Impact of Pediatric Rehabilitation Services on Children’s Functional Outcomes

Christine C. Chen, Allen W. Heinemann, Rita K. Bode, Carl V. Granger, Trudy Mallinson

OBJECTIVES. Relatively little is known about the treatment effectiveness and functional outcomes of pediatric rehabilitation therapies. This study was conducted to gain knowledge of the type and quantity of inpatient rehabilitation services provided to children who received acute inpatient rehabilitation and compare functional gains by age and diagnosis.

METHOD. A retrospective cohort design was used. Records of rehabilitation therapies and functional assessments of 814 pediatric patients who received inpatient rehabilitation during 1996, 1997, and 1998 were collected. The admission and discharge item ratings of the WeeFIM® instrument were first transformed into interval-level measures of self-care, mobility, and cognition. Parametric analyses were used to compare functional gains across impairment groups and to examine the relationship between amount of treatment and functional gains.

RESULTS. Occupational therapy and physical therapy were the primary rehabilitation services received by patients across impairment groups (98% and 99%, respectively). A large proportion of children with traumatic brain injuries also received speech therapy (97%) and psychology services (60%). Across domains (self-care, mobility, cognition), the largest gains were made by children who were older than 7 years and had traumatic injuries. Functional gains were significantly related to the amount of discipline-specific treatment received, after controlling for age, impairment, and functional status at admission.

CONCLUSION. Rehabilitation therapy provision in pediatric inpatient rehabilitation varies greatly depending on children’s age and the nature of the impairment. Systematic reporting of type and quantity of rehabilitation therapies along with functional assessments before and after hospitalization would allow researchers to track functional changes and study the determinants of functional improvement.


KEY WORDS
• rehabilitation therapy
• treatment effectiveness
• WeeFIM®
Rehabilitation therapy services such as occupational therapy, physical therapy, and speech therapy are important components of pediatric inpatient rehabilitation. In certain centers, specialized teams (such as a TBI [traumatic brain injury] unit) may develop. In others, additional services (such as aquatic therapy, music therapy, special education, child life) may also exist to provide more child-focused treatments. However, with few guidelines for practice in pediatric inpatient rehabilitation, the degree of variability in type, intensity, and duration of rehabilitation therapy services provided remains unknown.

The relationships between the quantity (number of treatment units) of rehabilitation services and functional outcomes have not been well studied (Chen, Heinemann, Granger, & Linn, 2002; Dudgeon, 1996). Studies of functional outcomes of children receiving rehabilitation treatments have generally found that children make improvements in functional status (i.e., performance in activities of daily living) while receiving therapy services (Dorval, Tetreault, & Caron, 1996; Ottenbacher et al., 2000; Swaine, Pless, Friedman, & Montes, 2000). However, the extent to which gains are retained after termination of services is often unknown because few well-designed follow-up studies are available (Coster, Haley, & Baryza, 1994; Yung et al., 1999). Moreover, it often is not clear if gains made during treatment can be attributed to a particular type of treatment or a specific program. For example, comparison of traditional to contemporary aquatic therapy for adolescent children with cerebral palsy revealed that all children made functional gains in therapy, and the gains (measured by the WeeFIM® instrument) (Uniform Data System for Medical Rehabilitation [UDSMR], 1993) scores were equivalent across treatment groups (Dorval et al., 1996).

When comparing functional status after rehabilitation in children with TBIs, researchers found no significant difference in the mean WeeFIM scores at discharge in children who received well coordinated and more comprehensive rehabilitation services than those who received less coordinated and less comprehensive rehabilitation services (Swaine et al., 2000). In the latter study, when comparing two cohorts of patients with the same diagnosis and receiving care in the same facility (a pediatric trauma center) during two time periods where there were significant programmatic differences, no difference was found in functional outcome. The rehabilitation program provided only limited therapy services (mainly occupational therapy and physical therapy) during the earlier period (1993). During the later period (1995), it provided not only more comprehensive therapy (e.g., neuropsychology, social services, and speech therapy), but also better-coordinated services with two full-time staff coordinating therapy services (during rehabilitation), discharge planning (placement and transition), and follow-up services.

