LSHSS

Research Article

Describing the Composition of Individualized Education Plans for Students With Traumatic Brain Injury

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Purpose: The purpose of this study was to explore and describe the features of Individualized Education Plans (IEPs) for a cohort of students with traumatic brain injury (TBI) to help elucidate current special education practices for students with TBI.
Method: We obtained permission from administrators of a local school district of 41,000 students in a Midwestern state to review de-identified IEP records of students verified with TBI. We examined demographic information (i.e., cause and age at time of injury), IEP services and intensity, IEP goal categories, and previous verification status.
Results: Descriptive results support that intervention services were more intense for students with TBI with greater lengths of time postinjury. Target behaviors within goals were more often related to math and reading than to the cognitive processes that govern these skills, such as attention, memory, and executive functioning. Finally, more than a third of our sample had been verified with a disability and were receiving special education services via an IEP prior to their TBI.
Conclusions: This work represents an important first step in understanding the special education services for students with TBI. Future research should explore interventions that are ecologically valid for school-based settings and are developed to address the idiosyncratic deficits of students with TBI, particularly interventions that focus on the underlying cognitive processes experienced by these students.

Pediatric traumatic brain injury (TBI) is a high-incidence medical issue in the United States (Centers for Disease Control and Prevention [CDC], 2019). The most recent incidence reports indicate approximately 812,000 children had TBI-related emergency department visits, and 23,000 of these resulted in hospitalizations in the United States in 2014 (CDC, 2019). Furthermore, a recent study examined parent reports of children between birth and age of 17 years who had a history of TBI, and estimated 1.8 million children in the United States had been diagnosed with TBI or concussion (Haarbauer-Krupa, Lee, et al., 2018). This finding supports estimates from Zaloshnja et al. (2008) that 145,000 children between birth and age of 19 years live with long term-disability resulting from TBI. In general, the number of individuals seeking emergency department services for TBI has increased over the last 10 years (CDC, 2019).

Regardless of the severity, pediatric TBI can result in brain damage that disrupts typical cognitive growth and development (Crowe et al., 2015; Popernack et al., 2015), which considerably affects academic performance and social interactions (Ettel et al., 2016; Sesma et al., 2008). Common deficits associated with TBI include poor attention, memory, and executive functioning, as well as cognitive–linguistic skills (Aldrich & Obrzut, 2012; Babikian et al., 2015; Slomine & Locascio, 2009). Psychosocial changes, sensorimotor impairments, and physical concerns may also be present (Ashman et al., 2006; Jantz & Coulter, 2007).

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Given the variability of severity and location of the lesion, considerable heterogeneity is noted across characteristics.

Children With TBI Are an Underserved Population

The number of school-age children with TBI reentering the educational system and being identified for special education services under the auspices of the Individuals with Disabilities Education Act (IDEA, 2004) has increased. In 2018, the number of students verified had increased 68% since the year 2000 (U.S. Department of Education, National Center for Education Statistics, 2019). Despite an influx in the number of students with TBI and subsequent special education services in the schools, researchers and professional educators agree that this population is likely underrepresented and underserved academically (Gioia et al., 2016).

Although 145,000 children live with lasting impairment of TBI, a fraction of these students receive special education services under the TBI category according to IDEA (Schutz et al., 2010). For example, in the 2017–2018 school year, the U.S. Department of Education reported only 27,000 students with TBI received special education services under IDEA (U.S. Department of Education, 2018). Recently, Glang et al. (2015) found over half (25 of 49) of the state special education directors who were surveyed acknowledged that students with TBI were not accurately identified in their respective state. The disparity between the pediatric TBI count in the United States and students actually served by the school systems is likely attributable to a variety of factors, including challenges with TBI identification and assessment for services.

Students with TBI are not always easily identifiable for several reasons. Although these reasons are not limited to a finite list, some may include time of onset, accurate report of injury, additional disabilities, and/or category of brain injury. Some brief explanations of these are as follows. First, the event that caused the TBI may have occurred before the child reached school age, and the information may not have been reported when the child entered school (Haarbauer-Krupa, Lee, et al., 2018). A second factor is that nonaccidental trauma, such as abuse or neglect, is likely underreported (Escobar et al., 2016). In addition, tracking students with TBI is difficult because some may already be receiving services under another primary disability when the TBI occurs. Co-occurrence of TBI with other health conditions is common (Haarbauer-Krupa, Lundine, et al., 2018). In such instances, services may continue with changes and accommodations applied, as needed, for the newly acquired characteristics associated with the TBI; however, a change in official eligibility category may not occur. If the new TBI diagnosis is not added to the educational record, future educators may never receive information about the co-occurring TBI and may consequently misassign learning difficulties.

Furthermore, students with no TBI are typically categorized under other health impaired instead of TBI (Dettmer et al., 2018; Prasad et al., 2017). This may be a result of how a particular state defines TBI or because of the confusion between acquired brain injury (ABI) versus TBI. Specifically, ABIs are those that are not congenital or developmental in nature. Examples of ABI include stroke, tumor, and hypoxic injuries (Ashley et al., 2016). TBI, injury caused by impact or inertial forces,is a subcategory of ABI. The shared characteristic of both types of injury is that brain development and maturation is disrupted at the time of damage. For our purposes, TBI will be used throughout.

TBI, as an etiology for disabilities, is often missed by educational professionals. Referrals to evaluate students with a potential disability often originate from teachers, yet, in many cases, educators are unaware of the diverse cognitive, behavioral, and social deficits associated with TBI (Glang et al., 2015). For example, Clark et al. (1999) found that many teachers attribute behavioral problems subsequent to TBI as premorbid conditions and did not recognize them as a symptom of the TBI sequela. Likewise, teachers do not often attribute deficits of students who sustained a TBI prior to school age to their injury (Ettel et al., 2016).

