavioral, sensory-perceptual and sensory-motor), locomotor disorder and variables of the same block
*Statistically significant value.

impairment (PR = 1.3; 95%CI [1.0; 1.6]) was also established, albeit with borderline statistical significance. The post-hospitalization therapeutic support variables (PR = 2.2; 95%CI [1.6; 3.2]), as well as lack of kinesiological and orthopedic care (PR = 2.8; 95%CI [1.5; 5.0]), remained significantly associated to functional disability.

Regarding the medical care received after hospital discharge, it was demonstrated that for every specialty researched, the SUS was the major funder. Of those patients who received neurological care, 57.6% were treated in institutions linked to SUS. The frequency distribution of medical consultations for kinesiological, orthopedic and clinical care was 69.1%, 85.8% and 74.4% respectively (data not shown).

The information presented in Table 5 shows that the model composed of socio-demographic variables for the six-month period served to explain 3.5% of functional disability. This percentage remained unchanged with both the inclusion of social support and lifestyle variables. It increased to 11.7% as a result of the inclusion of the seriousness of injury variables, and increased to 30% with the block of variables connected to somatic, cognitive-behavioral and sensory-perceptual symptoms. It

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Table 5. Assessment of the contribution of each block regarding the model adjustment.

Block of variables	-2nL	Number of variables	*p*-value	Explanatory power (%)
Six months post-injury				
Socio-demographic level	-156.8	3	0.01	3.5
Socio-demographic level + social support	-156.8	4	0.03	3.5
Socio-demographic level + lifestyle	-156.8	4	0.02	3.5
Socio-demographic level + etiology of the injury	-156.4	4	0.01	3.7
Socio-demographic level + seriousness of injury	-143.6	5	0.00	11.7
Socio-demographic level + seriousness of injury + symptoms	-113.1	15	0.00	30.0
Socio-demographic level + seriousness of injury + symptoms + sensory-motor disorders	-106.4	12	0.00	34.3
Socio-demographic level + seriousness of injury + symptoms + sensory-motor disorders + locomotor disorders	-105.8	13	0.00	34.7
Socio-demographic level + seriousness of injury + therapeutic support	-95.5	17	0.00	41.1
Twelve months post-injury				
Socio-demographic level	-148.2	2	0.18	1.1
Socio-demographic level + social support	-148.1	3	0.30	1.2
Socio-demographic level + lifestyle	-147.9	4	0.41	1.3
Socio-demographic level + etiology of the injury	-148.3	4	0.51	1.3
Socio-demographic level + seriousness of injury	-135.6	4	0.00	9.5
Socio-demographic level + seriousness of injury + symptoms	-109.6	14	0.00	26.0
Socio-demographic level + seriousness of injury + symptoms + sensory-motor disorders	-106.9	10	0.00	28.2
Socio-demographic level + seriousness of injury + symptoms + sensory-motor disorders + locomotor disorders	-104.1	11	0.00	30.1
Socio-demographic level + seriousness of injury + therapeutic support	-90.7	15	0.00	39.1

Source: Own elaboration.

increased to 34.7% after the addition of sensory-motor disorders. A higher proportion of cases (41.1%) were explained when all the model variables were included. The inclusion of the variable blocks seriousness of injury, somatic, cognitive-behavioral and sensory-perceptual symptoms, sensory-motor and locomotor disorders and post-hospitalization therapeutic support contributed significantly to the model. The adjustment of the model for the twelve-month period could also be observed.

DISCUSSION

This is the first Brazilian population-based study designed to estimate disability prevalence in

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young people and adults who suffered from TBI. A high frequency of moderate or severe overall functional disability was observed in those who suffered mild injuries (31.8%), as well as in those who suffered moderate (33.3%) or severe (62.3%) injuries one year after the episode. Such evidence is similar to the data found in studies conducted in developed countries, and suggests the need to invest in the follow-up and monitoring of those who suffer from this important condition. Also one year after the TBI episode, Thornhill *et al*. (22) estimated for the United Kingdom a 47% prevalence of moderate to severe disability in those patients who suffered from mild injuries, and 45% and 48% in those who suffered from moderate and severe injuries respectively. In Norway, Sigurdardottir *et al*. (9) identified similar disabilities in 36% of the patients followed after the TBI episode in the same period, regardless of the seriousness of the initial diagnosis. Due to the fact that the sequelae may be long-lasting and may compromise, for many years, the functional performance of individuals, the extrapolation of this information shows that every year new disabled people will join those who are already dealing with sequelae.

