

**Impact of the Assistive Technology Professional Involvement in the Provision of Mobility  
Assistive Equipment**

by

**Anthony Yang**

B.S. Kinesiology, Pennsylvania State University, 2012

Submitted to the Graduate Faculty of the  
University of Pittsburgh in partial fulfillment  
of the requirements for the degree of  
Master of Science in Rehabilitation Science and Technology

University of Pittsburgh

2019

UNIVERSITY OF PITTSBURGH  
SCHOOL OF HEALTH AND REHABILITATION SCIENCES

This thesis was presented

by

**Anthony Yang**

It was defended on

March 27th, 2019

and approved by

Richard M. Schein, PhD, MPH, Research Scientist, Department of Rehabilitation Science &  
Technology

Andi Saptono, PhD, Associate Professor, Department of Health and Information Management

Mark R. Schmeler, PhD, OTR/L, ATP, Associate Professor and Vice-Chair for Education &  
Training, Department of Rehabilitation Science & Technology

Copyright © by Anthony Yang

2019

# **Impact of the Assistive Technology Professional Involvement in the Provision of Mobility Assistive Equipment**

Anthony Yang, MS

University of Pittsburgh, 2019

People with disabilities who have functional mobility limitations often rely on mobility assistive equipment (MAE) to perform Mobility Related Activities of Daily Living (MRADLs). If an individual is not appropriately evaluated for Mobility Assistive Equipment to address current and prepare for future needs, negative outcomes are to be expected. The purpose of this study was to investigate differences between if an Assistive Technology Professional (ATP) was involved in the provision of MAE or if there was no ATP. The variables compared were based on demographics, current primary MAE, and baseline FMA scores. The data being analyzed was received through a pre-existing registry, with a population size of 2085 whereby 1123 met the inclusion criteria. If an ATP was involved, the individual using the MAE was more likely to have lived with their medical condition longer and use the MAE longer. The data shows that elderly females were more likely to not have an ATP, however a post hoc analysis determined that this result was more related to diagnosis than ATP involvement. Individuals who had an ATP were being provided with better quality MAE, being Group 3 power wheelchairs and ultra-lightweight manual wheelchairs compared to other wheelchairs, cane, crutches, or walkers if there was not an ATP involved. Baseline FMA scores suggest that having an ATP involved in the provision of MAE results in higher satisfaction scores than not having an ATP. Overall, this study provides evidence that an ATP has a positive impact on MAE provision by providing better quality MAE that is more durable and leads to higher self-reported satisfaction ratings.

## TABLE OF CONTENTS

<b>PREFACE.....</b>	<b>IX</b>
<b>1.0 INTRODUCTION.....</b>	<b>1</b>
<b>1.1 BACKGROUND .....</b>	<b>3</b>
<b>2.0 METHODS .....</b>	<b>6</b>
<b>2.1 STUDY DESIGN .....</b>	<b>6</b>
<b>2.2 PARTICIPANTS .....</b>	<b>7</b>
<b>2.3 INSTRUMENTATION.....</b>	<b>9</b>
<b>2.4 PROCEDURE .....</b>	<b>10</b>
<b>2.5 DATA ANALYSIS.....</b>	<b>11</b>
<b>2.6 RESULTS .....</b>	<b>11</b>
<b>3.0 DISCUSSION .....</b>	<b>20</b>
<b>3.1 NULL HYPOTHESIS 1 .....</b>	<b>20</b>
<b>3.2 NULL HYPOTHESIS 2 .....</b>	<b>22</b>
<b>3.3 NULL HYPOTHESIS 3 .....</b>	<b>24</b>
<b>3.4 STUDY LIMITATIONS .....</b>	<b>25</b>
<b>3.5 FUTURE WORK.....</b>	<b>26</b>
<b>3.6 CONCLUSION .....</b>	<b>27</b>
<b>APPENDIX A.....</b>	<b>28</b>

**BIBLIOGRAPHY..... 30**

## LIST OF TABLES

Table 1 Demographics and Results Descriptive .....	8
Table 2 Age Comparison Based on Most Prevalent Diagnoses** .....	21
Table 3 Gender Comparison Based on Most Prevalent and Common Diagnoses** .....	22
Table 4 MAE Comparison Based on Most Prevalent and Common Diagnoses** .....	24

## LIST OF FIGURES

Figure 1 Age Distribution .....	13
Figure 2 Gender Comparison Between Groups .....	14
Figure 3 Diagnosis Comparison Between Groups.....	15
Figure 4 Age of MAE Distribution.....	16
Figure 5 Years Since Onset Distribution .....	17
Figure 6 Current MAE Comparison .....	18
Figure 7 FMA Distribution .....	19

## **PREFACE**

I would first like to give a special thank you to Dr. Mark Schmeler. You have been an outstanding academic advisor, professor and mentor during my time at the University of Pittsburgh. I appreciate and will be forever grateful for your advice and guidance. To Dr. Rich Schein, thank you for always being available to show support and sharing your insight.

Thank you to Stephanie Vasquez and Vince Schiappa for your advice and feedback throughout this project. I appreciate the time and energy both of you have spent away from your own personal projects to help with mine. I would also like to recognize my fellow RST students for the memories and the life-long friendships that were created through our time in this program.

Lastly, thank you to my family and friends who have always provided words of encouragement throughout my education. Your support provided me with the patience and perseverance needed to complete this thesis.

## 1.0 INTRODUCTION

Over a billion people in the world have some form of disability. Between 100 million and 190 million adults have difficulties performing activities of daily living such as, dressing, bathing, and eating. With the rates of disabilities increasing due to an aging population, increase in chronic health conditions and amongst other reasons, more people are relying on mobility assistive equipment (MAE) (World Health Organization, 2018). MAE includes but are not limited to canes, crutches, walkers, wheelchairs (power and manual), and scooters. Medicare is the largest funding source for mobility MAEs in the United States and will typically replace a MAE once every five years (Medicare Rights Center, 2019). Thus, individuals who are receiving funding through Medicare must receive MAE that meets their needs and durable enough to last the five years. If individuals are not provided with the best MAE that fits their needs, a well-documented issue is abandoning their MAE (Scherer & Federici, 2015). MAE abandonment results in dissatisfaction, frustration, and wasting their financial resources (Batavia & Hammer, 1990). The most frequently abandoned mobility MAE are wheelchairs, followed by canes and walkers. Four predictive variables were identified that could result in abandonment are: change in the needs of the user, ease of obtaining the MAE from the supplier, meeting the user's expectations, and whether the user's opinion was considered in the selection process (Phillips & Zhao, 1993).

The Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) has developed an Assistive Technology Professional (ATP) certification that requires candidates to meet educational and work experience requirements that covers all major areas of assistive technology (AT). The ATP certification recognizes an individual's competence in analyzing the needs of people with disabilities, help with the selection of appropriate AT and providing the training in the use of the selected MAEs (RESNA, 2019). Health care professionals that primarily practice within the AT field generally agree that a team approach is optimal. Although the role of an ATP involvement is expected to be of high value, little research has been examined to show the relationship between ATP involvement and service delivery outcomes. (Jette et al., 2017).

The purpose of this study was to examine the differences in demographics, type of MAE provided, and Functional Mobility Assessment (FMA) scores between whether an ATP was involved or not in the provision of MAE. Three hypotheses that were investigated are as follows:

- Null Hypothesis 1: There will not be a statistically significant difference regarding age of person, gender, diagnosis, age of current primary MAE, and number of years since onset of diagnosis between groups with ATP involvement or no ATP involvement during mobility assistive equipment provision.
- Null Hypothesis 2: There will not be a statistically significant difference in current primary MAE between groups with ATP involvement or no ATP involvement during mobility assistive equipment provision.
- Null Hypothesis 3: There will not be a statistically significant difference in FMA scores between groups with ATP involvement or no ATP involvement during mobility assistive equipment provision.

## 1.1 BACKGROUND

People with disabilities (PwD) are often underestimated on what they are capable of. Disability is often viewed as a limiting factor, but their environment plays a major role in determining what they can do and be (Lid & Solvang, 2015). Although there is a wide variety of mobility-related technologies, there were about 3.6 million wheelchair users and 11.6 million people using a cane, crutch or walker in the United States in 2010. (US Census Bureau, 2012). This number is expected to grow due to the aging baby boomers and their increasing longevity. Although access to wheeled-mobility is vital, the proper process of service and delivery is where the persons functional abilities can be maximized. Improper service delivery can limit the persons functional abilities with self-care, participation in the community and employment. These complications can lead to secondary injuries, dependability on others and abandonment.

