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The Association Between Advanced Technology Use and Quality of Life Among Those With a Disability

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This is to certify that the doctoral dissertation by

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has been found to be complete and satisfactory in all respects,
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Walden University
2026

Abstract

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Dissertation Submitted in Partial Fulfillment

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Public Health and Epidemiology

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Abstract

Advanced medical technology use among individuals with physical disabilities remains understudied, creating a significant gap in understanding its impact on quality-of-life (QoL) outcomes across demographic and age groups. Guided by the social ecological model, the purpose of this quantitative study was to examine associations between advanced medical technology use, disability status, demographic factors (age, gender, and race/ethnicity), and QoL outcomes using 2017–2018 National Health and Nutrition Examination Survey data. The sample included 9,254 individuals age 6 years and older with physical functional limitations and complete technology-use and QoL data. Advanced medical technology use was significantly associated with improved QoL ($p < .001$). Disability status demonstrated a statistically significant but modest association with technology use, $OR = 0.84$, 95% CI [0.83, 0.85], $p < .001$. Age-stratified analyses indicated that advanced technology use significantly predicted improved QoL among adults aged 20 years and older, $OR = 6.90$, 95% CI [6.89, 6.91], $p < .001$, but not among youths aged 6–19 years ($p = .929$). Gender was a significant predictor of technology use, with females having higher odds than males, $OR = 1.07$, 95% CI [1.06, 1.08], $p < .001$. Race/ethnicity was also significantly associated with technology use; compared with non-Hispanic White adults, Mexican American ($OR = 0.43$, 95% CI [0.42, 0.44], $p < .001$), other Hispanic (OR = 0.58, 95% CI [0.57, 0.59], $p < .001$), and non-Hispanic Black adults ($OR = 0.79$, 95% CI [0.78, 0.80], $p < .001$) had lower odds of advanced medical technology use. The study may inform health care stakeholders about strategies to promote equitable access to advanced medical assistive technologies for social change.

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Dedication

This I dedicate this work to my father (Gregory Antus). You always reminded me that you were in my corner—no matter the circumstances and through every high and low life presented. Your unwavering support, trust in my decisions, and your uniquely sarcastic wisdom brought comfort, strength, and laughter when I needed it most. You believed in me even when the road was difficult, and your encouragement carried me to the very end, I am forever grateful.

This study is also dedicated to my friends and family (my mom, Arline Antus) who supported me throughout this journey, continually offering encouragement and motivation that helped me reach this milestone. A special dedication is extended to a dear friend, whose love, faith, and powerful prayers kept me focused, grounded, and steadfast in completing my studies and fulfilling my dream.

Acknowledgments

This study would not have been possible without the encouragement and support of my previous committee members, both of whom are now retired. I began this journey under the guidance of Dr. Loretta Shields and Dr. Nancy Rea, whose mentorship helped lay the foundation for this research. I am equally grateful to my current committee members, Dr. Hadi Danawi (chair) and Dr. Gerardo Lazaro (committee chair), for their dedication and guidance in helping me complete the final stages of my dissertation. This work could not have been completed without the continued support of Walden University's resources and the unwavering commitment of my committee, whose direction and encouragement carried me from the beginning of this journey to its successful conclusion.

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Chapter 1: Introduction to the Study

Background

Disability is a universal experience that affects individuals across diverse societies. Over the years, concerted efforts were made to foster the integration of disabled individuals into the general population. Despite these efforts, people with disabilities often strived to seamlessly blend into their communities. Unfortunately, pervasive stigma remained a significant barrier, hindering their full participation and inclusion. Throughout history, various societies stigmatized disability, viewing it through the lenses of sickness, curses, powerlessness, or dependency. This prejudiced perspective manifested in detrimental behaviors, including social avoidance, stereotyping, discrimination, hate crimes, and violence, as outlined by Beudaert (2018). People with disabilities had assistive devices or assistive technologies (AT) that were designed to improve their functional capabilities. The use of AT devices enhanced the lives of individuals with disabilities and enabled them to be part of society (De Freitas et al., 2022; World Health Organization [WHO], 2024).

AT has the capacity to aid individuals in several domains of their lives, encompassing education, employment, physical fitness, leisure, and routines such as self-care, culinary tasks, and reading. AT has a beneficial influence on individuals and their families and brings about wider socioeconomic advantages (De Freitas et al., 2022; WHO, 2024). In the face of these challenges, individuals with physical disabilities confront unique hurdles. However, one promising avenue for addressing these challenges is the integration of advanced technology, specifically artificial intelligence (AI). This technological intervention emerged as a beacon of opportunity, holding the potential to meet the diverse needs of those facing physical or cognitive impairments, ultimately enhancing their overall quality of life.

De Freitas et al. (2022) identified several gaps in the research examining how Artificial Intelligence of Things (AIoT) technologies are integrated into assistive devices. One of the major gaps the uneven distribution of peer-reviewed studies across different problem areas within the field. The majority of the peer review studies centered on visual disabilities, leaving limited coverage of other conditions, including hearing loss, motor and coordination challenges, degenerative disorders, and cognitive impairments. As reported by De Freitas et al., there is potential to use AIoT in assisting individuals with disabilities and a need for further research and development to be fully implemented in assistive devices. Another gap identified was related to the types of machine-learning models and methodological approaches employed in existing research. The study found that approximately 81% of the reviewed studies relied on neural-network-based machine-learning approaches (De Freitas et al., 2022).

Problem Statement

Individuals with disabilities continue to encounter significant challenges when attempting to access AT and necessary health services. Reports frequently describe experiences of stigma, bias, and discriminatory treatment within healthcare settings, which can restrict their ability to obtain appropriate support (Disability and Health, 2021). Although technological capabilities have advanced rapidly in recent years, there remains a substantial need for innovative solutions—particularly advanced and AI-enabled devices—that can more effectively address the daily functional needs of people with disabilities. When thoughtfully matched to an individual's abilities and circumstances, these technologies have the potential to enhance independence, improve daily functioning, and contribute to a higher quality-of-life.

The assistive technology available during the period of this study did not yet incorporate advanced or AI-enabled tools that could meaningfully improve quality-of-life for individuals with disabilities (Bajwa et al., 2021; De Freitas et al., 2022; Disability, 2020). Many assistive devices had not progressed in step with contemporary technological developments, limiting their usefulness in meeting daily needs. Prior research also indicated that few innovative AT were being adopted for routine use among people with disabilities, partly due to limited awareness and insufficient information regarding how such technologies could support everyday functioning. Given that over one billion people globally live with a disability, there is a clear need to examine how modern AT might better support this diverse population. Advancements in digital accessibility and AI-enhanced assistive devices hold considerable potential to reduce disparities and ensure that individuals with disabilities are not excluded or marginalized. However, persistent gaps in innovative accessibility solutions must be addressed (Disability, 2020). Strengthening resources and expertise in advanced technology, AI, and inclusion could help meet the unmet needs related to assistive products (Bajwa et al., 2021; WHO, 2021).

Purpose of the Study

The aim of this quantitative study was to examine whether advanced technology use is associated with quality-of-life outcomes for people with physical health disabilities, while accounting for age, gender, race/ethnicity, and education. The analysis utilized data from the National Health and Nutrition Examination Survey (NHANES) 2017–2018 cycle, which includes demographic and health information collected by the CDC. The NHANES data have questions on disability and use of assistive technology devices or adaptive equipment use.

There was little to no research done on how advanced technology usage can improved the quality of life for those who are physically disabled. Studies had shown that assistive technology devices aim to enhance the lives of people with disabilities (Ali et al., 2020). After an extensive review of many scholarly works and examining the latest developments in assistive technology devices, it was evident that there was a lack of advanced technology or AI applications specifically designed for the daily usage of individuals with disabilities. Researching modern assistive technology devices and their adaptation to modern technology had not been fully realized.

Theoretical Model

The theoretical foundation for examining physical disability, quality of life, and advanced technology use in this study draws on the socio-ecological model (SEM) developed by Urie Bronfenbrenner. The SEM offers a framework for understanding how individual behavior is shaped by interactions between personal factors and broader social and physical environments. This model has been widely used to explain influences on behavior and to guide the design of effective programs through attention to social and environmental contexts. SEM highlights multiple layers of influence—individual, interpersonal, organizational, community, and policy—emphasizing that the surrounding environment plays a critical role in shaping behaviors. Its principles also align with social cognitive theory, which suggests that supportive environments make it easier for individuals to adopt healthy lifestyle behaviors (Bronfenbrenner, 1977).

The SEM was an appropriate guiding framework for this research, as it captures how multiple ecological levels influence health outcomes and how advanced technology fits within these dynamics. Using SEM made it possible to examine how technology interacts with individuals, interpersonal relationships, organizations, and communities to influence quality of life for people with disabilities. Bronfenbrenner's (1977) work provided the conceptual basis for understanding how advanced technology can be integrated across these ecological layers to improve daily functioning and overall quality of life. This framework also supports exploration of how conditions at each level of the SEM contribute to quality-of-life outcomes.

Research Questions

Research Question 1: Is there an association between advanced technology use and quality-of-life outcomes among those who are physically disabled?

$H_0$1: There is no association between advanced technology use and quality-of-life outcomes among those who are physically disabled.

$H_1$1: There is an association between advanced technology use and quality-of-life outcomes among those who are physically disabled

Research Question 2: Is there an association between physical disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education?

$H_0$2: There is no association between disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

$H_1$2: Is there an association between disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

Research Question 3: Is there an association between disability and advanced technology use among those who are disabled?

$H_0$3: There is no association between disability and advanced technology use among those who are disabled.

$H_1$3: There is an association between disability and advanced technology use among those who are disabled.

Research Question 4: Is there an association between advanced technology use and quality-of-life outcomes among those who are disabled when controlling age, gender, race/ethnicity, and education?

$H_0$4: There is no association between advanced technology use and quality-of-life outcomes among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

$H_1$4: There is an association between advanced technology use and quality-of-life outcomes among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

Nature of the Study

The research study addresses the research questions using a quantitative methodology. This approach enables the examination of medical record data to evaluate patterns, differences, and associations among physical disability, advanced technology use, and quality-of-life outcomes. Quantitative methods are appropriate for studies that seek to test theoretical propositions or hypotheses through a deductive process (Burkholder et al., 2016; Creswell & Creswell, 2018; Walden University, n.d.). This study explores how factors such as physical disability, advanced technology use, education, and demographic characteristics relate to quality-of-life outcomes. The design uses existing data from the NHANES, which provides comprehensive demographic and health information collected by the CDC. Data analysis draws on responses obtained from medical records and intake questionnaires that were collected during patient visits. For use in statistical testing, variables were recoded into analytic formats appropriate for quantitative analysis.

Study Design Changes

The original study design proposed a broader quantitative investigation incorporating multiple disability categories and AT. However, after further review of data availability and variable structure within the NHANES data set, the study focus was refined to specifically examine individuals with *physical disabilities* and their reported use of *advanced or assistive technologies* in relation to *quality-of-life improvements*. The scope was narrowed to ensure valid, reliable, and interpretable statistical results using logistic regression analyses. Additionally, variables were recoded and consolidated to align with the available data, addressing limitations such as missing values and inconsistent disability definitions. These methodological refinements allowed for more accurate testing of the hypotheses and improved the overall validity of the findings presented in Chapter 5.

Definitions of Variables

The study identifies its variables as follows: the independent variables are advanced technology use and disability status, the dependent variable is quality of life, and the control variables include age, gender, race/ethnicity, and education.

Advanced technology or assistive device technology: The study conducted by Verontis et al. in 2021 used the term "advanced technology" to refer to the utilization of different technical advancements, including information technology, IoT, AI, machine learning and robotics. Han et al. (2019) referred to advanced technology as innovative and cutting-edge tools, systems, and resources to enhancing the one's experience which also include technological advancements to support personalized, interactive and accessible learning and devices.

Demographic factors: This study explores two main demographic variables: age, gender, race, place of residence, income, education, and employment.

Disability: The CDC describes disability as a physical or mental impairment that reduces a person's capacity to carry out everyday tasks or participate in typical social or environmental interactions. Such impairments may be short-term or long-term and can arise at any point throughout the lifespan (*Disability and Health Overview* | CDC, 2020). Both CDC and World Health Organization (WHO) emphasize that disability results from the interaction between a person's health condition—such as cerebral palsy, Down syndrome, or depression—and features of their surrounding environment. These environmental factors may include inaccessible buildings and transportation, limited social support, or negative societal attitudes, all of which can restrict participation (CDC, 2020; WHO, 2020). Barriers in the environment frequently hinder individuals with disabilities from achieving full and equitable involvement in community life. Reducing these barriers and strengthening supportive resources can substantially improve social inclusion, functioning, and overall quality of life for people with disabilities (*Disability and Health Overview* | CDC, 2020; World Health Organization: WHO, 2020).

Physical disability: According to the Centers for Disease Control and Prevention (CDC, 2020), a physical disability refers to a health condition that restricts an individual's ability to carry out certain activities or interact effectively with their surroundings. There are many types of physical disability that affect a person's vision, movement, communication, and social relationships (*Disability and Health Overview | CDC*, 2020).

Quality of life (QoL): Sitlinger and Zafar (2018) explained that health-related quality of life is generally understood as an assessment of how health conditions and their treatments influence an individual's daily functioning and sense of well-being. Teoli (2023) described quality of life as involving multiple domains, including physical, emotional, and spiritual wellness; relationships and social ties; educational and workplace factors; economic stability; perceptions of safety; autonomy and decision-making capacity; and broader environmental influences.

Sociodemographic factors: The study looked at sociodemographic variables. The variables are also racial and ethnic background as well as educational attainment. Vo et al. (2023) referred to sociodemographic factors that include gender, age, socioeconomic position and immigration history, race/ethnicity, marital or partnership situation, workforce participation, general health conditions, caregiving or parental responsibilities, and the size of the community in which individuals live. Vo et al. also noted that social and demographic characteristics, such as socioeconomic status (SES), are often assessed by an individual's educational achievement, occupation, and income.

Assumptions

This study makes certain assumptions regarding the data derived from the NHANES, which includes self-reported health information and examination results for individuals with and without physical disabilities. Assumptions are made about the characteristics of the dataset, such as the distribution of variables, presence of correlational patterns, and data quality. Any deviations from these assumptions could have led to inaccuracies in the outcomes; however, the reliability of results is supported by NHANES' large, nationally representative sample size and standardized data collection procedures. The study focused on the following assumptions necessary for the validity and background of the research:

- It is assumed that NHANES data accurately represent individuals with physical disabilities and their reported use (or non-use) of adaptive or assistive technology.
- It is assumed that responses regarding the use of assistive or adaptive medical devices reflect the participants' actual experience and are self-reported truthfully.
- It is assumed that participants with physical disabilities who reported using adaptive or assistive devices experienced some improvement in their quality of life.
- It is assumed that participants who did not report use of advanced or adaptive technology may have lower quality-of-life outcomes compared to those who did.
- Following these assumptions, the use of NHANES data and its complex, weighted sampling design reduces selection bias and ensures that each participant had an equal probability of inclusion in the national sample

These assumptions are necessary to ensure the data used according to institutional review board guidelines and the CDC guidelines, and that the data reviewed for accuracy, consistencies and completeness prior to analysis.

Limitations

Various limitations and barriers existed in conducting the research with people with physical disabilities and advanced technology. Researching people with physical disabilities and advanced assistive device technology is a valuable area of research, but like any other research, it came with some limitations. Some of the limitations include diversity of disabilities is diverse, ranging from mobility impairments to sensory impairments. Generalizing findings from a specific disability group to others may not be appropriate, and researchers must consider the unique challenges and needs of different disability types. Within any disability group, individuals may have varying levels of impairment and unique preferences. It can be challenging to develop technologies that cater to the individualized needs of each person. Technology evolves rapidly, and what may be considered advanced today could quickly become outdated. Studying the long-term impact of specific technologies may take time due to the fast pace of technological development. Not all people with physical disabilities had equal access to advanced technologies. Economic factors, lack of awareness, or limited availability may hinder some individuals from benefiting from the latest advancements. Developing user-friendly interfaces for individuals with physical disabilities can be complex. It requires a thorough awareness of the unique requirements and preferences of users. How well technology works depends greatly on its ability to be designed in ways that support a wide range of functional abilities.

Research involving technology and people with disabilities raises ethical issues—including protection of personal information, ensuring valid consent, and the possibility of unforeseen impacts. Researchers must be diligent in addressing these ethical concerns to ensure the well-being and rights of participants. Long-term studies assessing the impact of advanced technology on the quality of life of individuals with physical disabilities may be limited. More research is needed to understand the sustained benefits and potential challenges over an extended period. Cultural and social attitudes toward disability can influence the adoption and acceptance of advanced technology. These factors must be considered to ensure that technologies are culturally sensitive and socially acceptable. Studying the intersection of physical disabilities and advanced technology often requires collaboration between different disciplines, such as engineering, healthcare, and social sciences. Interdisciplinary research can be challenging due to differences in language, methodologies, and priorities. Findings from controlled research environments may only sometimes translate seamlessly to real-world settings. Researchers must consider the ecological validity of their studies and the practical implications of implementing technologies in everyday life.

Despite these limitations, research remains crucial for improving the well-being of people who have physical disabilities. By responding to these ongoing issues, researchers have contributed to developing more inclusive and effective technologies that enhance accessibility and quality of life for people with physical disabilities.

Significance

This study has significant implications to contribute to various aspects that improve the quality of life for this populations to help bring positive social change and awareness. Here are some key areas that could be significant in research.

- Enhanced Accessibility: Advanced technology has enhanced accessibility for individuals with physical disabilities. Research in this area can identify and develop technologies that make daily tasks, communication and information access more accessible, promoting greater independence and inclusivity.

- Improved Independence and Autonomy: Technology empowered individuals with physical disabilities by providing tools that facilitate greater independence. This includes assistive devices, smart home technologies, and mobility aids that enable users to navigate their environments and perform tasks with increased autonomy.
- Social Inclusion and Communication: Advanced technology can facilitate communication and social interaction for individuals with physical disabilities. Research can explore the development of communication aids, social media platforms, and virtual reality applications that promote social inclusion, reducing feelings of isolation and loneliness.
- Employment Opportunities: Accessible technology can open up new possibilities for individuals with physical disabilities in the workplace. Research can focus on technologies that support remote work, adaptive workstations, and assistive tools, contributing to increased employment opportunities and job satisfaction.
- Health Monitoring and Management: Technology can be instrumental in tracking and overseeing medical or wellness conditions. Wearable devices, smart healthcare applications, and telehealth services can provide individuals with physical disabilities better access to healthcare resources, improving overall health outcomes and overall well-being.
- Educational Advancements: Research in this area can address challenges related to education for individuals with physical disabilities. Adaptive

technologies, online learning platforms, and assistive tools can create more inclusive educational environments, fostering lifelong learning and skill development.

- Policy Advocacy and Implementation: Findings from research studies can inform policymakers and advocacy groups about the particular barriers and requirements experienced by individuals with physical disabilities. This information may help inform the creation and implementation of policy strategies that support the integration of advanced technology into daily life.
- Technological Innovation and Design: Research can drive innovation in designing technologies that address the varied requirements of people living with physical disabilities. Human-centered design approaches can lead to the creation of more inclusive and user-friendly products and services.
- Quality of Life Metrics and Measurement: Studies also support the formulation of robust metrics for evaluating how advanced technologies influence the well-being of people with physical disabilities. This enables a broader and more detailed view of the outcomes and effectiveness of technological interventions.
- Psychosocial Well-being: Technology can contribute to the psychosocial well-being of individuals with physical disabilities by addressing mental health challenges, reducing stigma, and promoting a positive self-image. Research can explore the psychological impact of technology use on overall well-being.

In summary, this research study is significant for its potential to positively influence various aspects of the lives of individuals with physical disabilities. Through advanced technology solutions and understanding their impact, researchers contribute to creating a more inclusive and supportive environment that enhances the overall quality of life for this population.

