Exploring the Facilitators of Adapted Mountain Biking Based on the Lived Experiences of Adults Living with a Spinal Cord Injury

by

Sarah K. Wildish

A thesis submitted to the
School of Graduate and Postdoctoral Studies in partial
fulfillment of the requirements for the degree of

Master of Health Sciences in Kinesiology

Faculty of Health Sciences

University of Ontario Institute of Technology (Ontario Tech University)

Oshawa, Ontario, Canada

August 2023

THESIS EXAMINATION INFORMATION

Submitted by: **Sarah Wildish**

Master of Health Sciences in Kinesiology

Thesis title: Exploring the Facilitators of Adapted Mountain Biking Based on the Lived Experiences of Adults Living with a Spinal Cord Injury

An oral defense of this thesis took place on August 4, 2023, in front of the following examining committee:

Examining Committee:

Chair of Examining Committee	Adam Dubrowski
Research Supervisor	Meghann Lloyd
Examining Committee Member	Nick Wattie
External Master's Thesis Examiner	Kelly Arbour-Nicitopolous

The above committee determined that the thesis is acceptable in form and content and that a satisfactory knowledge of the field covered by the thesis was demonstrated by the candidate during an oral examination. A signed copy of the Certificate of Approval is available from the School of Graduate and Postdoctoral Studies.

ABSTRACT

Research related to adapted mountain biking for people living with spinal cord injuries has primarily focused on the barriers that exist. Facilitators of adapted mountain biking have not been well-researched, and a better understanding of the facilitators that address these barriers is needed. The intention of this study was to understand how adapted mountain biking is facilitated. Ten adults with a spinal cord injury who have participated in adapted mountain biking were recruited as participants. Semi-structured interviews were held to understand the lived experiences of participants regarding the facilitators of their participation in adapted mountain biking. The main themes that emerged from this research were 1) general facilitators related to the physical environment, organizations, human connections, and the individual, along with motivations; 2) equipment as a facilitator. The facilitators described by participants reflect the current actions that enable participation and the suggestions for how to further facilitate the sport.

Keywords: Spinal Cord Injury; Facilitator; Adapted Mountain Biking; Handcycle; E-assist

AUTHOR'S DECLARATION

I hereby declare that this thesis consists of original work of which I have authored. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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_____ Sarah Wildish

STATEMENT OF CONTRIBUTIONS

I hereby certify that I am the sole author of this thesis and that no part of this thesis has been published or submitted for publication. I have used standard referencing practices to acknowledge ideas, research techniques, or other materials that belong to others. Furthermore, I hereby certify that I am the sole source of the creative works and/or inventive knowledge described in this thesis.

ACKNOWLEDGEMENTS

To Dr. Meghann Lloyd,

Thank you for your support and guidance over the past two years, and years before that, when things were challenging, and for celebrating all the big and small milestones of the research process. I appreciate your dedication to help make my writing better and better through each round of edits, and getting me to dig deeper to reach the heart of this research. Thank you for always encouraging me to step out of my comfort zone, to be confident in my work and more generally in myself. I am so thankful I had the chance to work with you on an area of research that really spoke to me and to have the opportunity to learn so much from you. I am forever grateful.

To Dr. Nick Wattie,

Thank you for being such an important part of this research. Through consultations about this study, I have learned a lot about how to approach research from different angles and theories, and its practical applications. Thank you for asking thought-provoking questions that inspired me to think bigger about what this research is and what it could be.

To Dr. Kelly Arbour-Nicitopolous,

Thank you for taking the time to lend your expertise and perspectives to my research. Your insights have been the cherry on top to complete the final product of this thesis. It was a pleasure collaborating with you.

To Mark Neville,

Thank you for your time and effort spent helping me improve my writing itself, as well as my mindset about writing. These lessons have had a lasting impression that I will carry with me long after my master's education.

To my lab mates,

When we were all in the lab together it made everything a bit more fun and a bit easier. Although we were all at different stages of our masters education, thank you Marie and Kyra for welcoming me into the lab and for passing down your wisdom.

Thank you as well to Alanna, for your help with intercoder reliability. The time and effort into helping me with technological difficulties, in addition to your thoughtful analysis of my research, is much appreciated.