MAE such as scooters, manual wheelchairs and power wheelchairs are easily accessible in the market. Like purchasing a new vehicle, it is important for PwD to have objective information regarding the safety and durability of these MAE. The American National Standards Institute (ANSI) and Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) have developed standardized testing to provide objective measurements. Although these standards have been established, the Food and Drug Administration (FDA) does not require wheelchair manufactures to meet these standards. The amount of manual and power wheelchairs that have not passed the ANSI/RESNA standards have been well documented (Rentschler et al., 2004; Souza et al., 2013; Kwarciak et al., 2005). These MAEs that have not pass ANSI/RESNA standards can become consequential for the users such as: injury, being

stranded, missing medical appointments, and inability to attend school/work (Hogaboom et al., 2018; Worobey et al., 2012).

RESNA has developed a *Wheelchair Service Provision Guide* to identify the essential steps in the provision of a wheelchair (Arledge et al., 2011). The components included in this wheelchair service delivery model include: Referral, Assessment, Equipment Recommendation and Selection, Funding and Procurement, Product Preparation, Fitting, Training and Delivery, Follow-up Maintenance and Repair, and Outcome Measurement. The guide further recommends that people who will be using a wheelchair and/or seating system for at least six months or on a permanent basis should be referred to a therapist (physical or occupational) and supplier who are both qualified, skilled and experienced in seating and mobility. The assessment component consists of three categories structured by the International Classification of Functioning, Disability, and Health (ICF): Body Structures and Functions; Activities and Participation; and Environment and Current Technology. Following the assessment, the client should be properly fitted and trained on the MAE being prescribed (Arledge et al., 2011).

In addition to the Wheelchair Service and Provision Guide, RESNA has also established “Standards of Practice” for ATP’s. The Standards of Practice are 22 essential concepts and rules to consider promoting the highest ethical standards among individuals who evaluate, identify needs, recommend or providing assistive technology (RESNA, 2016) (see Appendix A). By following these Standards of Practice, ATP’s can achieve the desired level of performance to help prevent major issues related to MAE, such as abandonment. Several factors that have been predictors of MAE abandonment are: change in needs, MAE performance, and client opinion not being considered in the selection (Phillips & Zhao, 1993; Reimer-Reiss & Wacker, 2000). Although the Standards of Practice address all the predictive factors of MAE abandonment, little

research has examined the relationship between ATP involvement and service delivery outcomes (Jette et al., 2017).

## **2.0 METHODS**

### **2.1 STUDY DESIGN**

The data for this study was received from the Functional Mobility Assessment/Uniform Dataset (FMA/UDS) Registry. Data from the FMA/UDS Registry is collected through an exempt IRB at the University of Pittsburgh and by a vetted Collaborative Corporate Research Agreement with the Van G. Miller Group, Inc. and its subsidiary U.S. Rehab (VGM/US Rehab). U.S. Rehab suppliers collaborate with clinicians to administer the FMA/UDS to people at the time of initial evaluation for a new mobility intervention and at period set times following provision of new MAE device. Specific variables such as ATP involvement, age, gender, year of onset, age of MAE, primary diagnosis, current primary MAE, and baseline FMA scores were exported from the FMA/UDS Registry at baseline to review for further analyses (Schmeler et al., 2019) At the time of this study, the registry consisted of 2085 baseline scores of individuals collected between 7/7/2015 – 10/8/2018 across 166 individual providers representing 40 States.

## 2.2 PARTICIPANTS

Of the 2085 baseline cases in the FMA/UDS Registry, 1123 cases indicated there was or was not an ATP involved (versus unknown) in the provision of their MAE and had a complete FMA/UDS dataset therefore met the inclusion criteria for this study. There were 523 complete datasets that indicated there was an ATP involved in the provision of their MAE and 600 cases that reported there was no ATP involved (See Table 1).

Of those 1123 cases, the following variables were included in the analyses:

- Year of Birth
- Gender
- Age of their current MAE at baseline
- Year of Diagnosis Onset
- Primary Diagnosis
- Current type Primary MAE at baseline
- Baseline FMA score

**Table 1 Demographics and Results Descriptive**

	ATP	No ATP	Total
Demographics	n = 523	n = 600	N = 1123
Age, <i>M±SD</i>	56.50±17.58	65.01±15.52	61.05±17.04
Range	19 - 106	19 - 99	19 - 106
Gender, <i>n(%)</i>			
Female	249 (47.6%)	336 (56.0%)	585 (52.1%)
Male	274 (52.4%)	264 (44%)	538 (47.9%)
Age of MAE, <i>M±SD</i>	5.39±2.20	4.29±2.94	4.80±2.68
Years Since Onset, <i>M±SD</i>	24.52 ±18.14	15.66 ±16.55	19.79 ±17.85
Diagnosis, <i>n(%)</i>			
Osteoarthritis	12 (2.3%)	48 (8.0%)	60 (5.30%)
Amyotrophic Lateral Sclerosis/ Primary Lateral Sclerosis	6 (1.1%)	28 (4.7%)	34 (3.00%)
Rheumatoid Arthritis	4 (.8%)	16 (2.7%)	20 (1.85)
Stroke/CVA	66 (12.6%)	112 (18.7%)	178 (15.95)
Multiple Sclerosis	56 (10.7%)	59 (9.8%)	115 (10.2%)
Amputation	17 (3.3%)	38 (6.3%)	55 (4.95)
Cardiopulmonary Disease	4 (.8%)	26 (4.3%)	30 (2.7%)
Cerebral Palsy	70 (13.4%)	26 (4.3%)	96 (8.5%)
Morbid Obesity	15 (2.9%)	32 (5.3%)	47 (4.2%)
SCI (Paraplegia)	63 (12.0%)	24 (4.0%)	87 (7.7%)
SCI (Tetraplegia/Quadriplegia)	51 (9.8%)	16 (2.7%)	67 (6.0%)
Parkinson Disease	5 (1.0%)	36 (6.0%)	41 (3.7%)
Traumatic Brain Injury (TBI)	10 (1.9%)	9 (1.5%)	19 (1.7%)
Post-Polio Syndrome	20 (3.8%)	11 (1.8%)	31 (2.8%)
Muscular Dystrophy	18 (3.4%)	5 (.8%)	23 (2.0%)
Spinal Stenosis	6 (1.1%)	10 (1.7%)	16 (1.4%)
Spina Bifida	27 (5.2%)	7 (1.2%)	34 (3.0%)
Cerebellar Degeneration, Arthrogryposis, Spinocerebellar Disease, Osteogenesis Imperfecta, Spinal Muscular Atrophy (SMA)	10 (1.9%)	9 (1.5%)	19 (1.7%)
Other Neuromuscular or Congenital Disease (Not Listed Above)	63 (12.0%)	88 (14.7%)	151 (13.4%)

**Table 1 (continued)**

	ATP	No ATP	Total
Current Primary MAE, <i>n</i> (%)	31 (5.9%)	154 (25.7%)	185 (16.5%)
Cane, Crutches, Walker	41 (7.8%)	262 (43.7%)	303 (27.0%)
Other Wheelchairs*	100 (19.1%)	18 (3.0%)	118 (10.5%)
Ultra-Lightweight Manual Wheelchair	11 (2.1%)	3 (.5%)	14 (1.2%)
Tilt-in-Space Wheelchair	9 (1.7%)	26 (4.3%)	35 (3.1%)
POV/Scooter	4 (.8%)	10 (1.7%)	14 (1.2%)
Group 1 Power Wheelchair	89 (17.0%)	110 (18.3%)	199 (17.7%)
Group 2 Power Wheelchair	233 (44.6%)	17 (2.8%)	250 (22.3%)
Group 3 Power Wheelchair	5 (1.0%)	0	5 (.4%)
Group 4 Power Wheelchair			
FMA Score, <i>M</i> ± <i>SD</i>	37.31±15.60	25.69±12.67	31.10±15.25
Range	0 - 60	0 - 60	0 - 60

*\*Other Wheelchairs includes – Standard Manual Wheelchair, Lightweight Manual Wheelchair, Bariatric Wheelchair, and Transport Wheelchair (attendant operated)*

## 2.3 INSTRUMENTATION

The FMA/UDS was the only instrument included in this study. The FMA is a self-reported questionnaire that measures an individual’s satisfaction in performing Mobility Related Activities of Daily Living (MRADLs). The questionnaire consists of ten statements that the individual can rate on a scale of 1-6. The scaling is measured as follows: 1-completely disagree, 2-mostly disagree, 3-slightly disagree, 4-slight agree, 5-mostly agree, 6-completely agree (Kumar et al, 2013). The FMA/UDS tool is typically administered by a trained VGM/US Rehab provider or clinician at baseline when a PwD is being evaluated for a new MAE and at periodic

times following provision of the new MAE intervention (Schmeler et al., 2019). For the purpose of this study, only the baseline FMA score were investigated.