Chapter 2: Literature Review

Introduction

In recent years, advances in modern technology have increasingly shaped everyday life, yet many people with disabilities continue to face challenges accessing and using these tools. Although smart devices and other advanced technologies are widely available, they are not always designed with the needs of people with disabilities in mind. As a result, persons with disabilities (PwD) often struggle to obtain or incorporate contemporary technologies into their daily routines. To enhance quality of life (QoL), many individuals with disabilities rely on electric mobility devices (e.g., powered wheelchairs) or assistive technology (AT) tools, including information and communication technologies (ICT). AT is often used to support communication or physical mobility, enabling greater participation in daily activities. Research has increasingly examined how advanced technology, including AI, may further improve independence and overall well-being for people with disabilities (Friedman & VanPuymbrouck, 2019). Access to such technology remains a critical need for this population (Barth, 2019). The use of AT has played an essential role in enhancing well-being by promoting meaningful participation in society and supporting independence for individuals with disabilities (Domingo, 2021).

Assessing quality of life for individuals with physical disabilities—particularly in relation to advanced technology—has been challenging due to limited availability of consistent measures in the public domain. Nevertheless, research demonstrates that AT can significantly enhance quality of life by increasing independence, reducing reliance on caregivers, and improving participation in daily activities. This increased independence contributes positively to self-worth and overall well-being (Collins et al., 2023). Despite these benefits, further investigation is needed to understand the specific impact of advanced technologies on quality-of-life outcomes among individuals with physical disabilities, beyond the effects of traditional assistive technology.

The literature review emphasizes the importance of peer-reviewed research examining how assistive and advanced technologies, including AI-enabled tools, influence quality of life for individuals with physical disabilities. This chapter outlines the strategies used to conduct the literature search, presents the theoretical and conceptual foundations guiding the study, and explains key concepts and variables relevant to the research topic.

Literature Search Strategy

The literature review searches were performed through various online databases through such as all ProQuest, PubMed/MedLine, CINAHL & MedLine Combine Search, IEEE Xplore, Science Direct, Sage Journals, BioMedical Central, Neuroscience Information that is provided through Walden Library. Google Schoolar was also used as a secondary for additional articles that Walden Library might not have. There was a need to expand outside the normal searches for advanced technology assistive technology and AI for assistive technology devices. A variety of search terms where used. There was a need to get assistance from the Walden Librarian to assist that all combination of terms were possibility used relevant for the literature search for the proposed research with different combination thereof:

1. Quality of Life
2. Improved quality of life
3. Daily activities, quality of life
4. Person with disability, People with physical disability, disabled
5. Person with disability without mental disability
6. Neurodevelopmental disorder use of assistive technology, adaptive technology
7. Neurodevelopmental disorder use of Advanced technology* or AI Technology
8. Machine learning, assistive technology, adaptive technology, assistive device technology
9. Artificial Intelligence technology, AI Technology
10. Assistive devices, assistive durable medical equipment, technology
11. Public health or community health or population
12. Not Mental health or psych*

In addition to the resources accessed through the Walden Library, I consulted several government-supported sites, including those maintained by the World Health Organization, the Centers for Disease Control and Prevention on Disability, and the U.S. Department of Health and Human Services. The literature review primarily focused on studies published within the past 5 years, supplemented by relevant sources from the previous decade. This strategy ensured a broad and comprehensive understanding of how modern technology relates to quality-of-life outcomes for individuals with disabilities.

Neurodevelopmental disorders are among the most prevalent conditions affecting motor function and development. There is a lack of literature evaluating the application of sophistication technologies in relation to these disorders. In their 2021 study, Mariblanca and De La Cuerda explored the potential of advanced rehabilitation techniques in assisting children with motor impairments. The literature review on neurodevelopmental disorders and the use of advanced technology or AI over the past decade has primarily followed a systematic approach but requires further investigation and additional research.

Theoretical and Conceptual Foundation

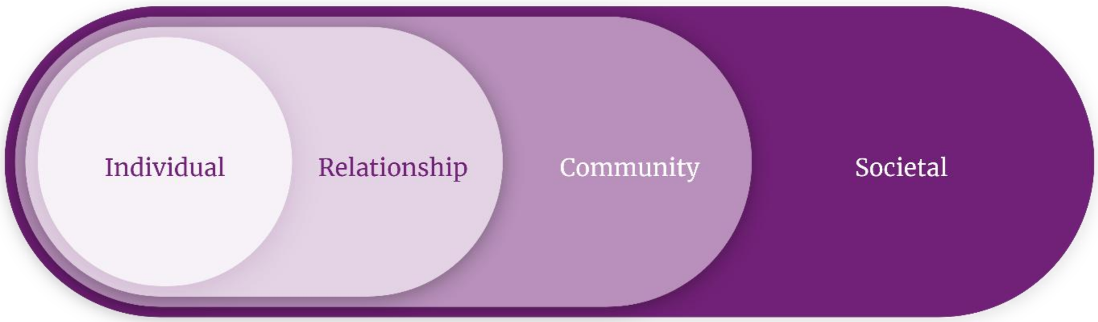
The SEM is the primary theoretical framework guiding this study. Developed by Urie Bronfenbrenner in the 1970s, the SEM offers a structure for understanding human development through the interaction between individuals and their surrounding social and physical environments. Bronfenbrenner's work has influenced numerous disciplines, including psychology, education, sociology, and public health (Hayden, 2019). The SEM highlights the multiple layers that shape behavior and development—individual, interpersonal, community, organizational, and societal levels. Because of its broad applicability, the SEM has been widely used in research addressing social and health-related issues (Bronfenbrenner, 1977; Hayden, 2019).

Advanced technology and AI, when considered within the SEM framework, have the potential to improve the lives of individuals with disabilities across these various levels. Together, SEM and advanced technology emphasize enhancing well-being, increasing access to opportunities, and promoting greater participation in society. The model also helps clarify how influences across different ecological levels interact with one another. It draws attention to the importance of preserving autonomy, mobility, and social participation when designing and implementing technology to support people with disabilities. Thoughtful application of technology guided by SEM principles encourages inclusion, supports independence, and expands opportunities for individuals with disabilities. At the same time, it underscores the importance of ensuring that technological innovations do not unintentionally introduce new barriers (Bronfenbrenner, 1977; Hayden, 2019; Hutchinson et al., 2020).

Integrating AI within the SEM structure further addresses the varied and interrelated needs of people with disabilities across ecological levels. It is essential that AI-driven and advanced technologies be designed with accessibility and inclusivity at the forefront. Ethical considerations such as privacy, data security, and informed consent also play a pivotal role in safeguarding the well-being of individuals who utilize these technologies. At the intrapersonal level, SEM highlights the importance of understanding the unique strengths, needs, and lived experiences of individuals with disabilities. This includes recognizing how disability influences daily functioning, personal goals, and long-term aspirations. On this level, the model stresses a person-centered approach, where technology is matched to the individual's characteristics and preferences. The SEM also encourages professionals and caregivers to adopt holistic practices that view the individual within a broader context of relationships, environments, and aspirations (Ahlborg et al., 2019; Bronfenbrenner, 1977).

Figure 1

Bronfenbrenner's Social Ecological Model



Note: This model is from https://www.cdc.gov/violenceprevention/about/social-ecologicalmodel.html. It has four layers of the Bronfenbrenner's Social Ecological Model. Individual, Relationship, Community and Societal

SEM and Variables

During the search for literature on the Walden Library on key variables for this study for the years of 2019 to present, the following search terms were used: Physical disability advanced technology and public health (372 results), disability or disabilities or disabled and advanced technology or adaptive technology and public health or community health or population *NOT mental or psych* (233 results), and added quality of life (129 results), neurodevelopmental disorder use of advanced technology or assistive device technology and quality of life (3 results)."

Advanced Technology

Bronfenbrenner's innermost level, the microsystem, represents the individual's immediate environment and is the setting with the strongest direct influence on the person. It includes the people with whom the individual interacts daily, such as family, friends, classmates, teachers, and others. Interactions within the microsystem operate in both directions—individuals influence their environment, and the environment shapes them in return. Because these relationships involve close and frequent contact, they play a substantial role in shaping development and behavior (Bronfenbrenner, 1977; Glanz et al., 2015; Hayden, 2017). Navarro and Tudge (2022) identified two forms of microsystems: physical and virtual. In an era where technology is intertwined with nearly all aspects of daily life, it is increasingly important to understand how various technological contexts influence a person's learning, behavior, values, and beliefs.

Navarro and Tudge (2022) expanded Bronfenbrenner's theory to include the influence of digital environments, distinguishing between physical microsystems and virtual ones. Physical microsystems refer to face-to-face interactions shaped by social roles, cultural expectations, and physical settings. Virtual microsystems, however, take place within digital platforms and technology applications, where engagement occurs through symbolic and relational interactions unique to online contexts. These virtual environments account for the influence of technology and digital content in contemporary development. Navarro and Tudge argued that understanding culture, subcultures, and daily activities within these digital contexts is essential for applying the microsystem concept to the modern era. Together, the physical and virtual microsystems create a broader ecological landscape in which a person's development unfolds, highlighting the importance of examining how technology shapes daily experiences.

The mesosystem represents the connections between different microsystems and the interactions that occur across them. These linkages influence how individuals develop and learn in various settings. Interpersonal relationships within the mesosystem—such as those involving peers, coworkers, neighbors, and family members—can significantly affect behavior and well-being (Bronfenbrenner, 1977; Glanz et al., 2015; Hayden, 2017). In modern society, Navarro and Tudge (2022) highlighted that physical, social, and digital environments are becoming increasingly interconnected, creating a bidirectional system that blends virtual and physical experiences. This interconnection reinforces the importance of understanding how technology shapes interactions across multiple ecological levels.

Research grounded in the mesosystem framework has shown that skills learned through virtual interactions may transfer into physical settings, contributing to positive outcomes such as improved communication, health behaviors, and social engagement. Navarro and Tudge (2022) noted the importance of considering how macrosystem-level influences—such as cultural norms and societal variations—shape proximal processes in physical and virtual microsystems. Understanding the diverse cultural and subcultural contexts in which people live and learn is essential for applying SEM to today's technology-rich environments. Examples include individuals connecting through online social networks or using advanced technology at home to enhance quality of life in daily and social settings (Navarro & Tudge, 2022). Technology ecosystems now influence multiple sectors, including healthcare, education, daily living, and society more broadly (Ramírez-Montoya et al., 2021).

The exosystem, often described as the organizational or external environment level, consists of settings that do not directly involve the individual but still shape their development. These include governmental policies, social service systems, community resources, workplace conditions, and mass media. Although the individual may not participate in these systems directly, decisions made within the exosystem influence the microsystems that the person interacts with (Bronfenbrenner, 1977; Glanz et al., 2015). In the digital age, technology increasingly plays a central role in the exosystem. Navarro and Tudge (2022) noted that decisions made by software developers, platform designers, and technology companies can greatly influence engagement within virtual microsystems.

Exosystemic forces are especially influential for young people in digitally mediated environments. Choices made by technology developers can determine how individuals engage with virtual platforms, shaping the opportunities available to them. Navarro and Tudge (2022) emphasized that researchers and practitioners must consider how these external influences—including collaborations between users and digital platform creators—affect developmental processes. The macrosystem, which encompasses societal values, cultural beliefs, and broad social patterns, further shapes individual outcomes in the digital technology era. Machine learning and algorithmic personalization within digital platforms illustrate how macrosystem-level forces can tailor individual experiences, demonstrating the intertwined nature of the macrosystem, exosystem, and virtual microsystems (Navarro & Tudge, 2022; Ramírez-Montoya et al., 2021). Understanding and navigating the exosystem is therefore essential for examining development in technology-rich contexts.

The community level or also known as the macrosystem involves the broader society and cultural forces that contributed to the individual development. Key elements of this level of Bronfenbrenner's theory encompassed values, social norms, conventions, traditions, ideology, and cultural beliefs. These cultural ideas are commonly held by cohorts of individuals with a parallel historical background or shared identity. These beliefs has also changed or evolved as time passes. These views can also differ depending on the geographical area and socioeconomic status. It refers to the overarching patterns of the micro-, meso- and exo-systems within a given culture, subculture, or broader social context (Bronfenbrenner, 1977; Navarro & Tudge, 2022). In other words, the macrosystem represents the broader societal and cultural influences that shaped and impacted the development of individuals, including young people. It included the changing expectations and events in larger society, both within and across generations, and how they affected human development over the life course. Furthermore, in the context of the digital age, the macrosystem became even more crucial as it reflected the diverse cultures and subcultures existing in society, including the influences of technology and virtual contexts on adolescent development (Navarro & Tudge, 2022; Ramírez-Montoya et al., 2021).

The macrosystem and technology were linked in the overarching patterns and influences that shaped the development of the individuals in the digital and technology age. The macrosystem encompassed the broader social context within which people live, including cultural beliefs, resources, lifestyle opportunities, and patterns of social interaction. In today's society, technology played a significant role in shaping these cultural dynamics, affecting how individual interact, communicate and engaged with their environment. The rapid advanced in the digital and technology have transformed the way individuals navigated and participate in cultural practices, influencing their opportunities for engagement and social interactions. Within the macrosystem, virtual space created by technology have become essential components of social life, impacting the way in which individuals from different cultural backgrounds connected and communicated (Navarro & Tudge, 2022; Ramírez-Montoya et al., 2021).

The macrosystem in the digital and technology age extended its influence into virtual microsystems, where individual interacted with technology in ways that shape their developmental experiences. Algorithms and machine learning algorithms on the digital technology platforms collected and interpreted data about individual's behavior, preferences, and interactions, shaping their experiences based on predetermined goals set by the developers and marketers (Navarro & Tudge, 2022). This highlighted how marcosystems was intertwined with technology as it exerted considerable influence on how individuals engaged with virtual environment and navigated their digital technology interactions. In conclusion, the connection between the macrosystem and technology in the digital underscored the complex interplay between cultural influences, technological advances, and individual development. Understanding this condition was crucial for researchers and practitioners aiming to support positive individual outcomes and navigate the evolving landscape of the technology digital interactions and experiences (Navarro & Tudge, 2022; Ramírez-Montoya et al., 2021).

The connection between chronosystems and technology lay in the evolving nature of technology and its impact on human development over time. Navarro and Tudge (2022), explained how the digital technology revolution has led the integration of advanced technology into everyday life, blurring the boundaries between the virtual and physical realms. This integration has transformed interactions with technology from the individual and unidirectional to complex, bidirectional and dynamic. Navarro and Tudge (2022) referred the chronosystem as the dynamic interplay between societal changes and human growth throughout one's life, encompassing both individual and generational experiences and their impact on each other. In the digital technology age, this bidirectional relationship between the macrosystem (cultural influences) and developing individuals was more fluid than before. It was important to understand the timing within the process-person-context-time (PPCT) model in the digital age (Bronfenbrenner & Morris, 2006). Mesotime, the repetition of direct process over days, weeks, and years, was influenced in the digital technology, both encouraged and disrupted engagement in direct processes. If the digital technology can enable regular interactions like usage of the reading books with distant grandparents or attending school digitally during times of disruptions, such as COVID-19 pandemic (Navarro & Tudge, 2022; Ramírez-Montoya et al., 2021). There for the connection between the chronosystems and technology in the digital technology area underscores the need to consider how technological advancements shape huma development over time, affecting direct process, persons characteristic, context, and cultural influences. As the digital technology word increasingly became intertwined with daily life, it was important for researchers and scholars to consider the influence of advanced technology context on outcomes of interest. By addressing the role of advanced technology in the model, researchers gained more comprehensive understanding of the complex interactions between individual and digital environments, ultimately guiding practices, policies, and support for the individuals in the advanced technology digital era.

Person With Disability

The SEM used for individuals with disability focused on considering the individual within their broader social and environmental context. When the microsystem system is applied to the SEM model to person with disabilities, it involves examining the immediate social and environmental factors that directly impact their daily lives, experiences, and well-being. The SEM takes into account for personal, social and environmental factors that may either enabled or hindered the empowerment of people with disabilities (Ramí-rez-Montoya et al., 2021). It emphasized the importance of tailoring assistive technology and advanced technology to the specific disability, context and cultural condition of the individual need. The SEM model emphasized the need to consider the individual's psychosocial and cultural issues, such as their expectations regarding assistive and advanced technology, social costs, and understanding their disability. It was crucial to analyze the enabling and disabling interactions that technology has on individuals with disabilities in medical, social, and educational setting to provide personalized assistance (Ramí-rez-Montoya et al., 202; Su & Mejia, 2022).

Family environment was crucial for the microsystem for individuals with disabilities. It concluded family's members attitudes, support, and interactions with the person with a disability. Understanding family dynamics and the level of support provided by family members had a signification impact on the individual's well-being and functionality. For people with disabilities, the school or educational environment was critical microsystem. It included interactions with teachers, peers, and the physical environment of the school. Similar, for adults with disabilities, the work place environment played a vital role in their inclusion, accommodation, and overall satisfaction with their employment. Peer relationship and social networks with in the community formed another aspect of the microsystem (Bronfenbrenner, 1977). Positive interactions with peers, friendships, and social support from individuals within their social networks contributed to the individual's sense of belonging, self-esteem, and overall quality of life. Interaction with healthcare providers, therapist, and other professionals within healthcare settings are part of the microsystem. Effective communication, quality of care, and access to necessary medical interventions and rehabilitation services were critical for individuals with disabilities to maintain their health and well-being. The availability and use of assistive and advanced technology devices and environmental adaptions were essential components of the microsystem. These tools and modifications enhanced the individual's independence, mobility, communication, and overall functioning withing various environments (Navarro & Tudge, 2022; Ramírez-Montoya et al., 2021).

The mesosystem, the second level of the SEM focused on the interactions and connections between different microsystem in an individual's life. Person with disabilities the mesosystem is examined how various setting sand environments interacted and influenced one another to impact the individuals' experiences, opportunities, and well- being. The school to home connection for person with disabilities, is the interaction between the school environment and the home environment is crucial. Effective communication and collaboration between teachers, special educators, therapists, and parents can ensure consistency in support, interventions, and expectations, leading to better education outcomes for younger person (Bronfenbrenner, 1977; Ramírez-Montoya et al., 2021). The healthcare and community support coordination for individual with disabilities often interact with multiple service providers, including healthcare professionals, therapist, community support organizations, and advocacy groups. The mesosystem involved ensuring coordination and collaboration between these entities to provide comprehensive, holistic are and support that addresses the individual's diverse needs and goals (Ramírez-Montoya et al., 2021). For adults with disabilities, the mesosystem included the interaction between the vocational rehabilitation's services, employers, and community support agencies. Effective linkages between these entities facilitated successful transitions to employment, provided necessary accommodation, and support ongoing career development and opportunities. During transition periods from school to adulthood or hospitalization to community living, the mesosystem involved coordination between different systems to ensure continuity of care, support, and services. These included collaboration between educational institutions, healthcare providers, social services agencies, and community-based organization to facilitate smooth transitions and promote independence and self-determination to improve quality of life (Bronfenbrenner, 1977; Navarro & Tudge, 2022).

The exosytem represented broader societal and institutional context that indirectly influenced individuals' experiences and opportunities. When applied to person with disabilities using advanced technology, the exosystem focused on the external environments and systems that impacted the availability, accessibility, and support for technology use. The healthcare policies and regulation related to insurance and assistive technology with the use of advanced technology devices, and standards for accessibility influenced the availability and affordability of advanced technology for person with disabilities. Changes in healthcare in policies affected individuals' access to necessary technology and support services. Education policies and practices including special education laws, funding allocations, and technology integration initiatives, impact ed the use of advanced technology in educational settings for students with disabilities. Accessibility standards and accommodations for technology use in schools enhanced learning opportunities and inclusion. Their employment and workplace regulations, community support service and programs, technology development and industry standards, transportation development and accessibility infrastructure, and media representation and public awareness. By recognizing and addressing the broader societal and institutional context within the exosystem, stakeholders can advocate for policies, practices, and investments that support the availability, accessibility, and effectiveness of advanced technology for persons with disabilities. Collaboration, advocacy, and public awareness efforts across different sectors were essential for promoting inclusive and equitable access to technology solutions that enhance independence, participation, and quality of life (Bronfenbrenner, 1977; Navarro &Tudge, 2022, Su & Mejia, 2022).

