The Impact of Family Income and Primary Caregiver Education Level on the Usage of Modified Ride-On Cars Among Children with Disabilities

by
Jenna Fitzgerald

A THESIS

submitted to

Oregon State University

Honors College

in partial fulfillment of
the requirements for the
degree of

Honors Baccalaureate of Science in Public Health
(Honors Scholar)

Presented March 8, 2019
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AN ABSTRACT OF THE THESIS OF

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Abstract approved:____

Samuel Logan

Modified ride-on cars are used by young children with disabilities for self-directed mobility. **Purpose:** The purpose of this study is to (1) determine the association between modified ride-on car driving time, family income, and primary caregiver education level; and (2) compare modified ride-on car driving time, family income, and primary caregiver education level between High Use and Low Use groups in the study. **Method:** The amount of time fourteen children with disabilities utilized modified ride-on cars during a three-month study period was recorded and analyzed according to family income and primary caregiver education level. **Results:** Driving time and family income, as well as family income and primary caregiver education level were correlated but driving time and primary caregiver education level were not. Between the High Use and Low Use groups, driving time was significantly different, but no significant differences were demonstrated in family income or between primary caregiver education level. **Conclusion:** A child's access to and usage of modified ride-on cars is impacted by intersectional factors beyond their disability. Effective rehabilitation interventions should consider factors such as family income and parental education level when working to address the physical or cognitive development of children with disabilities. *Key words: modified ride-on car, family income, primary caregiver education level, driving time*

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I understand that my project will become part of the permanent collection of Oregon State University, Honors College. My signature below authorizes release of my project to any reader upon request.

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Jenna Fitzgerald, Author

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TABLE OF CONTENTS

The Impact of Family Income and Primary Caregiver Educational Level on the Usage of Modified Ride-On Cars Among Children with Disabilities

INTRODUCTION

Self-Directed Mobility

Self-directed mobility, or movement that is initiated by an individual, is a fundamental right (Logan, et.al., 2017). Self-directed mobility is a significant contributor to cognitive (Foreman, Foreman, Cummings, & Owens, 1990), social (Campos, et.al., 2000), and motor (Lobo, Harbourne, Dusing, & McCoy, 2013) development. Evidence suggests that cognitive improvements from self-directed mobility include those related to spatial awareness, independence, and personal control (Kenyon, et.al., 2016; Ragonesi & Galloway, 2012; Livingstone & Field, 2014). Self-directed mobility is also related to improved social skills building from increased spontaneous socializations, which involves the initiation of meaningful interactions with others (Livingstone & Paleg, 2014; Jones, McEwen, & Hansen, 2003).

However, children with physical disabilities are often limited in opportunities to independently explore their environment through self-directed mobility and are therefore in a vulnerable position for secondary impairments related to cognitive, spatial-perceptual, and social-emotional development (Anderson, et.al., 2013). Fortunately, recent developments in assistive technologies have increased opportunities for self-directed mobility for children with disabilities.

Powered Mobility Devices

One way children with disabilities are provided with self-directed mobility is through the use of assistive technologies known as powered mobility devices (PMD). A PMD is any device that is activated by a battery or electrical power source and can be used by an individual to move from place to place (Logan, Feldner, Galloway, & Huang, 2016). Common forms of PMDs are motorized-wheelchairs and modified ride-on cars. Research has demonstrated that positive developmental gains in social communication, cognitive development, and other gross motor skills are common among children with disabilities who are granted access to self-directed mobility through PMDs (Jones, McEwen, & Hansen, 2003, Jones, McEwen, & Neas 2012, Butler, 1986; Livingstone & Paleg, 2014). Additionally, utilizing PMDs as a form of self-directed mobility could improve eye-hand coordination, spontaneous vocalization, motivation to explore, spatial awareness, and visual-perceptual skills, as well as could increase interactions with peers (Dietz, Swinth, & White, 2002; Livingstone & Paleg, 2014; Jones, McEwen, & Hansen, 2003; Butler, 1986).