## **2.4 PROCEDURE**

Baseline data was collected through the FMA/UDS Registry. All cases were previously given a unique identification number to protect the identity of each individual. Variables that were not investigated were eliminated from the dataset. Age was determined by subtracting the year of birth by the year this study was done, 2018. Age of the MAE was treated as ordinal data. The category “1 Year or less” was treated as 1 year old and the category “10 Years or more” was treated as 11 years old. Certain MAEs were grouped together under the Current Primary MAE variable. Standard Manual Wheelchair, Lightweight Manual Wheelchair, and Bariatric Wheelchair and Transport Wheelchair (attendant operated) were all in grouped in the “Other Wheelchair” category. The remaining MAE were treated as individual categories. One group was created in the Diagnosis variable. Cerebellar Degeneration, arthrogryposis, osteogenesis imperfect, and spinal muscular atrophy (SMA) were grouped under the same category. All remaining diagnoses were treated as individual categories. The remaining cases were divided into two groups: ATP involvement or no ATP involvement.

## 2.5 DATA ANALYSIS

IBM SPSS Statistics Version 25.0 was used to conduct all the statistical tests. All tests used an alpha level of 0.05. Each variable was investigated and compared by two groups, ATP vs no ATP. Continuous data was tested for normality and homogeneity of variance through the Shapiro-Wilk and Levene's Test, respectively. A 2-sample T-test was performed comparing each group. The variables being assessed by the 2-sample T-test was age of person, age of MAE, number of years since onset of medical condition and FMA score. A Crosstabulation and Chi-Square test was used to compare gender, diagnosis and primary current MAE.

## 2.6 RESULTS

The total population between both groups was 1123 (ATP = 523; No ATP = 600). In all cases, the Shapiro-Wilk test determined that the distribution of each group is not normally distributed. Non-normal distribution is a violation of the 2-sample T-test, however the Central Limit Theorem (CLT) states that if  $n > 30$ , the means of the distribution is approximately normal (Kawk & Kim, 2017). Levene's test of homogeneity of variance were statistically significant in all cases. With this result, a t-statistic not assuming equal variances was computed. All Crosstabulation and Chi Square tests had less than 20% of cells with an expected count less than 5, thus the Chi Square test was not violated.

The average age of the population in the ATP involvement group (M=56.50, SD=17.58) was younger than the population who did not have an ATP (M=65.01, SD=15.52) and the

difference in means was statistically significant between groups  $t(1049) = -8.55, p = 0.000$  (See Figure 1). A significant amount of females did not have an ATP ( $n=336$ ) compared to those with an ATP ( $n=249$ ) causing an unequal distribution between the two groups  $X^2(1)=7.88, p=0.005$  (See Figure 2). Diagnosis was not equally distributed between the two groups  $X^2(18)=187.24, p=0.000$ . The most prevalent diagnoses in the ATP involvement group was cerebral palsy (13.4%) and stroke/CVA (12.6%). The most prevalent diagnoses in the no ATP group was stroke/CVA (18.7%) and other neurological or congenital disease (14.7%) (See Figure 3). PwD with an ATP used their MAE longer ( $M=5.39, SD=2.20$ ) than PwD who did not have an ATP ( $M=4.29, SD=2.94$ ) and the difference was statistically significant  $t(1096) = 7.21, p=0.000$  (See Figure 4). The population in the ATP involvement group lived with their medical condition longer ( $M=24.52, SD=18.14$ ) than the population without an ATP ( $M=15.66, SD=16.55$ ). The difference in number of years since onset was statistically significant  $t(1065) = 8.51, p = 0.001$  (See Figure 5).

Current primary MAE was not equally distributed between the two groups  $X^2(8)=506.29, p=0.000$ . The most common MAE in the ATP involvement group are Group 3 power wheelchair and ultra-lightweight manual wheelchair. The most common MAEs in the no ATP group are other wheelchairs and cane, crutches, walkers (See Figure 6). PwD reported higher FMA scores ( $M=37.31, SD=15.60$ ) compared to the no ATP group ( $M=25.69, SD=12.67$ ) and the results were statistically significant  $t(1005) = 13.57, p=0.000$  (See Figure 7).