The SEM, the macrosystem represented the overarching cultural, societal, and historical context that influenced the experiences, attitudes, and opportunities of individuals. When applied to person with disabilities using advanced technology, the macrosystem focused on the broader cultural beliefs, societal values, and systemic factors that shaped the availability, accessibility, and acceptance of technology use. The macrosystems can be applied to cultural believes and attitudes, social policies and legislation, historical context and social movements, economic and technological trends, education systems and pedagogical approaches, media representation and cultural narratives, and globalization and international collaboration. Recognizing and addressing the broader cultural, societal, and systemic factors within the macrosystem, stakeholders can advocate for policies, practices, and investments that supported the availability, accessibility (Bronfenbrenner, 1977; Navarro & Tudge, 2022, Su & Mejia, 2022).

Person with disabilities the SEM model outer most layer was the chronosystem. It refers to the dimension of time and how changes over time, including historical events, life transactions, developmental trajectories, influenced individuals' experiences and opportunities. When applied to person with disabilities using advanced technology, the chronosystem focused on how temporal factors and life transitions impact the availability, accessibility, and utilization of technology solutions. The chronosystem can be applied to technological advances and innovation which included breakthrough in assistive technology devices, software applications, and accessibility features. The chronosystem reflected how ongoing technological innovation that shaped the availability and capabilities of advanced technology solutions. Other chronosystems are legislative changes and policy shifts, life transitions and development stages, historical context and societal attitudes, digital divide and technological inequities, lifespan perspective and aging with disability and technological obsolescence and lifelong learning. By recognizing and addressing the temporal factors within the chronosystem, stakeholders can advocate for policies, practices, and investments that support the dynamic needs and experiences of persons with disabilities using advanced technology across different life stages and historical contexts. Lifespan perspectives, historical awareness, and ongoing adaptation to technological changes was essential for promoting inclusive and equitable access to technology solutions that enhanced independence, participation, and quality of life (Bronfenbrenner, 1977; Navarro & Tudge, 2022, Su & Mejia, 2022).

Quality of Life

Applying the SEM to improve the quality of life for persons with disabilities utilizing advanced technologies involved considering multiple levels of influence, from individual to broader societal contexts. Here are some of the quality-of-life outcomes within each level of the SEM:

Individual Level Quality of Life Use of Advanced Technology

- Physical Independence with the use of advance technology or AI can enhance physical independence for individuals with physical disabilities by providing assistive devices such as exoskeleton, prosthetics, or mobility aids, quality of life outcomes included increased mobility, improved functional abilities, and greatly autonomy in daily activities (Jamwal et al., 2020; Su & Mejia, 2022; Yadav, 2021)

- Health Management: Advanced technology and AI tools has facilitated health management for individuals with physical disabilities, including remote monitoring devices, telemedicine platforms, and smart home healthcare systems. Quality of life outcomes include improved access to healthcare services, better management of chronic conditions, and enhanced overall well-being (Navarro & Tudge, 2022, Su & Mejia, 2022).
- Psychological Well-being: Utilizing advanced technology and AI for communication, socialization, and mental health support can contributed to improved psychological well-being. Quality of life outcomes include reduced feelings of isolation, increased self-confidence, and enhanced emotional resilience.

Microsystem Level Quality of Life Use of Advanced Technology

- Family Support and Relationships: Within the microsystem, quality of life outcomes include the impacted of advanced technology and AI on family dynamics and relationships. Access to assistive devices and AI-enabled communication tools can enhance communication, foster stronger family bonds, and promote caregiver well-being (Navarro & Tudge, 2022; Su & Mejia, 2022).
- Peer Connections and Social Networks: Quality of life outcomes related to peer connections and social networks involved the use of advanced technology and AI for socialization, community engagement, and peer support. Virtual communities, online forums, and social media platforms can

facilitate connections and reduce social isolation (Navarro & Tudge, 2022; Su & Mejia, 2022).

Mesosystem Level Quality of Life Use of Advanced Technology

- Healthcare Integration: Quality of life outcomes within the mesosystem included the integration of advanced technology and AI into healthcare systems and services. Collaboration between healthcare providers, assistive technology specialists, and AI developers ensures comprehensive care, personalized interventions, and timely access to innovative solutions (Navarro & Tudge, 2022; Ramirez-Montoya et al., 2021).
- Educational and Vocational Opportunities: Quality of life outcomes related to education and employment involve the use of advanced technology and AI to supported academic achievement, vocational training, and employment opportunities. Accessible learning platforms, adaptive technologies, and AI-driven job matching tools promoted inclusion and career advancement (Navarro & Tudge, 2022; Ramirez-Montoya et al., 2021).

Exosystem Level Quality of Life Use of Advanced Technology

- Policy and Accessibility: Quality of life outcomes within the exosystem reflected the impact of policies, regulations, and accessibility standards on the availability and accessibility of advanced technology and AI for persons with physical disabilities. Advocacy efforts for inclusive policies, funding initiatives, and universal design principles contributed to greater access and participation (Navarro & Tudge, 20220; Su & Mejia, 2022).

- Community Integration: Quality of life outcomes also involve the integration of persons with physical disabilities into community life through accessible infrastructure, transportation options, and recreational opportunities enabled by advanced technology and AI. Inclusive design and universal accessibility promoted social inclusion and participation in community activities (Navarro & Tudge, 20220; Su & Mejia, 2022).

Macrosystem Level Quality of Life Use of Advanced Technology

- Cultural Attitudes and Perceptions: Quality of life outcomes within the macrosystem included shifts in cultural attitudes, perceptions, and societal norms regarding disability and technology. Positive representations, awareness campaigns, and advocacy efforts promote acceptance, inclusion, and equal opportunities for persons with physical disabilities utilizing advanced technology and AI (Navarro & Tudge, 2022; Ramirez-Montoya et al., 2021; Su & Mejia, 2022).
- Global Collaboration and Innovation: Quality of life outcomes also involved global collaboration and innovation in advancing assistive technology and AI solutions for persons with physical disabilities. International partnerships, research initiatives, and knowledge sharing contributed to the development of cutting-edge technologies and best practices for enhancing quality of life on a global scale (Navarro &Tudge, 2022; Su & Mejia, 2022).

SEM on Quality of Life

There are five different levels of the SEM model that was applied. Within the microsystem, family members played a crucial role in supporting individuals with disabilities in utilizing advanced technology. Educating families about available technologies, providing training on how to assist with technology use, and fostering a supportive environment can enhanced the individual's quality of life (Bronfenbrenner, 1977; Jamwal et al., 2020; Su & Mejia, 2022). Peer support groups, social networks, and community organization, where individuals can shared experiences, learned from each other, and accessed peer support related to technology use, can promoted inclusion and well-being (Yadav, 2021).

The collaboration between healthcare providers, educations, and assistive technology and advanced technology specialist within the mesosystem was essential. Coordinated efforts ensured comprehensive assessments, access to appropriate technology solutions, and support services that address their needs across different settings such as healthcare facilities, schools, and community organizations (Bronfenbrenner, 1977; Navarro & Tudge, 2022). During key life transitions, such as transition from school to adulthood or from rehabilitation to community living, mesosystemic interventions supported successful transitions and continuity of technology support and services. Collaboration between different systems ensured that individuals have access to resources and support to navigate these transitions effectively (Bronfenbrenner, 1977; Navarro & Tudge, 2022, Su & Mejia, 2022).

Advocating for policies and systemic changes within the exosystem can promoted access to advanced technology and support services for persons with disabilities. Efforts to enhance funding for assistive technology, improve accessibility standards, and address digital divides contributed to a more inclusive and supportive environment. Improving community accessibility and infrastructure ensured that individuals with disabilities can fully participate in society and access technology-related opportunities. This included accessible transportation options, physical environments, digital platform, and information resources that accommodate diverse needs and preferences (Bronfenbrenner, 1977; Navarro & Tudge, 2022).

Within the macrosystem, promoting cultural awareness and sensitivity regarding disability a technology was essential. This is involved challenging stereotypes, promoting positive representations of persons with disabilities in media and popular culture, and fostering inclusive attitudes and values that recognize the rights and capabilities of all individuals. Global collaboration facilitated knowledge sharing, research collaboration, and the dissemination of best practices in disability and technology. International efforts contributed to the development of innovative solutions, advocacy for universal accessibility standards, and the promotion of human rights for persons with disabilities worldwide (Bronfenbrenner, 1977; Navarro & Tudge, 2022; Ramírez-Montoya et al., 2021).

Lifelong learning and adaptation to technological advancements were essential within the chronosystem. Providing ongoing education and training opportunities ensured that individuals can keep pace with technological changes, adopted new innovations, and maximized their independence and participation throughout their lives. Understanding the historical context and policy evolution surrounding disability and technology informed efforts to improve quality of life. Learning from past experiences, recognizing historical injustices, and advocating for policies that promoted equity and inclusion contributed to positive changes in the lives of persons with disabilities (Bronfenbrenner, 1977; Navarro & Tudge, 2022; Ramírez-Montoya et al., 2021). With each level of the SEM Model, stakeholders can implemented comprehensive interventions and strategies that enhanced the quality of life for persons with disabilities using advanced technology. Collaboration, advocacy, and cultural competence across different levels of influence were essential for creating a supportive and inclusive environment where individuals thrived and fully participated in society.

Summary and Conclusions

It was clear that the Social Ecological Model (SEM) played a vital role in supporting individuals with disabilities. The ecosystems described within SEM were designed to provide medical, social, and educational assistance tailored to each person's disability, cultural context, and environmental conditions. The use of assistive technology and advanced technology can substantially enhance communication, mobility, and overall quality of life for individuals with disabilities. It is therefore essential to consider the contextual and social elements that may either support or hinder the empowerment of people with disabilities.

The development of technological ecosystems that serve individuals with disabilities has been crucial for fostering inclusion, strengthening social welfare, and improving overall well-being. These ecosystems must adapt to diverse contexts and environments to meet the specific needs of individuals with functional diversity (Navarro

& Tudge, 2022). Advanced technology holds significant promise for improving the quality of life for people with disabilities by promoting independence, participation, and overall well-being. Through innovative applications across multiple domains, individuals with disabilities can overcome barriers, gain new opportunities, and pursue more fulfilling lives.

Literature Review Related to Key Variable and Concepts

This quantitative study examined the relationship between physical disability and the use of advanced technology as it relates to improving quality of life. The variables included in this study were physical disability status, advanced technology use, and quality of life. The literature review explores the intersection of these key variables—advanced technology, quality of life, and disability—with specific attention to physical disability. Previous studies have demonstrated that technological innovations can enhance motor coordination, communication, and daily functioning for individuals with neurodevelopmental conditions and physical disabilities (Brinsmead, 2019; Gardeazabal & Absscal, 2019). Despite these benefits, gaps remain in understanding the long-term effectiveness and accessibility of such technologies across diverse populations and settings (Mendonca et al., 2022). This review aimed to integrate recent research findings to provide a comprehensive understanding of how advanced technology may improve the quality of life for individuals with physical disabilities and related conditions. It highlights both the opportunities and challenges associated with adopting and sustaining these innovations.

Advanced Technology and Physical Disability

The integration of advanced technology in the management and support of individuals with disabilities, including neurodevelopmental disorders, had garnered significant attention. The future of technology and disability held great promise for enhancing accessibility and inclusivity for individuals with disabilities. As new technologies evolved, an increased focus was likely be on designing universally accessible products that enhance global accessibility and enabled individuals with disabilities to lead more independent lives. By utilizing AT like screen reader software, communication devices, and executive functioning tools, individuals with disabilities, including twice-exceptional children, could overcome their challenges and maximize their potential (Abdi et al.,2021; Gardeazabal & Abascal, 2019; Mendonca et al., 2022).

Brinsmead (2019) examined the use of Apple's iPad for children and young adults with neurodevelopmental disorders and physical disabilities, finding that devices like the iPad may enhance educational engagement and social communication. The study also emphasized the importance of redesigning mainstream technologies so they more effectively meet the needs of users with disabilities (Brinsmead, 2019). Assistive technology (AT) continues to play a critical role for adults with disabilities (Abdi et al., 2021). Mendonca et al. (2022) conducted a scoping review of 11 studies published from 2005 to 2021. Participants ranged from age 18 to 80 with varied functional abilities. The studies included multiple categories of assistive devices—such as seating and positioning supports, mobility devices, control systems, and computer-interface technologies. Outcomes were measured through indicators such as performance (speed and accuracy), physiological improvements, and user-reported ease of use. These findings revealed valuable insights but also pointed to limitations in design and study methodology).

Strengths of their approaches include the comprehensive search strategy, rigorous screening and inclusion criteria, and systematic data extraction process. By including both group and single-case designs, they were able to capture a range of perspectives and experiences related to the use of AD by adults with physical disability. Thematic categorization of the types of AD and outcome measured provided a structured way to analyze and present the findings. The focus on performance, physiological gains, usability, and training also highlighted important aspects of AD effectiveness for this population (Mendonca et al., 2022). Weaknesses inherent in their approaches included the limited availability of data on the topic, which likely impacted the number and quality of studies included in the review (Mendonca et al., 2022).

The studies themselves were found to have design and bias limitations, suggesting potential confounding factors that may have influenced the reported outcomes. The lack of demographic information, such as race/ethnicity and socioeconomic status, for the study participants was also a limitation. Further investigation with larger sample sizes, diverse populations, and more extended follow-up periods could help address these weaknesses and provided a more comprehensive understanding of the effectiveness of AD for adults with physical disability (Mendonca et al., 2022). Although existing studies provided insights into the use and effectiveness of AD for adults with disability; unresolved controversies and gaps in the literature warranted further investigation to enhance our understanding of the variables involved in AD interventions for this population (Mendonca et al., 2022).

Rincón et al. (2021) used a qualitative approach to explore how children with severe motor impairments, specifically neurodevelopmental disorder, imagined robots to play with. Through qualitative research involving focus groups with 19 children, the study aimed to understand features children believed would make a robot enjoyable to play with. The findings revealed that children envisioned a good robot as anthropomorphic, tough, strong, capable of moving, grabbing, speaking, and playing popular children's games. The study also discussed the influence of age, gender, culture, and physical environment on children's expectations of robots for playing with. Overall, the research underscored the potential of robots to assist children with motor impairments in engaging in play and provided valuable insight for developers designing assistive robots for play (Rincón et al., 2021).

Rincón et al.'s (2021) study explored using assistive devices to evaluate and enhance cognitive functioning and support meaningful play participation among individuals with disabilities, especially those experiencing motor or cognitive challenges. The development of robotic systems for children with disabilities, such as those with physical disability, involved consultation with experts to ensure the effectiveness of the technology in promoting engagement in play. Additionally, studies had shown that children with severe motor impairments can benefited from using robotics and information and communications technology (ICT) to support play activities, highlighting the potential of technology to assist children with disabilities in engaging in play (Rincón et al.,2021). The study's strength included having diverse researchers working with neurodevelopmental disorders and engineers specializing in health and technologies. The data collection and analysis conducted focus groups with children and achieved data saturation; this enhanced the credibility and dependability of the findings. The sample size and scope were limited and only consisted of a small group of children aged from 5 to 11 years of age from both rural and urban settings in developing countries, which may restrict how widely the findings can be applied to broader populations. The findings of the study's conclusion reflected the children's viewpoints about using robots for play rather than emphasizing measurable outcomes (Rincón et al., 2021). Overall, the research and development of AT, like robots for play, demonstrated the close association between technology and disability, with improving the daily play activities for children and the participation of individuals with disabilities (Rincón et al.,2021).

Jdaitawi and Kan'an (2021) systematically reviewed relevant studies and explored how augmented reality (AR) technology assisted special needs students in their learning outcomes in higher education settings. The study aimed to show students with disabilities by analyzing its advantages, limitations, and challenges in particular education contexts. The research also explored the top standard fields for AR in higher education. It suggests trends in the using AR technology and other advanced technology to support students with disabilities (Jdaitawi & Kan'an, 2021).

The research strength lay in its comprehensive systematic review of how augmented reality (AR) technology supports students with disabilities within educational environments. The research highlighted how AR enhanced physical, personal development, and social engagement for individuals with disabilities. The study's weakness was that it had several areas that need to be addressed for future research. The number of studies examined represented only a selection of available studies in particular education settings in higher education and there were potential biases based on the selected research sources.

The study offered detailed perspectives on how assistive devices (AD) are used and how effective they are for individuals—especially adults—with physical disabilities. However, there was several significant research gaps that warranted further investigation:

- Demographic Information: The absence of key demographic details, including race/ethnicity and socioeconomic background status of the study participants, was a notable limitation. Understanding how these factors might have influence the effectiveness of assistive devices was identified as a crucial area for future research.
- Limited Availability of Data: The paper acknowledges the limited availability of data on the topic, which likely impacted the number and quality of studies included in the review. This highlighted the need for more extensive research efforts to fill this gap.
- Confounding Factors and Bias: The studies identified design and bias limitations, suggesting potential confounding factors that could have influenced the reported outcomes. Further research was needed could aim to address these issues for a more robust understanding of the effectiveness of assistive devices.

- Controversies and Gaps: The existing studies provided valuable insights, but there were unresolved controversies and gaps in the literature, emphasizing the need for further investigation to enhance our understanding of the variables involved in AD interventions for this population.
- Long-term Effectiveness: The paper noted the need for longer and more sustained follow-up periods in future studies to assess the long-term effectiveness of assistive devices for adults with physical disability.

In conclusion, while the existing research offered substantial findings, addressing these research gaps through more comprehensive and diverse studies was expected to contribute significantly to advancing our understanding of the role and impact of assistive devices for individuals with physical disability. Additionally, the study focused on enhancing specific skills of individuals with disabilities, potentially neglected other important areas of education. The study also highlighted the limitations of AR technology, such as the needed for development based on individual abilities and prior experiences, as well as the challenges related to the complexity of the AR application for some students. The study had several areas that needed to be addressed for future research, like a broader range of disabilities beyond those studied, increased sample size, and the use of other forms of advanced technology that can be used outside of an educational setting and more in everyday life (Jdaitawi & Kan'an, 2021).

Advanced Technology and Quality of Life (QoL)

Advancements in technology increasingly became pivotal in enhancing the quality-of-life outcomes for individuals with disabilities, especially those living with physical impairments. The intersection of advanced technology, such as assistive devices and AI, with the day-to-day realities experienced by individuals with physical disabilities, forms a significant area of research. These technological innovations could potentially improve daily life, including communication, mobility, and independence. Quality of life, a multifaceted construct encompassing physical, psychological, social well-being/engagement, and family and peer support, was particularly impacted for individuals with disabilities through the use of such technologies (Ramirez-Montoya et al., 2021; Navarro & Tudge, 2022). This review examined the relationship between advanced technology and various quality of life outcomes for individuals with disabilities. It highlighted current research and identifies gaps to inform future studies.

Phycological Well-Being

Quality of life was a central factor for individuals with disabilities because it had a direct influence on their psychological well-being. A higher-level quality of life was associated with better mental health. Reducing the physical and social barriers that people with disabilities faced could decrease stress, anxiety, and depression. Being able to engage in activities independently boosted self-esteem and confidence. Success in personal and professional goals contributed to a positive self-image and sense of achievement (Navarro & Tudge, 2022; Ramí-rez-Montoya et al., 2021). Fernández-Batanero et al. (2022) stated that for students with disabilities, having access to the same opportunities as their peers was essential for participation in society, including education. Assistive devices, without technology, played a significant role in enhancing quality of life for individuals with disabilities by fostering inclusion and improving accessibility (Fernández-Batanero et al., 2022; Jdaitawi & Kan'an, 2021). Rincón et al. (2021) and Fernández-Batanero et al. (2022) noted that children with disabilities require opportunities to participate in play. For example, it is essential for children with severe motor impairments, such as neurodevelopmental disorder, as it supports their motor, social, emotional, and cognitive development. Rincón et al. (2021) suggested that advanced technology like robots is designed for play and could be crucial in improving the quality of life for individuals with disabilities by providing opportunities for interaction, learning, and enjoyment.

In the digital age, advanced technology significantly shaped psychological well-being, especially in adolescents. The ubiquity of digital technology, including smartphones and social media platforms, had transformed how individuals interacted and communicated (Navarro & Trudge, 2022). Research had shown that even standard medical assistive devices have contributed to enhancing day-to day quality of life. Ramirez-Montoya et al. (2021) and Navarro & Trudge (2022). Makwanda and Ikhile (2023) discussed the advancements in prostheses that have improved patient quality of life. The study focused on improving prosthetics design, sensors, and waterproofing technologies using advanced technology to improve the standard prostheses limb. The study showed that advanced technology in the prosthesis limb significantly improved the patients' daily activities, leading to enhanced psychological well-being (Makwanda & Ikhile, 2023). Enhancing the functionality and comfort of a person with disability experience improved self-esteem, reduced social stigma, and an overall positive influence on their mental health and overall quality of life (Fernández-Batanero et al.,2022; Makwanda & Ikhile, 2023).