Despite the importance of PMDs in the development of children with disabilities, self-directed mobility in the form of a PMD is often unattainable for young children. Children must rely on their caregivers for mobility, as well as for access to PMDs, rather than their own abilities to explore more independently. Other barriers children may face to accessing PMDs include cost, environmental accessibility, age, the adaptability of a device to the child's growth, and the social acceptance of a PMD (Henderson, Skelton, & Rosenbaum, 2008). Further barriers center around the family and may include the caregiver's perceptions of PMDs, children's capabilities, and interactions with siblings and peers (Teft, Guerette, & Furumasu, 2011; Rousseau-Harison & Rochette, 2013).

In 2012, a novel form of a PMD for self-directed mobility was introduced in the literature (Huang & Galloway, 2012). Supported by the Go Baby Go national program, this new device is known as a modified ride-on car (ROC) and includes the following features: low cost, lightweight and small size, easy to transport, child friendly toy designs and functions (Huang & Galloway, 2012). Electromechanical modifications of ROCs, which include changes to seating, steering systems, and drive systems, are relatively simple, can be permanent or temporary, and are customized for each particular child (Huang & Galloway, 2012). This form of low-cost, commercially available, and battery-operated PMD is intended to decrease barriers and increase self-directed mobility for children with disabilities (Logan, et.al., 2017).

Figure 1. Images of Modified Ride-On Cars with easy-to-use push button and safety protections.

Research has demonstrated positive effects on the behaviors and development of young children with disabilities when they are provided with access to modified ROCs (Huang, Rogonesi, Stoner, Peffley, & Galloway, 2014; Logan, Huang, Stahlin, & Galloway, 2014; Logan, et.al., 2016). Access to modified ROCs has been shown to increase independent mobility which results in increased opportunities for these children to freely act on their environment and learn the consequences of their actions (Huang, Chen, & Huang, 2017). Case studies with modified ROCs have demonstrated similar results as use has been associated with increased mobility (Huang, et.al., 2014; Logan, et.al., 2014), physical and social interaction with families and peers (Huang, et.al., 2014), vocalizations (Huang, et.al., 2014), and levels of enjoyment (Huang, et.al., 2014).

However, many studies also report variable modified ROC usage and driving adherence. Modified ROC studies involving a 12-week intervention period completed within a home setting have resulted in a wide range of driving times, from 120 minutes (Logan, Hospodar, Feldner, Huang, & Galloway, 2018) to 1150 minutes (Huang, et.al., 2014), despite the provision of driving frequency recommendations. The reasons behind variable modified ROC driving time in a home setting have not yet been explored. However, due to the understanding that positive impacts from modified ROC usage are more prominent as a result of effective and frequent use of the devices, it is essential to understand why modified ROC usage is varied in a home setting, especially with the increase in access to PMDs provided by modified ROCs.

<u>Impact of Family Income and Primary Caregiver Education Level on Child Development</u>

Even with decreased barriers and increased access to PMDs like modified ROCs, self-directed mobility may continue to be inaccessible for children with disabilities due to factors outside of their control. Two such factors, family income and caregiver education level, are associated with childhood development and health outcomes in general (Bradley & Corwyn, 2001). The association between family income level, parental education level, and child outcomes has been extensively studied, resulting in conclusions about the ways in which these factors impact child health and development in a general sense (Bradley & Corwyn, 2001).The income level of a family impacts a child's access to healthcare resources, services, education, and other stimulating resources and recreational facilities, merely as a result of financial means (Bradley & Corwyn, 2001). The education level of a parent contributes to their economic success, as well as their ability to successfully navigate health care systems and other related services (Bradley & Corwyn, 2001), which can subsequently affect the child's access to such services. All of these factors impact a child's quality of life, overall success, and long term health outcomes, including those related to disability.

Family Income

While no literature has examined family income and PMD usage, other studies have focused on the relationship between adherence to home exercise programs and family income. Tang, et.al. examined the the factors affecting the addition of a home program to weekly institutional-based therapy for children with undefined developmental delays (Tang, et.al., 2011). Results found that higher family income was significantly correlated with higher program execution, but not significantly associated with developmental progression of the children overall (Tang, et.al., 2011). Another study examined the factors that influenced the compliance of mothers with a home exercise program for their child with disabilities (Gajdosik & Campbell, 1991). One such factor included socioeconomic status which included both income and education level of the parents. Results indicated that socioeconomic status was not directly related to compliance (Gajdosik & Campbell, 1991).