**Status of Pediatric Outcomes Studies in Occupational Therapy**

Much of the pediatric occupational therapy research has focused on the development or validation of instruments to measure outcomes of therapy (Bundy, Nelson, Metzger, & Bingaman, 2001; Coster & Haley, 1992; Daniels, 1998; Hwang, Davies, Taylor, & Gavin, 2002). In recent years, researchers have paid increasing attention to therapy efficacy and treatment effectiveness (Case-Smith, 2002; Vargas & Camilli, 1999). However, much of the research addresses school-based performances (e.g., sensory motor performances, handwriting, and ability to cope in the school environment) (Case-Smith et al., 1998; Coster, 1998). Investigations of day-to-day function pertaining to self-care and mobility within relevant contexts have been largely lacking (Coster, 1998; Coster et al., 1994). Since pediatric occupational therapy research has mostly focused on acquisition or development of component skills, it is usually age-, setting-, or impairment-specific. As a result, the treatment effect often remains small due to small sample sizes (Ottenbacher & Maas, 1999).

Occupational therapy plays a central role in pediatric inpatient rehabilitation (Dudgeon, 1996). In particular, it addresses issues in activities of daily living and school-related functioning. However, few large scale and systematic investigations of pediatric functional outcomes across age and disability categories have been reported. Reasons for the paucity of such research may lie in the methodological and practical challenges of its design and execution, including lack of clear understanding of what to measure, lack of time and resources to recruit subjects, and lack of valid and reliable disability-oriented assessments (Chen et al., 2002; Coster, 1998; Heinemann & Chen, 1999; Law et al., 1999). Until recently, most pediatric assessments used by occupational therapists either measure developmental achievements (milestones) or capture components of function by emphasizing the presence or absence of underlying capacities (Coster, 1998). Among the few assessments that measure disabilities, the Pediatric Evaluation of Disability Inventory (Haley, Coster, Ludlow, Haltiwanger, & Andrellos, 1992) and the WeeFIM instrument (UDSMR, 1993) are suitable for reporting functional status before and after rehabilitation.

**Purpose of the Study**

This study presents the findings of a preliminary investigation into the functional outcomes of children receiving inpatient rehabilitation therapies across three types of acute
rehabilitation settings. The objectives of the study were: to gain knowledge of the demographic characteristics of such children and the patterns of rehabilitation services they received, and to compare gains in functional abilities at discharge across age and impairment groups. Based on limited previous studies and our own clinical experience, we hypothesized that: (a) the amount of functional gain varies by impairment and age, and (b) children who receive more total rehabilitation therapy minutes would make the largest gains in functional status. This study was part of a larger outcomes study approved by institution review boards at the affiliating universities. Additional IRB approvals were obtained when participating institutions required separate approvals.

Methods

The overall plan of the study was to collect data from individual facilities on billed discipline-specific units of treatment (e.g., physical therapy, occupational therapy, etc.) and then link such data to the WeeFIM database (described below) where functional assessment data were collected and stored. Once treatment data and functional data were linked, analyses could be performed to compare functional gain in relation to amount of treatment received.

The WeeFIM instrument is designed to measure a child’s overall function using a “minimum data set” (Msall et al., 1994). The 18 items of the instrument measure global function of activities of daily living (see Table 1). Each year, pediatric medical centers and rehabilitation facilities in the United States subscribe to and use the WeeFIM instrument as their functional outcome measure. The facilities regularly submit data to Uniform Data System for Medical Rehabilitation (UDSMR, located at the State University of New York at Buffalo, 270 Northpointe Parkway, Suite 300, Amherst, New York) where the database is maintained. The submitted data include demographic (e.g., age, gender, ethnicity), clinical (e.g., etiologic diagnosis, rehabilitation impairment type, length-of-stay [LOS], date of onset of the impairment, time from rehabilitation admission to date of onset, setting from which the child is admitted to rehabilitation), functional (e.g., eating, dressing, locomotion), and payment information (e.g., payer source, gross rehabilitation charge). Because such data are collected systematically and incorporated in a national database, researchers are able to examine functional changes on a large scale, and compare rehabilitation outcomes across age, diagnoses, and over time (UDSMR, 1993).

