

University of Texas at Arlington

MavMatrix

2022 Fall Honors Capstone Projects

Honors College

12-1-2022

THE RELATIONSHIP BETWEEN DEMOGRAPHICS AND EARLY AND LATER MOTOR PROBLEMS IN CHILDREN WITH MOTOR DIFFICULTIES

Promise Robinson

Follow this and additional works at: https://mavmatrix.uta.edu/honors_fall2022

Recommended Citation

Robinson, Promise, "THE RELATIONSHIP BETWEEN DEMOGRAPHICS AND EARLY AND LATER MOTOR PROBLEMS IN CHILDREN WITH MOTOR DIFFICULTIES" (2022). *2022 Fall Honors Capstone Projects*. 1. https://mavmatrix.uta.edu/honors_fall2022/1

This Honors Thesis is brought to you for free and open access by the Honors College at MavMatrix. It has been accepted for inclusion in 2022 Fall Honors Capstone Projects by an authorized administrator of MavMatrix. For more information, please contact leah.mccurdy@uta.edu, erica.rousseau@uta.edu, vanessa.garrett@uta.edu.

Copyright © by Promise Robinson 2022

All Rights Reserved

THE RELATIONSHIP BETWEEN DEMOGRAPHICS AND
EARLY AND LATER MOTOR PROBLEMS
IN CHILDREN WITH MOTOR
DIFFICULTIES

by

PROMISE ROBINSON

Presented to the Faculty of the Honors College of
The University of Texas at Arlington in Partial Fulfillment
of the Requirements
for the Degree of

HONORS BACHELOR OF SCIENCE IN EXERCISE SCIENCE

THE UNIVERSITY OF TEXAS AT ARLINGTON

December 2022

ACKNOWLEDGMENTS

Words cannot express my gratitude to my mentor, Dr. Priscila Tamplain, for her invaluable expertise and guidance she has provided throughout my undergraduate research career. She has been instrumental in helping me gain experience in the motor development field as well as supporting me when I constructed and conducted my own research study. Additionally, this endeavor would not have been possible without the generous support from Natalie Stephens and Dr. Kenyatta Dawson of the McNair Scholars Program, who helped support my research.

I am also grateful to my McNair Scholars cohort for the awesome bond and support system we have created. I would also like to thank the interns and volunteers in the Motor Development Lab at UTA for their encouragement and moral support throughout my research study. I would like to also extend my gratitude to the UTA writing center, the platforms that shared my study, Elizabeth McKinney of the Dyspraxia Foundation USA, Laura Moorer of Apraxia Kids, and the participants who made this study possible.

Most importantly, I would like to thank my wonderful family and friends. To my parents and my brother- I thank you for your love, support, and continuous encouragement.

December 16, 2022

ABSTRACT

THE RELATIONSHIP BETWEEN DEMOGRAPHICS AND EARLY AND LATER MOTOR PROBLEMS IN CHILDREN WITH MOTOR DIFFICULTIES

Promise Robinson, B.S. Exercise Science

The University of Texas at Arlington, 2022

Faculty Mentor: Priscila (Caçola) Tamplain

A child's achievement of motor milestones could result in later motor problems in children with Developmental Coordination Disorder (DCD). This study aimed to explore potential associations between early and later motor problems and demographic characteristics (such as race/ethnicity) in children with DCD. One hundred and thirteen parents/caregivers of children aged between 5 to 18 years with motor difficulties were asked to answer an online survey about early motor milestones, demographics, and current motor problems of children. The proper distribution for minority groups could not be found due to the sample being self-selected, however the focus was shifted to the achievement of ten developmental motor milestones. The results indicated that over 90% of children were suspect for DCD, but most children were "on time" for the achievement of motor

milestones. With motor milestones utilized as the primary marker for early development by pediatricians, the findings questioned the validity of the 10 motor milestones.

TABLE OF CONTENTS

ACKNOWLEDGMENTS	iii
ABSTRACT.....	iv
LIST OF ILLUSTRATIONS.....	viii
LIST OF TABLES	ix
Chapter	
1. INTRODUCTION	1
2. LITERATURE REVIEW	5
3. METHODOLOGY	10
3.1 Questionnaires.....	11
3.1.1 Demographic Questionnaire	11
3.1.2 Motor Milestone Questionnaire	11
3.2 Motor Assessment.....	12
3.2.1 DCDQ	12
4. RESULTS	13
4.1 Motor Milestone Questionnaire	13
4.2 DCDQ	13
5. DISCUSSION.....	15
6. LIMITATIONS.....	19
7. CONCLUSION.....	20
REFERENCES	21