To my family,
Thank you to my parents and sister who have taken care of me in many ways all these years, and especially the past few years for being understanding when I needed to prioritize my studies and this research. To my immediate and extended family, thank you for showing such interest in my research. Your genuine curiosity has helped me to be a better researcher and writer, by making me think more critically about how to articulate what this research is about and what it means. You are all my rocks that ground me and your support means the world.

To my lifelong friends,
Thank you for listening to regular updates from me about my research, and for knowing when to push me to work harder and rest even harder. Thank you for sticking by my side and encouraging me through it all. You are the kind of people that I can count on to show up and selflessly offer compassion and understanding. Thank you for holding space for me to grow.

Finally, to my participants,
This thesis would not have been possible without the participants who graciously offered their time to share their experiences with me. Your knowledge has been so instrumental to understanding the experience of a portion of adapted mountain bikers with a spinal cord injury. Witnessing your passion for the sport and accessibility has fuelled me, much more than I imagined, to share your words and ideas for how to make adapted mountain biking more accessible to more people. Thank you for your commitment to this study.

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LIST OF ABBREVIATIONS AND SYMBOLS

PAD	Physical Activity for people living with a Disability (model)

Chapter 1. Introduction

Overview of Physical Activity for People with Spinal Cord Injuries

A spinal cord injury results in a disability in which people experience significant challenges with mobility, often requiring the use of mobility aids such as wheelchairs (Stevens et al., 2008). Living with a spinal cord injury commonly affects the independence of individuals, which has been shown to have an effect on the physical and psychological traits of people (Jetha et al., 2011). Having a disability is more than just the condition itself; the most disabling element for individuals is often the inaccessibility of society, where the structures and systems in place have not been designed for people with disabilities, such as individuals living with spinal cord injuries (Albrecht & Devlieger, 1999). Inaccessibility creates barriers for people with spinal cord injuries which limits participation in many domains of life, such as physical activity, that people without a disability are more likely to be able to experience with ease (Vasudevan, 2016).

Physical activity is the fundamental action of an individual voluntarily using their skeletal muscles for movement, and it includes participation in competitive and recreational activities, as well as movement for transportation and occupations (Caspersen et al., 1985). Engaging in physical activity means different things to individual people, but from a health perspective, the overall importance of physical activity is that it improves the mental and physical health, contributing to the maintenance of a person's overall well-being (Fekete & Rauch, 2012; Levins et al., 2004; Miles, 2007). However, many people do not engage in enough regular physical activity, often due to multiple types of barriers including personal, societal, structural, or systemic barriers, that limit individuals from being physically active (Miles, 2007).

Experiences with physical activity barriers are more likely to be amplified for people with disabilities including those with spinal cord injuries, compared to people without disabilities, which is evident in national rates of physical activity (Martin, 2013; Rocchi et al., 2017). In Canada, approximately half of the 85,000 people with a spinal cord injury do not participate in any physical activity, while about 12 percent meet the physical activity guidelines specifically designed for people with a spinal cord injury (Carty et al., 2021; Noonan et al., 2012; Rocchi et al., 2017; Watson et al., 2022). Spinal cord injury physical activity guidelines suggest 2 days of strength training per week, similar to general Canadian guidelines for adults (Rollo et al., 2020; Watson et al., 2022). For people living with a spinal cord injury, guidelines include 20-30 minutes of aerobic activity 2-3 days per week, or 40-90 minutes per week, as opposed to 150 minutes for the overall population (Rollo et al., 2020; Watson et al., 2022).

Compared to people without disabilities, people with spinal cord injuries experience more barriers to physical activity participation, such as not having accessible spaces, not having the necessary resources, such as equipment, and the presence of negative societal perceptions about people with disabilities (Martin Ginis et al., 2010). The higher prevalence of these barriers is associated with the overall lower levels of physical activity among people with spinal cord injuries (Martin Ginis et al., 2010). Despite low levels of physical activity, there are people with spinal cord injuries who are physically active and benefit from enabling factors for participation in physical activities (Orr et al., 2021).