Recruitment and Data Collection

Program coordinators of the Uniform Data System for Medical Rehabilitation WeeFIM subscribers were contacted for consent to use the information in the database. The researchers sent a letter explaining the purposes of the study, and coordinators returned signed informed consent forms. In order to gather facility and treatment specific information not routinely collected as part of the WeeFIM database, a two-page survey was sent to the coordinators with questions about each facility (e.g., size of the facility, accreditation status, room per diem rate, services included within per diem, type of billed services, and full-time equivalency [FTE] of rehabilitation personnel employed) and the patients (e.g., dates of birth, admission, discharge, impairment, rehabilitation LOS, type and units of rehabilitation services received, and total therapy charges). Data, which were primarily extracted from patient billing or treatment records, or both, were entered by coordinators into a spreadsheet for transmittal to the researchers by mail or as e-mail attachments. The records were subsequently merged, cleaned, and linked to the WeeFIM database.

Instrumentation

The WeeFIM instrument, developed by a multidisciplinary task force in the early 1990s (UDSMR, 1993), was designed to measure functional outcomes of pediatric patients receiving medical rehabilitation. The assessment is intended for use with children ages 6 months to 7 years who have acquired or congenital disabilities, but it may also be used with older children or adolescents who are delayed in the development of functional abilities (Deutsch, Braun, & Granger, 1996). WeeFIM mirrors the organization and for-
mat of the Functional Independence Measure for Adults (FIM; UDSMR, 1997) and contains 13 motor and 5 cognitive items encompassing self-care, sphincter, locomotion, communication, and social cognition domains (Lollar, Simeonsson, & Nanda, 2000; Msall et al., 1994). It has a 7-level rating scale that assesses the extent of assistance needed to perform functional tasks, with 1 indicating total dependence and 7 indicating complete independence. Usually researchers report the means and standard deviations of the composite domain scores (i.e., the sum of ratings of all items in each domain). Reliability and validity of WeeFIM have been established (Ottenbacher et al., 1996; Ottenbacher et al., 1997; Ottenbacher et al., 1999), as has its utility to detect clinical changes (Ottenbacher et al., 2000).

**Data Cleaning and Inclusion Criteria**

Data for this study were collected on 910 patients discharged from 12 facilities during 1996, 1997, and 1998. An additional 20 facilities were willing but unable to participate because they lacked separate billable units for each rehabilitation discipline. All of the submitted records (admission, discharge dates, date of birth, or billing period) were compared to the records in the WeeFIM database. Cases with incongruent records were deleted from the study (n = 25). Patients with a LOS less than 5 or more than 150 days were not included (n = 39). Records with LOS of 4 days or less indicated short stays for evaluation only, while those with LOS over 150 days were excluded because the LOS exceeded three standard deviations from the mean LOS of the sample. Children younger than 12 months or older than 20 years were excluded (n = 32). Children under 12 months were not included because they are dependent on almost all WeeFIM items. Children older than 20 years were not included because they usually are assessed by the adult FIM, according to the WeeFIM Users Guide (UDSMR, 1993). Table 2 provides a summary of patient characteristics for the 814 cases included in the final analyses.

**Rating Scale Analysis (RSA)**

Following the approach of previous authors, data were transformed to an interval scale using Rasch analysis

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1 Each facility was offered an honorarium up to $200.
2 Dates submitted by the facilities differed from the dates recorded in the WeeFIM® database.
3 In the tradition of the Rasch measurement model that includes Rating Scale Analysis, “measures” is used for person ability, “calibration” is used for “item difficulty.” These terms are used as distinctive from “scores,” which is commensurate with “raw data.” In the subsequent portion of this paper, “measures” and “calibrations” will be used to indicate Rasch transformed points, “scores” to indicate nontransformed WeeFIM® scores.

(Granger, Hamilton, Linacre, Heinemann, & Wright, 1993; Heinemann, Linacre, Wright, Hamilton, & Granger, 1993, 1994; Linacre, Heinemann, Wright, Granger, & Hamilton, 1994). Construct unidimensionality and fit to the measurement model were established. Contact the first author for details.