In the present study, it was found that an extended hospital stay, considered to be longer than fifteen days, had a strong association with moderate or severe overall functional disability; it therefore can be regarded as a marker of the seriousness of the injury and as an indicator of the need for care in the post-hospitalization stage. These results resemble those presented by other researchers (20,23-25). According to these authors, patients who suffer more severe injuries remain in hospital for a longer period, and may present greater functional compromise, which includes cognitive and musculoskeletal disorders.

Age, skin color, lifestyle, household income, aspects related to social support and the cause of injury were considered by American and European authors as factors associated with both the occurrence and the consequences of TBI. In the present study, this association was not confirmed, and only age was associated with functional disability six months post-injury. It may be possible that these findings reflect the homogeneous sociodemographic features of the population studied, which may have influenced the discriminatory power of these variables regarding the studied phenomenon.

In the present study, even a year after the TBI episode the prevalence of functional disability was significantly associated with fatigue, aphasia, irritability, and difficulties in attention, concentration and memory. The importance of identifying these symptoms lies in the fact that, although a large part of individuals recover rapidly, with a significant and progressive decrease in these types of discomforts up to six months post-injury, others will continue to suffer from these acquired disorders for much longer periods (26).

The persistence of somatic symptoms, such as cephalgia, dizziness and fatigue, compromises the patient's participation in rehabilitation activities by hindering the relearning of motor skills necessary not only for their reintegration into society, but also for appropriate functional performance in daily and productive activities. Somatic, perceptual, cognitive and emotional symptoms after the TBI episode suggest the appearance of post-concussion or post-traumatic syndrome (27-31). This condition, which can be frequently found in patients who did not need to be hospitalized or who suffered from post-traumatic amnesia for a period shorter than 24 hours and whose neuroimaging study results were satisfactory, is currently in question and is attributed to those who suffered from moderate and severe injuries. Symptoms include cephalgia, dizziness, fatigue, memory loss, nausea, tinnitus, visual impairment, loss of concentration and irritability. However, such symptoms are common to the general population, and cannot be considered pathognomonic *per se*. Thus, although the reliability of the data can be questioned in terms of the well-known recall biases in symptomatic populations (32), the accounts were consistent in both interviews, that is to say, six and twelve months post-injury.

Cognitive-behavioral disorders – such as difficulties with memory, attention and concentration; aphasia; irritability; and alterations in personality – not only compromise the learning of functional abilities, but they also affect communication and imply additional difficulties that patients and their relatives will have to overcome in order to make progress in rehabilitation (33). Although the nature of the memory disorders was

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not explored in the present study, it is known that the wide variation in the intensity of this symptom may be caused by alterations in the coding, storing and retrieval of information.

The association between functional disability and secondary postural control disorder in TBI has been studied by researchers such as Duong *et al*. (10), Greenwald *et al*. (11), and Basford *et al*. (34), which affirms the consistency of such associations. It is known that balance involves a complex interaction among sensory-perceptual, motor and musculoskeletal systems, and that discreet modifications in the integration of this information may imply alterations in overall functional ability and the resuming of everyday and leisure activities (35). In this research study, the alteration of postural control was significantly associated with the overall functional ability evaluated six and twelve months post-injury, even after adjusting for the following variable blocks: socio-demographic factors, seriousness of injury, and somatic, cognitive-behavioural and sensory-perceptual symptoms. The use of objective measures to quantify the extent to which balance is compromised may assist in the monitoring of mobility recovery and in the justification for assigning aid benefits or maintaining multi-professional rehabilitation activities.