Physical Well-Being

The integration of technological advancements in assistive devices and equipment had the potential to significantly improved the quality-of-life outcomes for individuals with a disabilities and allowed them to navigate their environment better and engage in everyday activities (Toro et al., 2020). Integrating advanced technology with assistive devices can directly impacted an individual's ability to manage their health and maintain mobility, enhanced physical capabilities, reduced pain, and improved overall health outcomes. Improved quality of life through AT can promoted greater independence in daily activities. This can reduced reliance on caregivers and enhanced personal autonomy (Navarro & Trudge, 2022; Ramirez-Montoya et al., 2021).

The iPad is used as an assistive technology device, and it played an important role in improving the physical well-being on individuals with a physical disability. By incorporating features such as voice commands, touchscreen adjustments, and external switch controls, the iPad offered accessibility options that catered to the fine motor impairments experienced by users with neurodevelopmental disorder and people with disability, such as voice commands and touchscreen adjustments (Brinsmead, 2019). Advanced technology in upper limb prostheses has significantly contributed to patients' physical well-being by improving their dexterity, range of motion, comfort, and flexibility and reducing susceptibility to phantom pain. Overall, the advanced technology in prosthetic design and sensors improved patients' physical well-being, allowing them to lead a more active life (Makwanda & Ikhile, 2023).

Social Engagement

Advanced technology significantly enhanced social engagement by offering innovative solutions and facilitating more effective connections and interactions. One way in which advanced technology facilitates social engagement is through the development of social media platforms and communication tools. Advanced technology cu the skills and inclusion of a person with a disability in several ways. Fernández-Batanero et al. (2022) stated that advanced technology, such as communication devices, social skills apps, and online platforms, facilitated communication and interaction among disabled people and their peers, thus enhancing their social skills. A person with a disability's quality of life also related to their ability to participate in meaningful activities, access to necessary support and resources, maintain social connections, and experience a sense of belonging and inclusion within their community (Rincón et al.,2021). Additionally, AT has helped in the development of autonomy and independence, enabling a person with a disability to take more control over their learning social skills, improve motor skills, and enhance participation and, ultimately contributing to their social inclusion and overall well-being (Fernández-Batanero et al.,2022; Jdaitawi & Kan'an, 2021)

One-way advanced technology facilitated social engagements was through the development of social media platforms and communications tools. These platforms allowed people to maintained connections with friends and family even when separated by physical distance, fostering a sense of community and belonging (Li & Piachaud,2018). Jdaitawi and Kan'an (2021) found that individual with disabilities and special needs, including autism, intellectual disabilities, and visual impairments, were able to enhance their social skills, interact with their peers, and engage in real-world experiences using augmented reality (AR). AR technology enabled individuals to immerse themselves in interactive and engaging learning experiences, improving their academic skills and fostering their motivation, engagement, and independence (Jdaitawi & Kan'an,2021).

Furthermore, advanced technology in the form of social robots can provided companionship and emotional support to children, fostering social relationships and encouraging positive interaction. Robots designed to express positive emotions towards children can helped enhance engagement and enjoyment during social interactions (Rincón et al.,2021). Even with the advanced technology in prosthetic limbs, people with disability have significantly improved social engagement. The advancements in prosthetic design have enabled users to have increased dexterity and natural hand movements, allowing them to operate more effectively in social situations (Makwanda & Ikhile, 2023). Overall, the advancements in assistive devices using advanced technology, whether it is prosthetics, AR, robots, or other enhanced medical devices, played a crucial role in improving social engagement for individuals.

Family Support Outcomes and Peer Relations

Technologies such as speech-generating devices, eye-gaze systems and communication apps enabled individuals with disabilities to communicate more effectively with family members. This facilitated better understanding and reduced frustration, leading to stronger bonds. Advanced technology in medical devices played an important part in assisting family members and promoting peer interactions among students with disabilities (Fernández-Batanero et al., 2022; Rincón et al., 2021). Augmentative and alternative communication devices enabled individuals with speech impairments to express their needs and emotions (Camarata et al., 2020). Even in upper limb prostheses, social engagement has significantly improved for individuals with limb loss. Medical device advancements have enabled users to increase their engagement in activities and communicate with others (Camarata et al., 2020; Makwanda & Ikhile, 2023).

Rincón et al. (2021) found that using robots as companions, playmates, or assistants can created a more engaging and interactive experience for children, helping them feel less isolated and forming closer bonds with their family members and peers. AR was also shown to positively impact family and social relations, particularly with individuals with disabilities and other special needs (Jdaitawi and Kan'an, 2021). AR has provided immersive and interactive learning experiences that helped individuals with disabilities develop communication skills, increase independence, and engage in social activities (Jdaitawi and Kan'an (2021). Li and Piachaud (2018) found that advanced technology significantly impacted social care, where assistive medical devices that have enhanced technology are increasingly utilized to enable individuals, especially the elderly and those with disabilities, to live independently. Adults with physical disability with assistive devices such as control devices, computer interfaces, and mobility equipment can improve communication abilities and social interactions for individuals with disability. Access to electronic devices and communication more efficiently increased social participation and integration. Also, in turn, it has enhanced their participation in family activities and social events (Mendonca et al., 2022).

The literature review presented a comprehensive examination of the correlation between advanced technology and the quality-of-life outcomes for individuals with disabilities. It emphasized the significant impact of technological advancements, such as assistive devices and AI, on both psychological and physical well-being. However, one potential gap in the literature was the need for a more in-depth exploration of the long-term impact and sustainability of these technological interventions. While the reviews discussed the immediate benefits and improvements in daily activity routines, further research could concentrate on the long-term effectiveness, maintenance, and adaptability of these technologies for individuals with disabilities. Additionally, there is an opportunity for research that specifically addresses the intersectionality of different types of disabilities and how advanced technology can be customized to meet the unique needs of individuals with varying abilities. Further studies could also explore the cost-effectiveness and accessibility of these advanced technologies to ensure their widespread availability and benefits for all individuals with disabilities. Advanced technology can aided individuals with disabilities by improving family communication and caregiving, facilitating educational support, and fostering social connections with peers. These technologies can helped reduce isolation, enhance quality of life, and build stronger, more inclusive communities. Technology provides platforms for accessible communication and interaction, bridging the gap between physically distant individuals. By offering tools for communication, mobility, and accessibility, technology has the potential to empower individuals with disabilities to engage with their family, social circles, and society at large. Advanced technology served as an inclusive approach to fostering a sense of belonging and connectedness within communication, promoting empathy, understanding, and support for people with diverse needs (Toro et al., 2020).

Disability and Quality of Life

Quality of life (QoL) was a vital consideration for people living with physical disabilities, encompassing well-being across various domains such as physical well-being, emotional and mental health, autonomy, and social and family interactions and family relationships, and environmental interactions. Enhancing QoL for these individuals involves addressing multiple challenges and utilizing resources like assistive devices. Anand et al. (2020) and Yeung and Breheny (2019) underscored the importance of personal capabilities and having a sense of purpose, emphasizing their role in improving QoL for people with disabilities. Furthermore, Sulistyano et al. (2022) and Chaudhary et al. (2019) highlighted the considerable impact exerted by physical function and social factors, including religion and socio-economic status, on QoL.

Yeung and Breheny (2019) focused on their capabilities and purpose in life. Recognizing and enhancing the abilities and strengths of individuals with disabilities could empower them and improve their overall well-being. Providing opportunities for individuals with disabilities to pursue their interests, hobbies, and passions could help them find fulfillment and meaning in their lives. Additionally, setting goals and objectives tailored to an individual's unique strengths and interests could provide a sense of purpose and direction. Engaging in activities that bring joy and fulfillment, whether through work, hobbies, or social interactions, can significantly contributed to an enhanced the quality of life experienced by individuals with disabilities (Yeung & Breheny, 2019). Anand et al. (2020) also focused on capabilities ensuring that a disabled person has the opportunities to fulfill their potential in life. The purpose was to enable individuals with disabilities to live fulfilling and meaningful lives despite their challenges. Focusing on capabilities, which refer to what individuals can do and achieve, rather than just their limitations, allowed for a more holistic assessment of quality of life (Anand et al., 2020). Recognizing and building on the capabilities of individuals with disabilities promoted their independence and autonomy and enhanced their overall quality of life. Focusing on their strengths, interests, and abilities boosts their self-worth, self-esteem, and life satisfaction. Shifting from a deficit-focused viewpoint to an approach that emphasizes individuals' strengths and supports their empowerment and supported them in leading fulfilling and meaningful lives, this enabling them to pursue their goals, participate in society, and experience a sense of well-being and contentment, living life with dignity and respect despite their challenges (Anand et al., 2020; Yeung & Breheny, 2019).

The strengths of both studies included a comprehensive examination of the how life purpose and personal capabilities that impacted daily activities to enhance quality-of-life outcomes for older adults with disabilities. By taking a holistic approach, the study focused on enhancing the quality of life through daily activities rather than just quantifiable metrics of success and failure. The research identified significant associations between psychological well-being, physical wellness, life purpose, and individual capabilities with daily activities among older people with disabilities (Anand et al., 2020; Yeung & Breheny, 2019). Additionally, the study utilized a variety of statistical analyses, including multiple regression, to analyze how multiple factors interact in relation to and improving daily activities. These advanced statistical techniques allowed for a nuanced understanding of how different factors contribute the improving the daily activities in this population to potentially improved the quality of life (Anand et al., 2020; Yeung & Breheny, 2019).

Moreover, another notable strength was the study's comprehensive approach to assessing the daily activities-based on Amartya Sen's theory, which considered multidimensionality and the freedom to do what people value (Anand et al., 2020). The study provided both a theoretical analysis and empirical data consistent with this framework, shedding light on the impact of mobility impairment on capabilities and psychological well-being. The research identified areas where capabilities were significantly lower for individuals with mobility impairments, highlighting the widespread effects of such disabilities on various aspects of life.

However, the study also had some areas for improvement, including potential sampling and data collection limitations. The document did not provide detailed information on the study population's selection or the specific measures used to assess certain variables. While the study considered a range of variables such as health status, social isolation, emotional well-being, physical and psychological functioning, personal capabilities, and sense of life purpose, other important factors may not have been included in the analysis. Additionally, the lack of comparison across different levels of mobility impairment or other disabilities limited understanding how capabilities, functioning, and subjective well-being varied across various sub-groups. More information on AT's effectiveness in improving different aspects of life quality for those with mobility impairments would also have been helpful. Furthermore, the psychometric properties of the capabilities measured were relatively novel, so additional information would have benefited future research. Overall, the study provided valuable insights into the elements that shape the everyday functioning of older adults with disabilities, emphasizing how life purpose and individual capabilities contribute to overall well-being in this population (Anand et al., 2020; Yeung & Breheny, 2019).

Sulistyanto et al. (2022) research article on disability and quality-of-life outcomes among stroke patients treated at Poly Neurology Kraton Hospital of Pekalongan underscored the significant effect of physical functioning on their overall quality of life. The study found that better physical function among patients led to an improved t in their quality of life, highlighting the importance of examining how variations in physical functioning could influence quality-of-life outcomes life post-stroke. In addition to physical function, social factors – including religion and socioeconomic status -were key determinants of quality of life. While the study did not specifically analyze these social factors, it was evident that the ability to engage in religious practices and the availability of resources due to socio-economic status significantly impacted overall well-being and quality of life. Future research incorporating these aspects could have provided a more comprehensive understanding of the factors that shape quality-of-life outcomes for this population. Furthermore, the study underscored the essential role of nurses in delivering Range of Motion (ROM) interventions to support physical functioning in stroke patients. Addressing physical function through interventions like ROM exercises could enhance the overall well-being and quality-of-life outcomes of stroke patients. This highlighted the need for holistic care that considered not only physical aspects but also social and cultural factors impacting the overall quality-of-life experiences of individuals recovering from a stroke (Sulistyanto et al.,2022).

The research review provided a comprehensive analysis the factors that affect quality-of-life outcomes for individuals with disabilities, particularly focusing on the role of capabilities and purpose in life. However, there were notable research gaps that could be addressed in future studies. One prominent research gap was the need for more detailed information on the study population's selection and the specific measures used to assess certain variables. Additionally, while the paper considered various factors such as health-related concerns, social isolation, emotional difficulties, physical and psychological well-being, personal capabilities, and sense of purpose, there is a potential for further investigation into other important factors that may influence the quality of life of individuals with disabilities (Sulistyanto et al.,2022).

Furthermore, the lack of comparison across different levels of mobility impairment or other disabilities limited the understanding of how capabilities, functioning, and subjective well-being varied across various sub-groups. Future research could have benefited from exploring and comparing the effects of different types and levels of disabilities on the quality of life, thereby providing a more a deeper appreciation of the specific challenges experienced by individuals with differing types of disabilities. Additionally, more information on the effectiveness of AT in improving different aspects of life quality for those with mobility impairments could have further enhanced the understanding of how resources like assistive devices impacted quality-of-life outcomes for individuals with disabilities. Addressing these research gaps could have contributed to a quality-of-life outcomes for individuals with disabilities and inform the development of more targeted interventions and support strategies. Chaudhary et al. (2019) conducted a study in the rural area of Dehradun district and found that physical function significantly influenced the quality of life of disabled individuals, with 68.9% of participants expressing satisfaction in the physical domain. This emphasized the importance of addressing physical limitations and providing assistance that contributes to improving the overall well-being of individuals with disabilities. Additionally, social factors such as religion and socioeconomic status significantly impacted the quality of life. Religion emerged as a strong determinant for the physical, psychological, and environmental domains of quality of life, while socioeconomic status was closely associated with the psychological domain. These results emphasized the importance of adopting a holistic approach to disability management, addressing not only physical abilities but also social factors like religion and socioeconomic status. By considering these factors, stakeholder could enhance the quality-of-life outcomes for individuals with disabilities, leading to better overall well-being and societal integration (Chaudhary et al., 2019).

Disability and Geodemographics

Research consistently indicated that education, race, gender, and age significantly influenced the quality-of-life (QoL) outcomes for people with disabilities. According to Lorenti (2020), childhood disadvantages and lower education correlated with shorter life expectancy and increased disability, whereas Jani (2022) highlighted the link between higher education levels and improved QoL. De Oliveira and Meira (2023) emphasized the necessity for public policies that respond to the intersection between race and disability, acknowledging their combined impact on QoL. Furthermore, Chiu (2019) discussed how living arrangements and socioeconomic status affect the duration of life with and without disability. Sirgy (2021) elaborated on the influence of these demographic factors on subjective QoL. Syifa and Hadi (2023) identified additional determinants such as gender, age, degree of disability, access to assistive medical devices, and social relationships. Collectively, these studies illustrated the complex nature of QoL for people with physical disabilities and emphasized the importance of improving their overall well-being.

The studies by Lorenti et al. (2020) and Jani et al. (2022) how demographic factors intersect with disability-related outcomes, though in different contexts. Lorenti et al. (2020) focused on age, race, gender, and education among disabled individuals in the U.S., highlighting variations in disability years based on childhood disadvantages and educational attainment. They found that among the least educated, both men and women experienced differing disability expectancies depending on their childhood circumstances. Additionally, race/ethnicity played a role, with Hispanics often showing longer life expectancy and fewer years of poor health compared to other racial groups.

Jani et al.'s (2022) study in Malaysia examined demographic distributions among persons with disabilities, including age, gender, and education levels. They found that higher education levels correlated with an improved quality of life, underscoring the importance of educational opportunities for improving outcomes among disabled individuals. Both studies emphasized how education and demographic characteristics contribute to shaping quality-of-life outcomes and health trajectories for people with disabilities, suggesting that addressing these factors was crucial for improving their overall well-being and integration into society (Lorenti et al., 2020; Jani et al., 2022)

Lorenti et al. (2020) and Jani et al. (2022) both examined focused on how demographic factors influenced outcomes for individuals with disabilities, though they approached the topic from different perspectives. Both studies highlighted the how educational attainment influences quality-of-life outcomes and long-term health trajectories. Lorenti et al. (2020) utilized an innovative combination of inverse probability weighting and multistate modeling to explore how childhood disadvantages and education intersect, providing a nuanced understanding of these relationships. Jani et al. (2022) used the WHOQOL-DIS instrument to assess the quality-of-life outcomes for individuals with disabilities in Malaysia, finding a positive association between higher educational levels and enhanced quality of life. A notable difference appeared in in their methodologies and focus areas. Lorenti et al. (2020) emphasized the impact of childhood disadvantages on later life, including work and health trajectories, while acknowledging limitations such as excluding variables likeability and motivation, may have introduced biases. Conversely, Jani et al. (2022) focused on quality of life across various domains, noting the absence of statistical significance in the relationship between education levels and quality of life, suggesting that other factors may also play a role. This points to the need for further research to explore additional influences on quality-of-life outcomes for individuals with disabilities across varying contexts.

The research conducted by Lorenti et al. (2020) and Jani et al. (2022) investigated the influence of education and demographic characteristics on outcomes for individuals with disabilities. Though they explored different contexts, they highlight the importance of education in shaping quality of life and health trajectories. Lorenti et al. (2020) focused on the interplay between childhood disadvantages and education, using innovative methodologies to assess their impact on later-life work and health trajectories. On the other hand, Jani et al. (2022) used the WHOQOL-DIS instrument developed by the World Health Organization to assess quality-of-life outcomes among individuals with disabilities in Malaysia, finding a beneficial relationship between educational attainment and quality-of-life outcomes. However, the studies differ in their limitations and focus areas. Lorenti et al. (2020) identified potential biases from participant dropout due to health issues and the retrospective nature of childhood adversity data, which may affect accuracy. They also limit their health analysis to age 70, potentially missing later-life health challenges. Jani et al. (2022) highlighted the limitation of using education as a binary variable without considering socioeconomic status or health conditions, which could have offered a more comprehensive understanding of quality of life. Including these additional factors would have provided a more complete understanding of how education relates to the quality of life for persons with disabilities in Malaysia.

De Oliveira and Meira (2023) examined disability as a physical, intellectual, or sensory function limitation that affected an individual's ability to perform activities. Disabilities were categorized into physical, hearing, visual, and intellectual, following the 2010 IBGE (Instituto Brasileiro de Geografia e Estatística; Brazilian Institute of Geography and Statistics) data. It emphasized that disabilities affected various lives, including health outcomes, educational attainment, economic participation, poverty rates, and dependence on others. Race is a social construct differentiating individuals based on physical characteristics, significantly influenced social inequalities and affected education and employment opportunities (De Oliveira & Meira, 2023). The study noted that racial minorities, such as Black and Indigenous groups, often face disadvantages compared to White individuals, impacting their access to education and work. Although gender was not extensive discussed, it was included as an independent variable to assess its effect on life quality alongside disability, race, education, and income. The importance of inclusive policies and public assistance, such as quota laws for disabled individuals and racial minorities, was highlighted as essential measures to address systemic inequalities and improve the quality of marginalized populations in Brazil (De Oliveira & Meira, 2023).

The research strengths included a comprehensive analysis of the intersection of disability and race in Brazil, using data from the 2010 Demographic Census to evaluate impacts on education, income, and gender (De Oliveira & Meira, 2023). The study effectively considered confounding factors and employed a robust experimental design, utilizing ANOVA tests to assess the effects of race, education level, income, gender, and disability on quality of life. However, several limitations were noted. There was a need for more detailed assessments of regional, state, and municipal variations, along with improvements in the quality of statistics on people with disabilities, to enhance research accuracy. Additionally, the study primarily focused on physical, hearing, visual, and intellectual disabilities, potentially overlooking other forms of disability that could have provided a more comprehensive understanding of intersectionality in Brazil (De Oliveira & Meira, 2023).