Previous research showed that the FIM instrument contains two subsets of items, or two subdomains, motor and cognitive, and that patients within different impairment groups are admitted with different motor and cognitive patterns and achieve different extent of gain during rehabilitation (Granger et al., 1993; Heinemann et al., 1993, 1994; Linacre et al., 1994). Our previous research using subacute patient (adult) FIM data suggested that within the motor domain, self-care and mobility can be further separated (Chen et al., 2002). The subdomains of self-care, mobility, and cognition have been replicated with WeeFIM. The self-care scale contains WeeFIM items 1 to 6 (eating, grooming, bathing, upper-body dressing, lower-body dressing, and toileting); the mobility scale contains items 9 to 13 (transfer items, locomotion, and stair climbing); and the cognition scale contains items 14 to 18 (comprehension, expression, social interaction, problem solving, reasoning, memory, and learning).

### Table 2. Sample Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>465</td>
<td>(57)</td>
</tr>
<tr>
<td>Female</td>
<td>346</td>
<td>(43)</td>
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<tr>
<td><strong>Race</strong></td>
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<td></td>
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<tr>
<td>Caucasian</td>
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<td>(64)</td>
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<tr>
<td>African-American</td>
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</tr>
<tr>
<td>Hispanic-American</td>
<td>65</td>
<td>(8 )</td>
</tr>
<tr>
<td><strong>Admit From</strong></td>
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<td></td>
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<tr>
<td>Home</td>
<td>255</td>
<td>(31)</td>
</tr>
<tr>
<td>Acute—Own</td>
<td>151</td>
<td>(19)</td>
</tr>
<tr>
<td>Acute—Other</td>
<td>380</td>
<td>(47)</td>
</tr>
<tr>
<td><strong>Pre-Rehabilitation Setting</strong></td>
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<td></td>
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<tr>
<td>Home</td>
<td>773</td>
<td>(95)</td>
</tr>
<tr>
<td>Acute—Own</td>
<td>7</td>
<td>(1 )</td>
</tr>
<tr>
<td>Acute—Other</td>
<td>8</td>
<td>(1 )</td>
</tr>
<tr>
<td><strong>Discharge Setting</strong></td>
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<td></td>
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<tr>
<td>Home</td>
<td>745</td>
<td>(91)</td>
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<td>Nursing Home</td>
<td>4</td>
<td>(5 )</td>
</tr>
<tr>
<td>Rehabilitation Facilities</td>
<td>18</td>
<td>(2 )</td>
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<tr>
<td>Acute Units</td>
<td>23</td>
<td>(3 )</td>
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<tr>
<td><strong>Discharge Live With</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two Parents</td>
<td>314</td>
<td>(39)</td>
</tr>
<tr>
<td>One Parent</td>
<td>199</td>
<td>(24)</td>
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<tr>
<td>Relatives</td>
<td>37</td>
<td>(5 )</td>
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<tr>
<td>Foster Care</td>
<td>12</td>
<td>(2 )</td>
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<tr>
<td>Other (or missing)</td>
<td>252</td>
<td>(31)</td>
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<tr>
<td><strong>Primary Payer</strong></td>
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<tr>
<td>Medicaid</td>
<td>263</td>
<td>(32)</td>
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<tr>
<td>Commercial</td>
<td>286</td>
<td>(35)</td>
</tr>
<tr>
<td>HMO</td>
<td>216</td>
<td>(27)</td>
</tr>
<tr>
<td>Private Pay</td>
<td>16</td>
<td>(2 )</td>
</tr>
</tbody>
</table>

N = 814

*Note.* Total percentages may not add up to 100 due to “other” or “missing”

*Three participants are missing; percentages are rounded to nearest whole number*
memory) (see Table 1). Bowel and bladder were not included because they had large misfit statistics, suggesting incongruences between observed and expected responses (Linacre et al., 1994).

"Item difficulties" (item calibrations) and "child ability" (person measures) were simultaneously calibrated for self-care, mobility, and cognition subscales using Winsteps Software (Linacre, 2001). Measures and calibrations are reported as transformed-logits on a 0 to 100 scale for ease of interpretation (Linacre & Wright, 2000). For child ability measures, higher measures correspond to a higher level of functional ability. The person and item separation reliabilities (an indication of the precision with which the test captures the construct of functional ability) are more than adequate for each of the subscales, ranging from .90–.99 (Fisher, 1992; Wright, 1996).