BIOGRAPHICAL INFORMATION..... 27

LIST OF ILLUSTRATIONS

Figure		Page
4.1	Average Scores for Each DCDQ Category.....	14
4.2	Number of Participants with DCD Indication from the DCDQ Scores.....	14

LIST OF TABLES

Table		Page
3.1	Mean of Motor Milestone Achievement (in months) and the Number of Children that Parents Described Being Either on Time or Late	13

CHAPTER 1

INTRODUCTION

Developmental Coordination Disorder (DCD) is defined as a neurodevelopmental disorder categorized by poor motor proficiency and is associated with lower physical and mental health in children (Licari et al., 2021). The onset of DCD is apparent in the early years, but usually it is not diagnosed formally before the age of 5 years (Zoia et al., 2006). With no identifiable cause, this disorder defines children who, for no medical reasons, fail to acquire adequate motor skills despite their intelligence levels (Zoia et al., 2006). These widespread complications can be observed when children with DCD attempt to plan a motor task, organize movements, perform a coordinated action, and adjust movements when demands change, such as moving to catch a ball (Caçola, 2016). Indeed, because of the impact DCD has on a child's gross and fine motor skills, children with DCD encounter more challenges in their activities of daily living.

With the motor system underlying everything we do, it also serves as a platform of how we interact with the world (Caçola & Lage, 2019). Certainly, the motor system directs the trajectory of life, raising the question of how children with DCD interact and compare with their peers. In one study, it was shown that motor performance in children with DCD is slower, less accurate, and more varied than their peers (Brown-Lum & Zwicker, 2015). Not only do these children feel “slow” compared to their peers, but also isolated from others. Thus, they are predisposed to exhibit a number of vulnerabilities such as being clumsy, awkward, and unable to perform basic tasks, all of which increase the

likelihood of them being bullied (Hyman, 2014). In fact, previous studies have shown that children with DCD are at increased risk for numerous social, emotional, and mental health difficulties (Missiuna & Campbell, 2014). Some of those difficulties include peer problems, decreased participation in social activities, social isolation and loneliness, increased risk for peer victimization, reduced self-concept and/or self-esteem, and increased symptoms of anxiety and depression (Missiuna & Campbell, 2014).

Additionally, children with DCD often engage in less physical activity than typically developing (TD) children (Cairney et al., 2015). It is likely that children with DCD frequently withdraw from physical activities due to poor motor coordination and low perceived competence in sports (Caçola, 2016). However, despite the number of physical and mental health concerns in children with DCD, early identification could help to mitigate some of these issues. Moreover, if a child has not attained a particular developmental milestone like walking up the stairs, and a parent/caregiver recognizes the problem, then early intervention could help to minimize future problematic issues. Although DCD can continue to exist throughout adulthood, achieving developmental milestones as a child will reduce the hindrance that the disorder has placed on their livelihood.

Furthermore, as defined by the Centers for Disease Control and Prevention (CDC), motor or developmental milestones are things most children can accomplish by a certain age, when compared to the average (CDC, 2022). In fact, pediatricians use milestones to monitor child development, as indicators when examining the first few years of a child's life. The 10 most commonly used milestones are lift head, turn back to belly, sit without support, crawl hands and knees, stand with assistance, stand without support, walk with

assistance, walk without support, climb stairs, and walk up/down the stairs without support (Lee et al., 2021).

Therefore, if a child is developing correctly according to the milestones, then it is possible that doctors and specialists only use milestones as a possible indicator for motor delay. For that reason, there is often a delayed diagnosis associated with DCD, inhibiting children with motor difficulties from receiving the help that they need. Thus, the implication that infants in minority communities experience the same motor development issues or delays can only be hypothesized.

Hence, the lack of inclusivity in research amongst the minority population only heightens the severity of motor difficulties, making these children more susceptible to experiencing consequences of motor problems later in childhood. Indeed, many investigators have used motor milestones such as age of crawling or walking as indicators to determine the efficacy of early intervention on children's development. Furthermore, one study indicated that even a mild delay in crawling and walking onsets in early childhood escalates the risk for subsequent motor impairments in childhood (Hua et al., 2022). Unfortunately, there is little data on the prevalence of motor difficulties between racial/ethnic groups as well as limited research demonstrating the relationship between motor milestones and current or future levels of child development (Hamadani et al., 2013).

Moreover, if current research indicates a trend towards a higher prevalence of DCD in Black learners and suggests an even higher prevalence in multiracial learners, raising the question: Why is there not a focus on helping children of minority groups (de Milander et al., 2014)? Knowledge and preventive measures are key in treating children with any disorders. Although limited, current research has shown that racial-ethnic minority children

are not offered the opportunity to receive supporting intervention programs in comparison with their white counterparts (Iadarola et al., 2019). Pediatricians, doctors, therapists, and school administrators may not consider the prevalence of disabilities and disorders amongst the minority population and differences in the diagnostic and treatment pathways.