In summary, the study explored the intersection of disability and race in Brazil, focusing on the challenges faced by disabled individuals and racial minorities concerning education, income, and gender disparities. It underscored the need for inclusive policies and public assistance to address these challenges and enhance the quality of life for marginalized groups (De Oliveira &Meira, 2023). Future research should have address these gaps by exploring regional disparities, collecting detailed data on various disabilities, and considering additional social determinants of health, such as healthcare access and social support. Conducting qualitative research to capture the lived experiences of disabled individuals and racial minorities could also have offered valuable insights into the systemic inequalities they faced (De Oliveira & Miera, 2023)

Understanding these multifaceted determinants is essential for developing effective interventions to enhance the QoL for individuals with physical disabilities. Disability intersected with factors such as age, gender, race, and education, which in turn influenced the quality of life of individuals with physical disabilities. Studies have highlighted differences in quality of life-based on gender, with females facing challenges related to social exclusion and violence risks, leading to a lower quality of life compared to males (Detsky et al., 2021; Syifa & Hadi, 2023). Age was another determinant, where children, teenagers, and adults with physical disabilities experienced varying quality of life due to factors such as physical limitations, body image issues, and productivity demands. Additionally, the severity of disability played a significant role, as individuals with poor social support and stigma may experience a lower quality of life (Syifa & Hadi, 2023). When examining the relationship between race, education, and disability, it was crucial to recognize that existing research may not have extensively explored these factors specifically within the context the quality of life experienced by individuals with physical disabilities. However, the broader framework of social determinants of health indicates that race and education significantly influenced access to resources, opportunities, and the availability of support systems, all of which influenced the overall well-being and quality of life of individuals with disabilities. Further research focused on the intersectionality of disability, race, and education could have provide valuable insights into how these factors shape the experiences of individuals with physical disabilities and informed interventions to enhance their quality of life (Syifa & Hadi, 2023).

Syifa and Haidi's (2023) study’s strengths included a comprehensive literature review on determinants of the quality of life of individuals with physical disabilities, providing an in-depth understanding of factors influencing their well-being. The review also addressed global inclusion trends, highlighting challenges faced by persons with disabilities in achieving a high quality of life. Emphasizing a thorough approach to these determinants can effectively guide health interventions and support services. However, a limitation was the relatively small number of articles selected for the review; although inclusion criteria were explicit, expanding the sample size could offer a more robust overview. Including a diverse range of articles from various sources and countries would also have captured broader perspectives. Additionally, the study's focus on general determinants without analyzing specific subgroups of physical disabilities limited the depth of insights, as different types may have had unique factors affecting quality-of-life. In conclusion, although the study offered valuable insights, addressing these limitations by expanding the scope and detail of the analysis could have enhanced its overall impact and relevance.

Summary and Conclusions

While existing studies provided valuable insights into the determinants of the quality of life (QoL) of individuals with disabilities, there is a notable gap in examining the intersectionality of disability with race and education specifically within the context of QoL. Most research has focused on isolated demographic factors, leaving a need for comprehensive analysis that considers how these elements interacted to influence overall well-being. Research consistently highlighted that education, race, gender, and age significantly impacted QoL for individuals with disabilities. Studies showed that higher education correlates with improved QoL, while childhood disadvantages and lower educational attainment are linked to shorter life expectancy and increased disability. The intersection of race and disability further affected QoL, necessitating inclusive public policies. Additional determinants such as socioeconomic status, living arrangements, and social support networks also played crucial roles. The multifaceted nature of QoL for individuals with physical disabilities underscored the importance of addressing various determinants in a holistic manner. Future research should have focused on the intersectionality of race, education, and disability, examining how these factors collectively shaped experiences and outcomes. This approach would have informed more effective interventions designed to improve the overall well-being of individuals with disabilities, addressing systemic inequalities, and promoting inclusion.

Chapter 3: Research Method

Introduction

This chapter outlines the methodological approach used in the study. This longitudinal analysis evaluated how advanced technology use related to quality-of-life outcomes for individuals with physical disabilities, incorporating statistical controls for age, gender, race/ethnicity, and education. In addition, the research design reflected how the SEM model assumed that interaction between individuals and their environment were reciprocal, implying that an individual with physical disability and the environment were influenced by a person's surroundings (Úbeda-Colomer et al., 2019).

This research relied on existing NHANES data, which provided the necessary variables for the study. NHANES survey data served as the source of information for this study. The NHANES data set included an accompanying codebook that detailed the variables and data structure used for analysis. A codebook for the NHANES data set, which included detailed descriptions of the available secondary data, was obtained to guide the analysis. The codebook provided details regarding the organization's, data structure, and arrangement of the data file obtained from the institution. The codebook defined the precise standards and instructions for coding data segments, guaranteeing consistency and uniformity during the analysis process. The standardize codebook ensured the reliability in the research process. However, the data still needed to be reviewed before running the analysis on the data, to check for missing data, detect outliers, and ensure data entries are consistently recorded.

Gap and Research Significance

According to the WHO (2021), Trewin et al. (2019), and Scendoni et al. (2023), all state that assistive device technology is not often considered when it comes to people with a disability. Advanced technology and Assistive Device technology was used every day. Advanced technology or Assistive Device technology were transforming how people do things on a daily basis, from helping doctors to spot cancers, assistive device is helping corporations with recruiting, there were autonomous vehicles, and also everyday use on the internet using our voice, like Alexa, Siri and ChatGPT.

Research Design and Rationale

A longitudinal design was selected to assess potential associations between the independent and dependent variables. The analytical approach was quantitative.   Non-parametric procedures were applied when the data did not meet normality assumptions, whereas parametric tests were used when normality criteria were satisfied.

This design was chosen to expand understanding of how advanced or assistive technology may contribute to quality-of-life improvements for individuals with physical disabilities. The independent variables were physical disability and advanced technology or assistive device technology. The dependent variable was quality of life while statistically adjusting for age, gender, race/ethnicity, and educational attainment. The use of secondary data in this quantitative study sample size will be dependent on what was available from the data set. This study utilized secondary data obtained from the NHANES. The subject and participants did not have direct interaction with the data used in this study. Using secondary data has reduced time and resource restrictions on this study.

Methodology

Population, Data Sources of the Study and Data Collection

The study focused on U.S. residents with physical disabilities as its target population. The U.S. Census Bureau (2022) reports that nearly 61 million adults—roughly 19% of the nation's population—identify as having a disability. Physical disabilities can manifest in a variety of forms, including limitations in mobility, motor function, or other physical impairments that affect daily living activities. These conditions often intersect with social, economic, and environmental factors, influencing quality-of-life outcomes. Understanding how advanced technology supports this population is essential for promoting accessibility, autonomy, and health equity. Rather than collecting primary survey data, this study utilized existing national data that include health and functional measures relevant to disability, technology use, and quality-of-life indicators.

NHANES is a national program that evaluates the health and nutritional conditions of adults and children in the United States. It focused on a wide range of health conditions, including complex disabilities related to brain, bone, and movement disorders, providing valuable data for research and public health planning. Data collection was completed through structured interviews, clinical examinations, and laboratory testing, ensuring a comprehensive view of participants' health statuses. The survey employed a stratified, using a multistage probability sample to ensure national representativeness (CDC, 2022). For example, in recent NHANES cycles, data collection covered various socio-demographic factors and health outcomes, enabling researchers to analyze trends and disparities in health care access and outcomes (CDC, 2023). This robust dataset illustrated the extensive reach and utility of NHANES for public health studies and policy-making efforts.

Selection Criteria

Selection and inclusion criteria were essential parts of this study and were applied to selecting the specific data variables from a secondary data source or accessing NHANES survey data.

Inclusion Criteria

The secondary data variables included this study were:

- Residents living in the United States
- Frist age group 13 to 17 if a parental consent form has been completed.
- Second age group 18 and older
- Born with a disability who is cognitive
- Acquired disability that is permanent
- Used assistive devices and or assistive technology devices

Exclusion Criteria

The secondary data variables that will not include in this study are:

- Has a physical disability who has mental or intellectual disability
- Short-term disability
- Ages under the age of 5 is omitted

Sampling Procedure

The sample size for this study focused on identifying individuals with physical disabilities and determining whether they reported using assistive medical devices and or technology medical devices. The NHANES data set provides valuable secondary data, offering insights into health conditions, socio-demographic factors, and access to assistive devices among individuals with disabilities. While NHANES did not specify whether assistive technology devices incorporated more advanced technology or assistive device technology, it included detailed data on functional limitations and the use of assistive devices, enabling relevant analyses. For example, recent NHANES cycles have sampled thousands of individuals, ensuring a robust dataset for examining trends and outcomes in disability and technology use (CDC, 2022, 2023). The sample consisted of participants who satisfied the requirements of the research question and met the established inclusion criteria. Because the exact number of individuals with physical disabilities using assistive devices in the dataset was unclear, Slovin's formula was applied to determine both the appropriate sample size and the acceptable margin of error (Ryan, 2013). Slovin's formula provides a way to estimate the necessary sample size to achieve a selected confidence level during the process of sampling a population. The aforementioned method was and is typically used when limited information exists about a population's characteristics, helping researchers approximate an appropriate sample size (Ryan, 2013). The Slovin's formula below:

$$n = N/(1+Ne^2)$$

Where:

n = Number of samples

N = Total Population and

e = Margin of error or Error tolerance (level)

If there was a large sample size and the population is heterogenous, the Cochran's formula is better used. Cochran's formula allows researchers to compute an optimal sample size by incorporating the preferred precision level, confidence level, and estimated proportion of the population possessing the target characteristic (Cochran, 1963). The Cochran formula is listed below:

$$n = Z^2 \frac{P(1-p)}{e^2}$$

Where:

e = is desired level of precision, the margin of error

n = the sample size

Z = the level of confidence

p = the fraction of the population (%)

Operationalization

The study examined the independent factors of physical handicap without comorbid mental health conditions and sophisticated technology or assistive device technology. The variable under investigation is the quality of life. The variables considered were age, gender, race/ethnicity, and education. Table one displayed the potential categorization of the variables that are crucial for operationalizing the research questions, together with the potential responses provided in the data. Table two presented the potential definitions for the variables.

Table 1

Breakdown of Variables

Name	Definition	Origin (NHANES/Researcher Defined)
Persons with Disabilities (PwD)	Person with Disability: is a bodily condition that restricts a person's capacity to carry out various tasks and engage fully with their surroundings. Various types of physical disabilities may influence a person's vision, movement, communication, and social relationships (CDC, 2020).)	Researcher-defined composite — derived from NHANES Disability (DLQ) variables: DLQ010 (difficulty walking), DLQ020 (difficulty standing), DLQ040 (difficulty using hands/arms), DLQ050 (difficulty seeing), DLQ070 (difficulty hearing). Recoded into binary variable PwD_Total (1 = any disability; 0 = none)
Advanced Technology or Assistive Medical Device Technology	High tech or exotechnology, highest form of technology available today in assistive medical devices	Researcher-defined composite — from NHANES DLQ150 (use of equipment to aid walking),

		DLQ160 (use of special equipment for mobility), DLQ170 (use of other adaptive medical devices). Recoded into binary variable MD_AnyDeviceUse (1 = yes; 0 = no)
Disability	Person with a disability Level 1 (Mild): individuals can ambulate independently, and their day-to-day functioning is largely unaffected Level 2 (Moderate): individuals may require supports such as braces, medications, adaptive tools, or technology to perform daily tasks Level 3 (Severe): individuals often rely on wheelchairs and experience considerable	Researcher-defined derived variable — constructed by grouping responses from DLQ010–DLQ070 items according to degree of difficulty (none, some, or extreme).

	difficulty completing everyday activities	
QoL	Quality of Life (QoL): Health-related QoL reflects an individual's overall functioning and well-being in relation to illness and treatment impacts. Teoli (2023) highlights key aspects, including personal well-being (physical, mental, and spiritual), interpersonal connections, education, work conditions, social status, financial resources, safety, personal freedom, independence, belonging, and the physical environment.	Researcher-defined composite — derived from NHANES Health Status and Physical Functioning modules: HSD010 (self-rated general health), PFQ059 (days physical health not good). Recoded into binary variable QoL_AnyImprovement (1 = improvement; 0 = no improvement)
Age Group	Chronological age of the respondents at the time of survey participants.	Researcher-defined (recoded) – NHANES variable RIDAGEYR (continuous) recoded: *Youth*

		(≤19 years) and *Adult* (≥20 years).
Education Level	Highest level of education completed by the respondent.	Researcher-defined (recoded) — NHANES variable DMDEDUC3 recoded into two groups: *Youth/School Age* (Grades K–12 or equivalent) and *Adult Education* (High school graduate or higher).
Demographic Controls	Additional sociodemographic factors used as covariates in regression models	NHANES – defined RIAGENDR (gender), RIDRETH3 (race/ethnicity),

Note. Variables were drawn or constructed from NHANES 2017–2018 data. Researcher-defined composites were developed to align with the study's theoretical framework and logistic-regression analyses.

Table 2

Definition of Variables

Variable	Category	Variable type	Measurement
Person with Disability (PwD)	0=None 1= One Type of Disability 2= Multiple type of Disability	IV	Ordinal

	(*Learn About Disability and Health*, 2023)		
Disability	0= Yes 1= No	IV	Nominal
Advanced Technology Use or Assistive Medical Device Technology Use	1= Yes 0= No	IV	Nominal
Quality of Life	0= No improvement 1= Improvement	DV	Nominal/ Binary
Race/Ethnicity	1= Mexican American 2= Other Hispanic 3= Non-Hispanic White 4= Non-Hispanic Black 6= Non-Hispanic Asian 7= Other Race-Include Multi-Racial	Covariate	Nominal
Age	0= to 19 Years Old 1= 20+ Years Old	Covariate	Ordinal

Education Youth	0= No Schooling or Kindergarten Only 1= Elementary (1st to 5th Grade) 2= Middle School (6th to 8th Grade) 3= High School (9th-12th Grade, HS Grad, GED, >HS)	Covariate	Ordinal
Education 20 Plus	0= No School 1= Less than High School 2= Graduated HS (Diploma, GED or Equivalent) 3= Some Collage or College Graduate	Covariate	Ordinal
Gender	1= Male 2= Female	Covariate	Nominal

Note. Variables were coded in IBM SPSS for logistic-regression analysis. Binary and categorical variables were used to satisfy model assumptions and ensure adequate cell counts across demographic groups.

Data Analysis Plan

Data analysis for this study was performed using IBM SPSS Statistics (Version 29; IBM Corp., 2022), which provided the tools necessary for managing and analyzing large, weighted survey dataset. This software was selected due to its robust capabilities for performing complex sample analyses, applying weighting variables, and conducting logistic regression to test the study's hypotheses. All data management and transformation were completed using SPSS syntax commands to ensure accuracy, transparency, and reproducibility of results. Syntax coding was used to merge NHANES files label variables, and recode categorical data (e.g., age, education, and disability indicators) into binary or ordinal groupings. Employing syntax rather than point-and click procedures allowed for a more efficient workflow and consistent replication of variables construction across analyses. This study relied on publicly available data from the National Health and Nutrition Examination Survey (NHANES), which offers comprehensive health and demographic information collected through standardized national assessments. NHANES offered a comprehensive dataset that included medical information and socio-demographic information relevant for analyzing assistive technology devices used among individual with disabilities (CDC, 2022, 2023). The analytic procedures were structured to address the study's core research questions, ensuring alignment between the statistical approach and the study objectives:

Research Question 1: Is there an association between advanced technology use and quality-of-life outcomes among those who are physically disabled?

Null Hypothesis ($H_0 1$): There is no association between advanced technology use and quality-of-life outcomes among those who are physically disabled.

Alternative Hypothesis ($H_a 1$): There is an association between advanced technology use and quality-of-life outcomes among those who are physically disabled.

Research Question 2: Is there an association between physical disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education?

Null Hypothesis (H_o2): There is no association between physical disability and advanced technology use among those who are disabled while controlling for age, gender, race and education.

Alternative Hypothesis (H_a2): There is a relationship between physical disability and advanced technology use among those who are disabled while controlling for age, gender, race and education.

Research Question 3: Is there an association between disability and advanced technology use among those who are disabled?

Null Hypothesis (H_03): There is no association between disability and advanced technology use among those who are disabled.

Alternative Hypothesis (H_a3): There is an association between disability and advanced technology use among those who are disabled.

Research Question 4: Is there an association between advanced technology use and quality-of-life outcomes among those who are disabled when controlling age, gender, race/ethnicity, and education?

Null Hypothesis (H_04): There is no association between advanced technology use and quality-of-life outcomes among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

Alternative Hypothesis (H_a4): There is an association between advanced technology use and quality-of-life outcomes among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

The approach is to do a parametric test if the data is a normal distribution. If the data does not have a normal distribution would use a non-parametric test. The longitudinal data analysis would be done for this study.

Table 3

Research Questions Variables and Statistical Analysis

Research question	Data collected/ variables	Statistical analysis
RQ1: Research Question: Is there an association between advanced technology use and quality-of-life outcomes among those who are physically disabled?	IND- Advanced Technology or Assistive Device Technology Use DEP- Quality of Life	Simple Logistic Regression
RQ2: Research Question: Is there an association between physical disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education?	IND- Advanced Technology or Assistive Device Technology Use DEP- physically disabled COV- Gender, Age, Race/ Ethnicity, and Education	Multiple Logistic Regression
RQ3: Research Question: Is there an association between physically disabled and advanced technology use among those who are disabled?	IND – Advanced Technology or Assistive Device Technology Use DEP- physically disabled	Simple Logistic Regression
RQ4: Research Question: Is there an association between advanced technology use and quality-of-life outcomes	IND – Advanced Technology or Assistive Device Technology Use	Multiple Logistic Regression

among those who are disabled with physically disabled when controlling for age, gender, race/ethnicity, and education?	DEP- Quality of Life COV - Gender, Age, Race/ Ethnicity, and Education

Note. Independent variables are denoted as (IND), Dependent variable (DEP) and Covariates (COV).

Threats to Validity

Despite the potential for a large and unknown sample size, it was necessary to maintain statistical rigor (Shirilla et al., 2021. However, doing secondary dataset analysis does had significant constraints that could hinder the both the study's internal rigor and the extent to which its findings can be generalized. Several limitations existed within the results generated by this study. These included the presence of inconsistencies in defining disability, the absence of clear differentiation between different disability categories, potential inaccuracies in the answers provided by the dependent variable, imbalanced sample sizes, incomplete data from the data set, and challenges associated with meeting ethical requirements when conducting research involving individuals with disabilities. The objective of this section was to consolidate the possible deficiencies and constraints that arise during the process of performing quantitative disability research. These limitations highlight the need for further investigation and future studies.

Ethical Procedures

The first choice for the secondary data was NHANES, administered by the Centers for Disease Control and Prevention (CDC), was selected because it provides a rich collection of health, functional, and socio-demographic information suitable for secondary analysis. Because NHANES is a publicly accessible dataset with all personal identifiers removed, its use did not require direct IRB approval. However, ethical considerations still applied due to the sensitive nature of health-related datae first choice for the secondary data was the National Health and Nutrition Examination Survey (NHANES), which offers extensive health and socio-demographic data collected through the Centers for Disease Control and Prevention (CDC). Accessing NHANES data did not require direct Institutional Review Board (IRB) approval because it is publicly available, but ethical consideration remained essential, especially when analyzing sensitive health information. A second option for data was leveraging Walden University's access to datasets, which allows students to use curated datasets for their research. Ethical approval might have been required depending on the source and nature of the specific dataset. Concerns about secondary data use include safeguarding individual privacy, especially when dealing with sensitive health data, and ensuring compliance with ethical standards in data handing and analysis (CDC, 2022; Walden University, 2023) The following process will be taken:

1. Institutional Review Board (IRB): The study proposal was submitted to Walden University's IRB for review and authorization to use the selected secondary dataset.
2. Consent Forms: Participant consent forms were not required for this study because there was no direct contact with human subjects. The data used were obtained from the NHANES, a publicly accessible secondary dataset maintained

by the Centers for Disease Control and Prevention (CDC). According to the NHANES methodology, all participants in the original survey participants originally gave consent during the NHANES data collection process, and the CDC ensures that all personal identifiers are removed before public release. Therefore, no personally identifiable information was accessed or used in this study (CDC, n.d.).

