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Application of Dual Task Performance in Pediatrics and Adults with Traumatic Brain Injury: A Systematic Review

Lauren Bilski
Department of Physical Therapy, Jefferson College of Health Professions, Thomas Jefferson University, Philadelphia, PA, lauren.bilski@jefferson.edu

Kathleen Clancy
Department of Physical Therapy, Jefferson College of Health Professions, Thomas Jefferson University, Philadelphia, PA, kathleen.clancy@jefferson.edu

Victoria Dean
Department of Physical Therapy, Jefferson College of Health Professions, Thomas Jefferson University, Philadelphia, PA, victoria.dean@jefferson.edu

Danielle Melfi
Department of Physical Therapy, Jefferson College of Health Professions, Thomas Jefferson University, Philadelphia, PA, danielle.melfi@jefferson.edu

Kristin Reardon
Department of Physical Therapy, Jefferson College of Health Professions, Thomas Jefferson University, Philadelphia, PA, kristin.reardon@jefferson.edu

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Application of Dual Task Performance in Pediatrics and Adults with Traumatic Brain Injury: A Systematic Review

Lauren Bilski, Kathleen Clancy, Victoria Dean, Danielle Melfi, Kristin Reardon, Louis N. Hunter, PT, DPT
Department of Physical Therapy, Jefferson College of Health Sciences, Thomas Jefferson University, Philadelphia, PA

Background

In physical therapy practice, dual task training (DTT) has been utilized in patients with neurologic dysfunction, and there is consistent evidence in the literature to support the implementation of such paradigms. Despite previous understanding that gait is largely an automatic skill, research has found that gait is indeed attention-demanding, high-level, controlled task.1 Individuals with neurologic dysfunction have both cognitive and motor processing deficits that impact attention and functional abilities. Dual task performance is relevant in neuroplastic populations due to its potential to increase interaction between dual task cognition and gait abilities. Additionally, this association between attention and mobility is integral for appropriate negotiation of complex environments encountered in daily life. Thus, the ability to divide attention and selectively orient to appropriate tasks is an important skill that propitiates everyday function.2

Dual task training is defined broadly as simultaneous performance of two concurrent tasks, this can be the combination of two motor tasks or a motor task and a cognitive task.2 Common sequelae of traumatic brain injury (TBI) include decreased sustained and divided attention, reduced cognitive processing, impaired ability to complete motor tasks automatically, and compromised executive function.2,3 Survivors of moderate to severe TBI may suffer from impaired attention and increased distractibility.4-6 TBI effects are lifelong individually and the rate has been continually increasing over time.2 Based on these statistics, almost half a million hospital visits associated with TBI occurred among children from birth through 14 years of age.7 This further magnifies the need to identify effective rehabilitation interventions to improve community reintegration.

Purpose

The aim of the systematic review of the literature is to investigate the application of cognitive and motor dual task paradigms in the physical therapist management of moderate to severe TBI population across the lifespan in physical therapy practice.

Methods

Preliminary Search

- Databases Searched: Embase, Scopus, Medline Ovid, Google Scholar
- Search conducted: individually by the primary authors
- Exclusion criteria: participants diagnosed with a moderate to severe traumatic brain injury; incorporation of TBI interventions (gait with a cognitive task with a lower extremity functional task; task with one functional outcome measure, written in English and published within last 5 years (see exclusion criteria at each selection stage below).

Results

Table 1. Study Participant Demographics

<table>
<thead>
<tr>
<th>Articles</th>
<th>THI participants</th>
<th>Control participants</th>
<th>Mechanism of Injury</th>
<th>THI Severity</th>
<th>Time Since Injury</th>
</tr>
</thead>
</table>

Table 2. Results of Outcome Measures

| Articles | Study Design | Group comparison study | Time for the THI group for the Trail Making B, Stroop Color, Stroop Word, and Stroop Interference Tests in TBI compared to the THI group for the Trail Making A and the Stroop Color and Interference Tests in TBI.
|----------|--------------|-----------------------|----------------------|-----------------|
| Cantin et al (2003) | Case control study | Motor | Stroop Color (p=0.02) or Stroop Word (p=0.027) compared to unobstructed walking in TBI pts from the THI group for the Trail Making B, Stroop Color, Stroop Word, and Stroop Interference Tests.
| Fitch et al (2004) | Case control study | Motor | Stroop Color (p≤0.03) or Stroop Word (p≤0.027) compared to unobstructed walking in TBI pts from the THI group for the Trail Making B, Stroop Color, Stroop Word, and Stroop Interference Tests.
| Katz-Leurer et al (2005) | Case control study | Motor | Stroop Color (p≤0.03) or Stroop Word (p≤0.027) compared to unobstructed walking in TBI pts from the THI group for the Trail Making B, Stroop Color, Stroop Word, and Stroop Interference Tests.
| McCallum et al (2006) | Case control study | Motor | Stroop Color (p≤0.03) or Stroop Word (p≤0.027) compared to unobstructed walking in TBI pts from the THI group for the Trail Making B, Stroop Color, Stroop Word, and Stroop Interference Tests.
| Vallieres et al (2009) | Case control study | Motor | Stroop Color (p≤0.03) or Stroop Word (p≤0.027) compared to unobstructed walking in TBI pts from the THI group for the Trail Making B, Stroop Color, Stroop Word, and Stroop Interference Tests.
| Zwerina et al (2010) | Case control study | Motor | Stroop Color (p≤0.03) or Stroop Word (p≤0.027) compared to unobstructed walking in TBI pts from the THI group for the Trail Making B, Stroop Color, Stroop Word, and Stroop Interference Tests.

Discussion

The application of cognitive and motor dual task paradigms in the moderate to severe traumatic brain injury population may improve functional outcomes and stabilization progression in everyday tasks and environments. Results from these studies demonstrated that there is a relationship between DTT and the four outcomes of mobility (gait speed, step width, balance, and foot clearance) across the lifespan but further research is required to illustrate the significance of such a relationship. There was also a correlation found between performance on the neuropsychological assessments and performance of DTT. The majority of the studies reviewed demonstrated a decrease in gait speed with the introduction of DTT, with the exception of the case study that utilized dual task as an intervention. All other obesity outcomes identified had variable results, making it difficult to generalize to the TBI population. These variations were due to:

- Several planned experiment outcomes were changed
- Inconsistencies between DTT protocols
- Range in time elapsed from injury to the application of DTT

Therefore, the implementation of dual task as an intervention over a period of time in the moderate to severe TBI population is recommended to further clarify the relationship between dual task and gait parameters.

Future Research

Future research regarding DTT in the moderate to severe TBI population should address the following:

- Plan that makes DTT poststroke rehabilitation practice specific to outcome measures, such as the TUG test for adults
- Outcome measures in both dual task settings versus functional environments to determine when complex environments are appropriate to introduce in patients recovering from TBI
- Conclusion

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Due to the possibility of attention and cognitive processing deficits in the TBI population, there is a necessity for physical therapists to address motor deficits within functional daily situations. Interventions requiring dual tasking could help with addressing these persistent attentional deficits that interfere with daily living after a TBI. However, there is insufficient quality of evidence to support and justify using DTT during physical therapy for patients with attention deficits to severe TBI. Further research among adults and pediatric TBI populations is warranted due to the obli...