Therefore, I propose that this lack of research and rationale for inclusivity often results in parents not being able to give their child the resources and treatment they need. This in turn, could potentially heighten the consequences of disabilities, by resulting in social isolation from their peers and not wanting to participate in school settings. This is a problem that must be considered amongst researchers. Furthermore, this study aims to explore potential associations between early and later motor problems and demographic characteristics (such as race/ethnicity) in children with DCD.

This study aims to determine the trajectory of early identification and experiences with healthcare providers in children with motor difficulties. More specifically, to explore potential differences in race/ethnicity in the diagnostic process of motor difficulties. The following research question will be addressed: Is a child's achievement of motor milestones and later motor problems in children with Dyspraxia/DCD associated with race/ethnicity? I expect that there is a significant difference between a child's race/ethnicity and the early identification and experiences in this population.

CHAPTER 2

LITERATURE REVIEW

DCD is a motor skills disorder that affects five to six percent of all school-aged children (CanChild, 2022). Evidence indicates that DCD is a unique and independent neurodevelopmental disorder that has been characterized as a known comorbidity with other neurodevelopmental and neurobehavioral disorders (Blank et al, 2019). Children with DCD demonstrate limited participation in daily occupations which negatively impacts their physical and psychosocial wellbeing (Anderson et al, 2017). Due to the motor deficit, children may also encounter difficulties in school settings because of difficulty sitting upright or still and trouble holding a pencil or crayon (Understood Team, 2022). In fact, motor problems make it difficult for a child to operate in natural academic settings because of the challenges they face with their gross and fine motor skills. For example, fulfilling certain activities of daily living like getting dressed and tying their shoes is difficult for children with DCD (Anderson et al., 2017). Furthermore, in one study, it was stated that children with DCD have difficulties learning to perform all kinds of motor skills in daily life that their TD peers seem to acquire almost effortlessly (Schoemaker & Smits-Engelsman, 2015), a finding that underlines the importance of early motor milestone achievement.

The achievement of gross motor milestones in infancy is moderately universal, although age of attainment is influenced by both biology and the environment (Benjamin Neelon et al., 2012). The World Health Organization (WHO) developed normal age ranges

for achievement of motor milestones among healthy children, creating a standard of how children should grow (Onis & WHO, 2006). Thus, deviations from the normal age range of motor milestone achievement are shown as signs of developmental delay. This in turn signaled the need for appropriate screening when individual children appear to be late in achieving milestones, and to raise awareness about the importance of overall development in child health (Onis & WHO, 2006).

One study concluded that at as early as 6–8 months, the motor abilities of children with DCD can be observed to diverge from TD children by having a delayed crawling onset, which mostly reflects an impaired balance development at a later stage (Cairney et al., 2015). Another study found that children with DCD demonstrated both delayed motor milestone achievement and impaired concurrent motor ability (Lee et al., 2021). Therefore, the expectation that children with DCD fail to achieve one or more milestones can be reported. Based on data comparing children with DCD and TD children it was found that the DCD group reached motor milestones later than the TD sample (Lee et al., 2021). Moreover, one study argued that children with DCD lack the required motor problem-solving skills necessary to further improve their performance (Schoemaker & Smits-Engelsman, 2015). Therefore, this data raises the question of whether minority children with DCD specifically are in fact facing the same issues at a larger scale.

Furthermore, if the possibilities that the same benefits and achievements of motor milestones in TD children can be said for children that have motor difficulties, specifically in the minority community, then this research area should be extensively supported amongst researchers. Minority children, particularly those who are economically marginalized and are perceived as having low socioeconomic status, may be at particular

risk of motor, including neurodevelopmental, delay, as well as language and reading difficulties (McPhillips & Jordan-Black, 2007). Even with at-risk minority populations, there are only a few studies examining the potential differences in race/ethnicity in relation to DCD. In one study analyzing the families of children on the autism spectrum, it was found that white children are often overrepresented and racial and ethnic minority children from low-income families are underrepresented (Angell & Solomon, 2017). In fact, large clinical trials in autism spectrum disorder, a known comorbidity with DCD, have been criticized for their tendency to recruit white, educated, and high-resourced participants (Iadarola et al., 2019).