Although previous research is mixed about the impact of family income on compliance in home exercise programs, they provide essential support for the necessity of a novel study to examine these factors in a modified ROC program within a home setting by demonstrating a potential explanation for varying modified ROC usage.

Primary Caregiver Education Level

As with family income, Tang, et.al. reported that higher parental education level was significantly correlated with higher execution in the home and institutional-based program. However, there was no significant association again with developmental progression of the children overall (Tang, et.al., 2011). Medina-Mirapeix, et.al. examined the predictors, including parental education level, of parents' adherence to home exercise programs for children with developmental disabilities and found that sociodemographic caregiver factors did not predict adherence in this study (Medina-Mirapeix, et.al., 2017). Furthermore, there are no studies that focused on parental education level and PMD usage. However, the evidence from previous studies examining the impact of parental education level on adherence in a home exercise program provides a potential explanation for modified ROC usage.

PURPOSE OF STUDY

The purpose of this study is twofold: (1) determine the association between modified ROC driving time, family income, and primary caregiver education level; and (2) compare modified ROC driving time, family income, and primary caregiver education level between High Use and Low Use groups in the study. High Use and

Low Use groups were based on minutes of modified ROC time throughout the study period. It was hypothesized that driving time, family income, and primary education level would be significantly and positively associated. It was also hypothesized that there would be significant differences between the High Use and Low Use groups regarding driving time, family income, and primary caregiver education level.

METHOD

Study Design

This study was a part of a larger project that used a prospective, descriptive research design and examined the feasibility of the use of modified ROCs within families with children with disabilities, the pretest/posttest changes in child development and participation, and caregiver attitudes towards disability models, people with disabilities, and self-directed mobility.

Procedure

The components of the study involved one initial visit, a three-month period of modified ROC usage, and one follow-up visit. The initial visit, in which families completed study questionnaires, including a family demographic form, and received modified ROC safety training, lasted about 1.5 hours. In this time, each child was also properly fit into the car and had the opportunity to explore under the supervision of a researcher. For the three months of modified ROC usage, families were instructed to utilize the car in a way that best fit into their daily lives. There was no consistent contact with researchers during this three-month period, and parents were asked to log their modified ROC usage on a form provided. During follow-up visits at the end of the three months, families completed questionnaires again, and data was collected about modified ROC usage.

Institutional Review Board approval, as well as written informed consent from parent or legal guardian, were obtained prior to data collection.

Participants

Participants in the study were enrolled and completed the study in three-month increments between August 2017 and June 2018. Initially, there were 18 children enrolled but the final sample was composed of 14 children due to the fact that four families were unable to be contacted for follow-up. The final sample contained children who fit the inclusion criteria: between the ages of 10 months and 3 years at entry, ability to sit with support, and diagnosed with a mobility-related disability or identified as being delayed or at risk for delay in the onset of independent locomotion. Additionally, all 14 participants completed initial paperwork, participated in three-months of modified ROC usage, completed post-study paperwork, and returned SD card tracking information.

For the purpose of this study, caregivers were also important participants as they provided consent for the participation of their children and contributed essential information regarding demographics. All but one child participant had two caregivers. Additionally, the primary caregiver for 13 of the 14 participants was a mother, while a grandmother was the primary caregiver for the final participant. Overall, maternal figures played a large role in completing all forms in this study, as well as facilitating the use of modified ROCs. For this reason, maternal caregivers are referred to as primary caregivers throughout this study.

Instruments

Modified Ride-On Car: Three modified ROC models, with varied seating forms to fit children's specific needs, were used in this study. All car models were suited for children up to 36 months of age, used a 6-volt battery, had a maximum speed of two miles in forward motion, and were modified for best use (Logan, et.al., IN REVIEW). Modifications included the addition of structural support that involved PVC pipe, pool noodles, and kickboards, as well as a large, easy-to-use activation switch (Huang & Galloway, 2012; Logan, et.al., 2017). Car safety and parent usage were evaluated by an engineer and researcher respectively ahead of modified ROC provision. Usage evaluation included a demonstration of the parent's ability to safely secure their child in the car, to turn the car on and off, to charge the battery, and to provide arm's lengths supervision at all times. An additional safety agreement about appropriate driving areas was signed by both parent and researcher.