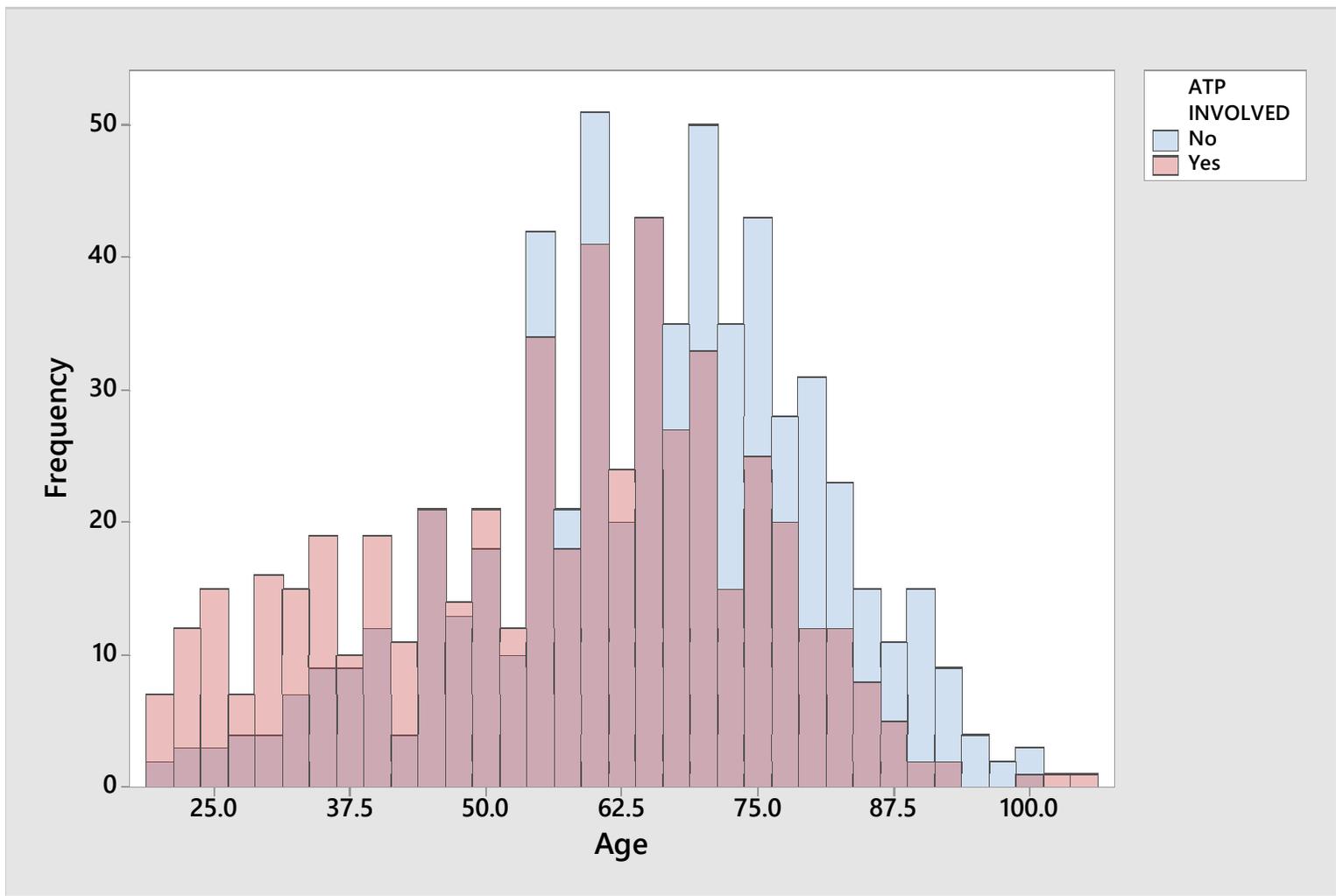
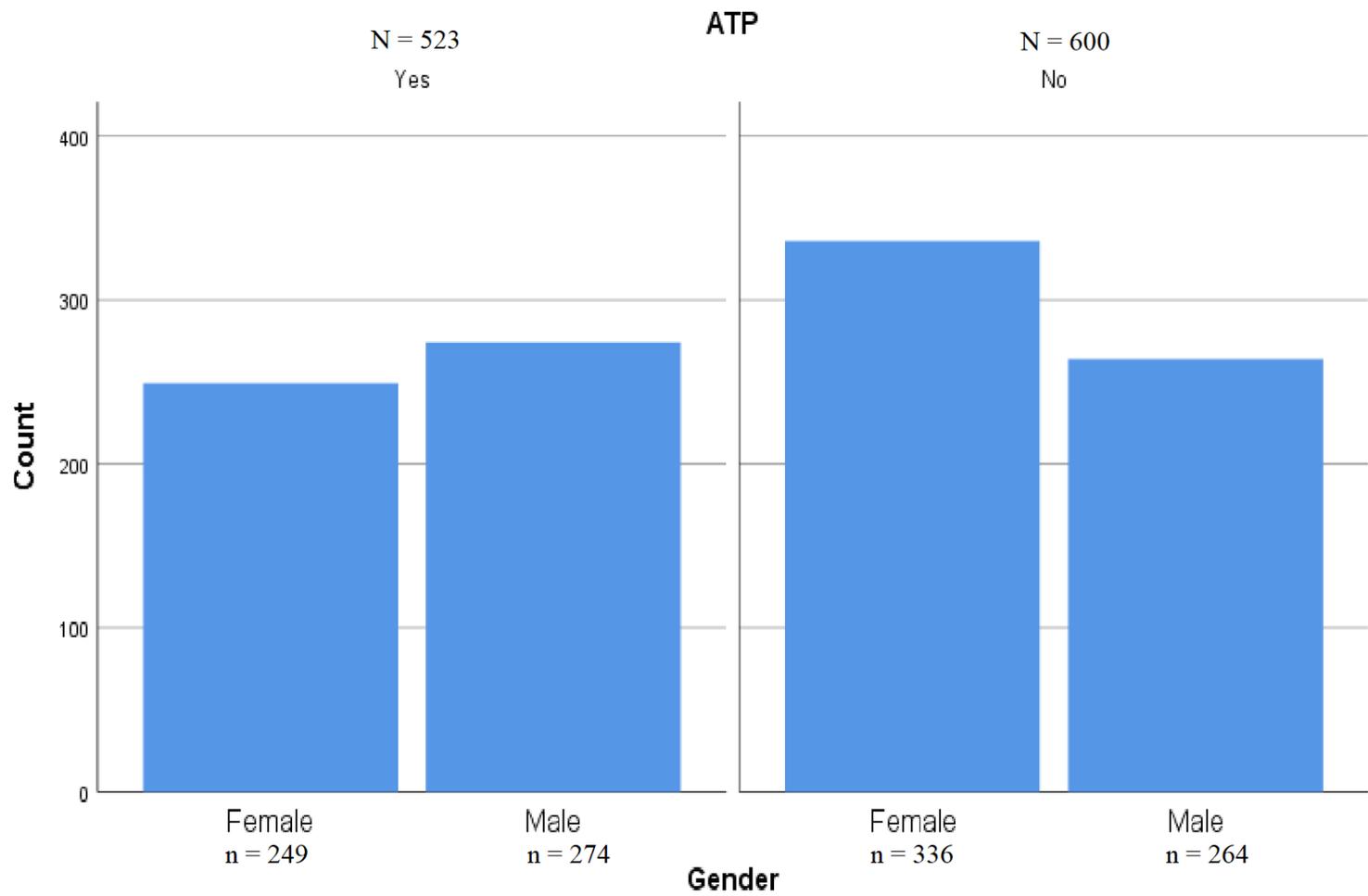
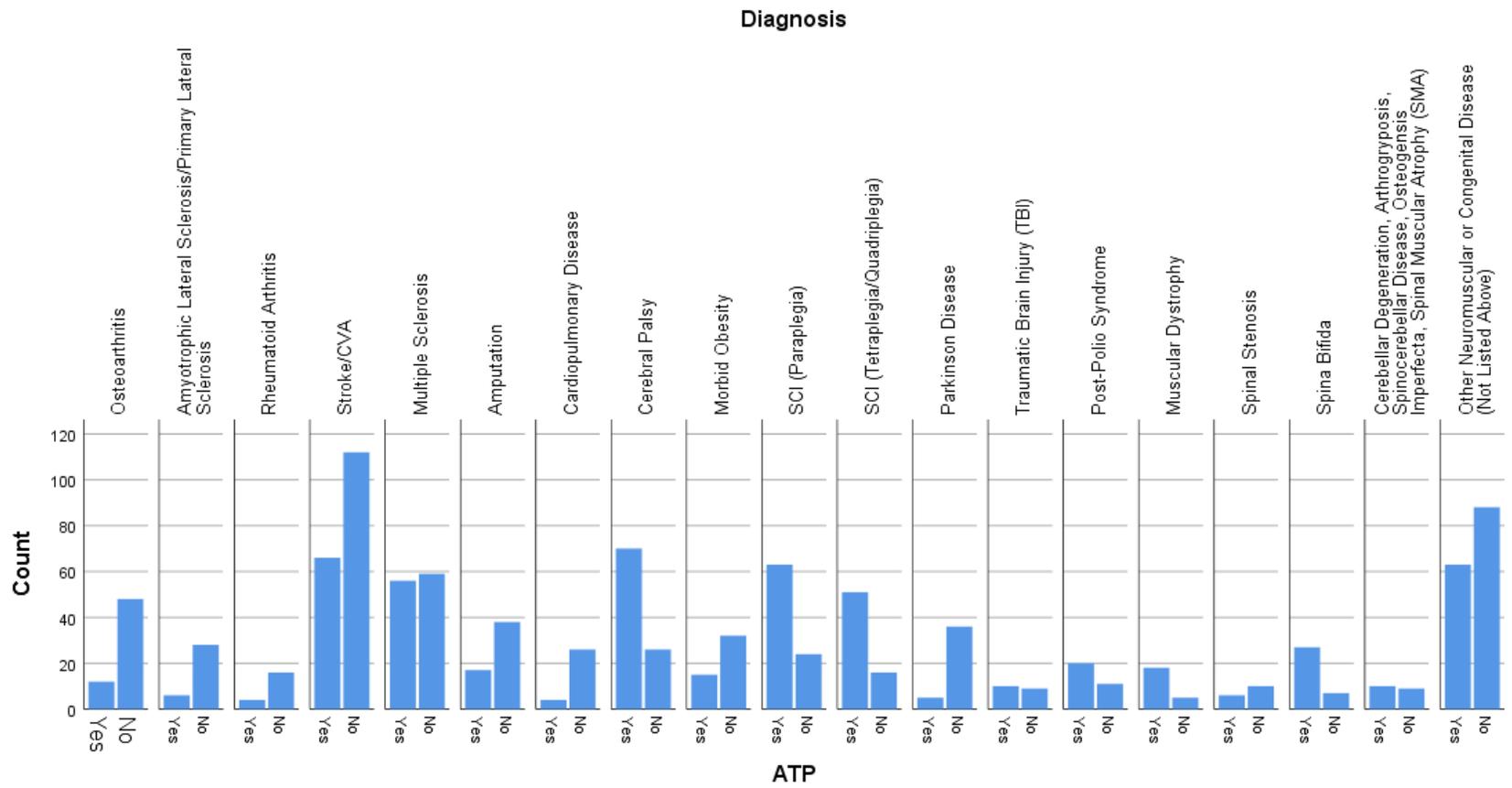