This is concerning, considering that some minority children may not be receiving the care that they need (Iadarola et al., 2019). Undoubtedly, early motor milestones are important markers to identify DCD (Hua et al., 2022). Because of this, parents of the children diagnosed with DCD and other motor difficulties have had to step in to advocate for the well-being of their child. Angell and Solomon (2017) found that low-income parents of color face even greater challenges because they may not be as knowledgeable about what their child's diagnosis entails; that these parents may get overlooked, and therefore not be taken seriously; and, indeed, that parents' race/ethnicity influences the responses of their child's medical team.

On the other hand, parents who are well versed in their child's diagnosis tend to force school officials, administrators, and anyone involved in the child's treatment plans to take action - signifying that knowledge is power (Angell & Solomon, 2017). Interestingly, it was stated that school officials approached special education as a "business" where saving money—rather than educating and caring for children—was a

prevailing goal (Iadarola et al., 2019). That is why parents feel as though they, along with their children, are not being taken seriously. Some minority parents even stated that their school was practicing unethical measures (Iadarola et al., 2019).

Undoubtedly, parents play a critical role in their child's participation in intervention programs, yet their perspectives are often overlooked in literature (Brown et al., 2021). Parents are having to fight to get their concerns heard, and some of these families have constant resistance from school administrators to provide service for their children (Angell & Solomon, 2017). In one study it was expressed that minority parents with children who have autism spectrum disorder experience copious amounts of stress (Iadarola et al., 2019). The same could be said for minority parents with children who have DCD. For example, a study found that parenting stress counteracted the positive effects of some early intervention programs (Osborne et al., 2008), particularly for interventions with a large time commitment. Low-income parents are more than likely to be working multiple jobs and therefore do not have time to advocate for their children as other parents do. Moreover, issues related to race and ethnicity included a preference for privacy in black and Latino families that deters parents from accessing services and social support (Iadarola et al., 2019).

Therefore, it is important to study how race and ethnicity affect the way the minority population is received as well as their experiences and how they differ from White parents. With very few studies examining the relationship between minority populations and disabilities like DCD, this research is highly significant. Information obtained from this study is crucial for future research and future intervention programs aimed at promoting the well-being of all parents and children. With a lack of studies examining the

trajectory of early identification of and current motor problems and their relationship to race/ethnicity in children with movement difficulties, this research study can inform the understanding of social factors and how they play a role in movement problems and future assessment/intervention/rehabilitation outcomes for this population.

CHAPTER 3

METHODOLOGY

The design of the study involved parents/caregivers of children aged 5 to 18 years old with motor difficulties. Parents ($n = 113$) were asked to answer an online survey about early motor milestones, demographics, and current motor problems of children. The parents/caregivers were at least 18 years of age and reported having a child with motor difficulties or disabilities, undiagnosed or diagnosed with DCD or dyspraxia (another term for DCD). One participant was excluded due to having cerebral palsy, a condition associated with other motor problems that excludes DCD. Another participant was excluded due to being 19 years old, leaving a total of 111 participants. Furthermore, the mean and standard deviation for the ages of the children, whose parents participated in this study on their behalf, was calculated at 11 years old ($SD 3.9$), or 130 months ($SD 47.9$).

Parents accessed the survey via a flyer posted on social media or from their email. Then, they clicked the link posted on the flyer to access the survey and completed it. Consent took place before the participant (parent) began the survey. The parent indicated their voluntary agreement by clicking the “Accept” button. Then, they completed the following sections of the survey: (1) demographic questionnaire, (2) motor milestone questionnaire, and (3) developmental coordination disorder questionnaire (DCDQ). Filling out all sections of the survey took about 15 minutes to complete. Recruitment for the current study was through posts on Facebook, Twitter, Instagram, emails, and flyers.

The flyer listed the inclusion criteria for the study: movement difficulties, developmental coordination disorder, and dyspraxia. All methods were approved by the Institutional Review Board at the University of Texas at Arlington.

3.1 Questionnaires

3.1.1 Demographic Questionnaire

We asked questions surrounding the following topics: age, gender, ethnicity, country, information on diagnoses, the social support level received from family and friends after receiving their child's diagnosis, income, experiences of racial discrimination based on questions given in a previous study (Alabi, 2015), history of movement-related difficulties, and the highest level of education (surveylegend) of the person answering the survey.

3.1.2 Motor Milestone Questionnaire

We asked parents to indicate whether their child was “on time” or “late” based on the parent questionnaire of the age of acquisition of motor milestones (Benjamin Neelon et al., 2012; Cyrulnik et al., 2007) for 10 developmental milestones. Those 10 developmental milestones are as follows: 1) lift their head, 2) turn back (roll) to belly, 3) sit without support, 4) crawl hands and knees, 5) stand with assistance, 6) stand without support, 7) walk with assistance, 8) walk without support, 9) climb stairs, and 10) walk up/downstairs without support. We also asked parents to specify the month that their child achieved each milestone to the best of their knowledge.