**Parametric Analyses**

Descriptive analyses were used to examine demographic and clinical characteristics of children who received inpatient rehabilitation, and therapy service provision patterns among different impairment groups. Multivariate analysis of covariance (MANOVA) was used to compare the mean gains in self-care, mobility, and cognition across impairment groups, with age, LOS, and logarithms of total treatment intensity as covariates (Kleinbaum, Kupper, & Muller, 1988). Treatment intensity was calculated as the sum of all 15-minute units of treatment (occupational therapy, physical therapy, speech therapy, and psychology services combined) divided by total days of LOS. Regression analyses were used to examine the unique contribution of predictor–independent variables (i.e., age at admission, functional status at admission, and logarithm of total combined units or units of discipline-specific treatment, namely occupational therapy, physical therapy, speech therapy) to the outcome–dependent variable (i.e., gain in self-care, mobility, or cognition).

**Results**

**Facility Characteristics**

Of the 12 facilities that submitted records, four were comprehensive medical and trauma centers (providing a total of 208 records), four were freestanding rehabilitation facilities (n = 431 records), and four were children's specialty hospitals (n = 175). The size of hospitals ranged from 36 to 550 total beds, with 6 to 52 as designated rehabilitation beds. The average per diem rate was $557 in 1996, $567 in 1997, and $609 in 1998 ($290–$840 in 1996 and 1997; $299–$951 in 1998). All 12 facilities provided occupational therapy (with an average of 3.1 FTE of occupational therapists), physical therapy (3.5 FTEs of physical therapists), speech therapy (2.4 FTEs of speech therapists), and psychology services (1.8 FTEs of psychologists). Occupational therapy, physical therapy, and speech therapy units were separately billed. Psychology and other services such as social work, life task (in 6 of 12 facilities), respiratory therapy (4 facilities), cognitive therapy (9 facilities), education or tutorial (10 facilities), or recreational therapy (8 facilities) were often offered but not separately billed. In addition, child life, art therapy, music therapy, aquatic therapy, and nutrition counseling were offered in one to two facilities.

**Demographic and Clinical Characteristics of Children Receiving Inpatient Rehabilitation**

Four impairment groups represented in the sample had more than 50 children each: traumatic brain injury (TBI; n = 336), nontraumatic brain injury (NTBI; n = 114)4, cerebral palsy (CP; n = 91), and major multiple trauma5 (MMT; n = 57). We used “other” to capture children with an assortment of their impairments such as juvenile arthritis, burns, spina bifida, feeding disorder, amputation, congenital limb deficiency, or all six. Two hundred fifty nine children (32%) were younger than 84 months of age at admission (i.e., < 7 years), and 555 children (68%) were 84 months or older (i.e., > 7)6. Patients’ age, LOS, and WeeFIM admission, discharge and change scores are summarized in Table 3. Because clinicians are more familiar with raw FIM scores, we present the descriptive statistics of admission and discharge, FIM as both raw scores and Rasch-transformed measures. FIM gain is calculated as the difference in FIM score between admission and discharge. FIM efficiency is calculated as total FIM gain divided by net LOS. Both FIM gain and FIM efficiency are performance measures frequently referred to in the literature (Fiedler, Granger, & Russell, 1998).

**Rehabilitation Therapies Received During Inpatient Rehabilitation**

Total (15-minute) units of rehabilitation therapy (occupational therapy, physical therapy, speech therapy, and psychology combined) ranged from 23 to 2079 units. This range corresponds closely to LOS, which ranged from 5 to 145 days (r = .91). The mean and standard deviations of

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4 Includes encephalus, brain tumor, anoxia, seizure, and others.

5 Major multiple trauma refers to those who sustain multiple combined traumatic injuries such as brain and spinal cord injuries; brain injury and multiple fractures or amputation; or spinal cord injury and multiple fractures or amputation.

6 Children were classified as older (> 7) or younger (< 7) because WeeFIM® is normed up to 7 years of age.
total therapy units are as follows: cerebral palsy: 229 (± 135) units; non-TBI: 290 (± 201); TBI: 352 (± 289); MMT: 435 (± 351); “other”: 262 (± 221). Both occupational therapy and physical therapy were the primary therapy services received. Ninety-eight percent of the children (796/814) received occupational therapy with an average of 3.62 (± 1.26) units per day. Ninety-nine percent (807/814) received physical therapy with an average of 3.59 (± 1.27) units per day, followed by speech therapy (651/814) with an average of 2.65 (± 1.40) units per day, and psychology services (420/814) with an average of 1.56 (± 1.36) units per day. Children with TBI received the highest combined total therapy units per day (on average 10.8 units, 160 minutes) while children with cerebral palsy received the least amount of therapy with 8.6 units (129 minutes) on average per day. Children with TBI received more speech therapy and psychology services than the other impairment groups. Figure 1 shows the mean rehabilitation therapy units received by impairment group.