Finally, students with a mild-to-moderate TBI may receive fewer services or no services at all (Prasad et al., 2017). Although the majority of impairments caused by mild TBI are not permanent, lack of services can be problematic for students with mild TBIs, which may still result in persistent deficits in cognitive, motor, emotional, and behavioral domains (Babikian et al., 2015; Dettmer et al., 2018). Taken together, lack of consistency and continuity in early identification processes for all students with TBI may prevent them from receiving the appropriate services and supports necessary for academic success.

Individualized Education Plans

Without appropriate identification and assessment, students with TBI will not receive the necessary support through Individualized Education Plans (IEPs), for which they are eligible under IDEA. IEPs are comprehensive, legal documents that outline the details of the services, goals, and accommodations that will be provided to a child who is deemed to have a disability that negatively impacts their academic success (IDEA, 2004). IEPs have been described as central to the individualization of services provided to a child who has a disability (Pretti-Frontczak & Bricker, 2000). Over the past 30 years, a growing body of research has been examining specific features of these legal documents, including their quality, measurability of goals, and potential for generalization of behaviors in contexts outside an academic setting (Drasgow et al., 2001; Farquharson et al., 2014; Pretti-Frontczak & Bricker, 2000; Yell & Stecker, 2003).

Customization of IEPs

In addition to outlining individualized education, IEPs must also be customized to the type and frequency of services needed by each child for educational success. The type and frequency of services should be enumerated within the

IEP and should be unambiguous so that all members of the IEP team—including the parents—have a clear understanding of the "school's commitment of resources" (Drasgow et al., 2001, p. 372; IDEA Regulations, Appendix C). The wide range and heterogeneity of impairment patterns caused by TBI within a child's course of development present challenges in individualized education planning.

In addition to speech and language, deficits resulting from TBI are idiosyncratic and may include one or any combination of the following: reduced attention (Fan et al., 2002); impaired memory (Constantinidou & Neils, 1995; Pershelli, 2007); slow processing (Constantinidou & Thomas, 2010; Constantinidou et al., 2008, 2005); impaired executive functioning (Sohlberg, 2012; Sohlberg et al., 2003); psychosocial and emotional issues with self-awareness and impulse control (Ylvisaker et al., 2005); and sensorimotor impairments with vision, hearing, and balance (Lambregts et al., 2018). In contrast to some of the objective aspects of education (e.g., measuring reading fluency with a words-per-minute count and comprehension with question/answer accuracy), cognitive deficits can be difficult to track and measure (Anderson & Catroppa, 2006; Turkstra et al., 2008). Furthermore, for students with TBI, cognitive processes that have not fully developed prior to injury are often impaired but are not apparent until later in the child's development when cognitive demands are greater and there are higher expectations of the student (Goodman, 1989). These issues affect most aspects of educational performance, elucidating the need for an IEP and appropriate special education services.

Appropriate IEP Goals

Many researchers agree that individualized goals should be written to support students with cognitive, language, psychosocial, and/or sensorimotor impairments resulting from TBI (Aldrich & Obrzut, 2012; Arroyos-Jurado & Savage, 2008; Feeney & Ylvisaker, 2008; Glang et al., 2012; McKinlay et al., 2016; Mealings et al., 2012). Goals should be individually tailored for each student with TBI to address their specific needs and deficits, as there is not one standard plan that can be applied to all students with TBI. As the cognitive–linguistic demands of school increase in the educational continuum, students with TBI may experience varying degrees of academic difficulty throughout their school experience (Babikian et al., 2015).

Relearning known information (i.e., rehabilitation) and learning how to acquire new information (i.e., habilitation) are critical for students with TBI (Kaufman et al., 2017). Ongoing challenges for students with TBI tend to vary over time, with intervention needs and primary concerns (e.g., attention, social skills, organization) spiking during surges in cognitive development (Slomine & Locascio, 2009) and during periods of transition (Mira & Tyler, 1991; Semrud-Clikeman, 2010). Depending on the severity, long-term impairments caused by TBI can last beyond school, thus affecting academic, social, and vocational participation in adulthood (Rivara et al., 2012). The nature of a TBI, resulting in an ongoing recovery process, warrants frequent updates of educational plans and goals (Taylor et al., 2003) and should address the increasing cognitive demands with grade advancement.

The Current Study

Collectively, the variability in appropriately identifying the specific needs of students with TBI, paired with the limited empirical support available for specific accommodations and interventions, creates complex problems, especially because TBI can be a chronic condition (Babikian et al., 2015; Zaloshnja et al., 2008). Clearly, students with TBI need appropriate identification and subsequent support for continued learning throughout their academic experience. Tailored interventions are essential for their educational success and ultimately success in life (Arroyos-Jurado & Savage, 2008; Ylvisaker et al., 2001). Without appropriate services, students with TBI may perform worse as they advance through grade levels. Before professionals can develop customizable protocols, however, we must have a general description of current special education services for students with TBI. One way to do this is by analyzing the IEPs of students with TBI.

In this study, we explore the characteristics of a cohort of students with TBI who were verified for special education services within one school district. Specifically, we describe the students' demographic information (i.e., grade, sex, prior verifications, cause of injury, age at injury, time since injury) and summarize features of their IEPs (i.e., type and frequency of services and target behaviors of goals). Describing demographic information and comparing it to national statistics were of keen interest because differences could have implications for awareness, accommodations, and funding. We also examine our data for patterns across grade levels, goal categories, cause of injury, previous verifications, and service intensity. These patterns were of interest so that we may begin to understand the factors upon which certain service delivery decisions may be predicated. Our specific research questions and hypotheses were as follows:

1. How do the demographics of a sample of students with TBI from one school district compare to national statistics of students with TBI?