3.2 Motor Assessment

3.2.1 DCDQ

The DCD-Q (Wilson et al., 2009) is used as a parental report to screen for children between 5 and 15 years of age with possible motor difficulties. This questionnaire contains 15 questions relating to the child's gross and fine motor skills.

CHAPTER 4

RESULTS

4.1 Motor Milestone Questionnaire

For all 10 developmental milestones, the mean age of achievement in months is shown in Table 3.1, along with parental indication of their child being “on time or late” for each milestone.

Table 4.1: Mean of Motor Milestone Achievement (in months) and the Number of Children that Parents Described Being Either on Time or Late.

Developmental milestone	Mean age in months of milestone achievement	On time	Late
Lift head	3	93 (84%)	18 (16%)
Turn back (roll) to belly	5	82 (74%)	29 (26%)
Sit without support	8	71 (64%)	40 (36%)
Crawl hands and knees	11	54 (49%)	57 (51%)
Stand with assistance	11	71 (64%)	40 (36%)
Stand without support	14	62 (56%)	49 (44%)
Walk with assistance	13	65 (59%)	46 (41%)
Walk without support	16	60 (54%)	51 (46%)
Climb stairs	19	55 (50%)	56 (50%)
Walk up/downstairs without support	33	35 (32%)	76 (68%)

4.2 DCDQ

For the fifteen items categorized into three components, the mean score was taken (Figure 3.1). The three components of the DCDQ include: Control During Movement (CDM), Fine Motor/Handwriting (FMH), and General Coordination (GC). Based on the

sum of mean scores from the three DCDQ categories, we see the total number of participants with a possible DCD indication (Figure 4.2).

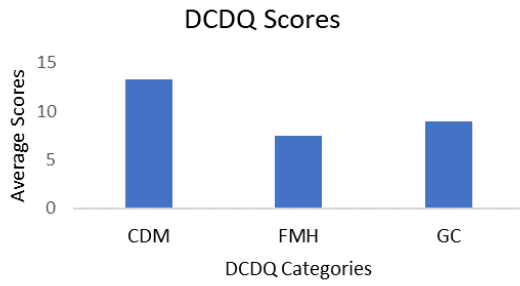


Figure 4.1: Average Scores for Each DCDQ Category

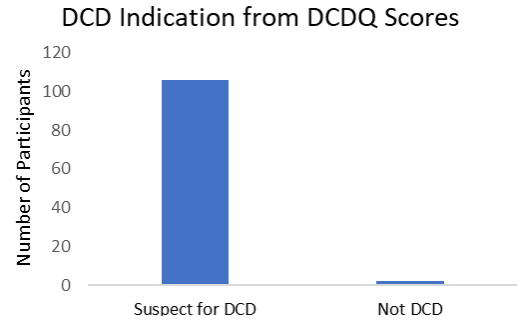


Figure 4.2: Number of Participants with DCD Indication from the DCDQ Scores

CHAPTER 5

DISCUSSION

The aim of the study was to investigate if a child's achievement of motor milestones and later motor problems in children with Dyspraxia/DCD was associated with race/ethnicity. We hypothesized that there was a significant difference between a child's race/ethnicity and the early identification and experiences in the population. Unfortunately, we could not include an analysis of the minority population with motor problems due to the lack of diversity amongst the sample population. The sample was self-selected, and we could not find the proper distribution for minority groups, therefore the data was not reliable and cannot be used. Nevertheless, the focus will be on the achievement of motor milestones and if the current 10 developmental milestones are a reliable indicator of motor problems.

First, the demographic questionnaire allowed a better understanding of the framework of the data sample. The majority of our participants were from the United States, but also from Brazil, France, Ireland, Australia, Canada, Bolivia, the United Kingdom, and more. Interestingly, 65% of participants stated that their average household income was \$70,000 or more. Similarly, 70% of parents/caregivers had either their bachelors or masters degree. Given the income and education level of the sample, along

with the fact that over 50% of the participants stated that their household income does not affect the child's level of treatment for diagnosis, we could only speculate that the opposite could be said for minority parents/caregivers.

Although some parents were knowledgeable about their child's diagnoses or motor delays, they still had to advocate for their child's needs to be heard. One parent mentioned that even though they work as "a speech language pathologist (SLP) and had knowledge of [their] daughter's difficulties, [they] still had to search far to get the right OT and diagnosis." In fact, another parent commented about their child saying, "I feel the system let him down by diagnosing him so late." With these comments from parents, we recognize the reality that some of them have not received adequate support for themselves nor their children.