Figure 2. Photograph of three different modified ROC models used in this study. Models from left to right are Spongebob, Paw Patrol, and Lightning McQueen (Logan, et.al., IN REVIEW).

Feather Interface Tracking (FIT) System: Each modified car was additionally outfitted with a Feather Interface Tracking (FIT) System. The FIT system included Adafruit Feather M0 Adalogger, Precision Real Time Clock FeatherWing, and Quincrun 60A 2S-3S Waterproof Brushed Electronic Speed Controller. The hardware components provided information related to car usage, recording date, timestamp, and duration of switch activation in milliseconds for each time the switch was activated and released. Data was stored in the form of a line of text for each activation, released on a micro SD card, and downloaded to a laptop computer at the follow-up visit (Logan, et.al., IN REVIEW).

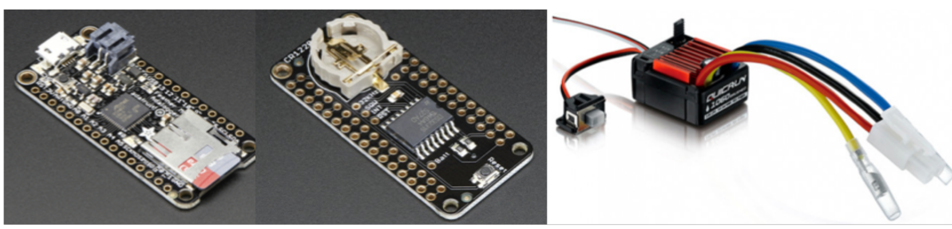


Figure 3. Adafruit Feather, Real Time Clock, and Speed Controller from left to right.

Family Demographic Survey: Each family completed a family demographic survey during the initial visit which allowed researchers to collect self-reported information about the child's disability, the parental education level, and family income information. The questions related to the child's disability were open-ended, while the parental education level and family income questions required categorical answers. Information essential to this study includes primary caregiver, primary caregiver education level, and family income.

<u>Data Analysis</u>

In order to analyze data in relation to the first aim and determine the association between driving time, family income, and primary caregiver education level for all participants, a Spearman's Rank Order non-parametric correlation was completed. This test was used to measure the strength and direction of the association between all variables in the study. This test was chosen for several reasons: the sample size is small; the data is not normally distributed; and the data is ordinal. The strength of correlations was interpreted according to guidelines set by Cohen: 0.10-0.29=low, 0.30-0.49=moderate, 0.50 and above=strong (Cohen, 1988).

The fourteen participants were separated into two equal groups based on amount of driving time during the three-month period. The seven participants who drove the most were placed in the High Use group and the seven participants who drove the least were placed in the Low Use group. See Tables 1 and 2 below. The groupings of High Use and Low Use allowed for the analysis of education level and family income between groups. The mean and standard deviations were then calculated for driving time and primary caregiver education level to provide an effective comparison between High Use and Low Use groups.

Table 1. High Use Group

Participant ID	Driving Time (minutes)	Primary Caregiver	Primary Caregiver EDU level (years)	Family Income (annual)
9	791	mother	20	$70,001 or more
12	440.5	mother	16	$70,001 or more
3	170.8	mother	14	$46,001-$54,000
8	165.6	mother	14	$70,001 or more
11	153.2	mother	10	$30,001-$46,000

13	130.4	mother	16	$70,001 or more
4	110.5	mother	14	$62,001-$70,000

Table 2. Low Use Group

Participant ID	Driving Time (minutes)	Primary Caregiver	Primary Caregiver EDU level (years)	Family Income (annual)
23	94.9	mother	12	$54,001-$62,000
27	89.9	mother	18.5	$62,001-$70,000
26	80.8	mother	15.5	$38,001-$46,000
14	68.6	mother	14	$30,001-$46,000
20	67.3	grandmother	14	Less than $22,000
7	35.9	mother	15	$54,001-$62,000
19	0	mother	12	$46,001-$54,000

A Mann-Whitney U Test was calculated to compare driving time, family income, and primary caregiver education level between High Use and Low Use groups. As a non-parametric alternative to an independent t-test, this test was used because the data is not normally distributed, the sample size is small, and the data is ordinal. A Bonferroni correction will be used to determine significance due to the calculation of three t-tests (alpha = .05/3 = p critical .016).