   We hypothesized that our sample would largely mirror national demographic statistics; however, due to our Midwest locale, we anticipated less racial and ethnic diversity.

2. In a sample of students with TBI, what is the reported cause of and age at injury? Do patterns exist between time since injury, type and intensity of services, or categories of IEP goals addressed?

   We hypothesized that students who had experienced a more recent injury may receive more and/or more intensive services compared to students who had been living with injury for a longer time.

3. What are the recommended services and intensity of those services for students with TBI? Do patterns

exist between service intensity, cause, grade level, or IEP goal categories?

We anticipated more intensive services for students who experienced a more severe injury and students with more intensive services may have goals across many cognitive skill categories.

4. What are the primary categories for target behaviors in IEP goals of students with TBI? Do goal categories differ across grade levels?

   We hypothesized that we would see differences in the types of goals addressed across grade levels, which would be both developmentally and therapeutically appropriate (e.g., we predicted skills such as reading fluency and decoding would be more prevalent for students in fourth grade and below, and higher level cognitive language skills such as written expression and executive functions would be more common in later grades).

5. What is the percentage of students with TBI who had a previous special education verification prior to their injury? Do patterns exist between previous verification and cause of injury or IEP goal category?

   We anticipated some students with TBI to have prior special education verification and that learning disabilities would stand out as the first verification category for these students.

Method

To address these research questions, we obtained permission from administrators of a school district in a Midwestern state to review de-identified IEP records of students verified with TBI during the 2016–2017 academic year. The urban district is the second largest in the state, consisting of over 60 schools and special programs. Of the 41,000 students who attend, approximately 6,800 receive special education services. Forty-six percent of students qualify for free or reduced-fee lunch. The majority of students in the state are White (67%), 19% are Hispanic, 7% are Black, 4% identify as two or more races, 3% are Asian, and 1% are Native American. The term "verification" used in this context refers to the process by which students are determined to be eligible to receive an IEP under a specific verification label (e.g., speech-language impairment [SLI], specific learning disability [SLD], autism, other health impaired). To qualify in the state in which the research took place, the student must have acquired a brain injury by external physical force causing full or partial physical disability, psychosocial impairment, or both. The injury must have had a negative effect on educational and developmental performance as determined by an educational team of professionals. The verification category of TBI does not include congenital or degenerative injuries, or those resulting from birth trauma.

Participants

We reviewed IEPs for the total number of students verified within the TBI category, without exclusion, for the 2016–2017 school year (n = 46). The full demographic details for this sample are located in the Results section.

Procedure

Two of the school district's speech-language pathologists (SLPs) reviewed the student records and entered the requested data in a spreadsheet. See Appendix A for the requested categories from initial data collection. Prior to releasing the data to the researchers, the SLPs coded all student records and removed the names, birthdates, and ages to protect student identities. Because the research involved review of existing de-identified data only, the Institutional Review Board for Human Subjects Research granted exempt status for this study.

Once the de-identified IEP data were obtained by the researchers, we coded categories to standardize inconsistent terminology across student records. Data that required coding included age at injury, time since injury, injury cause, service delivery in minutes per week, and IEP goal categories. Specifically, age at injury was calculated in months and then transformed to years and months. The first reported date of injury was used to determine age at time of injury in cases where multiple injuries were reported (n = 3). Age at time of injury was estimated for eight students because the exact date was not provided in the students' records. When an age estimate was indicated (i.e., "age of 3 or 4 years"), the youngest age was used for analysis to consistently account for the full possible amount of time the student had been living with a TBI. In four cases, the age at injury was either unknown or left out of the data entirely. In one of these four cases, the child had sustained multiple injuries. We were given information about an estimated date of the most recent injury for this child but not the age at which this injury occurred. As such, for these four cases, we do not have age at injury. For all others, the first and second authors calculated age at injury with 91% agreement. Disagreements were resolved with consensus.

We did not have access to students' ages at the time the study took place. Therefore, time since injury was calculated by counting years/months back from the time of the completion of data collection. Some records indicated exact dates (i.e., month, date, and year) of injury. In records in which a month and year were indicated but no day was provided, the researchers assigned the 15th, the middle of the month; when a year but no month was provided, the researcher assigned June, the middle of the year. We used the midpoint of the month or year as a logical estimate of the time since injury. Twelve cases were missing the necessary information to calculate date of injury information. Therefore, data for the time each student had been living with the TBI were calculated without these 12 cases. The first and second authors calculated time since injury within 1 month or less difference with 91% agreement. Disagreements were resolved with consensus. We used the statistical program SPSS to establish four age groups with equal numbers of students within the category of "time since injury" to analyze average therapy minutes per time since injury.

The age groups calculated by SPSS in years and months were 0–2.10, 2.11–4.11, 5.00–8.10, and 8.11–16.00.

Cause of injury was divided into eight categories, including nonaccidental trauma (e.g., shaken baby syndrome and abuse were included in this category), falls, sports, unspecified (this was used when no cause was indicated), hit by car (i.e., pedestrian hit by a car), motor vehicle accident (used when the student was in the vehicle, not hit by one), violence (used in cases of gunshot or assault, not child abuse), and near-drowning (which does not appear to meet the state's definition, but nevertheless was classified as TBI in one case). The first and second authors determined cause of injury category with 91% agreement. Disagreements were resolved with consensus.