Summary

This study employed a cross-sectional design that relied on previously collected national survey data to investigate associations among disability status, the use of advanced or AT, and indicators of quality of life. Guided by four research questions, the study applied both simple and multiple logistic regression techniques to evaluate whether significant associations exist between these variables. The statistical procedures incorporated demographic factors—such as age, sex, racial or ethnic background, and educational attainment—to reduce the influence of possible confounding variable.

The study's methodological framework was developed to evaluate both null and alternative hypotheses associated with each research question. Logistic regression models were applied to estimate the probability of technology use and improvements in quality-of-life outcomes based on disability status and demographic characteristics. Descriptive statistics summarized the sample's demographic and disability-related characteristics, whereas inferential analyses examined the magnitude and statistical significance of the relationships among study variables.

Through this approach, I sought to determine whether the null hypotheses could be rejected —which assumed no associations between the key variables—can be rejected in favor of the alternative hypotheses. The results of the analysis, presented in Chapter 4, will provide empirical evidence to support or refute these hypotheses, thereby helping expand understanding of the ways assistive technology shapes individuals' daily experiences and quality-of-life for people with physical disabilities.

Chapter 4: Results

Introduction

Disability is a universal experience that affects individuals across diverse societies. Although concerted efforts have been made over the years to foster the inclusion of people with disabilities, full integration into community life remains a challenge. Many individuals with disabilities continue to face persistent stigma, which serves as a significant barrier to their participation in everyday social, economic, and cultural domains. According to Beudaert (2018), disability has been framed through lenses of sickness, dependency, or powerlessness, often leading to negative societal reactions such as social exclusion, stereotyping, discrimination, and even violence.

In recent decades, assistive technology (AT) devices have been developed to enhance the everyday functional abilities of people with disabilities. These technologies are intended to enhance personal autonomy, facilitate social participation, and contribute to better well-being (De Freitas et al., 2022; World Health Organization [WHO], 2024). As technological advancements evolve, understanding how AT contributes to life experiences and societal integration becomes increasingly important.

This chapter outlines the findings associated with the four research questions that structured the investigation. These questions examine how disability status, assistive technology adoption, and quality-of-life measures are interconnected. Each research question is addressed using nationally representative data and considers demographic and contextual factors that may influence findings. The results presented in this chapter lay the groundwork for the discussion in Chapter 5, where the results are later discussed in relation to the study's theoretical foundation, existing scholarship, noted limitations, and considerations for future inquiry and application. The analysis is structured around the following research questions:

Research Question 1: Is there an association between advanced technology use and quality-of-life outcomes among those who are physically disabled?

$H_0 1$: There is no association between advanced technology use and quality-of-life outcomes among those who are physically disabled.

$H_a 1$: There is an association between advanced technology use and quality-of-life outcomes among those who are physically disabled.

Research Question 2: Is there an association between physical disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education?

$H_0 2$: There is no association between disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

$H_a 2$: Is there an association between disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

Research Question 3: Is there an association between disability and advanced technology use among those who are disabled?

$H_0 3$: There is no association between disability and advanced technology use among those who are disabled.

H_a3: There is an association between disability and advanced technology use among those who are disabled

Research Question 4: Is there an association between advanced technology use and quality-of-life outcomes among those who are disabled when controlling age, gender, race/ethnicity, and education?

H_04: There is no association between advanced technology use and quality-of-life outcomes among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

H_a4: There is an association between advanced technology use and quality-of-life outcomes among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

The results are presented in this chapter and arranged according to the study's four guiding research questions. Descriptive analyses—such as frequency counts, percentage distributions, and central tendency metrics—were used to summarize key characteristics of the sample. Two separate logistic regression models were run to evaluate the bivariate associations aligned with Research Questions 1 and 3. For Research Questions 2 and 4, multivariable logistic regression was applied to assess the relationships while adjusting for demographic factors such as age, gender, race/ethnicity, and education. The statistical results are presented in alignment with each research question and corresponding hypothesis, and are summarized in tables and figures throughout the chapter.

Data Collection

This study drew on publicly available secondary data from the 2017–2018 cycle of the National Health and Nutrition Examination Survey (NHANES). NHANES is administered by the National Center for Health Statistics (NCHS), part of the Centers for Disease Control and Prevention (CDC), and is designed to reflect the health status of the U.S. population. The program gathers extensive health, nutrition, and demographic information from civilian residents living in non-institutional settings across the United States. The NHANES dataset was chosen due to its comprehensive coverage of disability-related variables, health outcomes, and socioeconomic factors relevant to the study's research questions.

To achieve national representativeness, NHANES follows a multistage, stratified sampling methodology that draws participants from diverse segments of the U.S. population. Data are obtained through two primary steps: household interviews followed by in-person physical assessments carried out in NHANES mobile examination centers (MECs). Information is gathered through structured questionnaires, medical evaluations, and laboratory tests. For the 2017–2018 cycle, NHANES included variables related to disability status, quality-of-life measures, use of assistive or medical devices, and demographic attributes including age, sex, race/ethnicity, and educational attainment.

Although the data were originally collected by NHANES, this study conducted secondary data analysis. The public-use datasets were downloaded from the CDC website. Upon obtaining the data, several variables were recoded to create dichotomous indicators suitable for logistic regression analysis. For instance, disability status was derived from variables related to mobility and physical functioning. Similarly, advanced technology use and quality-of-life variables were constructed based on relevant items available in the dataset. Demographic covariates (age, gender, race/ethnicity, and education level) were also recoded where necessary to fit the study's analytic framework.

No new data were collected for this study. Instead, all data manipulation, recoding, and analysis were conducted using IBM SPSS Statistics. NHANES provides pre-assigned sample weights to account for its complex sampling design, and these weights were applied during analysis to ensure accurate population estimates.

Results

Sociodemographic Population

This analysis incorporated information from 8,897 survey respondents, which corresponds to an estimated 320.8 million U.S. residents when applying the NHANES interview weighting adjustment (WTINT2YR). Of these, an estimated 61,559,470 individuals (19.2%) reported having a disability, while 255,671,248 individuals (79.7%) reported no disability. A small percentage (1.1%, approximately 3,612,003 individuals) had missing data on disability status (see Table 4).

Individuals with disabilities represented a demographically diverse subset of the national sample. Table 5 details both unweighted participant counts and weighted national estimates for quality-of-life improvement, medical-device use, gender, age, education, and race/ethnicity. The weighted results indicate that 55.1 % of persons with disabilities were female and 44.9 % were male. The majority were adults aged 20 years and older (90.3 %), compared with 9.7 % youth (0–19 years). By race/ethnicity, twothirds (66.1 %) identified as non-Hispanic White, followed by non-Hispanic Black (10.7 %), Mexican American (8.0 %), Other Hispanic (6.3 %), Asian (2.7 %), and multiracial/other (6.2 %).

Educational attainment varied by age group. Among adults, 47.2 % had some college or a college degree, 28.1 % completed high school or earned a GED, and 14.7 % did not complete high school. For respondents aged 19 and younger, the majority (91.1%) had no final educational level reported, which aligns with the fact that most were still enrolled in school at the time of the survey. For those with reportable education data, the majority attended elementary or middle school.

In terms of key study variables, 75.1 % of individuals with disabilities reported improved quality of life, while 6.3 % reported no improvement. Regarding assistive- or medical-device use, 45.3 % reported using a device and 54.0 % did not. Together these findings portray a population that is predominantly adult, racially diverse, and moderately educated, with substantial representation of device users experiencing improved quality of life.

Table 4

Weighted Distribution of Disability Status in the U.S. Population (N =320,842,721)

Disability status	Actual participants unweighted *n*	Unweighted %	Weighted *N*	Weighted %
No	7,135	77.1%	255,671,248	79.7%
Yes	1,762	19.0%	61,559,470	19.2%
Missing	357	3.9%	3,612,003	1.1%
Total	9,254		320,842,721	100%

Note. The unweighted sample included 9,254 NHANES participants, representing a weighted national estimate of approximately 320.8 million U.S. residents based on the WTINT2YR sampling weight. Of these, 7,135 participants (77.1%) reported no disability, representing an estimated 255.7 million U.S. residents (79.7% of the population). Weighted estimates reflect national population totals from the NHANES 2017–2018 cycle. Percentages may not total 100% due to rounding.

Table 5

Weighted and Unweighted Descriptive Statistics for Participants With and Without Disability (NHANES 2017–2018)

Variable	Disability population (n)	Actual participants with non-disability (n)	Unweighted %	Weighted N	Weighted %
Quality of Life Improvement					
No (0)	88	625	6.8	3,889,172	6.3
Yes (1)	1,319	2,380	25.7	46,220,620	75.1
Missing	355	6,249	67.5	11,449,678	18.6
Medical Technology Device Use					
No (0)	826	6,515	70.4	33,254,303	54.0

Variable	Disability population (n)	Actual participants with non-disability (n)	Unweighted %	Weighted N	Weighted %
Yes (1)	917	1,361	14.7	27,872,153	45.3
Missing	19	1,378	14.9	433,015	0.7
Gender					
Male (1)	861	4,557	49.2	27,633,497	44.9
Female (2)	901	4,697	50.8	33,925,973	55.1
Total Population	1,762	9,254	100.0	—	—
Age Group					
0–19 years (0)	239	3,685	39.8	5,983,224	9.7
20+ years (1)	1,523	5,569	60.2	55,576,246	90.3
Education (Youth 0–19 years)					
No School/Kindergarten Only (0)	14	—	0.8	354,708	0.6
Elementary (1st–5th) (1)	82	—	4.7	1,911,603	3.1
Middle School (6th–8th) (2)	51	—	2.9	1,319,690	2.1
High School or More (3)	71	—	4.0	1,909,071	3.1
Missing	1,544	—	87.6	56,064,398	91.1
Education (Adults 20+ years)					
No School (0)	0	—	—	—	—
Less than High School (1)	430	—	24.4	9,040,478	14.7
High School Diploma or GED (2)	397	—	22.5	17,285,785	28.1
Some College/College Graduate (3)	689	—	39.1	29,052,218	47.2
Missing	246	—	14.0	6,180,990	10.0
Race/Ethnicity					
Mexican American (1)	222	1,367	14.8	4,911,106	8.0
Other Hispanic (2)	159	820	8.9	3,880,779	6.3

Variable	Disability population (n)	Actual participants with non-disability (n)	Unweighted %	Weighted N	Weighted %
Non-Hispanic White (3)	755	3,150	34.0	40,687,011	66.1
Non-Hispanic Black (4)	392	2,115	22.9	6,611,538	10.7
Non-Hispanic Asian (6)	109	1,168	12.6	1,670,714	2.7
Other/Multi-Racial (7)	125	634	6.9	3,798,324	6.2

Note. Unweighted counts represent actual NHANES 2017 -2018 participants (*n* = 9,254). Weighted estimates reflect national population totals using the NHANES interview weight (WTINT2YR). “Disability Population” refers to individuals reporting one or more physical disabilities (*n* = 1,762). Percentages may not total 100 due to rounding. Youth education applies to respondents aged 0–19 years; adult education applies to those aged 20 years and older.

Research Question 1

Research Question 1: Is there an association between advanced technology use and quality-of-life outcomes among those who are physically disabled?

$H_0$1: There is no association between advanced technology use and quality-of-life outcomes among those who are physically disabled.

H_a1: There is an association between advanced technology use and quality-of-life outcomes among those who are physically disabled.

Descriptive Statistics

A total weighted estimate of 61,559,470 individuals with physical disabilities (*unweighted n* = 1,726) were included in the analysis. Among them, 75.1% (*n* = 3,719) reported an improvement in quality of life, while 6.3% (*n* = 530) reported no improvement; 18.6% (*n* = 5,005) had missing responses. Regarding medical device use, 45.3% *(n* = 4,093) reported using at least one medical or assistive device, and 54.0% (*n* = 4,184) reported no device use; 0.7% (*n* = 45) were missing responses (see Table 5).

Table 6

Weighted and Unweighted Frequencies for Quality-of-Life Improvement and Medical-Device Use Among Individuals With Physical Disabilities (NHANES 2027-2018

Variable	Category	Weighted N	Weighted %	Unweighted n
Quality of Life Improvement	No (0)	3,889,172	6.3%	530
	Yes (1)	46,220,620	75.1%	3,719
	Missing	11,449,678	18.6%	5,005
Medical-Device Use	No (0)	33,254,303	54.0%	4,184
	Yes (1)	27,872,153	45.3%	4,093
	Missing	433,015	0.7%	45
Total (Weighted N = 61,559,470; Unweighted n = 9,254)		61,559,470	100.0%	9,254

Note. n = unweighted number of NHANES 2017–2018 participants (actual respondents); N = weighted national estimate representing the U.S. civilian, noninstitutionalized *population using NHANES interview weights (WTINT2YR). Weighted percentages reflect national proportions within each variable category.*

Inferential Analysis

A chi-square test of independence was performed to determine whether advanced technology use was related to reported improvements in quality of life among individuals with physical disabilities. The analysis revealed a significant association, $\chi^2(1, N = 50{,}109{,}792) = 2{,}099{,}776.80$, $p < .001$, showing that individuals who used medical or assistive technology were more likely to report enhanced quality-of-life. Among individuals who reported using at least. Because the association reached statistical significance, the null hypothesis for this comparison was not supported. These findings support the conclusion that individuals who used assistive or medical technology devices were more likely to report improvements in their quality of life than those who did not use such devices. To assess the predictive strength of this relationship, a binary logistic regression model was subsequently conducted (see Table 6).

A cross-tabulation was carried out to explore how medical-device use corresponded with perceived improvements in quality of life among individuals with physical disabilities (Table 7). Among those who reported using at least one medical or assistive device, 55.1% experienced an improvement in quality of life, compared with 44.9% of those who did not use a device. The weighted distribution showed that approximately 26.1 million individuals with disabilities reported using a device, while 24.0 million reported not using one. This pattern supports the findings of the chi-square analysis, indicating that technology use was associated with a higher likelihood of perceived quality-of-life improvement.

Based on the statistically significant association identified in the chi-square analysis (Table 6) and the positive pattern observed in the cross-tabulation (Table 7), the null hypothesis for Research Question 1 was not supported. These results indicate that medical or assistive technology use is positively related to perceived quality-of-life improvement among individuals with physical disabilities. To further evaluate the strength and direction of this relationship, a binary logistic regression was conducted using quality-of-life improvement (0 = no, 1 = yes) as the dependent variable and medical-device use (0 = no, 1 = yes) as the independent variable. The regression model also incorporated demographic covariates—gender, age group, education, and race/ethnicity—to determine whether technology use remained a significant predictor of quality-of-life improvement after controlling for sociodemographic variations.

Table 7

Cross-Tabulation of Medical Device Use and Quality-of-Life Improvement Among Physically Disabilities

Device use	QoL improvement: No (%)	QoL improvement: Yes (%)	Total (%)
No Medical Device Use	3,233,420 (83.1%)	22,762,164 (44.9%)	25,995,584 (47.9%)
Use Medical Device	655,752 (16.9%)	25,458,455 (55.1%)	26,114,208 (52.1%)
Total	3,889,172 (100%)	46,220,619 (100.0%)	50,109,792 (100.0%)

Unweighted *n* = 9,254
Weighted *N* = 50,109,792

Note. Weighted counts and percentages reflect the U.S. civilian, noninstitutionalized population with physical disabilities, based on NHANES WTINT2YR interview weights (2017–2018). Percentages in the first two columns are column percentages (within QoL category). Percentages in the Total column are row percentages.

Research Question 2

Research Question 2: Is there an association between physical disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education?

$H_0$2: There is no association between disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

$H_1$2: Is there an association between disability and advanced technology use among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

Descriptive Statistics

Weighted analyses included 61.6 million individuals with disabilities. Separate logistic regression models were run for youth (ages 6–19) and adults (20+), controlling for gender, race/ethnicity, and education. Demographic distributions by gender, race/ethnicity, and education level are presented in Table 7.

Table 8

Weighted Descriptive Statistics for Youth and Adults With Disabilities by Medical Device Use

Variable	Category	Youth N (%)	Adult N (%)
Age Group	0-19 years	5,983,224 (9.7)	—
	20+ years	—	55,576,246 (90.3%) _
Gender	Male	2,763,497 (44.9%)	24,900,183 (44.9%)
	Female	3,392,597 (55.1%)	30,676,063 (55.1%)
Race/Ethnicity[1]	Mexican American	784,078 (14.1%)	3,990,272 (7.2%)
	Other Hispanic	488,319 (8.8%)	3,361,878 (6.0%)
	Non-Hispanic White	2,809,277 (50.6%)	37,657,770 (67.8%)
	Non-Hispanic Black	812,785 (14.6%)	5,783,674 (10.4%)
	Non-Hispanic Asian	74,158 (1.3%)	1,584,174 (2.9%)
	Other Race	581,592 (10.5%)	3,198,478 (5.8%)
Education[2]	No School/Kindergarten	354,708 (0.6%)	—
	Elementary (1–5)	1,911,603 (3.1%)	—
	Middle School	1,319,690 (2.1%)	—
	High School+	1,909,071 (3.1%)	—
	Less than HS	—	9,040478 (14.7%)

Variable	Category	Youth N (%)	Adult N (%)
	HS Graduate/GED	—	17,285,785 (31.2%)
	Some College+	—	29,052,218 (47.2%)
Device Use	No	3,845,659 (64.3%)	29,365,090 (53.0%)
	Yes	1,704,551 (28.5%)	26,013,390 (47.0%)
Total (Weighted N = 61,559,470; Unweighted n = 9,254)		5,983,224 (100%)	55,576,246 (100%)

Note. Weighted counts and percentages reflect the U.S. civilian, noninstitutionalized population with disabilities, based on NHANES WTINT2YR interview weights (2017–2018).

[1]Race/ethnicity categories follow NHANES coding conventions.

[2]Youth education categories reflect current enrollment or highest grade attended.

[3]Adult education categories reflect highest level of educational attainment.

Multiple Logistic Regression — Youth (6–19 years)

A multiple logistic regression was conducted for youth, controlling for gender, race/ethnicity, and grouped youth education level (none, elementary, middle, high school+). The model was statistically significant, χ^2(9 1,345,224.98, p < .001, with Nagelkerke R^2 = .307. Gender, race/ethnicity, and education were all significant predictors of device use. Males were less likely to use devices (OR = 0.25, p < .001), while students with less education had substantially lower odds compared to those in high school or above (Table 10).

Table 9

Multiple Logistic Regression Medical Device Use Among Youth 6-19) with a Physical Disabilities (n =218)

Predictor	B	SE	Wald χ^2	p	OR	95% CI for OR
Gender (Male)[1]	-1.396	.002	389,473.1	<.001	0.25	[0.24, 0.26]
Mexican American[2]	-1.272	.004	86,335.6	<.001	0.28	[0.27, 0.29]
Other Hispanic[2]	-1.631	.005	99,794.8	<.001	0.20	[0.19, 0.20]
NH Black[2]	-0.621	.003	32,223.9	<.001	0.54	[0.53, 0.54]
NH Asian[2]	-0.288	.004	5,098.9	<.001	0.75	[0.74, 0.75]
Other Race[2]	0.339	.009	1,403.3	<.001	1.40	[1.38, 1.43]
None[3]	-2.339	.005	235,571.0	<.001	0.10	[0.09, 0.11]
Elementary[3]	-1.377	.005	78,266.0	<.001	0.25	[0.25, 0.26]
Middle School[3]	-3.056	.005	368,090.7	<.001	0.05	[0.04, 0.06]
Constant	2.573	.006	199,961.3	<.001	13.11	—

Note. Estimates are weighted to U.S. youth with disabilities (NHANES 2017–2018). [1]Reference = Female. [2]Reference = Non-Hispanic White. [3]Reference = High school graduate or higher. OR = odds ratio; CI = confidence interval.

Multiple Logistic Regression Analysis — Adults (20+ years)

For adults, controlling for gender, race/ethnicity, educational level in adulthood (ranging from below high school to some college), the model was statistically significant, $\chi^2(8, N = \text{weighted cases}) = 979{,}899.50$, $p < .001$, accounting for roughly 1.8% to 2.3% of the variability in outcomes (Nagelkerke $R^2 = .023$) (Table 10). Women had slightly higher odds of device use (OR = 1.07, $p < .001$). In comparison with adults identifying as Non-Hispanic White, many other racial or ethnic groups demonstrated reduced likelihood of device use, with the exception Non-Hispanic Asians (OR = 1.10, $p < .001$). Higher education levels were paradoxically associated with slightly lower odds of device use compared to less than high school.