RESULTS

The Spearman's Rank Order test demonstrated the associations between driving time, primary caregiver education level, and family income. See Table 3. The 2-tailed significant levels were determined to be significant only at or below the -0.05 level, providing strong evidence that there was a strong positive correlation between family income and primary caregiver education level and a strong positive correlation between family income and driving time. However, the data did not show any significant correlation between driving time and primary caregiver education level.

Table 3. Correlation Matrix, Spearman's Rank Order.

*. Correlation is significant at the 0.05 level.

	Driving Time	Primary Caregiver EDU Level	Family Income
Driving Time	1.000		
Primary Caregiver EDU Level	0.295 (sig. 0.306)	1.000	
Family Income	0.580* (sig. 0.030)	0.581* (sig. 0.029)	1.000

A Mann-Whitney U Test indicated a significant difference between the High Use and Low Use groups of driving time (p = .002). In contrast, no significant differences were observed between the primary caregiver education level and family income when comparing the High Use and Low Use groups. See Table 4.

Table 4. Mann-Whitney U Test, Grouped by Usage Group

*. Difference is significant below the 0.05 level.

	Driving Time	Primary Caregiver EDU Level	Family Income
Asymp.Sig. (2-Tailed)	0.002*	0.647	0.052

Mean and standard deviation calculations of driving time demonstrated high variability in the data within High Use and Low Use Groups. Primary caregiver education level was less variable in each group, but differences can be observed between the two groups. See Table 5 below.

Table 5. Mean and Standard Deviation of Driving Time and Primary Caregiver Education Level by Usage Group

	Driving Time (minutes)		Primary Caregiver EDU Level (years)	
	High Use	Low Use	High Use	Low Use
Mean	280.286	62.486	14.857	13.75
Standard Deviation	251.357	33.688	3.024	2.244

DISCUSSION

<u>Association between Driving Time, Family Income, and Caregiver Education Level</u>

The first aim of this project was to determine the association between modified ROC driving time, family income, and primary caregiver education level. A strong positive correlation was found between family income and primary caregiver education level. This data supports past reports that demonstrates the positive association between educational attainment and overall income level through the relations between unemployment rates, median weekly earnings, and education attainment (U.S. Bureau of Labor Statistics).