Total amount of service delivery time assigned per student was transformed to minutes per week for all records to allow for direct comparison across IEPs. Each quarter consisted of 9 weeks, and each month consisted of 4 weeks. For example, special education recommendations for services 30 min in length, 6 times per quarter, were calculated as 180 min per 9 weeks, indicating 20 min per week. All time units were converted for consistency. The second and third authors calculated service delivery time with 91% agreement.

The school-based SLPs who de-identified the data recorded the IEP goals as written by school personnel. Three of the researchers reviewed the goals independently and created goal categories. Upon comparison, we found most of the categories were very similar in labels (e.g., "reading comprehension," "math," "articulation"). However, we had some differences in labels for some categories (e.g., "social language" vs. "pragmatic" and "functional skills" vs. "activities of daily living"). We came to agreement about 13 category labels and recoded the goals using the agreed-upon categories. The resulting categories were reading comprehension; reading fluency; written language; math; social emotional behavior; pragmatics; expressive language; receptive language; speech articulation; cognition (combined in the areas of executive functions, attention, and memory); transitioning, including in the classroom and for vocational skills; activities of daily living; and physical motor skills. Examples of goals in each category are listed in Appendix B.

An interrater reliability analysis, Gwet's AC1 (AC1), was computed. AC1 is a statistical method in which agreement between multiple raters is calculated while accounting for an unbalanced distribution (Gwet, 2008). Specifically, AC1 allows for the analysis of categorical data across more than two raters, particularly when raters will not use every category (R. L. Brennan & Prediger, 1981). In our data, every category could not be used with every goal. Therefore, AC1 was an appropriate analysis for our reliability across the raters. AC1 is interpreted with the following classifications: < 0.2 = *poor/slight,* 0.21–0.40 = *fair,* 0.41–0.60 = *moderate,* 0.61–0.80 = *substantial/strong,* and 0.81–1.0 = *almost perfect* (P. Brennan & Silman, 1992; Landis & Koch, 1977). Our AC1 value was 0.76 (95% confidence interval [0.70, 0.82]), indicating a substantial/strong level of agreement. Disagreements were resolved by consensus.

Student grade, sex, prior verification, and "special notes" categories did not require further coding because these data were reported relatively uniformly across schools and students. The paucity of data for severity of injury as well as school status (i.e., full- or part-time attendance) immediately following injury and at the time of data collection prevented inclusion for data analysis. Furthermore, the data collected regarding multidisciplinary team assessments demonstrated areas of need and recommended accommodations were widely varied and unsystematic; therefore, the researchers chose not to focus on these particular aspects of the IEP in this article.

Data Analysis

We reviewed the data for descriptive information relative to students with TBI receiving special education services. We used visual inspection of the data to determine if patterns existed between student-level variables (e.g., date of injury, cause of injury, grade level, and prior verification in another category) and service-level variables (e.g., goal categories, types of services receive, service minutes per week).

Results

Participants

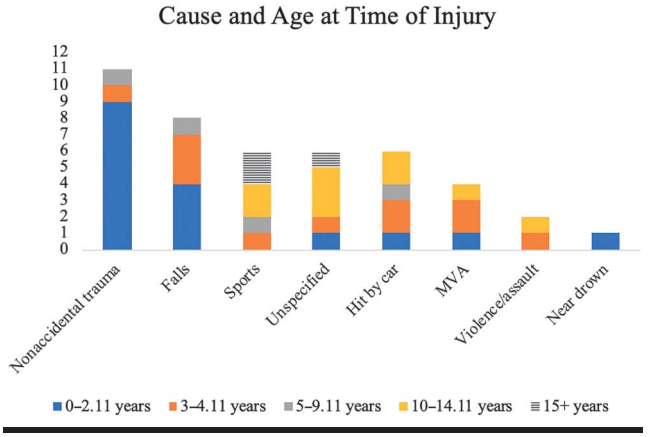
The total number of students verified in the TBI category was 46 (32 males and 14 females). The majority of the sample were identified as Caucasian (n = 22). Eight students identified with two or more ethnicities, five were African American, five were South Asian, three were Hispanic, three were Asian, and one record did not report ethnicity. The IEPs represented students from prekindergarten to 12th grade. No first graders were represented in the sample. The 46 records contained a total of 138 IEP goals, which were reviewed for this study. On average, each student had three total goals on their IEP (range: 1–8, mode = 2).

Cause and Age at Time of Injury

Age at the time of injury ranged from 5 months to 17 years (M = 8.71 years, SD = 8.29 years). The median age was between 4 and 5 years (57.5 months). Figure 1 illustrates the distribution of causes of TBI by age for this sample. Observable patterns related to cause of injury and age of onset emerged. Approximately 20% of students (n = 9) were injured before the age of 3 years and more often sustained nonaccidental trauma than injury by other causes. The data revealed that, following nonaccidental trauma, falls were the next most likely cause of injury for students injured between birth and 5 years of age. Students injured at age of 10 years and older had more unspecified causes than other age groups. Age at injury was not available in four cases.

Using the available data (n = 34), time since injury ranged from 11 months to 16 years (M = 5 years 6 months, SD = 4 years 3 months). The median time since injury was 4 years. Visual inspection of the data between time since injury and average recommended intensity of services

Figure 1. Cause and age at time of injury. MVA = motor vehicle accident.



suggested that a recent onset did not necessarily trigger more services. In fact, older injuries appeared to be linked to higher amount of services combined. Figure 2 illustrates the average recommended number of minutes categorized by time since injury.