Facilitators or enabling factors of physical activity are personal or societal features that facilitate participation in physical activity and are vital to the improvement

and maintenance of health and well-being (Carty et al., 2021). Facilitators are particularly essential for individuals living with disabilities like spinal cord injuries, because they can address multiple barriers that limit the opportunities for accessible physical activities (Levins et al., 2004). Some of the physical activity environments that are not often accessible to people with spinal cord injuries are outdoor nature spaces, particularly in rural areas such as national or provincial parks (Moore et al., 1996). Forests and fields are areas that provide ample space and opportunities for physical activity, and are shown to increase positive health outcomes, such as improved cardiorespiratory health and boosts in mood from being in nature (Mitchell, 2013; Stieb et al., 2016). However, many rural parks with trails are not widely accessible to people with spinal cord injuries who use wheelchairs. Many rural trails have unclear information about the accessibility of the facilities, such as the availability of accessible restrooms, and parking spaces. Additionally many trails themselves are considered to be inaccessible in terms of the width of the trails and the presence of obstacles (Moore et al., 1996). Research has shown that addressing barriers through facilitators can make physical activity more accessible through the promotion of inclusive physical and social spaces (Zeller, 2008).

Social and Environmental Determining Factors of Physical Activity for People with Disabilities

Organizations that provide access to equipment and resources to be physically active specifically for people with disabilities have been shown to increase participation rates, and the opportunities for physical activities (Tolerico et al., 2007). For nature trail use, there are benefits to designing nature trails that prioritize sustainability of the parks, as well as having available resources and equipment for people with disabilities to use

nature trails safely and effectively (Fagher et al., 2022). Equipment such as handcycles are commonly used by people with spinal cord injuries for adapted mountain biking; handcycles can be costly and are therefore not accessible to many individuals (Ponti et al., 2020). However, having recreation programs and parks that supply adapted sport equipment has been shown to help enable people with disabilities to be more physically active in a variety of spaces, like outdoor trails (Ponti et al., 2020).

Recreational programs are important and are often necessary for providing people with spinal cord injuries equipment that enables physical activity, but another benefit to recreation programs is the opportunity for forming social connections (Tolerico et al., 2007). Engaging in physical activity programs which promote social inclusion are associated with having a sense of belonging and community that can provide fulfilment and enjoyment in activities, to further facilitate physical activity participation (Tolerico et al., 2007). However, due to barriers that people with spinal cord injuries often experience, the potential for obtaining these benefits of physical activity can be restricted due to inaccessible physical activity opportunities (Carty et al., 2021). To obtain health benefits associated with physical activity, it is important to address societal barriers, to help enable opportunities for people with spinal cord injuries to access more spaces that can be used for physical activity (Carty et al., 2021).

Personal Determining Factors of Physical Activity for People with Disabilities

Facilitators of physical activity that are considered to be personal, are factors that are modifiable or within the control of an individual, such as finding enjoyable activities, building self-confidence, and self-efficacy (Brown & Pappous, 2018; Fekete & Rauch, 2012). Having higher self-confidence can enable people to try new activities that they

consider enjoyable, such as exploring a variety of spaces like outdoor nature trails (Fekete & Rauch, 2012; Hardiman & Burgin, 2013). However, people with disabilities are less likely to have opportunities to build self-confidence in physical activity situations due to the barriers they consistently encounter (Fekete & Rauch, 2012). Fear of falling or re-injury is a common barrier for people with spinal cord injuries, which is correlated with lower self-efficacy for physical activity (Levins et al., 2004; Musselman et al., 2018). While these are individual features that affect participation in activities, many personal factors are influenced by societal factors that stem from the narratives presented about people with disabilities (Brown & Pappous, 2018). Narratives that emphasize people with disabilities deserving the right to beneficial and enjoyable physical activities, such as exploring nature trails, promote more positive perspectives, that can alter a person's belief in themselves to participate in new activities (Papathomas et al., 2015).

The Importance of Nature Trails for Physical Activity

The benefits of being in nature have been well researched, with a number of studies focusing on the correlations between being physically active in nature and improved health outcomes (Mitchell, 2013; Stieb et al., 2016; White et al., 2016). When it comes to parks and nature trails, the more natural elements there are, the more the space becomes encouraging for greater use of nature trails and for participating in more physical activity (Mitchell, 2013). From a population level standpoint, the design and maintenance of trails have important roles in promoting physical activity through the availability of spaces to be physically active (Godbey et al., 2005). Schasberger et al. (2009) identified that people are more physically active in rural natural environments, and

that implementing more trail routes to rural trails from urban or suburban areas helps to make nature trails more accessible, increasing physical activity.