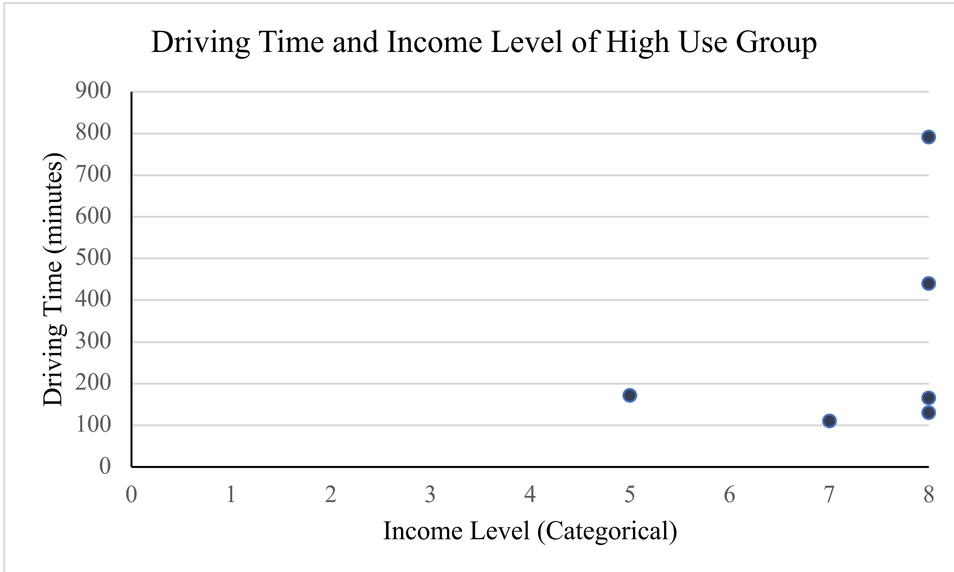
Results also demonstrated a strong positive correlation between driving time and family income, indicating that as driving time increased, family income also increased. It is unclear exactly why a higher income level may contribute to a greater usage of modified ROCs in this particular study. It can be inferred that this may be a result of various factors. Families of a higher income level may be more likely to have the space to facilitate active and consistent driving with the modified ROCs whether that is inside a larger home, in a large backyard, or safely outside of the home at a park or within a neighborhood. The likely presence of at least one of these factors within the environment of a higher income family may contribute to a trend of increased driving time. In contrast, lower income families who do not have access to appropriate and safe driving environments might experience barriers to utilizing the modified ROCs. It is possible that time for parental supervision and usage of the modified ROC may have contributed to the overall use. If a low-income family is composed of only a single parent or of two parents who work multiple jobs, finding the time to supervise a child in their modified ROC might be more difficult. Regardless of the explanation, the correlation between family income and modified ROC usage, demonstrates the importance of considering the impacts of factors beyond a child's disability when examining the utilization of seemingly accessible PMDs, as well as understanding variable driving times in a home setting.

<u>High Use and Low Use Group Differences</u>

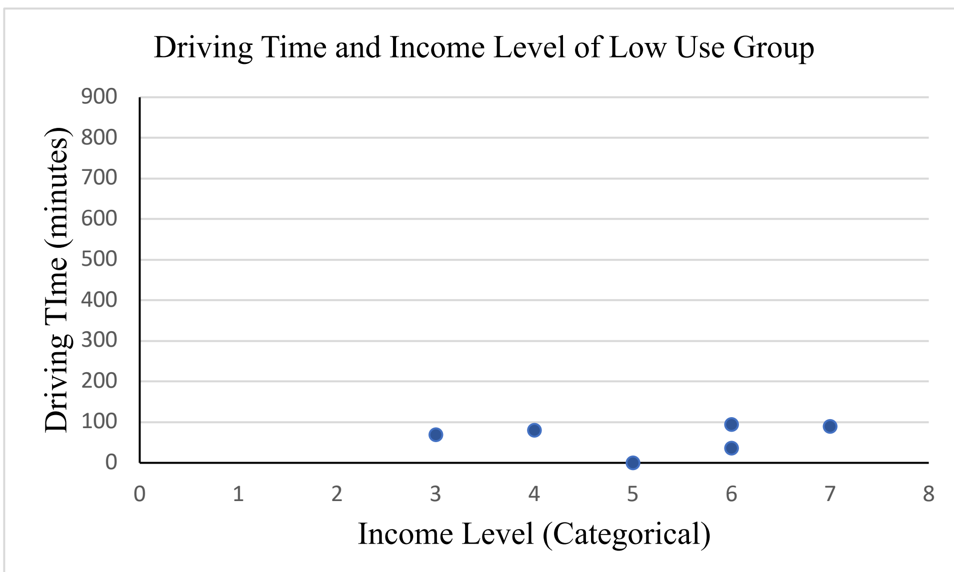
The second aim was to compare each factor between the High Use and Low Use groups with the goal of observing group differences. However, as illustrated in the results, group differences were minimal. A significant difference between driving times of the two groups was found, but no significant differences between family income level or primary caregiver education level. The significant differences between driving times was important for the examination of other factors because it shows that there were differences in the amount of time that participants used the modified ROCs.