Services and Intensity

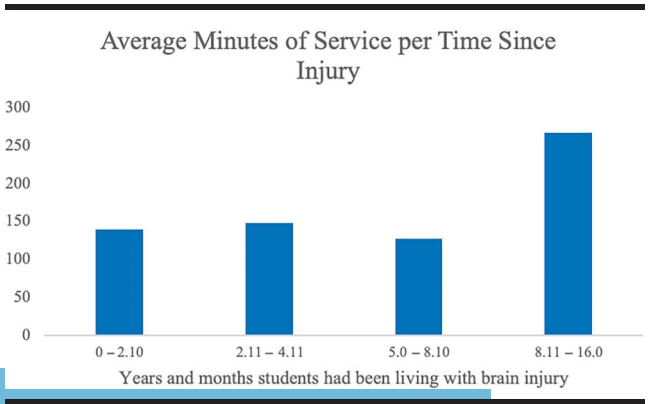
The average time from date of injury to initial IEP was 5.6 months. However, students previously verified for services for another condition were likely receiving services prior to TBI verification (although this was not always explicit in the charts reviewed), so the range was −6 years 6 months (negative numbers indicated the student had an existing IEP prior to the TBI) to 12 years 6 months (*SD* = 3 years 6 months). The median time from date of injury was 6.5 months.

Recommended services included special education, speech-language therapy, occupational therapy, physical therapy, vision services, service for hearing impairment, and psychotherapy. The median total of service provided per week was 1.85 hr (*Mdn* = 112.5 min). Table 1 illustrates the range and recommended intensity of services delivered for this sample.

Visual inspection of the data revealed that ninth graders (n = 5) received more minutes of special education services per week than students in other grades. Recommendations for service time with ninth graders ranged between 75 and 1,500 min (M = 692.50, SD = 287.92).

Twelfth graders (n = 5) received the next highest amount of therapy, and the majority of these students were injured in motor vehicle accidents. Recommendations for service time with 12th graders ranged between 12.5 and 1,504.44 min (M = 401.89, SD = 626.36). There is considerable variability in the types and recommended intensity of services provided to students. No other clear patterns of intensity were observed across students of similar ages, grades, or cause of injury. Figure 3 illustrates the average recommended number of minutes of therapy, per type of injury, across grade levels.

Figure 2. Average minutes of service per time since injury.



IEP Goal Categories

IEP goals focused on both specific academic and broader social–emotional–cognitive categories. In order of frequency of assignment across the 46 cases, goal categories included reading comprehension, written language, math, reading fluency, cognition (including attention and executive functions), social emotional behavioral, expressive language, pragmatics, transitioning including vocational skills, activities of daily living, speech articulation, receptive language, and physical motor skills. No goals were observed for cognition in the area of memory. An observable pattern emerged between grade level and reading fluency, suggesting that word fluency is addressed in the early grades from kindergarten through fourth grade. In addition, expressive language goals, specifically vocabulary, were limited to kindergarten through fourth grade, and cognitive goals, most often in the area of executive function, were limited to Grades 7 through 12 in all but one case, which occurred for a kindergartner. Reading comprehension, written expression, and math goals were present in all grade levels. Table 2 illustrates IEP goal categories and the number of records addressing specific categories at each grade level.

Previous Verification Categories

As previously described, "verification" used in this context refers to the process of identifying students who meet the criteria to receive an Individualized Education Plan under a specific label (e.g., SLI, SLD, autism, other health impaired). In our sample, 35% of the records (n = 16 students) indicated previous verification for special education services in a category other than TBI. Categories of previous verification included SLD and/or SLI (SLD/SLI; n = 6), developmental delay (n = 5), SLI with articulation (not counted in SLD/SLI; n = 3), other health impaired (n = 1), and 504 Plan (n = 1). Visual inspection revealed no observable patterns between students with previous verifications

Table 1. Services and intensity for students with traumatic brain injury.

Service	Cases (%)	*M*	*SD*	*Mdn*	Range
Special education	45 (98)	223.98	346.71	112.50	1.25–1,500.00
Speech-language	36 (78)	22.98	14.89	23.75	0.00 (consult)–60.00
Occupational therapy	10 (22)	6.17	3.03	5.84	0.00 (consult)–10.00
Physical therapy	5 (10)	7.22	4.06	5.00	4.44–14.16
Vision	1 (2)	1.60			
Hearing	1 (2)	50.00			
Psychotherapy	1 (2)	46.67			

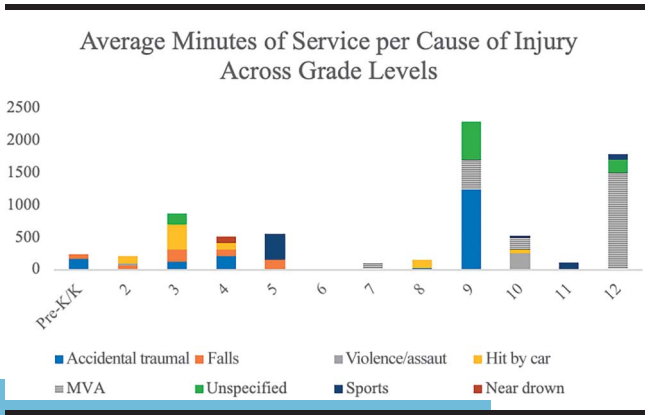
Note. All time was reported in minutes per week.

and cause or categories of IEP goals addressed. That is, students verified both with TBI and with a second diagnosis did not share similar cause of injury and did not have more of one certain category of IEP goals than another. The data revealed a parallel between prior verification and age at injury. Younger students were more likely to have been verified with SLI in the area of articulation, and students verified with both SLI and SLD were concentrated in Grades 9 and higher. However, students with prior verification did not receive more therapy than those who were not receiving therapy prior to TBI. Figure 4 illustrates the number of students verified for service prior to TBI verification.