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Table 3. Descriptive Statistics by Impairment Group

<table>
<thead>
<tr>
<th>IMPAIRMENT</th>
<th>CP (n = 91)</th>
<th>NTBI (n = 114)</th>
<th>TBI (n = 336)</th>
<th>MMT (n = 57)</th>
<th>Other (n = 216)</th>
<th>Total (N = 814)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in months)</td>
<td>87 (48)</td>
<td>104 (62)</td>
<td>133 (63)</td>
<td>157 (55)</td>
<td>137 (63)</td>
<td>126 (64)</td>
</tr>
<tr>
<td>Onset Days²</td>
<td>845 (1554)</td>
<td>96 (415)</td>
<td>35 (171)</td>
<td>29 (60)</td>
<td>199 (768)</td>
<td>178 (723)</td>
</tr>
<tr>
<td>Range</td>
<td>0–6782</td>
<td>0–3978</td>
<td>0–2780</td>
<td>1–407</td>
<td>0–5207</td>
<td>0–6782</td>
</tr>
<tr>
<td>Length of Stay</td>
<td>27 (16)</td>
<td>30 (22)</td>
<td>33 (26)</td>
<td>40 (31)</td>
<td>28 (21)</td>
<td>31 (24)</td>
</tr>
<tr>
<td>Range</td>
<td>5–85</td>
<td>5–123</td>
<td>5–145</td>
<td>7–119</td>
<td>5–120</td>
<td>5–145</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Raw FIM Scores³</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission Total FIM</td>
<td>41 (20)</td>
</tr>
<tr>
<td>Discharge Total FIM</td>
<td>56 (25)</td>
</tr>
<tr>
<td>FIM Gain</td>
<td>15 (14)</td>
</tr>
<tr>
<td>FIM Efficiency</td>
<td>.60 (.65)</td>
</tr>
</tbody>
</table>

Rasch-Transformed Measures

<table>
<thead>
<tr>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission Self-Care</td>
</tr>
<tr>
<td>Discharge Self-Care</td>
</tr>
<tr>
<td>Self-Care Gain</td>
</tr>
<tr>
<td>Admission Mobility</td>
</tr>
<tr>
<td>Discharge Mobility</td>
</tr>
<tr>
<td>Mobility Gain</td>
</tr>
<tr>
<td>Admission Cognition</td>
</tr>
<tr>
<td>Discharge Cognition</td>
</tr>
<tr>
<td>Cognition Gain</td>
</tr>
</tbody>
</table>

1CP = Cerebral Palsy, NTBI = Nontraumatic Brain Injuries, TBI = Traumatic Brain Injuries, MMT = Major Multiple Trauma, Other = Other impairments
2Interquartile range of onset (time from diagnosis of impairment to rehabilitation admission): CP 3–1525 days, NTBI 1–38 days, TBI 6–19 days, MMT 7–23 days, Other 8–42 days
3FIM = WeeFIM® (Functional Independence Measure for Children)(UDSMR, 1993)

Figure 1. Mean Therapy Units (15-Minute) by Impairment.

N = 814
CP = Cerebral Palsy, NTBI = Nontraumatic Brain Injuries, TBI = Traumatic Brain Injuries, MMT = Major Multiple Trauma, Other = Other impairments
Functional Gains During Rehabilitation

Between admission and discharge, children made an average gain of 25.5 (± 20.3, SD) Rasch transformed points in self-care, 24.7 (± 18.1) points in mobility, and 17.2 (± 19.3) points in cognition. Taking self-care as an example, 7 (1%) children lost function by discharge, 102 (12.5%) remained the same, and 705 (86.6%) made positive gains. Large standard deviations also indicate that there were large variations among children in terms of their making functional improvement.