In the current research study, paresis and plegia were also factors associated with functional disability. Generally, the occurrence of paresis or hemiparesis is attributed to strokes, but it may also occur in patients dealing with TBI sequelae and complicate their recovery. Hemiparesis can be the result of an epidural or subdural hematoma, and may derive from the development of a contra-lateral herniation in the area from the brain peduncles to the compression at the base of the midbrain. Neurologic injuries caused by the compression of the midbrain and the uncus herniation can be reversible, provided the compression is eliminated after it appears (19). Ktaz *et al*. (36) reported the appearance of hemiparesis in 17% of TBI patients who were followed and, among these, 82% recovered in the space of six months. In our study, the presence of hemiparesis or limb paresis occurred with a higher frequency than that reported in other previous studies, and recovery within a one-year period was not observed. It is possible that the difficulties in accessing rehabilitation treatment led to a less favorable result.

Patients who suffer from TBI may simultaneously experience other important related damages, such as fractures and other musculoskeletal injuries. When these problems are associated, they may foster the development of muscle contractions, particularly if they prevent patients from being placed, moved or set in a seated position outside of the bed or in a supported standing position. All fractures must be correctly treated in order to prevent patients from becoming functionally disabled to perform their social roles (37). However, due to the seriousness of certain brain injuries, many fractures may not be treated, and in the future may prevent progress in rehabilitation. Davies (18) emphasizes that the need for orthopedic correction may be present even years after the occurrence of the brain injury. In this study, approximately 20% of patients showed concomitant fractures, which were significantly associated with moderate or severe functional disability twelve months after the TBI episode, just when many injures become compromising for those who survived and started to show cognitive improvements.

The high prevalence of functional disability observed six and twelve months post-injury in the group which undertook physiotherapeutic treatment could be explained by the fact that more severe patients require more frequent treatment than those less compromised. However, it should be noted that among those patients who did not undertake this type of treatment, the prevalence of moderate or severe functional disability was also high, indicating the existence of severe cases which are not treated. When these patients were asked about the reasons for not undertaking rehabilitation, they primarily cited difficulties with transportation, lack of care options from the SUS near their homes, and lack of knowledge regarding the need for further treatment after being discharged. In this study, 42 patients received kinesiological treatment during the first six months after being discharged and 40 patients during the following six months. However, only 26 undertook treatment during both periods. Another element which may explain the high prevalence of moderate or severe functional disability among those who undertook kinesiological treatment is the fact that TBIs are multifocal injuries, whose motor sequelea may compromise several systems,

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such as cognitive-behavioral, sensory-perceptual and sensory-motor systems, the reason why a multi-professional approach would be the most appropriate intervention. The dysfunctions present in these patients require the attention not only of kinesiologists, but also of occupational therapists, speech-language pathologists, psychologists and physical educators, as part of a team of rehabilitation professionals.

In the relevant literature, the effectiveness of treatment in the functional recovery of patients who suffered neurological injuries is well-described. In this regard, neuroplasticity studies provide evidence that the brain responds to harm through reorganization and adaptation in restoring its functions (18,38-40). The traditional view of permanent loss of function and the possibility of obtaining little compensation after the brain injury is, in fact, refuted (38,39). Certain dormant areas of the brain can be specialized in order to substitute lost functions, and new networks can be created in order to compensate the effects of tissue injuries. However, in order to optimize rehabilitation, stimuli need to be intensive and repetitive in order to aid in the reorganization of the central nervous system (40). Bach-y-Rita (38) suggests that the brain gradually reorganizes itself in a series of stages. The idea that potential recovery could be completed after a period of six months to two years has been questioned, and it has been shown that rehabilitation can be effective even seven years after the occurrence of the initial injury. This highlights the importance of functional stimulation and the precocity of treatment as key factors in the process of neurological rehabilitation (38,41).