Discussion

The purpose of this study was to explore and describe the features of IEPs for a cohort of students with TBI in one school district. Specifically, we were interested in examining demographic information (i.e., grade level, age at injury, and cause of injury), IEP services and intensity, IEP goal categories, and previous verification status as an initial step toward understanding the special education services of students with TBI. Our results support four interesting findings. First, the demographics of our sample aligned with national statistics with respect to sex and age at injury, but not ethnicity for students with TBI.

Figure 3. Average minutes of service per cause of injury across grade levels. MVA = motor vehicle accident.



Second, time since injury did not appear to be related to intervention intensity. Third, target behaviors within goals were more often related to math and reading than to the cognitive processes that govern these skills, such as attention, memory, and executive functioning. Finally, more than a third of our sample had been verified with a disability and were receiving special education services via an IEP prior to their TBI. In what follows, we expand on each of these findings.

Demographics

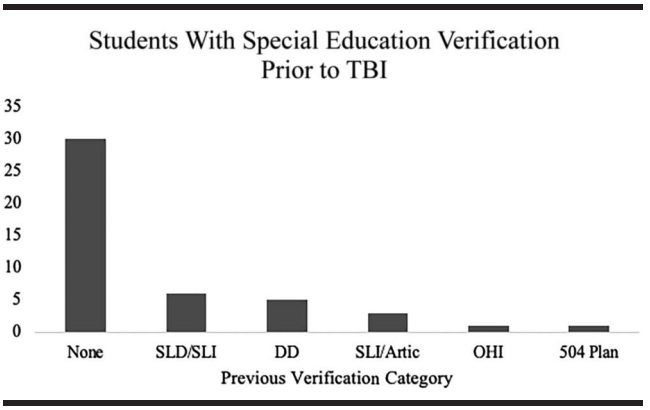
To begin, we explored the demographic information related to the students in our sample and compared them to national statistics. This is an important question to explore first because we are reporting on data from one midwestern school district; we need to consider the extent to which this sample may be similar to or different from districts around the United States. Second, given our small sample size, it is essential that we understand how similar

Table 2. Number of Individualized Education Plan goals per goal category and student grade level.

	Grade											
	Pre–K/K	1	2	3	4	5	6	7	8	9	10	11	12
n =	5	0	4	6	4	3	1	1	2	5	6	4	5
Goal category													
Reading comprehension	2			3	3	2	1		1	4	3	1	2
Written language	3		2	5	2	2				3	1	1	1
Math	1		1	3	2	1			1	2	3		2
Reading fluency	1		2	4	3	1							
Cognition	1							1	1	2	4	1	3
Social/emotional	1		1	3	1	1				2			2
Expressive language	2		2	2	2								
Transitioning	1				1					1	2	4	
Activities of daily living	2				1							1	1
Pragmatics	2				1	1				2			
Speech/articulation			1	1	3								
Receptive language	1					1							
Physical skills	1												

Note. The transitioning goal category included vocational skill goals.

Figure 4. Students with special education verification prior to traumatic brain injury (TBI). None = no Individualized Education Plan verification prior to TBI; SLD/SLI = specific learning disability and/or speech-language impairment; DD = developmental delay; SLI/Artic = speech-language impairment with articulation; OHI = other health impairment; 504 Plan = document accommodations for students with Individualized Education Plan.



our sample is to a larger national sample to best interpret the remainder of our results.

As such, first, regarding sex, approximately twice as many males as females were verified with TBI, which is consistent with national trends (Fauld et al., 2010). However, the same was not true for ethnicity. National statistics report that ethnic minorities experience more TBIs, specifically, mild injuries. By contrast, our sample was nearly 50% Caucasian, which would be predicted in this Midwest locale. We did not have clear information on severity. Thus, despite our sample being small and circumscribed to one Midwest state in the United States, we found some demographic data to be similar to what is reported nationally; therefore, some general comparisons may be drawn.

Next, we examined the average ages and causes of injury for the students in our sample. Similar to national statistics, we found that birth to age of 4 years was the most common age group. This aligns with the national statistics, which indicate that children from birth to 4 years of age have the highest rates of emergency department visits for any age group in 2009 and 2010 (CDC, 2019). Almost 20% of our sample was injured by nonaccidental trauma. This is not surprising, as pediatric nonaccidental trauma is a leading cause of childhood TBI (Paul & Adamo, 2014). The next largest category was falls, which are nationally the leading cause of TBI-related hospitalizations for children 0–14 years (CDC, 2019). Sports- and recreation-related TBIs were the third largest category for our sample, which is commensurate with national statistics (CDC, 2019). The CDC (2019) reports that adolescents aged 15 to 19 years tend to have high risk factors for sports injuries and motor vehicle accidents; however, we did not see a spike in incidence for this age group. This could be because sports injuries often result in mild TBI, and students with mild TBI often either do not qualify for or do not need special education services (Ylvisaker et al., 2001).

These descriptive data are important to continue to contextualize the subpopulations of students that may receive special education services within and across a variety of states. Although we report data that align to some degree with national data, many of the differences that we report are likely related to our sample coming from one state in the United States. State-based statistics reporting incidence, emergency department visits, age, sex, cause, and service needs are helpful in considering the kinds of variability that may exist within particular states and the extent to which that variability can be clinically or educationally meaningful. However, for the current study, we did not have access to statewide data and, therefore, were not able to compare our results to data from this specific state.