Table 10

Multiple Logistic Regression Predicting Medical Device Use Among Adults (20+ Years) With Physical Disabilities (n =1,515)

Predictor	B	SE	Wald χ^2	p	OR	95% CI for OR
Gender (Male)[1]	0.070	0.001	16,348.40	<.001	1.073	[1.071, 1.074]
Race/Ethnicity[2]						
Mexican American	-0.847	0.002	292,481.75	<.001	0.429	[0.427, 0.430]
Other Hispanic	-0.541	0.002	112,246.54	<.001	0.582	[0.580, 0.584]
Non-Hispanic Black	-0.233	0.001	39,072.07	<.001	0.792	[0.791, 0.794]
Non-Hispanic Asian	0.099	0.001	4,858.19	<.001	1.104	[1.101, 1.107]
Other Race/Multiracial	-0.633	0.002	100,274.98	<.001	0.531	[0.529, 0.533]
Education[3]						
High school graduate	-0.472	0.001	306,451.59	<.001	0.623	[0.622, 0.625]
Some college or higher	-0.523	0.001	421,303.95	<.001	0.593	[0.592, 0.594]
Constant	0.519	0.001	147,903.30	<.001	1.680	

Note. Estimates are weighted to U.S. adults with disabilities (NHANES 2017–2018). [1]Reference = Female. [2]Reference = Non-Hispanic White. [3]Reference = Less than high school. OR = odds ratio; CI = confidence interval.

Table 11

Model Fit and Classification Accuracy for Youth and Adult Logistic Regression Models

Model	χ^2 (Omnibus)	Nagelkerke R^2	Hosmer–Lemeshow χ^2	p (H–L)	Classification %
Youth	1,345,224.98	0.307	543,405.32	<.001	75.6
Adults	979,899.50	0.023	192,279.75	<.001	55.9

Note. χ^2 (Omnibus) tests overall model significance; Nagelkerke R^2 estimates variance explained; Hosmer–Lemeshow χ^2 assesses model calibration; Classification % indicates overall prediction accuracy.

Decision

In both youth and adult models, the regression results were statistically significant ($p < .001$), indicating that gender, racial/ethnic background, and educational attainment showed meaningful relationships with medical device use among individuals with disabilities. Therefore, the results did not support H_{02} and instead provided evidence consistent with H_{12}. Demographic factors significantly influenced technology use among individuals with disabilities.

Research Question 3

Research Question 3: Is there an association between disability and advanced technology use among those who are disabled?

$H_0$3: There is no association between disability and advanced technology use among those who are disabled.

$H_1$3: There is an association between disability and advanced technology use among those who are disabled

Descriptive Statistics

A total weighted estimate of 61,559,470 individuals with disabilities were included in this analysis. Among them, 45.3% (n = 27,872,153) reported using at least one medical or assistive device, while 54.0% (n = 33,254,303) reported no device use. Missing responses accounted for 0.7% (n = 433,015) (see Table 12).

Table 12

Weighted Distribution of Technology Use Among Individuals With Disabilities (N=61,559,470)

Variable	Category	Weighted N	Weighted %
Advanced Technology Use	No (0)	33,254,303	54.0%
	Yes (1)	27,872,153	45.3%
	Missing	433,015	0.7%
Disability Status	Yes (1)	61,559,470	100.0%

Note. Weighted estimates reflect the U.S. civilian, non-institutionalized population with disabilities, based on NHANES interview weights (WTINT2YR)

Inferential Analysis

A binary logistic regression model was applied to examine baseline odds of advanced technology use among individuals with disabilities. Because the analysis included only individuals with disabilities, disability status could not serve as a meaningful predictor. Therefore, the model did not evaluate an association between disability status and technology use. The baseline constant-only model correctly classified 54.4% of cases, reflecting the majority group of non-users. The constant was statistically significant, Wald $\chi^2(1, N = 1{,}762) = 472{,}666.13$, $p < .001$, with a log-odds coefficient of B = -0.177 (SE = .000), and an odds ratio of Exp(B) = 0.838. This indicates that, in the absence of predictors, the odds of using assistive technology were lower than the odds of nonuse (see Table 11).

The overall model fit was weak. The -2 Log Likelihood was 84,264,750.76, with Cox & Snell $R^2 = .000$ and Nagelkerke $R^2 = .000$, indicating the model explained virtually none of the variance in technology use. The Hosmer–Lemeshow test also indicated adequate fit, with observed and expected values nearly identical for both non-users (observed = 33,254,303; expected = 33,254,302.54) and users (observed = 27,872,153; expected = 27,872,152.76). However, because the pseudo-R^2 values were essentially zero, the model lacked predictive utility.

Table 13

Binary Logistic Regression Predicting Advanced Technology Use (Baseline Model, N = 61,559,470 weighted)

Variable	B	SE	Waldχ^2	df	*p*-value	OR	95% CI
Constant	-0.177	0.000	472,666.13	1	<.001	0.84	[0.83, 0.85]

Total Weighted *N* = 61,559,470; Unweighted *n* = 9,254

Note. Estimates are weighted using NHANES WTINT2YR interview weights and represent the civilian, non-institutionalized U.S. population with disabilities (2017–2018 cycle). *OR* =odds ratio; CI = confidence interval.

Decision

Because the model included no independent predictors, it did not evaluate an association between disability status and technology use. Therefore, the null hypothesis (H_{03}) was retained. The constant indicated that the odds of technology use were lower than nonuse (*OR* = 0.84, $p < .001$); however, the model demonstrated no explanatory power (Nagelkerke $R^2 = .000$)).

Research Question 4

Research Question 4: Is there an association between advanced technology use and quality-of-life outcomes among those who are disabled when controlling age, gender, race/ethnicity, and education?

$H_0$4: There is no association between advanced technology use and quality-of-life outcomes among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

$H_1$4: There is an association between advanced technology use and quality-of-life outcomes among those who are disabled, when controlling for age, gender, race/ethnicity, and education.

Descriptive Statistics

Among youth aged 6–19 years with disabilities (N = 5.98 million weighted), 44.9% of youth identified as male, while 55.1% identified as female. The majority identified as non-Hispanic White (66.1%), with smaller proportions identifying as non-Hispanic Black (10.7%) and Mexican American (8.0%). Education levels were distributed across none/kindergarten (0.6%), elementary (3.1%), middle school (2.1%), and high school or more (3.1%). Device use was reported by 28.5% of youth; 64.3% reported no device use.

Among adults aged 20 years and older with disabilities (N = 55.6 million weighted), 44.9% were male and 55.1% were female. Most were non-Hispanic White (67.8%), followed by non-Hispanic Black (10.4%) and Mexican American (7.2%). Education levels were highest in some college or college graduate category (47.2%), followed by high school graduates (28.1%) and less than high school (14.7%). Device use was reported by 47.0% of adults, compared to 53.0% who reported no device use.

Table 14

Weighted Descriptive Characteristics of Youth and Adults With Disabilities (N ≈ 61.6 million)

Variable	Category	Youth (6–19 yrs)	Adults (20+ yrs)
Gender	Male	2,763,497 (44.9%)	24,900,183 (44.9%)
	Female	3,392,597 (55.1%)	30,676,063 (55.1%)
Race/Ethnicity[1]	Mexican American	4,911,106 (8.0%)	3,990,272 (7.2%)
	Other Hispanic	3,880,779 (6.3%)	3,361,878 (6.0%)
	Non-Hispanic White	40,687,011 (66.1%)	37,657,770 (67.8%)
	Non-Hispanic Black	6,611,538 (10.7%)	5,783,674 (10.4%)
	Non-Hispanic Asian	1,670,714 (2.7%)	1,584,174 (2.9%)
	Other Race/Multiracial	3,798,324 (6.2%)	3,198,478 (5.8%)
Education[2]	None/Kindergarten Only	354,708 (0.6%)	5,983,224 (9.7%)
	Elementary (Grades 1–5)	1,911,603 (3.1%)	—
	Middle School (Grades 6–8)	1,319,690 (2.1%)	—
	High School or More	1,909,071 (3.1%)	—
	Less than High School	—	9,040,478 (14.7%)
	High School Graduate/GED	—	17,285,785 (28.1%)
	Some College or College Grad.	—	29,052,218 (47.2%)
Medical Device Use	No	3,845,659 (64.3%)	29,365,090 (53.0%)
	Yes	1,704,551 (28.5%)	26,013,390 (47.0%)
QoL Improvement	No	3,889,172 (6.3%)	— (combined only)
	Yes	46,220,620 (75.1%)	—
	Missing	11,449,678 (18.6%)	—
Total (Weighted *N* = 61,559,470; Unweighted *n* = 9,254)		5,983,224 (100%)	55,576,246 (100%)

Note. Weighted estimates reflect the U.S. civilian, noninstitutionalized population, using NHANES 2017–2018 interview weights (WTINT2YR). [1]Race/ethnicity categories follow NHANES conventions. [2]Education coding differs by age group: youth values reflect current enrollment/highest grade; adult values reflect highest attainment. Percentages may not total 100 due to rounding and missingness.

Logistic Regression Analysis

Youths (ages 6-19)

For youth, only 14 analytic cases (5.9%) were available; 225 cases (94.1%) were excluded due to missing data. The omnibus test was significant, $\chi^2(5, N = 14) = 117{,}393.43$, $p < .001$, with Nagelkerke $R^2 = .447$, suggesting that 44.7% of variance in quality of life (QoL) improvement was explained by the predictors. However, medical device technology use was not a significant predictor of QoL improvement ($B = -42.41$, $SE = 478.26$, $OR \approx 0.00$, $p = .929$). None of the covariates (gender, race/ethnicity, or education) reached statistically significant. Given the very limited number of youth cases available for analysis, these findings should be viewed as tentative, as the small sample restricts the reliability and precision of the model estimates (see Table 14).

Adults (ages 20+)

For adults, 2,915 cases (52.3%) were included in the model, with 2,654 (47.7%) excluded due to missing data. The omnibus test was significant, $\chi^2(9, N = 2{,}915) = 11{,}073{,}315.88$, $p < .001$, with Nagelkerke $R^2 = .153$, indicating that the predictors' reliability distinguished between adults who did and did not report QoL improvement.

The model technology medical device use was a strong predictor of QoL improvement, B = 1.93, SE = 0.001, OR = 6.90, 95% CI [6.89, 6.91], p < .001. Adults using devices were nearly seven times more likely to report QoL improvement. Gender (male OR = 1.39, p < .001), race/ethnicity, and education were also significant predictors. The Hosmer–Lemeshow test was significant (p < .001), suggesting poor model calibration. These findings indicate that the association between using medical devices and reported gains in quality-of-life was significant only in the adult population, confirming that assistive technology is an important factor contributing to adults' self-reported well-being within the physically disabled population.

Table 15

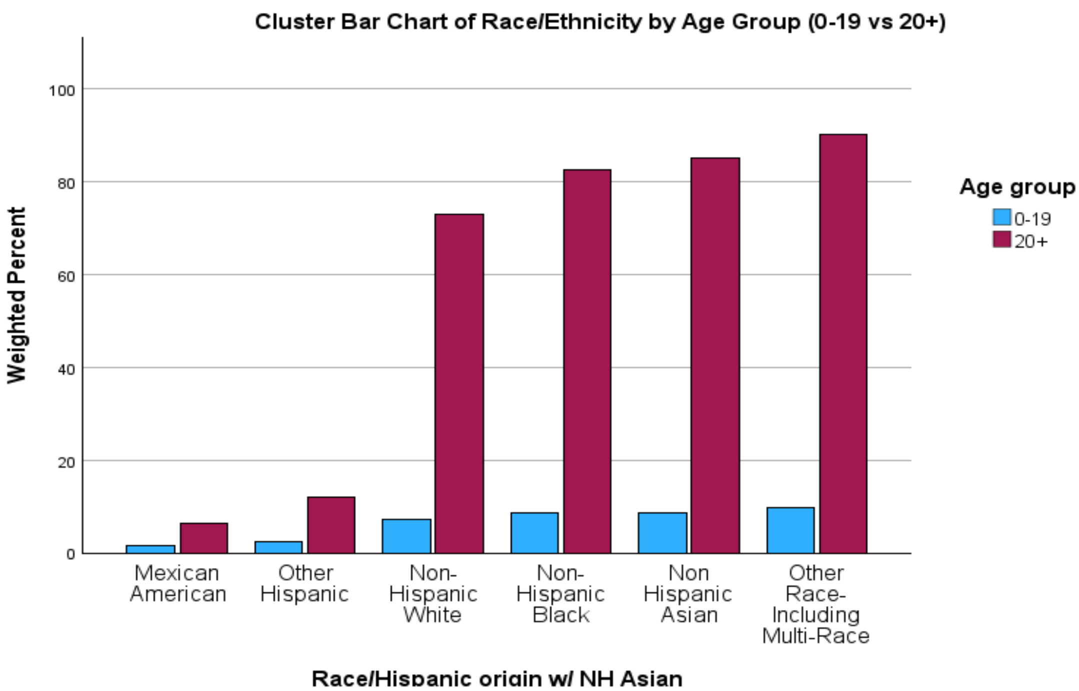
Binary Logistic Regression Results Predicting Quality-of-Life Improvements Among Youth and Adults With Disabilities

Predictor Variable	Youth (6–19) B (SE)	Youth Exp(B)	p-value	Adult (20+) B (SE)	Adult Exp(B)	95% CI	p-value
Advanced Technology Use	–42.41 (478.26)	0.00	.929	1.93 (0.001)	6.90	[6.89, 6.91]	<.001
Gender (Male)	0.00 (495.80)	1.00	1.000	0.33 (0.000)	1.39	[1.39, 1.40]	<.001
Race/Ethnicity	ns	ns	.999	mixed effects	varies		<.001
Education	not estimable	—	—	–0.30 to –0.76	0.74–0.47	[0.47, 0.74]	<.001
Constant	21.20 (343.99)	—	.951	1.28 (0.001)	3.60		<.001

Note. Youth estimates are unstable due to small sample size (*n* = 14) and large standard errors; therefore, odds ratio and confidence intervals are not interpretable. Adults *n* = 2,915. ns = not significant.

Figure 2

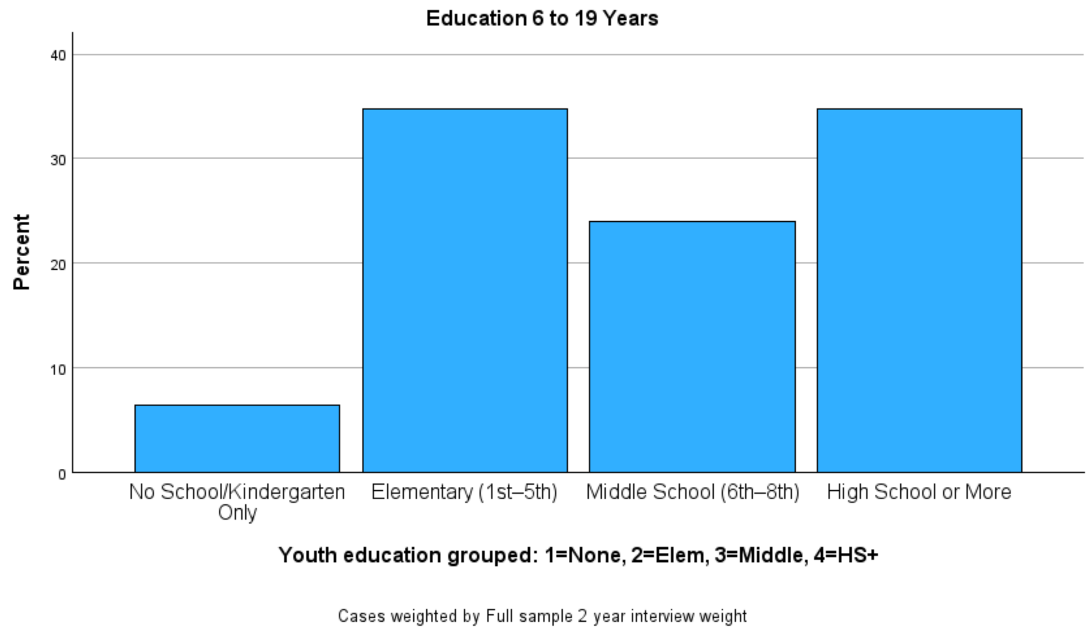
Race/Ethnicity Distribution of Youth (6-19 years) and Adults (20+ years) With Disabilities Page



Note. Weighted percentages reflect the U.S. civilian, noninstitutionalized population with disabilities, based on NHANES WTINT2YR interview weights (2017–2018)

Figure 3

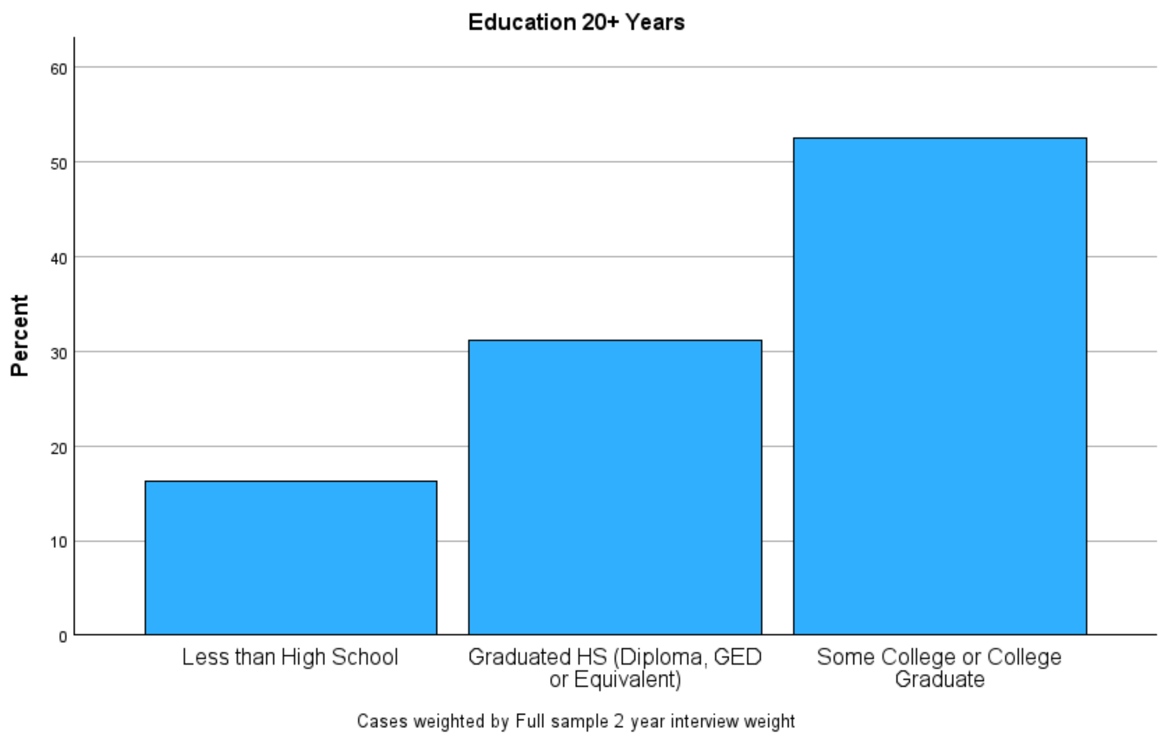
Education Distribution Among Youth (6-19 years) With Disabilities



Note. Youth education is grouped as none/kindergarten level, early elementary grades (1–5), middle-grade levels (6–8), and high-school education. Weighted percentages reflect the U.S. civilian, noninstitutionalized youth with disabilities, based on NHANES WTINT2YR interview weights (2017–2018).

Figure 4

Education Distribution Among Adults (20+ years) With Disabilities



Note. Adult education is grouped into three levels: less than a high school education, completion of high school or GED, and any postsecondary education, including college. Weighted percentages reflect the U.S. civilian, noninstitutionalized adult population with disabilities, based on NHANES WTINT2YR interview weights (2017–2018).