In contrast, no significant differences were found between groups in relation to family income. This is especially important to note because when examining the association of these factors without grouping the data, a positive correlation between family income level and driving time was found. It is likely that the lack of statistical differences was a result of variability within the groups, as well as the use of categorical ranges when describing income level. By referencing Tables 1 and 2, as well as Graphs 1 and 2, it can be observed that the High Use group contains substantially more participants who are a part of the highest income bracket (Category 8) of $70,001 or more per year. This group only has two members of the seven total who reported an income under $62,000 per year (Category 7). In contrast, the Low Use group contains only one member with an annual family income above $62,000 a year (Category 7), meaning that the rest of the participants in this group are members of lower income brackets. While statistical calculations did not demonstrate a significant difference between these two groups, it is still important to note these observed differences, and consider potential limitations, such as the use of broad categories and the relatively small sample size, that may have contributed to the calculated outcomes.

Graph 1. Driving Time and Income Level of High Use Group



Graph 2. Driving Time and Income Level of Low Use Group



Finally, the lack of a significant difference in primary caregiver education level between the two groups is likely due to the high variability within each group. Results show over a year difference in education level of the two groups (See Table 5). However, the standard deviation of primary education level in the High Use group is 3.024 years and the standard deviation of the Low Use group is 2.244 years. The high variability of each group likely impacted the lack of significant difference between two groups.

Strengths and Limitations

Strengths of this study are primarily related to the time-period and overall study design. The study period of three months provided enough time for families to determine the ways in which a modified ROC would, or would not, fit in their daily lives, as well as allowed for enough time for parents to provide feedback for future improvements. The study design did not build in repetitive check-ins with families which provided data that was more reflective of how each family was able to incorporate the modified ROC into their daily lives. Furthermore, the design may have allowed a greater accessibility of the study as researchers were able to incorporate more families due to the low time commitment required by families to participate. Participation included one initial visit and one follow-up visit.

However, the lack of consistent check-ins may have also been a limitation of the study and could have contributed to the overall low driving times across groups. Additionally, the sample population was quite limited in scope, including only 14 children with disabilities and their families within the Pacific Northwest. Without a larger and more diverse population, the results are not generalizable.

Future Directions

Future studies should work toward eliminating limitations and improving the study design while testing the same factors in order to increase the validity and generalizability of this study. Additional research may also incorporate questionnaires or surveys to understand caregiver’s perceptions of the barriers that they may or may not face in relation to providing their children access to use a modified ROC. This information could then guide interventions focused on reducing parent-reported perceived barriers to modified ROC usage.

The conclusions from this study illustrate an increased need to consider factors such as family income when creating interventions for children with disabilities. Future interventions should offer additional support for families of a lower income level in order to ensure use and access to modified ROCs and other PMDs in a way that truly benefits children and families. With an intersectional and public health approach that focuses on the impact of variables beyond a child's disability, future interventions could become more comprehensive and beneficial to a wider population.

CONCLUSION

Results found in this study both consistent and inconsistent with previous research in this field. As demonstrated in the introduction, there is no literature that has examined the impact of family income or primary caregiver education level on the usage of modified ROCs or other PMDs. Although the available research surrounding pediatric rehabilitation for children with disabilities for the most part does not focus on the impact of these factors, some studies have found that these factors are both related (Tang, et.al., 2011) and unrelated (Gajdosik & Campbell, 1991; Medina-Mirapeix, et.al., 2017) to compliance in rehabilitation programs, creating a challenge in making conclusions around this topic. This study has data to both support and refute the idea that family income and primary caregiver education level impact driving time. However, the conclusions drawn from this current research, as well as previous studies, demonstrate that further research is necessary in order to make stronger conclusions and build effective interventions.

Despite the lack of strong conclusions, this study investigates a novel idea and utilizes a public health perspective to examine the impact that factors beyond a child's disability and control may have on their access to and utilization of modified ROCs. The understanding of correlation between driving time and family income helps to further support the idea that childhood disability and development is impacted by intersectional factors. Disability is often viewed as one's master status, or a dominant identity that has an overarching nature in a person's life (Barnartt, 2013). However, the conclusions of this study provide support for the necessity of using an intersectional and public health approach to understand and intervene in issues related to childhood disability. Effective rehabilitation interventions should consider factors such as family income when working to address physical or cognitive development of children with disabilities. The promotion of rehabilitation programs and services is essential for increasing access to self-directed mobility for children with disabilities, but such programs must also address the intersectionality of disability and the wider scope of social determinants that influence a child's experience of development and disability.

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