Time Since Injury

We were surprised to see that intensity of services appeared to be lower for students who had more recently sustained a TBI. We hypothesized that students with more recent injuries may receive more or more intensive services. In part, we hypothesized this because students with recent injuries may still be experiencing acute symptoms of the TBI. However, based on our current small sample, a student with a recent injury does not necessarily receive services that are more intensive. Ideally, this indicates therapy intensity is determined based on students' individual needs. For example, perhaps by the time an IEP is implemented, students are not exhibiting acute symptoms, and therefore, services are recommended to fit their unique needs. We suggest that future research explore the decision-making process about the determination of dosage with this population. In addition, future research should investigate the extent to which therapy intensity should be adapted over time to adjust for the variety of needs that evolve as the student matures and progresses through school.

Setting Goals for Students With TBI

Next, in our review of 142 goals for 46 students from prekindergarten through 12th grade, we expected and confirmed substantial variability. However, we did find that the majority of goals focused on reading or math. Practically speaking, this makes sense as IEP goals are written to support educational performance and access to the curriculum. However, it remains somewhat surprising, when much of the research and literature about students with TBI focuses on the underlying cognitive processes, attention, memory, and executive functioning (Aldrich & Obrzut, 2012; Arroyos-Jurado & Savage, 2008; Dettmer et al., 2018; Feeney & Ylvisaker, 2008; Jantz & Coulter, 2007; Mealings et al., 2012). Thus, the pattern we discovered in this sample of students with TBI who also have IEPs suggests that reading and math are the target behaviors; however, these behaviors do not necessarily map on to the phenotypical areas of need for students with TBI (e.g., attention, memory, and problem solving). Both reading and math rely heavily on cognitive processing and the extent to which various cognitive skills

contribute to reading or math changes as students progress through the grades.

Research supports that cognitive skills differentially contribute to reading ability over time. For instance, Language and Reading Research Consortium et al. (2018) reported that memory and attention collectively explained substantial, but different, portions of variance in both reading and listening comprehension. As one example of their results, attention was "equally" predictive of both listening and reading comprehension for first and second graders. However, for third graders, attention was "only" predictive of listening and not reading comprehension. This developmental progression highlights two important points: (a) cognitive processes, like attention, are important for the acquisition of reading skills, and (b) the extent to which cognitive processes, like attention, contribute to reading success changes as students progress through grades. We then consider that students with TBI notably experience difficulties with cognitive processes, like attention (Constantinidou & Neils, 1995; Fan et al., 2002; Pershelli, 2007; Sohlberg, 2012; Sohlberg et al., 2003). Taken together, we recommend that educators ensure that cognitive processes, like attention and memory, are considered during assessment, intervention, and progress monitoring for students with TBI. It is plausible that this population of students experience a developmental progression that is similar to typically developing children; however, it is also plausible that the developmental progression will be disrupted subsequent to the TBI. Indeed, future work should empirically examine the extent to which cognitive processes are related to the acquisition—or reacquisition—of reading skills for students with TBI. It will also be important to examine those cognitive processes over time.

In our data, we examined IEP goal categories across grade levels and noted some developmental differences. For instance, vocabulary was a common category for students in kindergarten through fourth grade but less common for students in older grades. Conversely, we also found more cognitive and executive functioning goals written for students in seventh through 12th grades. Both examples seem reasonable. We expected foundational learning goals early on and more abstract thinking and application goals later. However, this pattern can also be problematic for students with TBI for varying reasons. First, younger students with TBI also need support with respect to their cognitive processing. For this subsample of students, their executive functioning skills may not have begun to develop before they experienced their TBI. As such, they may require more explicit instruction and strategies to support their classroom attention and memory for class content. Second, we were pleased to see the focus on cognitive processing skills for older students. Indeed, older students experience greater expectations and increasing levels of independence with course work (Prasad et al., 2017). However, and by contrast to the younger students, there appeared to be few to no goals written to support vocabulary skills. Certainly, vocabulary skills continue to grow and evolve as the rigor of the academic curriculum increases. We also know that cognitive skills differentially contribute to reading outcomes over time (Language and Reading Research Consortium et al., 2018). Perhaps the focus on cognitive processes (e.g., memory) ultimately works toward supporting specific academic content, such as vocabulary. Future research should empirically test these associations to determine the best ways to support cognitive processes and explicit curricular content for students with TBI.

Services Prior to Injury

Finally, we examined the extent to which students with verified TBIs had received special education services prior to injury. Thirty-five percent of our population had prior special education verifications. This association was not surprising. Haarbauer-Krupa, Lee, et al. (2018) found the most common additional health conditions for children with reported TBIs were learning disorders (21%), attention-deficit/hyperactivity disorder (ADHD; 20%), speech-language problems (19%), developmental delay (15%), and bone and muscle conditions (14%). Almost 20% of our sample fell in the SLI, SLD, or articulation categories, and almost 11% were diagnosed with a developmental delay. In addition, 17% of our sample had documentation of suspected or existing ADHD. Although it is not a category that verifies students for services on its own, there is a reasonable amount of evidence indicating premorbid psychosocial factors may be present for individuals who sustain TBI (Ylvisaker et al., 2005). That is, individuals who sustain a TBI have less inhibition or a propensity for risky behaviors prior to actually experiencing their injury (Ylvisaker et al., 2005). It is plausible that this psychosocial profile leads to a higher risk for injuries—TBIs and otherwise—as a result. For instance, Iverson et al. (2016) found that adolescent student athletes with ADHD had significantly higher history of concussion compared to athlete peers without reported ADHD. In summary, our results, from a small sample of students with TBI who also have IEPs, corroborate previous connections between preexisting factors and risk for TBI.