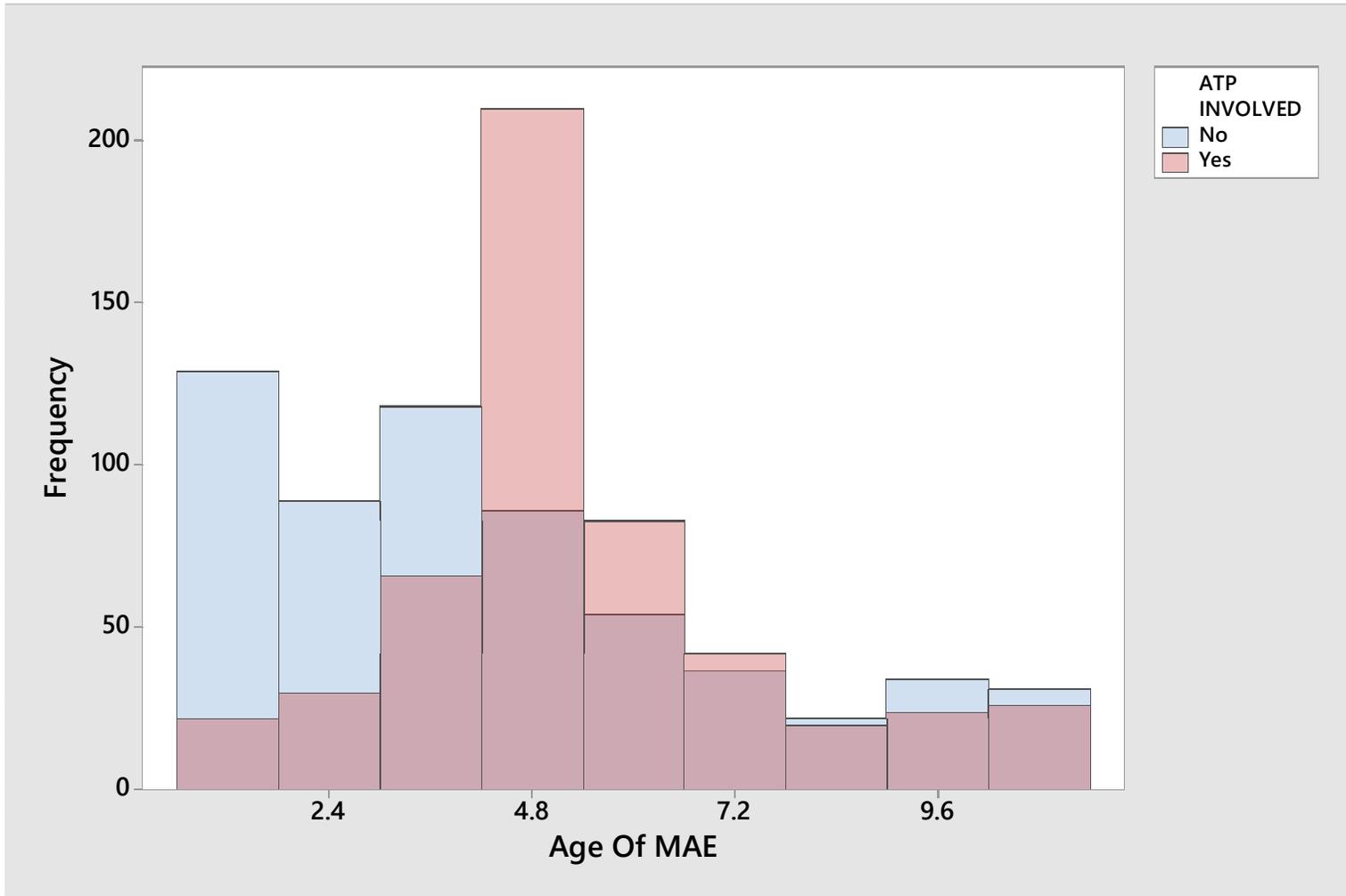
Figure 1 Age Distribution



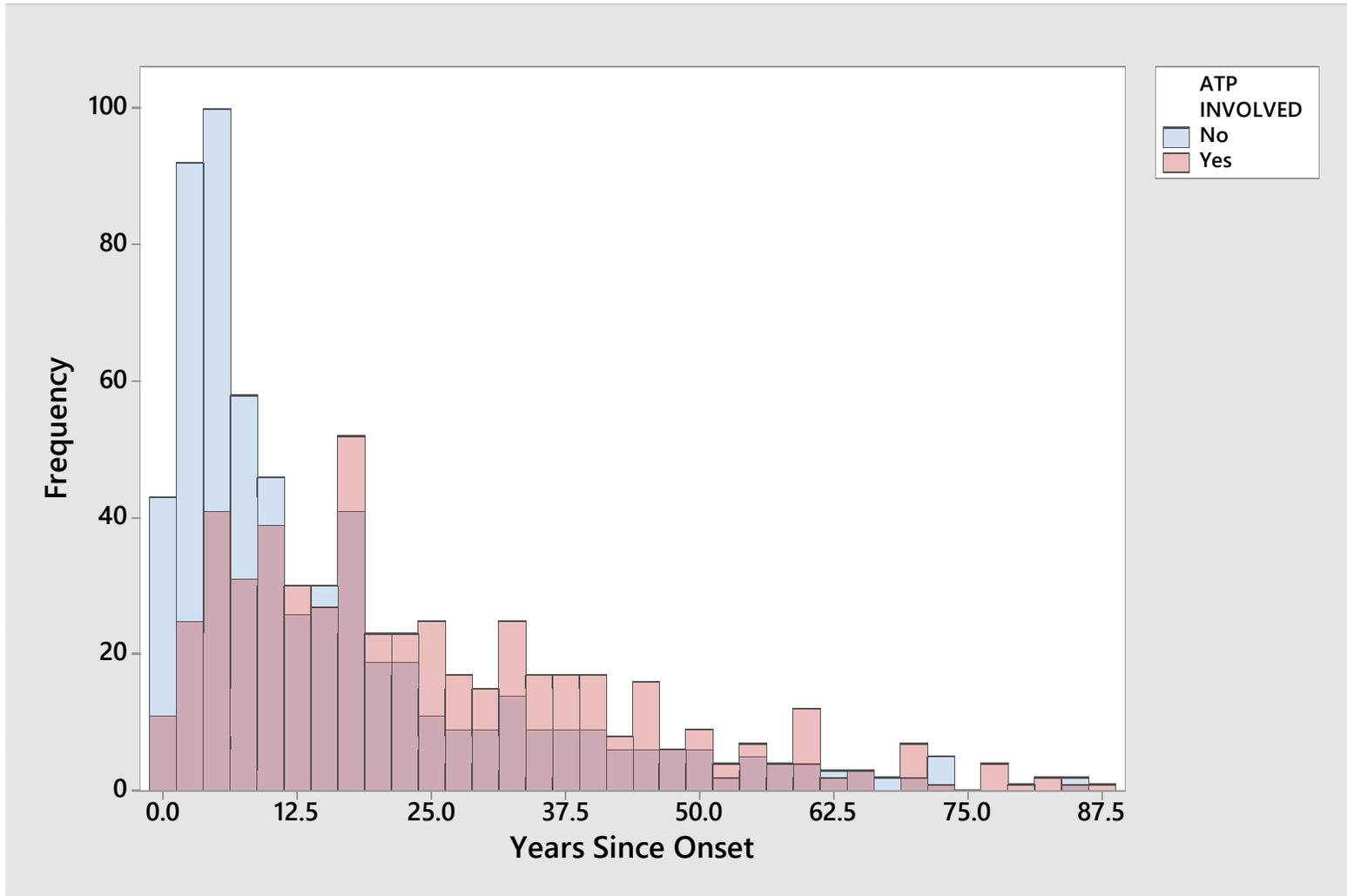
**Figure 2 Gender Comparison Between Groups**



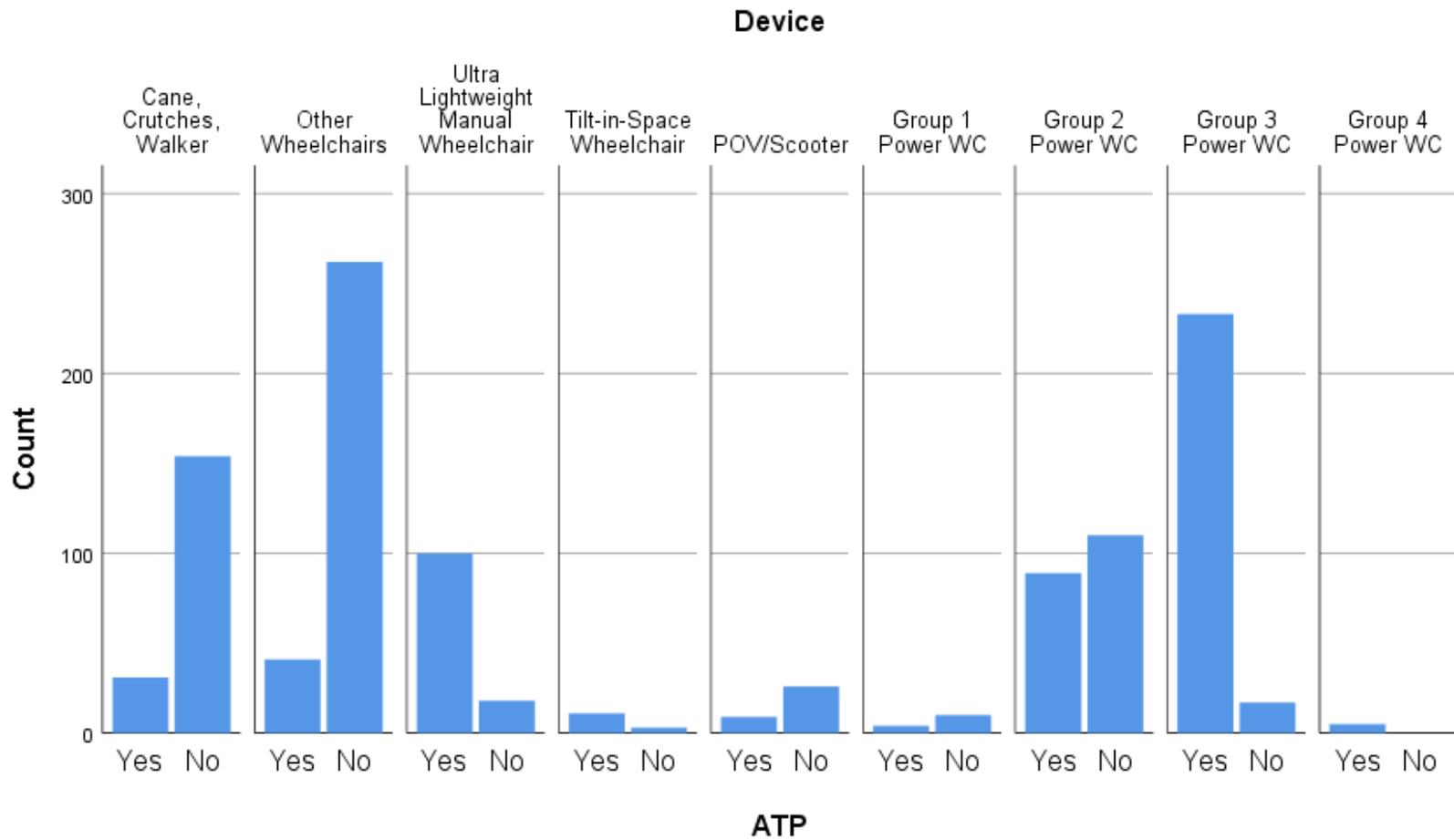
**Figure 3 Diagnosis Comparison Between Groups**