Furthermore, as shown in Table 1 in the "on time" category, 78% of parents considered their children to have reached seven of the ten developmental milestones "on time." These seven milestones include: lift head (84%), turn back to belly (74%), sit without support (64%), stand with assistance (64%), stand without support (56%), walk with assistance (59%), and walk without support (54%). With seven of the 10 developmental milestones considered to be "on time," it reinforces the notion that these milestones may not be beneficial indicators of developmental delay. Usually, TD children who do not reach a milestone or reach them much later than children of the same age, can be the earliest indication that a child may have a developmental delay (CDC, 2022). Therefore, since the scores in the DCDQ are suspect for DCD, and only two motor milestones (crawl hands and knees and walk up/downstairs without support) are considered "late," it raises some concern of inconsistency.

Even though, the milestones crawl hands and knees, and stand with assistance share the same mean age of milestone achievement (11 months), yet one was achieved “late” and the other “on time.” According to parental reports, 51 % of children crawled “late,” whereas standing with assistance (64%), was achieved “on time.” Interestingly, for the developmental milestone climb stairs, 50% of children were “on time” and 50% were said to have achieved the milestone “late.” However, the DCDQ scores reflect the reality that over 90% of the children in this sample could have possible motor problems.

Besides, if parents reported that their child has achieved most motor milestones “on time,” it further emphasizes the credibility of using milestones as a gauge to hint at the possibility of children experiencing motor problems or developmental delay. Interestingly, the mean ages of milestone achievement for the DCD group in a similar study were quite similar (Lee et al., 2021). The average age a child lifted their head was 2.57 months and sit without support was 7.62 months (Lee et al., 2021). Similarly for the results in the current study, at three months children lifted their head, and achieved sit without support at eight months. Moreover, the developmental milestones that children achieved “late” were also somewhat similar to the results in that study.

However, if the results are almost comparable to that of a previous study, this raises the notion that milestones are not great predictors of later motor development and probably should not be the only deciding factor of developmental delay. Note, however, that a significant number of children struggled with achieving each of these milestones, more specifically with climbing up and down the stairs without support. Nevertheless, the overwhelming amount of children suspect for DCD, based on the DCDQ scores, do not reflect the reality of parental reports of the motor milestone questionnaire.

Therefore, more research is needed to analyze developmental milestones and their efficacy of indicating motor problems. Moreover, if milestones are the most used indicators for motor problems, further research is needed to construct a new method to signify the prevalence of DCD and other motor problems. Additionally, when a parent asked their pediatrician about delays their child was experiencing, the pediatrician stated that “he was still in the normal range.” In fact, the parent also commented that “this delayed testing and therefore support, for three years.” This not only spotlights the need for a policy change related to motor milestone achievement in the medical community, but also accentuates the lack of support parents feel when voicing the concerns they have for their children. Consequently, if motor milestones and another measure of indication could be used to validate the existence of developmental delay in children, then it could prove beneficial to the DCD diagnostic process. Thus, contributing to the importance of further research to identify measures that could be used to best identify motor problems.

CHAPTER 6

LIMITATIONS

The results of this study were reliant upon parental reports. Although the methods utilized were valid and reliable, we cannot overlook possible bias from parents. Hence, the missing data for the motor milestone questionnaire, due to parents being unsure of the exact account, did affect the sample size of mean ages in the analyses. Additionally, with about 89% of the self-selected data sample being white and about 11% non-white, we could not use the data to support the claim that the relationship between motor milestone achievements and race/ethnicity in the minority population were associated. Thus, making the data not credible for this group.

CHAPTER 7

CONCLUSION

Motor milestone achievement has been shown to be an indicator of motor difficulties with children who have DCD and other known disorders. However, we demonstrated that the children in this study had a slightly higher age of attainment of certain motor milestones when compared to the expectation. More specifically, whether parents reported their child being “on time” or “late” was different than over 90% of children being suspect for DCD. We also recognized the lack of empathy towards parents with children with DCD or motor delays, highlighting the need for parental support. Our findings suggest the importance of advocating for children with motor difficulties, as well as questioned the validity of the 10 motor milestones used to indicate potential motor problems.