Limitations

Although this study is the first to explore and describe the components of IEPs for students with TBI, limitations need to be addressed. First, our sample is relatively small and is limited to one Midwestern school district. Second, our analysis of these IEPs was cross-sectional, not longitudinal. We did not have the data or permission to retrospectively review earlier IEPs of students with preexisting verifications. As such, we were unable to report on any adaptations that may have been made. In addition, the heterogeneity across IEPs resulted in some missing information regarding onset date, severity, and student age at time of data collection. However, this is reflective of the nature of our data, which includes actual IEPs for students currently receiving services in school-based settings. Future work should indeed expand to include multiple school districts; however, the heterogeneity of the IEPs themselves will likely remain a natural obstacle. Finally, we do not have information

regarding the ways in which the target behaviors in the IEP goals were addressed. Specifically, although the target behavior in the goal may be "reading comprehension," it is possible that the educational professionals working with these students are targeting that behavior using a cognitive approach that supports the (re)development of necessary executive functioning and attention skills. Further qualitative work may shed light in this area.

Conclusion

This work represents an important first step in understanding the special education services for students with TBI. Our aim was to explore the components of IEPs for students with TBI with a long-term goal of determining effective interventions for this population. Because there is substantial heterogeneity naturally present among students with TBI, as well as a large variation in educational documentation, effective interventions for students with TBI will likely include a wide range of supports. We are currently analyzing goals and their quality for students with TBI to further understand services for this population. Next, we will explore interventions that more explicitly address the desired outcomes (e.g., improved reading comprehension, greater language use, specific math applications). Importantly, we are interested in interventions that are both ecologically valid for school-based settings and are developed to address the idiosyncratic deficits of students with TBI.

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Appendix A

Categories for Initial Data Collection

A. Student information
   1. Grade
   2. Gender
   3. Ethnicity
   4. Current school status (full time vs. part time)

B. Traumatic brain injury details
   1. Cause
   2. Severity
   3. Age at injury
   4. Date of injury
   5. School status immediately post injury (full time vs. part time)

C. Multidisciplinary team (MDT)
   1. Prior and secondary verifications
   2. Areas of need
   3. MDT recommendations

D. Individual Education Plan (IEP)
   1. Date of initial IEP meeting
   2. IEP goals
   3. IEP service in minutes per quarter

E. Progress reports

F. Special notes

Appendix B

Examples of Goals in Each Category From the Individual Education Plan (IEP)

Reading comprehension	Given guided reading instruction, student will improve his reading comprehension skills on his weekly assessments from a current baseline of scoring 60%–80% as measured by weekly assessments.
Written language	Student will write a complete sentence with correct capitalization, end punctuation, and spacing from a current baseline of 0–5 as measured by classroom writing samples and teacher observations by (date).
Math	Given drill and practice, student will improve her addition and subtraction facts by demonstrating satisfactory progress from a baseline of 66% accuracy to 80% accuracy as measured by timed tests.
Reading fluency	Given reading instruction, student will increase his fluency rate from a current baseline of 14–60 words per minute as measured by DIBELS by (date).
Cognition—executive function	Classroom skills: Given instructional strategies and resource supports, student will increase classroom skills by completing assignments on time with acceptable quality from a current baseline of 75%–90% as measured by teachers' assignment books by (date).
Cognition—attention	Student will participate during play times by staying engaged in an activity. We will know student has met this goal when he play with four activities for 5 min each once daily for 2 consecutive weeks.
Social and emotional behavior	Given visual/verbal cues, adult models, and opportunities for practice, student will improve her ability to interact with teachers and peers and increase her participation in a variety of activities at school, progressing from a baseline of 10–20 points as measured by the Social Skills Rubric by (date).
Expressive language	Given curriculum-based materials, student will demonstrate knowledge of vocabulary words (by multiple choice and/or defining), improving from a baseline of knowing 0% of each word list to knowing 80% of each word list as measured by speech-language pathology data collection and classroom assessments by (date).
Transitioning including vocational skill	Transition activities: Given (instructional strategies, supports), student will complete transition activities increasing from a baseline of zero to three activities completed (develop a 4-year plan with her counselor, participate in registration of classes, and participate in a vocational evaluation with her IEP manager as measured by the LPS Transition Progress Monitoring Chart by (date).
Activities of daily living	Student will participate during bathroom time by following the bathroom routine. We will know student has met this goal when he calmly goes into the bathroom, sits on the toilet, and pulls his pants up twice a day for 2 consecutive weeks (currently student has a difficult time going into the bathroom to get his diaper changed).
Pragmatics	Given direct skill practice in the needed areas of cooperative skills, sharing adult attention, stating his wants and needs, turn-taking, and honestly taking responsibility for actions by (date).
Speech articulation	Given a visual/verbal model as needed, student will improve his speech production of the /l/ and /th/ sounds improving from a baseline of 0% accuracy in isolation (/l/) and 30% accuracy in initial words (voiceless /th/) to at least 80% accuracy in sentences (/l/ and /th/) as measured by the SLP Articulation Data Collection Chart by (date).
Receptive language	Given visuals, positive reinforcement, resource support, and sensory strategies as needed, student will identify information gained by following directions to complete tasks (assignments and activities), increasing from a current baseline of 50%–80% as measured by teacher data collection by (date).
Physical skills	Will continue to make progress in his mobility by meeting designated objectives: will bear weight up to 30 s on his feet when supported on his trunk 2/5 days a week, will propel the trike himself for 10 revolutions 2/5 days per week, will roll a ball toward a partner once physically prompted while floor sitting or on his tray, will bear weight in stander for 15 min or more 3 times per week.