**Figure 4 Age of MAE Distribution**

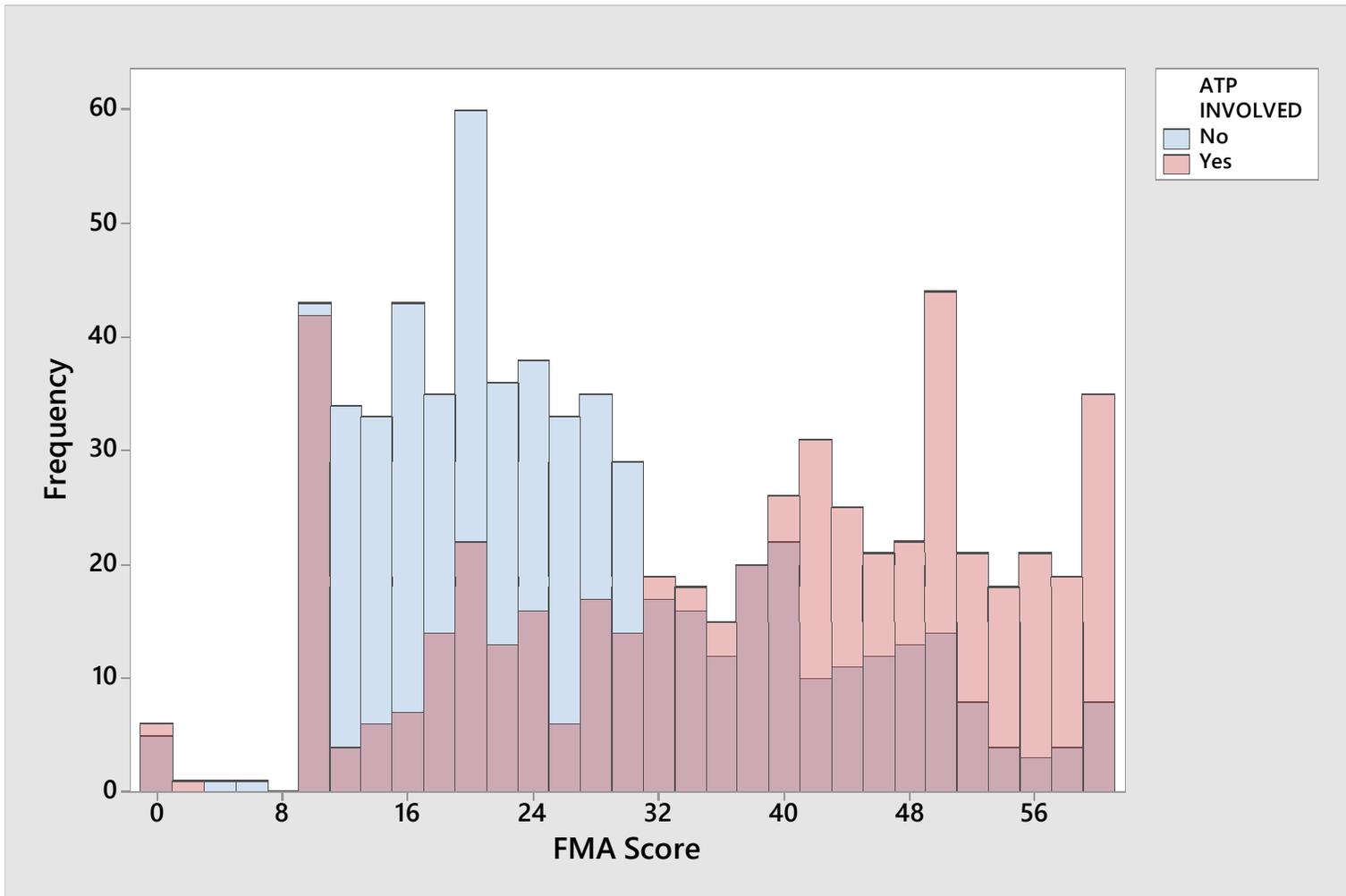


**Figure 5 Years Since Onset Distribution**



**Figure 6 Current MAE Comparison**

*Other Wheelchairs includes – Standard Manual Wheelchair, Lightweight Manual Wheelchair, Bariatric Wheelchair, and Transport Wheelchair (attendant operated)*



**Figure 7 FMA Distribution**

## **3.0 DISCUSSION**

### **3.1 NULL HYPOTHESIS 1**

All analyses showed statistical significance when comparing the two groups; thus, the null hypothesis is rejected. The data shows that the average age of a person that did not have an ATP when receiving their MAE is statistically higher than if someone did have an ATP. This result means that the older a person is, that person is less likely to not have an ATP when being assessed for a MAE. Gender distribution between the two groups were found to be statistically significant. This is likely from the disparity in the number of females in each group. This result implies that females who need a MAE are less likely to be evaluated by an ATP. The distribution of diagnosis was statistically different between the two groups. These results show that the diagnoses comprising the two groups are different, however the top three most common diagnoses in both groups qualify for a group 3 power wheelchair. The average age of current primary MAE was statistically significant when comparing the two groups. The data shows that if a person has an ATP, they are likely to keep the MAE one year longer than if there is no ATP involved. This is significant because Medicare and other funding sources typically pay to replace MAE after it has reached a 5-year lifecycle. There is a statistically significant difference in number of years since onset between the two groups. The data shows that the longer a person has lived with their disability, the more likely they will have been involved with an ATP.

Post hoc analyses were conducted in order to confirm a statistically significant difference in age and gender based on the most prevalent diagnoses between both groups. There is a statistically significant difference in age of person based on the top five most prevalent diagnosis in the ATP involvement group (M=57.41, SD=17.44) and no ATP group (M=66.18, SD=14.45)  $t(617) = -7.10, p = 0.000$ . Three of the most prevalent diagnoses in each group were similar, stroke/CVA, multiple sclerosis and other neurological/congenital disease. The other two of the most prevalent diagnoses in the ATP group had a younger population, Cerebral Palsy (M=41.61, SD=16.31) and SCI (Paraplegia) (M=54.51, SD=14.42) whereas the no ATP had two older populations, Osteoarthritis (M=74.50, SD=12.46) and Amputation (M=61.87, SD=13.63) (See Table 2).

**Table 2 Age Comparison Based on Most Prevalent Diagnoses\*\***

	ATP <sup>1</sup>		No ATP <sup>2</sup>		t	M Difference	95% CI	
	M	SD	M	SD			Lower	Upper
Age	57.41	17.44	66.18	14.45	-7.02*	-8.76	-11.20	-6.33

\*  $p < 0.05$ , \*\* includes Stroke/CVA, Multiple Sclerosis, and Other Neurological/Congenital Disease. <sup>1</sup>includes Cerebral Palsy and SCI (Paraplegia), <sup>2</sup>includes Osteoarthritis and Amputation

When comparing gender distribution based on the three most prevalent and same diagnoses found in each group (stroke, other neurological/congenital disease and multiple sclerosis), gender was evenly distributed between both groups  $X^2(1)=0.059, p=0.808$  (See Table 3). These results

imply that age and gender may not be a determining factor on whether a PwD has an ATP or not because the average ages and gender in both group were influenced based on a difference in diagnoses.

**Table 3 Gender Comparison Based on Most Prevalent and Common Diagnoses\*\***

	ATP		X <sup>2</sup>
	Yes	No	
Females, <i>n</i> (%)	108 (41.1%)	155 (58.9%)	0.059
Males, <i>n</i> (%)	76 (42.2%)	104 (57.8%)	-

*\*p < 0.05, \*\*includes Stroke/CVA, Other Neurological/Congenital Disease and Multiple Sclerosis*

### 3.2 NULL HYPOTHESIS 2

Current primary MAEs were not equally distributed between the two groups; thus, the null hypothesis is rejected. In terms of power mobility devices, the data shows that when an ATP is involved, the PwD is likely to receive a group 3 power wheelchair. If there is no ATP, a group 2 power wheelchair is likely to be provided. This is due to Medicare’s policy that in order to receive a group 3 power wheelchair, the beneficiary must be evaluated by an ATP (Centers for Medicare & Medicaid Services, 2017). Group 3 power wheelchairs are intended for individuals who have a diagnosis related to a neuro-muscular or congenital anomaly condition, mobility limitations that require a seating system with more than one seat function (ex. tilt, recline, and

elevating leg rests), sufficient for “all day” use, and are more durable (compared to group 1 and 2 power wheelchairs) (Dicianno & Tovey, 2007). Unfortunately, for individuals who do not have an ATP but qualify for a group 3 power wheelchair, they are unlikely to receive one.