We first examined the differences in functional gain (self-care, mobility, cognition) by impairment with age as a covariate. MANOVA revealed significant differences in functional gains among impairment groups (F = 17.49, df = 12, 2127), after controlling for age (at admission), LOS and treatment intensity. Separate univariate analyses (one-way analysis of variance for self-care gain, mobility gain, and cognitive gain) further confirmed that both impairment and age group are significantly related to the amount of functional gain. Scheffé post hoc analysis (Scheffé, 1959; SPSS, 2002) indicated that children who were older than 7 years of age and had a TBI (n = 245) or major multiple trauma (n = 50) made significantly larger gains in all areas of function (self-care, mobility, and cognitive) than children without a traumatic injury (children with cerebral palsy, non-TBIs, or “other” conditions, n = 266). Moreover, among younger children (< 7 years of age), those who had TBIs (n = 91) made significantly more self-care gains than children with non-TBIs or with “other” conditions, they also made more mobility and cognitive gains than children with cerebral palsy (n = 59), nontraumatic brain injuries (n = 44) or “other” conditions (n = 52).

Next, we examined the impact of therapy on functional gains (self-care, mobility, and cognition). Since the previous analysis indicated that children with traumatic injuries make, on average, larger gains than children with nontraumatic injuries, we collapsed impairment groups into traumatic (TBI and MMT) and nontraumatic (cerebral palsy, non-TBIs, or “other” conditions, n = 266). Moreover, among younger children (< 7 years of age), those who had TBIs (n = 91) made significantly more self-care gains than children with non-TBIs or with “other” conditions, they also made more mobility and cognitive gains than children with cerebral palsy (n = 59), nontraumatic brain injuries (n = 44) or “other” conditions (n = 52).

![Table 4. Prediction of Gain in Self-Care, Mobility and Cognition](https://www.ajot.org/sites/default/files/2018-08/Table4.png)

The results indicate that, depending on the domain, variances explained by the model ranged from .23 to .40 suggesting that, together, the predictor variables in the model explained 23–40% of the variations in functional domain gains among children in the sample. This range is comparable to findings on adult functional gains (Chen et al., 2002; Heinemann, Hamilton, Linacre, Wright, & Granger, 1995). Children improved more in self-care if they were more than 7 years of age, had lower self-care measures at admission, had traumatic injuries, and received more occupational therapy. Children improved more in mobility if they were more than 7 years of age, had lower mobility measures at admission, had traumatic injuries, and received more physical therapy. Children improved more in cognition if they were more 7 years of age, had lower cognition measures at admission, had traumatic injuries, and received more speech therapy. The regression analyses of self-care, mobility, and cognitive gain, the variance (adjusted R²’s), the standardized coefficients (β represents the relative contribution of each independent variable when all other variables are controlled for) and the F statistics are summarized in Table 4.

Discussion

We hypothesized that functional gains, as measured by the WeeFIM instrument, vary depending on impairment, age, and units of therapy received. The results of our study support these hypotheses. Significant differences in gains across age and impairment groups were observed: Children older than 7 years and those with a traumatic injury (such as TBI...
or MMT) made larger gains than children younger than 7 years and with a nontraumatic injury. The amount of total treatment (combined occupational therapy, physical therapy, speech therapy, and psychology services), as well as discipline-specific treatment (e.g., occupational therapy alone, physical therapy alone, or speech therapy alone), significantly contributed to gains in self-care, mobility, and cognition after controlling for age group, impairment type, and admission functional status. However, the amount of treatments, combined or discipline-specific, moderately and negatively correlated with admission functional status (Pearson r’s are between -.48 and -.50), and positively correlated with LOS (between .67 and .85). Such correlations tend to suppress the influence of other variables in the model. Thus it is likely that occupational therapy and other discipline-specific treatments may be more effective than they appear.

Previous studies had reported overall outcomes after rehabilitation (Boyer & Edwards, 1991; Coster et al., 1994; Di Scala, Grant, Brooke, & Gans, 1992; Dorval et al., 1996). However, reporting of functional outcomes (essential activity of daily living) as a result of specific rehabilitation interventions has been lacking (Dudgeon, 1996). The results of this study provide preliminary evidence that the use of more (combined) therapy and more discipline-specific therapy that targets a specific domain (i.e., occupational therapy treatment targets gains in self-care; physical therapy treatment targets gains in mobility; speech therapy treatment targets gains in cognition) have significant effects on functional gains in the targeted domain.