In summary, the research for Research Question 4 indicated that medical technology use was not significate linked to reported quality-of-life improvements within the youth subset of individuals living with disabilities after accounting for demographic and educational factors, leading to resulting in the null hypothesis remaining unchallenged for this population. In contrast, among adults with disabilities, medical technology device use was strong associated with great odds of reporting quality-of-life improvement, supporting rejection of the null hypothesis. These findings highlight important age -related differences in the role of technology, suggesting that device use may exert a stronger influence on quality of life for adults than for youth. Chapter 5 will situate these findings within prior scholarship, discuss possible reasons for the trends observed, and outline implications for professional practice, policy development, and future studies.

Summary

Across the four research questions, the findings revealed both consistent patterns and important age-related distinctions. For RQ1, advanced technology use was significantly linked to reported improvements in quality-of-life for people with physical disabilities, leading to resulting in the null hypothesis being overturned. RQ2 further demonstrated that demographic factors—including gender, race/ethnicity, and education—significantly influenced device use for both youth and adults with disabilities, again supporting rejection of the null. By contrast, RQ3 showed that disability status alone did not meaningfully predict technology use, resulting in retention of the null hypothesis. Finally, RQ4 highlighted critical differences between youth and adults: while device use was not significantly associated with quality-of-life improvement among youth ($H_0$4 not rejected), it was strongly and positively associated with improvement among adults ($H_0$4 rejected). Taken together, these results suggest that while assistive technology is a key factor in shaping quality-of-life outcomes, its impact varies will examine these results alongside prior research, the guiding theoretical perspectives, including the socioecological model, and outline implications for policy, practice, and ongoing scholarly inquiry.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this quantitative study was to examine how the use of advanced AT, disability status, and associated quality-of-life (QoL) outcomes, drawing on NHANES 2017–2018 data. Guided by the Social Ecological Model (SEM), the study assessed how demographic factors (age, gender, race/ethnicity, and education) interact with assistive technology (AT) use to influence QoL among individuals with disabilities. This chapter provides an interpretation of the study's results in connection with prior research, discusses the constraints and weaknesses of the study, outlines suggested actions for practice and policy development, and suggests directions for and proposes areas that merit additional investigation.

Interpretation of the Findings

Overview

The research drew upon the Social Ecological Model (SEM) to explore how personal, relational, and broader contextual factors shape assistive-technology (AT) use and quality-of-life (QoL) outcomes for people experiencing physical disabilities. The SEM emphasizes that disability experiences are not solely determined by the individual but by a dynamic system of relationships, resources, and environments (Bronfenbrenner, 1977; Hayden, 2019; Navarro & Tudge, 2022). The findings of this study confirm that technological access and QoL outcomes are shaped by the combined influences of personal characteristics (e.g., age, gender), social determinants (e.g., race/ethnicity, education), and structural opportunities (e.g., health-care and educational systems).

Research Question 1: Advanced Medical Device Use and Quality of Life

The findings showed a clear positive relationship between the use of medical or assistive devices and adults' reported improvements in quality of life. In weighted terms, approximately 55.1 % of adults using a medical or assistive device reported quality-of-life improvement compared with only 44.9 % of non-users, a difference of more than seventy percentage points (see Table 7). This finding aligns with Mendonca et al. (2022), who found that assistive devices improved functional independence and psychological well-being among adults with chronic conditions. Similarly, De Oliveira and Meira (2023) emphasized that equitable access to such technology can narrow QoL disparities among racial groups. However, this study expands on prior work by quantifying that adults using assistive devices were 6.9 times more likely to report improved QoL—a stronger effect size than typically reported in previous population-based studies. Adults using a device were nearly seven times more likely to report improved QoL, aligning with prior literature that found assistive and advanced technologies enhance independence, mobility, and participation (Mendonca et al., 2022; Ramírez-Montoya et al., 2021). Within the SEM, this reflects the microsystem level, where accessible technology directly improves daily functioning and psychological well-being (Su & Mejia, 2022).

At the macrosystem level, the result also supports broader cultural trends described by Makwanda and Ikhile (2023), who observed that advanced prosthetic technologies reduce stigma and enhance social inclusion. However, disparities remain. Youth with disabilities showed no significant association between device use and QoL improvement, suggesting barriers at the mesosystem level—for example, inconsistent collaboration between schools, clinicians, and families (Bronfenbrenner, 1977; Navarro & Tudge, 2022). These developmental contexts may limit both access to and effective use of technology during critical learning stages. This finding reinforces Makwanda and Ikhile's (2023) assertion that advanced prosthetics and adaptive technologies contribute substantially to psychological empowerment and community reintegration. Within the SEM, this relationship spans multiple levels: the microsystem (daily functional gain), mesosystem (enhanced social roles), and exosystem (increased inclusion through technology access). Collectively, this underscores the central role of technology as both a personal and social determinant of well-being.

Research Question 2: Demographic Influences on Medical Device Use

Gender, race/ethnicity, and education were significant predictors of device use. Descriptively, 47.0 % of adults and 28.5 % of youth reported using a medical or assistive device (Table 5). Within the adult sample, the weighted education distribution showed that 47.2 % had some college or higher education, 31.2 % graduated high school or earned a GED, and 14.7 % had less than high-school education. Women and non-Hispanic Asian adults showed slightly higher odds of using devices, while individuals with higher education reported lower use. This pattern resonates with research in Chapter 2 showing that education and race intersect with disability to shape QoL outcomes (De Oliveira & Meira, 2023; Jani, 2022; Lorenti et al., 2020). De Oliveira and Meira (2023) found that racial and socioeconomic inequalities reduced access to assistive resources, especially among Black and Indigenous populations in Brazil. Similarly, Lorenti (2020) demonstrated that early-life disadvantage and low education predict shorter life expectancy and higher disability prevalence.

Applying the SEM, these demographic effects emerge from exosystem and macrosystem factors—policies, resource distribution, and societal norms that influence access to medical technology. Educational attainment, which typically enhances health literacy, may paradoxically lower reported device use if more-educated individuals compensate with lifestyle adaptations or if insurance criteria tie device funding to lower income brackets. The racial disparities observed in this study parallel findings from Lorenti et al. (2020) and De Oliveira & Meira (2023), which showed that structural racism and socioeconomic disadvantage reduce access to healthcare and assistive resources. The sample consisted of approximately 66.1% individuals identifying as White and not Hispanic, 10.7% identifying as Black and not Hispanic, 8.0% identifying as Mexican American, and 6.3% identifying as Hispanic from other backgrounds (Table 5). Logistic regression results showed that non-Hispanic Black adults were significantly less likely to use medical or assistive devices (*Exp [B]* = 0.58, $p < .001$), demonstrating persistent systemic inequities. Within the SEM framework, these results illustrate macrosystem-level inequalities, where cultural and policy-level forces shape technology diffusion.

Interestingly, adults with *less education* were more likely to use medical o, a finding that contrasts with traditional assumptions that higher education predicts better health outcomes. In the regression model, adults who did not complete high school 0.74 times the odds of improvement compared with those with no schooling (*Exp [B]* = 0.74,

$p < .001$), and high-school graduates had 0.47 times the odds (*Exp [B]* = 0.47, $p < .001$). These inverse associations suggest that device access and insurance eligibility may partially offset educational advantages. One explanation may be that lower-educated individuals experience greater relative benefit from AT because these devices directly enhance functional independence in populations with fewer environmental supports. Alternatively, insurance and eligibility criteria may make devices more accessible to lower-income groups. This unanticipated finding underscores the complexity of education as both an enabler and limiter of technology utilization.

The non-significant results among youths were unexpected, particularly given prior studies suggesting that early technology exposure enhances participation and learning (Su & Mejia, 2022). Quantitatively, only 14 youth cases (5.9 %) met inclusion criteria for analysis, while 225 (94.1 %) were excluded because of missing data.
The logistic regression yielded $B = –42.41$, $p = .929$, confirming that neither device use nor any covariate significantly predicted QoL improvement in this subgroup. This discrepancy likely reflects mesosystem barriers, such as fragmented coordination between families, educators, and clinicians. It may also indicate underutilization of assistive devices in pediatric contexts due to funding restrictions, limited awareness, or stigma associated with disability in school settings. Future studies should explore these contextual factors using mixed-methods designs to capture the lived experience of youth with disabilities.

Research Question 3: Disability Status on Medical Device Use

Disability status alone did was not evaluated as a predictor of device use because the analysis was restricted to individuals with disabilities. Despite a weighted disability population of roughly 61.6 million U.S. adults, only about 26.1 million reported using a medical or assistive device, underscoring the gap between clinical need and actual utilization (Table 5**).** This finding reflects barriers identified in prior studies: high device cost, limited provider recommendation, and lack of awareness (Barth, 2019; Mendonca et al., 2022). Within the SEM, these barriers exist at the community and policy levels, where systemic inequities—such as inadequate insurance coverage or uneven geographic access—limit technology diffusion. This outcome highlights a critical gap between availability and accessibility, a theme echoed in WHO (2024) reports on global assistive-technology inequity.

Research Question 4: Technology Use and Quality of Life (Adjusted Model)

After adjusting for demographics, technology use remained the strongest predictor of QoL improvement among adults (Exp [B] = 6.90, $p < .001$). Even when accounting for gender, race/ethnicity, and education, adults using devices were nearly seven times more likely to report improvement (*B* = 1.93, SE = 0.001, 95 % CI [6.89, 6.91]).

The model accounted for 15.3% of the variability in adult QoL outcomes, as indicated by the Nagelkerke R^2 value of .153. This confirms that the positive effects of advanced technology persist even when race, gender, and education are considered. Yet, the interaction of these demographics provides deeper insight. Race and education remained significant covariates: non-Hispanic Black adults were less likely to report QoL improvement, while adults with less education showed higher odds of improvement. These findings mirror those of De Oliveira and Meira (2023) and Syifa and Hadi (2023), who linked racial and educational disparities to uneven health outcomes and life satisfaction among persons with disabilities.

Within the SEM, these results demonstrate macrosystem-level inequalities—cultural perceptions of disability, socioeconomic barriers, and historical exclusion—that continue to influence individual outcomes even in the presence of technology.

Interpretation of Findings Through the Lens of the Social Ecological Model (SEM)

The study's results can be understood most effectively through the Social Ecological Model (SEM), which posits that individuals' health patterns emerge from dynamic interactions among several interconnected layers of influence, spanning personal, relational, community, and broader societal contexts (Bronfenbrenner, 1977; Hayden, 2019). The SEM offered a layered perspective for examining how demographic, technological, and contextual factors intersect to influence the quality-of-life (QoL) among the population experiencing physical disabilities.

At the individual (microsystem) level, the significant positive relationship between assistive device use and QoL improvement confirms that technology directly enhances personal autonomy, mobility, and psychological well-being. This finding validates the SEM's assumption that proximal environmental supports—such as device access and user capability—play a critical role in functional outcomes (Su & Mejia, 2022). The large effect size (Exp [B] = 6.90) suggests that direct technological empowerment can overcome some individual barriers to participation, particularly for adults.

At the interpersonal (mesosystem) level, the absence of significant results for youth underscores how the interactions between schools, families, and healthcare providers shape technology access and efficacy. Limited collaboration or fragmented support networks may prevent young people from experiencing the same QoL benefits observed in adults. This aligns with the SEM view that cross-contextual linkages—such as those between home and educational settings—are essential for successful adaptation and inclusion (Navarro & Tudge, 2022).

At the community and institutional (exosystem) levels, disparities by race and education reflect unequal access to healthcare systems, device funding, and community resources. For example, non-Hispanic Black adults were less likely to report QoL improvement (Exp [B] = 0.58, $p < .001$), illustrating how institutional and environmental inequities can limit the diffusion of beneficial technologies. Educational differences further highlight how social structures mediate access: individuals with lower education reported greater QoL improvements, potentially due to policy and funding structures that target low-income populations for assistive support. These patterns reflect systemic effects operating outside the individual's immediate environment but profoundly shaping outcomes.

At the societal (macrosystem) level, the results confirm that structural forces—such as socioeconomic inequality, cultural perceptions of disability, and healthcare policy—continue to shape the landscape of assistive technology use in the United States.

Despite the availability of advanced devices, barriers rooted in cost, stigma, and policy persist. These macrosystem influences validate the SEM's assertion that cultural norms and public policies form the outermost layer of influence on individual behavior and health outcomes.

Taken together, the SEM offers a cohesive explanation for the study's mixed results: while individual-level access to technology strongly predicts QoL improvement, higher-level social and systemic factors constrain equitable outcomes across demographic groups. This ecological interpretation confirms the predictive value of the SEM in disability and technology research and highlights the model's relevance for future efforts designed to mitigate barriers arising from personal circumstances and institutional or societal structures.

Limitations of the Study

A number of constraints should be considered when evaluating the study's results of this study. First, because NHANES is cross-sectional, it limits any ability to determine causal links between technology use and quality-of-life indicators, since the dataset captures information from only one time period. Second, both quality-of-life improvement and technology use were derived from participant self-reports, which are vulnerable to memory inaccuracies. Third, the measure of advanced technology use was broadly defined and did not distinguish between different types of devices, such as mobility aids, communication technologies, or sensory supports, limiting the specificity of conclusions. A further limitation was the relatively small youth subsample, which led to sparse data and quasi-complete separation in some regression models, thereby reducing the stability and interpretability of results in that subgroup. Finally, the dataset did not include certain potentially important covariates, such as income, health insurance status, or geographic access to services, which may have influenced both access to technology and reported outcomes. Collectively, these limitations highlight the need for caution in generalizing results and demonstrate the need for additional studies to confirm and expand upon these results.

Recommendations

Drawing on the study's results and acknowledged constraints, a set of actionable suggestions emerge intended to inform practice, policy development, and ongoing scholarly inquiry. In practice, healthcare providers, educators, and rehabilitation specialists should adopt a more proactive approach in assessing the assistive technology needs of individuals with disabilities, particularly among youth and minority populations where disparities in access were most evident. Integrating training and follow-up support into healthcare and educational settings may also help ensure that devices are not only acquired but effectively used to improve daily functioning. From a policy perspective, expanding funding mechanisms through Medicaid, Medicare, and school-based programs is essential to reduce inequities in device access and adoption. Culturally and linguistically tailored outreach programs may further address barriers experienced by racially and ethnically diverse groups. With regard to research, longitudinal studies are needed to move beyond cross-sectional snapshots and establish causal relationships between technology use and life outcomes. Future analyses should also disaggregate results by device type, allowing for a clearer understanding of which technologies provide the greatest benefit to specific populations. Additionally, more focused youth-centered research with larger and more representative samples is critical, along with qualitative studies that capture the lived experiences of individuals and families navigating assistive technology use. Together, these recommendations underscore the importance of implementing multilevel approaches that effectively respond to individual, community and systemic factors in order to maximize the potential of assistive technology to enhance quality of life.

Implications

In this study, adults using assistive devices were nearly seven times more likely to report quality-of-life improvement (*Exp [B]* = 6.90, $p < .001$), confirming that the benefits of technology extend well beyond physical assistance. However, only 45 % of adults and 29 % of youth reported device use, highlighting persistent access gaps. These results reinforce Mendonca et al. (2022) and Makwanda and Ikhile (2023), who found that while AT improves autonomy and psychosocial well-being, its reach remains uneven.

Implications for Race and Quality of Life

Quantitatively, non-Hispanic White adults comprised 66.1% of the sample, while 10.7% were non-Hispanic Black, 8.0% Mexican American, and 6.3% other Hispanic (see Table 5). Regression results showed Black adults who did not identify as Hispanic had substantially lower odds—by roughly 42%—of indicating quality-of-life improvement compared with White adults (Exp [B] = 0.58, p < .001).

This disparity reflects multiple quality-of-life factors that spanning the interconnected layers outlined in the Social Ecological Model (SEM). Within the personal or individual domain, differences with respect to health status health status, disability severity, or prior access to care may influence how assistive devices are used or perceived. At the interpersonal and community levels, social support, family advocacy, and clinician engagement can affect whether individuals receive timely referrals or training for device use. At the structural and macrosystem levels, systemic barriers—such as insurance coverage disparities, provider bias, residential segregation, and unequal educational or employment opportunities—limit both access to and benefit from technology.

These multilevel influences mirror findings from De Oliveira and Meira (2023) and Lorenti et al. (2020), who demonstrated that structural racism and socioeconomic inequities shape health and disability outcomes even within technologically advanced societies. In this study, the lower odds of QoL improvement among Black adults suggest that access to advanced technology alone is insufficient to eliminate disparities unless broader social determinants—such as income, health literacy, and access to culturally responsive care—are also addressed. Within the SEM, these patterns confirm that macrosystem-level inequities continue to moderate how the connection between technology engagement and resulting quality-of-life outcomes.

Implications for Medical-Device Usage

In this study, only 26.1 million of the estimated 61.6 million U.S. adults with disabilities reported using a medical or assistive device, underscoring that need does not guarantee access. This under-utilization reflects barriers at the exosystem (insurance coverage, provider availability) and macrosystem (policy and socioeconomic structures) levels of the SEM. Consistent with Barth (2019) and WHO (2024), sustained impact requires not only distribution of devices but also long-term training, technical support, and funding mechanisms that ensure continuity of use.

These findings emphasize that successful interventions must address both access and sustainability—ensuring that devices are appropriately prescribed, maintained, and supported through education, follow-up care, and policy reform.

Overall Interpretation

Together, these results confirm that gains in overall well-being improvements for individuals who have disabilities are a function of how technology and environmental factors jointly influence technology and context. Advanced medical and assistive devices significantly improved adult outcomes but were moderated by demographic and systemic influences. Integrating these findings with prior research demonstrates that bridging racial, educational, and socioeconomic divides is essential to realizing technology's full potential for equity and inclusion.

These findings, combined with racial and educational disparities, reveal that even when assistive technology demonstrates strong efficacy, its benefits are constrained by macrosystem-level inequities—consistent with the SEM's emphasis on the dynamic interaction between individual and structural factors.

Collectively, the statistical evidence—particularly the strong adult effect (Exp[B] = 6.90, $p < .001$) contrasted with the nonsignificant youth model ($B = -42.41$, p =

.929)—illustrates how life stage and social context shape the realized benefits of technology. Adults who used a device were nearly seven times more likely to report QoL improvement (75.1% vs. 6.3% of non-users), while youth showed no significant association.

The unexpected finding that adults with lower education levels reported higher odds of improvement (Exp[B] = 0.47, $p < .001$) demonstrates the complexity of how social determinants interact with technological adoption. These patterns affirm that, within the SEM, interventions must extend beyond the individual to address environmental and structural dimensions—such as education, race, and access—that mediate technology's impact significant association.

Conclusion

This study contributes to the limited national evidence base linking assistive technology (AT) use to quality-of-life (QoL) outcomes for persons with physical disabilities. The most striking finding was the magnitude of technology's impact on adults—nearly sevenfold increased odds of improved QoL—contrasted with its non-significant effect among youths. Equally notable were the demographic inequities: racial and educational differences persisted despite device access, confirming that systemic inequalities continue to moderate technological benefits. For example, non-Hispanic Black adults were 42% less likely to report QoL improvement than non-Hispanic White adults (Exp[B] = 0.58, $p < .001$). These results highlight the need for multilevel interventions that not only expand access to technology but also address the social and policy structures that shape its use and impact.

This study examined the relationships among disability, technology use, and quality-of-life outcomes in a nationally representative U.S. population. The results demonstrated that:

- RQ1 & RQ4 (adults): AT use significantly improves QoL among adults with disabilities.
- RQ2: Demographic factors (gender, race/ethnicity, education) strongly influence AT adoption.
- RQ3**:** Disability status alone does not predict AT use.
- RQ4 (youth): Youth with disabilities did not show significant QoL improvements linked to AT use.

By explicitly identifying which hypotheses were rejected or retained, this study contributes to a nuanced understanding of AT's role in promoting health equity. The findings suggest that while AT can be transformative, its benefits are not distributed evenly. Addressing systemic and demographic barriers is essential to ensure that technology fulfills its promise of improving the lives of all individuals with disabilities. By situating these outcomes within the Social Ecological Model, this study advances understanding of how personal, social, and systemic contexts jointly determine the success of AT. The results provide actionable insight for policymakers, clinicians, and educators seeking to design inclusive, evidence-based strategies that promote equitable quality-of-life gains for all individuals with physical disabilities.

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