In terms of manual wheelchairs, ATP’s are most likely to provide an ultra-lightweight wheelchair compared to another wheelchair (standard, lightweight, bariatric or transport) if there is no ATP involved. Ultra-lightweight wheelchairs weigh the least of all types of manual wheelchairs, weighing below thirty pounds. Lighter wheelchairs require less force to propel allowing the individual to push at faster speed at further distances while using less energy (Beekman, Miller-Porter, & Schoneberger, 1999). Ultra-lightweight wheelchairs are the only wheelchairs that are fully adjustable. Making correct adjustments and positioning can decrease rolling resistance and require less energy to propel (DiGiovine et al., 2012). When comparing fatigue life using ANSI/RESNA’s durability tests, ultra-lightweights had the longest lifespan compared to other types of manual wheelchairs (Fitzgerald et al., 2001).

A post hoc analysis was conducted to confirm if MAE was unevenly distributed between the two groups. The post hoc analysis was based on the most prevalent MAE and three of the most prevalent and similar diagnoses (stroke, other neurological/congenital disease and multiple sclerosis) between groups. The results show that MAE is unevenly distributed based on diagnosis between both groups  $X^2(8)=41.85$ ,  $p=0.000$  (See Table 4) with PwD with an ATP are likely to receive a Group 3 Power Wheelchair and PwD without an ATP likely to receive an Other Wheelchair.

**Table 4 MAE Comparison Based on Most Prevalent and Common Diagnoses\*\***

	ATP		X <sup>2</sup>
	Yes	No	
Cane, Crutches, Walker, n(%)	19 (10.9)	55 (23)	149.53*
Other Wheelchairs, n(%)	24 (13.7)	128 (53.6)	-
Ultra-Lightweight Manual WC, n(%)	13 (7.4)	4 (1.7)	-
Group 2 Power WC, n(%)	43 (24.6)	47 (19.7)	-
Group 3 Power WC, n(%)	76 (43.4)	5 (2.1)	-

\* $p < 0.05$ , \*\* includes Stroke/CVA, Other Neurological/Congenital Disease and Multiple Sclerosis

### 3.3 NULL HYPOTHESIS 3

There was a statistically significant difference in FMA scores when comparing the two groups; thus, the null hypothesis is rejected. On average, people who have an ATP are more satisfied with their MAE. This result can be attributed to an ATP's ability to select the appropriate MAE. The selection of AT is crucial because the individual is expected to use the MAE for at least five years. The ATP is also expected to anticipate future needs of the individual and prepare intervention strategies in case of changes in the individual's medical condition. Education regarding maintenance, safety and replacement of the MAE should also be given by the ATP. Proper training on how to use the MAE should also be a focal point to maximize the benefits and prevent secondary injuries.

### 3.4 STUDY LIMITATIONS

Several limitations can be found in this study. The data for the variable “Age of MAE” was analyzed as continuous data but was collected as ordinal data. The mean average age of MAE for the group without an ATP ( $M=4.29$ ) could have been impacted because of the population size in the “1 year or less” category ( $n=129$ ). The population size within the “10 years or more” category was relatively small ( $n=31$ ) and would not have had a major affect on the average age of MAE. For the ATP involvement group, the population within the “1 year or less” ( $n=22$ ) and “10 years or more” ( $n=26$ ) were relatively small and would not have a major impact on the average age of MAE. For this study, the age of MAE was used to predict the average amount of years an individual has been using their MAE. Although this should be accurate for the ATP involvement group because these individuals are expected to be the first owners of their MAE, a significant difference may be found in the group without an ATP. This is due to the phrasing of the question. Instead, or in addition to asking for the age of the MAE, the person should be asked how many years they have been using their current MAE. Individuals without an ATP could have not been the original owner of the MAE currently being used, so the actual age of the MAE is being documented instead of the amount time they have been using the MAE.

Another limitation can be associated with the FMA score. Like the variable “age of MAE,” the FMA is ordinal data that is being analyzed as continuous data. Ordinal data being analyzed as continuous data can report accurate results if the following assumptions can be made: sufficiently large number of response categories, absence of skewness and equal thresholds across items (Lubke & Bengt, 2004). For the purpose of this study, these assumptions

were made. However, the numerical distance between categories in the FMA can change depending if all questions were answered but was not taken into consideration for this study.

### **3.5 FUTURE WORK**

Data should continuously be collected to gather information regarding both groups being investigated in this study. How long the current MAE has been used by its current owner should be included in future databases. Knowing how long the MAE has been used for before seeking replacement will give a more accurate representation of what types of MAE are being abandoned prematurely based on funding policy of replacing MAE when it reaches a 5-year lifecycle. If possible, data being collected should try to be measured on a continuous scale. Continuous data allows for flexibility and more common statistical testing, allowing the reader to interpret and comprehend the data easier. All data should be reviewed before submission to the database. Large amounts of cases were excluded from this study based on missing or erroneous data.

This study provides an overview of the impact of ATP involvement in the provision of MAE. Many in-depth studies can be performed to further investigate the differences between these two groups. Current primary MAEs and diagnoses can be compared based on ATP involvement or not to further investigate what MAE is being provided to people with a specific diagnosis. This would show the difference in the types of MAE an ATP would provide compared to what an individual would receive without an ATP. These results could provide further evidence that if an ATP is involved, PwD are more likely to have MAE provided that meets their needs.

Future work should also include increasing awareness of an ATP to other medical professionals. If more medical professionals were aware of the benefits of having an ATP, more people with disabilities could be referred to one to receive more appropriate MAE to meet their needs. Increasing awareness of an ATP should be focused on the general public as well. With the growing number of people with disabilities becoming aware of an ATP, more ATP's will be needed in order to meet the future demand.

Future statistical testing that analyze FMA scores as continuous data should take into consideration report outcomes with "does not apply" chosen as one of the responses. This will change the total score, 60, and the numeric distance between each category will change. This will violate one of the assumptions made when analyzing ordinal data as continuous data.

### **3.6 CONCLUSION**

ATP's are recognized as having the ability to identify needs, select appropriate AT, and provide proper education and training for people with disabilities. This study provides evidence that there is a significant difference between people who receive MAE through an ATP and those who do not. This study also shows that there is still a large population of people with disabilities who do not have an ATP that require a MAE. Having an ATP results in receiving higher quality MAE, keeping the MAE longer, and higher FMA scores.

**APPENDIX A**

**RESNA STANDARDS OF PRACTICE FOR ASSISTIVE TECHNOLOGY  
PROFESSIONAL**

## RESNA STANDARDS OF PRACTICE for Assistive Technology Professionals

These Standards of Practice set forth fundamental concepts and rules considered essential to promote the highest ethical standards among individuals who evaluate, assess the need for, recommend, or provide assistive technology. In the discharge of their professional obligations the following principles and rules shall be observed:

---

1. Individuals shall keep paramount the welfare of those served professionally.
2. Individuals shall engage in only those services that are within the scope of their competence, their level of education, experience and training, and shall recognize the limitations imposed by the extent of their personal skills and knowledge in any professional area.
3. In making determinations as to what areas of practice are within their competency, assistive technology practitioners and suppliers shall observe all applicable licensure laws, consider the qualifications for certification or other credentials offered by recognized authorities in the primary professions which comprise the field of assistive technology, and abide by all relevant standards of practice and ethical principles, including RESNA's Code of Ethics.
4. Individuals shall not willfully misrepresent their credentials, competency, education, training and experience in both the field of assistive technology and the primary profession in which they are members. Individuals shall disclose their employer and the role they serve in the provision of assistive technology services and devices in all forms of communication, including advertising that refers to their certification in assistive technology.
5. Individuals shall inform consumers or their advocates of any employment affiliations, and financial or professional interests that may be perceived to bias recommendations. In some cases, individuals shall decline to provide services or supplies where the conflict of interest is such that it may fairly be concluded that such affiliation or interest is likely to impair professional judgments.
6. Individuals shall use available resources to meet the consumers' identified needs including referral to other professionals, practitioners or sources which may provide the needed product and/or service.
7. Individuals shall cooperate with members of other professions, where appropriate, in delivering services to consumers, and shall actively participate in the team process when the consumers' needs require such an approach.
8. Individuals shall offer an appropriate range of assistive technology services which may include assessment, evaluation, trial, simulation, recommendations, delivery, fitting, training, adjustments and/or modifications and promote full participation by the consumer in each phase of service.
9. Individuals shall verify consumer's needs by using direct assessment or evaluation procedures with the consumer.
10. Individuals shall inform the consumer about all device options and funding mechanisms available regardless of finances, in the development of recommendations for assistive technology strategies.
11. Individuals shall consider future and emerging needs when developing intervention strategies and fully inform the consumer of those needs.
12. Individuals shall provide technology that minimizes consumers' exposure to unreasonable risk. Individuals shall provide adjustments, instructions or necessary modifications that minimize risk.
13. Individuals shall fully inform consumers or their advocates about relevant aspects of the final recommendations for the provision of technology, including the financial implications, and shall not guarantee the results of any service or technology. Individuals may, however, make reasonable statements about the recommended intervention.
14. Individuals shall document, within the appropriate records, the technology evaluation, assessment, recommendations, services, or products provided and preserve confidentiality of those records, unless required by law, or unless the protection of the welfare of the person or the community requires otherwise.
15. Individuals shall endeavor, through ongoing professional development, including continuing education, to remain current on assistive technology relevant to their practice including accessibility, funding, legal or public issues, recommended practices and emerging technologies.
16. Individuals shall endeavor to institute procedures, on an on-going basis, to evaluate, promote and enhance the quality of service delivered to consumers.
17. Individuals shall be truthful and accurate in public statements concerning their role in the provision of all assistive technology products and services.
18. Individuals shall not discriminate in the provision of services or supplies on the basis of impairment, diagnosis, disability, race, national origin, religion, creed, gender, age, or sexual orientation.
19. Individuals shall not charge for services not rendered, nor misrepresent services delivered or products dispensed for reimbursement or any other purpose.
20. Individuals shall not engage in fraud, dishonesty or misrepresentation of any kind, or forms of conduct or criminal activity that adversely reflects on the field of assistive technology, or the individual's ability to serve consumers professionally.
21. Individuals whose professional services are adversely affected by substance abuse or other health-related conditions shall seek professional advice, and where appropriate, voluntarily withdraw from practice.
22. Individuals shall respect the rights, knowledge, and skills of colleagues and others, accurately representing views, information, ideas, and other tangible and intangible assets including copyright, patent, trademark, design contributions, and findings.