It is also noticed that, among those who did not make self-care gains (remained the same or lost function, n = 109), some had very long rehabilitation stays and received substantial amounts of treatment. These study participants (those who did not improve) had an average of 35 days (+ 30 days) of LOS as contrasted with 30 days (+ 23 days) of LOS for those who improved their self-care function. Additional t tests support that there are statistically significant differences in age and admission status between children who made functional gains and those who did not. Differences in LOS, however, were not significant. As a group, those who did not make functional gains (remaining the same or lost function) were younger, and had substantially lower functional status at admission than those who made functional gains.

Generally speaking, children with traumatic injuries stayed longer, received more rehabilitation services (therapy type), and more minutes of therapy (quantity). However, there is wide variation in the amount of individual therapies they received. Functional status at admission is an important predictor for functional gains. Those with lower admission function gained more. Age seems to be an important moderating variable that influences the amount of functional gain during rehabilitation. However, it is not clear how age may interact with functional gain or relearning of skills or both. That is, since most children with traumatic brain injuries or major multiple trauma were older, they had already learned most functional skills prior to their injuries, as contrasted with their age peers who had cerebral palsy who had never mastered many of the functional skills. It is also not clear to what extent a more diffused and generalized brain dysfunction such as may accompany cerebral palsy, anoxia, or early onset encephalitis may limit the child from learning functional skills and making substantial gains.

**Limitations**

The results of this study should be interpreted in light of the following study limitations. First, only 12 of 32 eligible facilities participated in the study; the results may not be generalizable beyond the current sample. Moreover, since we were unable to obtain any data from the nonparticipating facilities, it is not clear if there are important programmatic differences between participating and nonparticipating facilities in terms of their rehabilitation philosophy, treatment focus or efforts when treatments were not separately billed. Third, as in most real-life clinical studies, the variables that affect functional outcomes are moderately to highly correlated with one another. Therefore, caution should be taken when interpreting the magnitude or influence of predictors.

**Implications for Occupational Therapy**

This is one of the first studies that has attempted to examine rehabilitation outcomes in relation to quantity of treatment in pediatric inpatient rehabilitation settings. Our data suggest that children receiving inpatient rehabilitation are heterogeneous in their age, gender, diagnoses, and severity of disability, with traumatic brain injuries as the largest impairment group (41% of our sample). Most children undergoing inpatient rehabilitation receive occupational and physical therapy, however, speech therapy and psychology services are provided more selectively to those who need such treatments. The majority of the children improved function after receiving rehabilitation, however, older children (age greater than 7) with a traumatic injury and low functional level at admission seemed to improve most. The amount of rehabilitation therapy did uniquely contribute to gains in self-care, mobility and cognition, after controlling for other predictor variables.
The current research has important implications for the profession of occupational therapy. First, occupational therapists are concerned about patients’ day-to-day function but few studies have documented children’s functional gains after their inpatient rehabilitation stays. This study provides preliminary evidence of the effectiveness of rehabilitation therapies. In today’s health care environment, as payers step up their demands for monitoring cost and patient care, it is important to document functional outcomes and treatment effectiveness. Using a database approach to conducting large-scale studies allows for comparison of patients across impairments and over time. Such studies can provide payers with a more comprehensive view of the effectiveness of rehabilitation therapies.

Moreover, physical therapists and occupational therapists often perform assessments focusing on measurement of underlying impairment rather than disability. Although understanding symptoms or impairments or both may help clinicians plan targeted treatment, we do not know the extent to which reduction of impairment is translated into improved functional performance. Nor is there sufficient evidence that impairment-focused treatment is effective in terms of patient function. By contrast, an assessment such as WeeFIM that captures changes in functional independence may be more meaningful to family members and school personnel who are providing assistance in self-care, ambulation, and transfer (Ottenbacher et al., 1999).

Conclusion

This study has demonstrated that the majority of children receiving inpatient rehabilitation improve in the area of self-care, mobility, and cognition. It is recommended that functional assessment should be routinely performed by rehabilitation therapists to track changes and document treatment effectiveness. Future replication research should include a larger sample of children and more facilities.

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