REFERENCES

- Alabi, J. (2015). Racial Microaggressions in Academic Libraries: Results of a Survey of Minority and Non-minority Librarians. *The Journal of Academic Librarianship*, 41(1), 47–53. <https://doi.org/10.1016/j.acalib.2014.10.008>
- Anderson, L., Wilson, J., & Williams, G. (2017). Cognitive Orientation to daily Occupational Performance (CO-OP) as group therapy for children living with motor coordination difficulties: An integrated literature review. *Australian Occupational Therapy Journal*, 64(2), 170–184. <https://doi.org/10.1111/1440-1630.12333>
- Angell, A. M., & Solomon, O. (2017). ‘If I was a different ethnicity, would she treat me the same?’: Latino parents’ experiences obtaining autism services. *Disability & Society*, 32(8), 1142–1164. <https://doi.org/10.1080/09687599.2017.1339589>
- Benjamin Neelon, S. E., Oken, E., Taveras, E. M., Rifas-Shiman, S. L., & Gillman, M. W. (2012). Age of Achievement of Gross Motor Milestones in Infancy and Adiposity at Age 3 Years. *Maternal and Child Health Journal*, 16(5), 1015–1020. <https://doi.org/10.1007/s10995-011-0828-3>

- Blank, R., Barnett, A. L., Cairney, J., Green, D., Kirby, A., Polatajko, H., Rosenblum, S., Smits-Engelsman, B., Sugden, D., Wilson, P., & Vinçon, S. (2019). International clinical practice recommendations on the definition, diagnosis, assessment, intervention, and psychosocial aspects of developmental coordination disorder. *Developmental Medicine and Child Neurology*, *61*(3), 242–285.
<https://doi.org/10.1111/dmcn.14132>
- Brown, K. K., Smith, J., Bailey, T. N., Ortiz, G., Gu, X., & Tamplin, P. (2021). Parent-reported motivators and barriers to participation in a community-based intervention designed for children with motor skill difficulties: A qualitative program evaluation. *Adapted Physical Activity Quarterly*, *39*(1), 109–128.
<https://doi.org/10.1123/apaq.2020-0142>
- Brown-Lum, M., & Zwicker, J. G. (2015). Brain Imaging Increases Our Understanding of Developmental Coordination Disorder: A Review of Literature and Future Directions. *Current Developmental Disorders Reports*, *2*(2), 131–140.
<https://doi.org/10.1007/s40474-015-0046-6>
- Caçola, P. (2016). Physical and Mental Health of Children with Developmental Coordination Disorder. *Frontiers in Public Health*, *4*, 224.
<https://doi.org/10.3389/fpubh.2016.00224>
- Caçola, P., & Lage, G. (2019). Developmental coordination disorder (DCD): An overview of the condition and research evidence. *Motriz. Revista de Educação Física*, *25*(2). <https://doi.org/10.1590/s1980-6574201900020001>

- Cairney, J., Missiuna, C., Timmons, B. W., Rodriguez, C., Veldhuizen, S., King-Dowling, S., Wellman, S., & Le, T. (2015). The Coordination and Activity Tracking in CHildren (CATCH) study: Rationale and design. *BMC Public Health*, *15*(1), 1266. <https://doi.org/10.1186/s12889-015-2582-8>
- CanChild. (2022). “Developmental coordination disorder.” www.canchild.ca/en/diagnoses/developmental-coordination-disorder
- [CDC]. (2022, August 1). Module 2 [Training course]. Of *Watch me! Celebrating milestones and sharing concerns*. Centers for Disease Control and Prevention. <https://www.cdc.gov/ncbddd/watchmetraining/module2.html>
- Cyrulnik, S. E., Fee, R. J., De Vivo, D. C., Goldstein, E., & Hinton, V. J. (2007). Delayed Developmental Language Milestones in Children with Duchenne’s Muscular Dystrophy. *The Journal of Pediatrics*, *150*(5), 474–478. <https://doi.org/10.1016/j.jpeds.2006.12.045>
- de Milander, M., Coetzee, D., & Venter, A. (2014). Developmental Coordination Disorder in grade 1 learners. *South African Journal for Research in Sport, Physical Education and Recreation*, *2031*, 1075–1085.
- Hamadani, J. D., Tofail, F., Cole, T., & Grantham-McGregor, S. (2013). The relation between age of attainment of motor milestones and future cognitive and motor development in Bangladeshi children. *Maternal & Child Nutrition*, *9*(S1), 89–104. <https://doi.org/10.1111/mcn.12020>