Several studies indicate that the evolution of the patient's functional ability depends not only on the development of a specific type of treatment, but also on multi-professional care, family participation, and the duration, intensity and timeliness of the interventions. The development of multi-professional rehabilitation activities has been recommended as an effective measure for recovering functional abilities in patients who suffered brain injuries. However, the appropriate intensity of treatment for the recovery of functional abilities has not yet been established, although several studies recommend a higher intensity treatment as an ideal measure in order to obtain more promising results (1,43,44). The duration of the recommended treatment in countries such as the US, England, Germany and France varies from two to four hours per day. However, treatment may vary from less than one hour to eight hours per day. Shiel *et al*. (44) carried out a prospective study in two treatment centers, whose therapeutic activities had different daily lengths. Sixty patients who had suffered from severe TBI were included in the study. In one of the two centers, rehabilitation activities lasted 402 minutes per week, and in the other the duration was 580 minutes. The assessed outcomes upon discharge and after one year showed that patients who performed rehabilitation activities more intensively benefited most; that is to say, they had quicker functional improvement and had short hospitalization periods. In the current study, few patients had access to multi-professional treatment, despite the fact that more than half of the patients suffered from balance disorders and many others showed an evolution accompanied by somatic, cognitive-behavioral and sensory-perceptual symptoms, paresis or plegia. It is worth remarking that many of these disorders were associated with functional disability.

Regarding the early or late initiation of rehabilitation activities, study results clearly suggest that the earlier the interventions are carried out, the better the possibilities are for rehabilitation. Such evidence has been employed by US professionals to demonstrate the effectiveness of rehabilitation programs that start as soon as possible. Rappaport *et al*. (45) compared patients who were admitted in a rehabilitation program within sixty days of the TBI episode with others who were admitted later. The patients were compared using the Disability Rating Scale according to the degree of severity of the injury at the time of admission in the rehabilitation program. The researchers reported an impact in the conditions of everyday life and work ability, and they verified that the long-term results were significantly related to the time elapsed between the injury and the admission to an intensive hospital rehabilitation program.

In Latin America and the Caribbean several rehabilitation programs for people with disabilities have been included in the health network, but not always in a coordinated way, and often only for a select group of people. In many countries, legislation has been passed in order to protect people

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with disabilities, and several specialization programs have been created for professionals working in rehabilitation services. With the support of private national and international organizations, projects to include specific areas of rehabilitation have been developed. However, in spite of the efforts made by the Pan-American Health Organization (PAHO), the most disadvantaged members of the population still have insufficient access to these care services. According to the PAHO (48), in Latin America and the Caribbean the public sector has limited participation in the development of rehabilitation programs, particularly in financial terms, as they are not considered a priority. In 1996, these countries had very few institutions which could provide rehabilitation services. In addition, the quality was inconsistent and objectives were seldom achieved, as a result of the shortage of resources and the little connection with the other areas dealing with comprehensive rehabilitation. Furthermore, it should be emphasized that comprehensive rehabilitation is the responsibility of both the private and public spheres, and not only in the health sector, but also in the areas of labor and education (48). Nevertheless, the health sector has the responsibility to provide care services and plan for the required demand in order to facilitate the social reintegration of those who suffer from this health problem.

In Bahia, as in Brazil as a whole, there are few comprehensive rehabilitation institutions. There still is a pending debate on whether national institutions really offer what is considered a comprehensive rehabilitation care proposal based on the observations in developed countries. Minayo and Deslandes (49) suggest that the existing service is absolutely insufficient, that services are scarce in the SUS network, and that this issue is not sufficiently hierarchized in the political agenda of the health sector. However, according to these authors there are rehabilitation centers linked to the municipal, provincial and federal public health network which are in position to respond to the needs arising from the current situation of injuries due to external causes in Brazilian cities.

One of the limitations of this study was the small study sample, which may have made it difficult to visualize the possible effects of other factors associated with functional disability. However, two major advantages should be emphasized: on the one hand, the strict training of interviewers; and, on the other, the home-based follow-up, which fostered the inclusion of severely disabled patients who did not have the necessary conditions to travel elsewhere in order to have outpatient or hospital assessments.

The findings of the study led to the conclusion that living with somatic, cognitive-behavioral, and sensory-perceptual symptoms, postural disorders and limb paresis may be the reality of many patients who suffer from TBI. In the Metropolitan Area of Salvador, the offer of services is unequal and does not contribute to the resolution of the issues that patients will have to deal with for long periods. Offering active rehabilitation and high intensity stimulation programs free of charge should be considered seriously as a policy of social inclusion, particularly for those whose functional performance does not permit their reintegration into daily life, society, and the workforce. Therefore, it is highly recommended that investment in the offer of specialized, multiprofessional rehabilitation services be made.

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