## BIBLIOGRAPHY

- Arledge, S., Armstrong, W., Babinec, M., Dicianno, B. E., Digiovine, C., Dyson-Hudson, T., Pederson, J., Piriano, J., Plummer, T., Rosen, L., Schmeler, M., Shea, M., & Stogner, J. (2011). RESNA wheelchair service provision guide. Retrieved from <https://www.resna.org/sites/default/files/legacy/resources/position-papers/RESNA WheelchairServiceProvisionGuide.pdf>
- Batavia, A. I., & Hammer, G. S. (1990). Toward the development of consumer-based criteria for the evaluation of assistive MAEs. *The Journal of Rehabilitation Research and Development*, 27(4), 425-436. doi:10.1682/jrrd.1990.10.0425
- Beekman, C. E., Miller-Porter, L., & Schoneberger, M. (1999). Energy Cost of Propulsion in Standard and Ultralight Wheelchairs in People with Spinal Cord Injuries. *Physical Therapy*, 79(20), 146-158. doi:10.1093/ptj/79.2.146
- DiGione, C.D., Rosen, L., Berner, T., Betz, K., Roesler, T., & Schmeler, M. (2012). RESNA Position on the Application of Ultralight Manual Wheelchairs. Retrieved from <https://www.resna.org/sites/default/files/legacy/resources/position-papers/UltraLightweightManualWheelchairs.pdf>
- Centers for Medicare & Medicaid Services. (2017). Group 3 Power Wheelchairs for Prior Authorization – Coverage. Retrieved from <https://www.cms.gov/Research-Statistics-Data-and-Systems/Monitoring-Programs/Medicare-FFS-Compliance-Programs/DMEPOS/Downloads/Open-Door-Forum-Coverage-for-Group-3-Power-Wheelchairs.pdf>
- Dicianno, B. E. & Tovey, E. (2007). Power Mobility MAE Provision: Understanding Medicare Guidelines and Advocating for Clients. *Archives of Physical Medicine and Rehabilitation*, 88, 807-816. doi:10.1016/j.apmr.2007.03.024
- Fitzgerald, S. G., Cooper, R. A., Boninger, M. L., & Rentschler, A. J. (2001). Comparison of Fatigue Life for 3 Types of Manual Wheelchairs. *Archives of Physical Medicine and Rehabilitation*, 8, 1484-1488. doi:10.1053/apmr.2001.26139

- Hogaboom., N. S., Worobey., L. A., Houlihan, B. V., Heineman., A. W., & Boninger., M. L. (2018). Wheelchair Breakdowns Are Associated With Pain, Pressure Injuries, Rehospitalization, and Self-Perceived Health in Full-Time Wheelchair Users With Spinal Cord Injuries. *Archives of Physical Medicine and Rehabilitation*, <https://doi.org/10.1016/j.apmr.2018.04.002>
- Jette, A. M., Spicer, C. M., & Flaubert, J. L. (2017). *The Promise of Assistive Technology to Enhance Activity and Work Participation*. Washington, DC: The National Academic Press. doi: <https://doi.org/10.17226/24740>.
- Kumar, A., Schmeler, M.R., Karmarkar, A.M., Collins, D.M., Cooper, R., Cooper, R.A., & Holm, M.B. (2013). Test-retest reliability of the functional mobility assessment (FMA): a pilot study. *Disability and Rehabilitation Assistive Technology*. 8(3), 213-219. Retrieved from <http://www.tandfonline.com/doi/full/10.3109/17483107.2012.688240>
- Kwak, S. G., & Kim, J. H. (2017). Central limit theorem: the cornerstone of modern statistics. *Korean Journal of Anesthesiology*, 70(2), 144-156. <https://doi.org/10.4097/kjae.2017.70.2.144>
- Kwarcias, A. M., Cooper, R. A., Ammer, W. A., Fitzgerald., S. G., Boninger, M. L., & Cooper, R. (2005). Fatigue Testing of Selected Suspension Manual Wheelchairs Using ANSI/RESNA Standards. *Archives Physical Medicine and Rehabilitation*, 86. 123-129. doi:10.1016/j.apmr.2003.11.038
- Lid., I. M., & Solvang., P. K. (2015). (Dis)ability and the experience of accessibility in the urban environment. *ALTER, European Journal of Disability Research*, 10, 181-194. doi: <http://dx.doi.org/10.1016/j.alter.2015.11.003>
- Lubke, G. J., & Muthen, B. O. (2009) Applying Multigroup Confirmatory Factor Models for Continuous Outcomes to Likert Scale Data Complicates Meaningful Group Comparisons. *Structural Equation Modeling: A Multidisciplinary Journal*, 11(4), 514-534. [http://dx.doi.org/10.1207/s15328007sem1104\\_2](http://dx.doi.org/10.1207/s15328007sem1104_2)
- Medical Rights Center. (2019). Replacing DME. Retrieved from <https://www.medicareinteractive.org/get-answers/medicare-covered-services/durable-medical-equipmentdme/replacing-dme>
- Phillips, B., & Zhao, H. (1993). Predictors of Assistive Technology Abandonment. *Assistive Technology*, 5(1), 36-45. doi:10.1080/10400435.1993.10132205
- Reimer-Reiss, M. L., & Wacker, R. R. (2000). Factors Associated with Assistive Technology Discontinuance Among Individuals with Disabilities. *Journal of Rehabilitation*. 66(3), 44-50.

- Rentschler., A. J., Cooper., R. A., Fitzgerald., S. G., Boninger., M. L., Guo, S., Ammer., W. A., Vitek., M., & Algood., D. (2004). Evaluation of Selected Electric-Powered Wheelchairs Using the ANSI/RENSA Standards. *American Journal of Physical Medicine & Rehabilitation*, 85, 611-619. doi:10.1016/j.apmr.2003.06.023
- RESNA. (2019). Assistive Technology Professional (ATP) Certification. Retrieved from <https://www.resna.org/atp-general-info>
- Scherer, M. J., & Federici, S. (2015). Why people use and don't use technologies: Introduction to the special issue on assistive technologies for cognition/cognitive support technologies. *Neurorehabilitation*, 37(3), 315-319. doi:10.3233/nre-151264
- Schmeler, M.R., Schein, R.M., Schiappa, V.J., & Saptono, A. (2019). Development & Implementation of a Wheelchair Outcomes Registry. Manuscript submitted for Publication.
- Souza., A. E., Pearlman., J. L., Cooper., R., Kelleher., A., Gebrosky., B., & Cooper., R.A. (2013). Evaluation of scooters using ANSI/RESNA standards. *Journal of Rehabilitation Research & Development*, 50(7). 1017-1034. <http://dx.doi.org/10.1682/JRRD.2011.03.0054>
- U.S. Census Bureau (2012). Americans With Disabilities: 2010. Retrieved from <https://www2.census.gov/library/publications/2012/demo/p70-131.pdf>
- World Health Organization. (2018). Disability and health. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/disability-and-health>
- Worobey, L., Oyster, M., Nemunaitis, G., Cooper, R., & Boninger, M.L. (2012). Increased in Wheelchair Breakdowns, Repairs, and Adverse Consequences for People with Traumatic Spinal Cord Injury *American Journal of Physical Medicine & Rehabilitation*, 91(6), 463-469. doi:10.1097/PHM.0b013e31825ab5ec.