- Hua, J., Williams, G. J., Jin, H., Chen, J., Xu, M., Zhou, Y., Gu, G., & Du, W. (2022). Early Motor Milestones in Infancy and Later Motor Impairments: A Population-Based Data Linkage Study. *Frontiers in Psychiatry, 13*.
<https://www.frontiersin.org/article/10.3389/fpsy.2022.809181>
- Hyman, S. (2014, September 20). Motor coordination disorder: Bullying and depression. Sydney Cognitive Development Centre. <https://scdcentre.com/motor-coordination-disorder-bullying-depression/>
- Iadarola, S., Pérez-Ramos, J., Smith, T., & Dozier, A. (2019). Understanding stress in parents of children with autism spectrum disorder: A focus on under-represented families. *International Journal of Developmental Disabilities, 65*(1), 20–30.
<https://doi.org/10.1080/20473869.2017.1347228>
- Lee, J., Mayall, L. A., Bates, K. E., Hill, E. L., Leonard, H. C., & Farran, E. K. (2021). The relationship between motor milestone achievement and childhood motor deficits in children with Attention Deficit Hyperactivity Disorder (ADHD) and children with Developmental Coordination Disorder. *Research in Developmental Disabilities, 113*, 103920. <https://doi.org/10.1016/j.ridd.2021.103920>
- Licari, M. K., Alvares, G. A., Bernie, C., Elliott, C., Evans, K. L., McIntyre, S., Pillar, S. V., Reynolds, J. E., Reid, S. L., Spittle, A. J., Whitehouse, A. J. O., Zwicker, J. G., & Williams, J. (2021). The unmet clinical needs of children with developmental coordination disorder. *Pediatric Research, 90*(4), 826–831.
<https://doi.org/10.1038/s41390-021-01373-1>

- McPhillips, M., & Jordan-Black, J.-A. (2007). The effect of social disadvantage on motor development in young children: A comparative study. *Journal of Child Psychology and Psychiatry*, 48(12), 1214–1222. <https://doi.org/10.1111/j.1469-7610.2007.01814.x>
- Missiuna, C., & Campbell, W. N. (2014). Psychological aspects of developmental coordination disorder: Can we establish causality? *Current Developmental Disorders Reports*, 1(2), 125–131. <https://doi.org/10.1007/s40474-014-0012-8>
- Onis, M. d., & WHO Multicentre Growth Reference Study Group. (2006). WHO motor development study: Windows of achievement for six gross motor development milestones. *Acta Paediatric Supplement*, 95(S450), 86–95. <https://doi.org/10.1111/j.1651-2227.2006.tb02379.x>
- Osborne, L. A., McHugh, L., Saunders, J., & Reed, P. (2008). Parenting stress reduces the effectiveness of early teaching interventions for autistic spectrum disorders. *Journal of Autism and Developmental Disorders*, 38(6), 1092–1103. <https://doi.org/10.1007/s10803-007-0497-7>
- Schoemaker, M. M., & Smits-Engelsman, B. C. M. (2015). Is Treating Motor Problems in DCD Just a Matter of Practice and More Practice? *Current Developmental Disorders Reports*, 2(2), 150–156. <https://doi.org/10.1007/s40474-015-0045-7>
- Understood Team. (2022). Understanding developmental coordination disorder (DCD). <https://www.understood.org/en/learning-thinking-differences/child-learning-disabilities/dyspraxia/understanding-developmental-coordination-disorder-dcd>

Wilson, B.N., Crawford, S.G., Green, D., Roberts, G., Aylott, A., & Kaplan, B. (2009).

Psychometric Properties of the Revised Developmental Coordination Disorder

Questionnaire. *Physical & Occupational Therapy in Pediatrics*, 29(2):182-202.

Zoia, S., Barnett, A., Wilson, P., & Hill, E. (2006). Developmental Coordination

Disorder: Current issues. *Child: Care, Health and Development*, 32(6), 613–618.

<https://doi.org/10.1111/j.1365-2214.2006.00697.x>

BIOGRAPHICAL INFORMATION

Promise Robinson was born in Memphis, TN and moved to Euless, Texas at the age of 16 years old. She started her college education at Texas Christian University and later transferred to the University of Texas at Arlington (UTA) her sophomore year. Coming into undergraduate studies, Promise has always been fascinated by how the body was able to conduct movement. Her time at UTA has allowed her the opportunity to take classes regarding this phenomenon.

Promise was introduced to research in the motor development field through volunteering and working in the Motor Development Lab under the supervision of Dr. Priscila (Caçola) Tamplain. Robinson was directly involved in piloting an asynchronous virtual program for children with Developmental Coordination Disorder. In her time in the lab, she has also worked on various research studies and conducted her own research study as a McNair Scholar.

Robinson is extremely grateful for the opportunities Dr. Tamplain, the McNair Scholars Program, and her instructors have given her to learn from them and contribute to her field of knowledge. Being in Dr. Tamplain's lab has opened her eyes to the disparities that are present in children with motor difficulties and how most of the world is unbeknownst to them. Robinson hopes to further her knowledge in the field of motor development by pursuing her Ph.D. in motor development and progress towards becoming a researcher and professor.