Nature Trail Experiences of People with Disabilities

McAvoy et al. (2006) and Zeller (2008), explored the influence of outdoor nature experiences for people with disabilities who used a wheelchair. Both studies found that being in nature is a source of joy, and brings meaning to individuals through outdoor physical activity. Zeller (2008) found that through experiences with wilderness activities, such as hiking and kayaking in rural parks, people with disabilities are more likely to have opportunities to encounter greater independence with the necessary resources and supports. Outdoor physical activity experiences have been shown to have lasting effects on skill development as well as the formation of connections between people and nature that are specific to the wilderness and the use of nature trails (McAvoy et al., 2006). Although the benefits of wilderness activities are significant to the health and well-being of people, there is limited research on physical activity experiences through wilderness expeditions for persons with disabilities (Zeller, 2008). The research of McAvoy et al. (2006) and Zeller (2008) has indicated that exploring the wilderness with other individuals with disabilities is an important facilitator for engagement in trail use. Thus, there is a need for more opportunities such as wilderness exploration programs for people with disabilities to experience nature trails.

The physical trail surfaces, the availability of accessible amenities at parks and trails, and the clarity of information about the trail are all factors in the accessibility of nature trails (Brown et al., 1999). When there are barriers to trails related to such factors, people with disabilities often experience these barriers more than people without

disabilities (Moore et al., 1996). The conditions of trails in addition to width and ground surfaces of paths can be unsafe for users with spinal cord injuries, especially those who use wheelchairs and other mobility devices (Ponti et al., 2020). It is important that safety concerns related to the usability of trails are considered when engaging in outdoor physical activity, because doing so can enable more people with disabilities to explore nature trails and find an interest in physical activities (Moore et al., 1996).

Safety is an important consideration when being physically active in nature, but for people with disabilities there can often be misinterpretations on what is meant by safety (Loeffler & White, 2022). When it comes to addressing safety concerns for people with disabilities engaging in physical activity, there is a tendency for assumptions to be made on what activities and spaces are considered appropriate and safe for participation (Loeffler & White, 2022). Making assumptions limits the opportunities for physical activity involving risk-taking that persons with disabilities can experience. People with disabilities have been excluded from participating in various physical activities, particularly those outdoors, based on what people without disabilities consider acceptable activities (Loeffler & White, 2022). While safety is essential, experiencing risk is a natural part of life that is valuable for people with disabilities. Risk allows for the chance to experience enjoyable physical activities that provide fulfillment through elements of challenge, such as riding through rough terrains of nature trails (Loeffler & White, 2022).

Gaps in the Literature

There is a significant amount of research that has identified barriers, and some research on facilitators of physical activity for people with disabilities (Miles, 2007; Tolerico et al., 2007; Vasudevan, 2016). While there is a growing amount of research that

looks at how to promote physical activity for people with spinal cord injuries, there are many physically inactive people with spinal cord injuries in Canada (Rocchi et al., 2017). There is a gap in the research on the facilitators of trail use, more specifically for adapted mountain biking, among people living with spinal cord injuries. The lived experiences of people tell important stories about who they are, as well as the challenges individuals are faced with, and how challenges can be approached (Zeller, 2008). By researching the lived experiences of people with spinal cord injuries who participate in adapted mountain biking, facilitators of outdoor physical activity for people with spinal cord injuries can be better understood. Having a deeper understanding of what facilitates physical activity can help grow opportunities to facilitate participation for people living with spinal cord injuries (Godbey et al., 2005; Hardiman & Burgin, 2013; Zeller, 2008). To address gaps in the literature, the research questions of this study are:

1. What are the facilitators of adapted mountain biking related to the lived experiences of people living with a spinal cord injury?
2. How does equipment facilitate adapted mountain biking for people living with a spinal cord injury based on their lived experiences?

Theoretical Framework

Theoretical Framework Description and Rationale

There are many factors that enable or inhibit participation in physical activity, however, for people with disabilities, the inhibitory factors are amplified (Rocchi et al., 2017). As a way to organize the interconnectedness of many barriers and enabling factors, the Physical Activity for Persons with a Disability (PAD) Model was developed

(Van der Ploeg et al., 2004). The PAD model highlights a distinction between personal and environmental factors of physical activity while also demonstrating a connection among overlapping concepts, such as the impact that social influences have on intentions to be physically active (Buffart et al., 2009). This model not only emphasizes the roles that people have in participating in physical activity, but also the responsibilities of others, including close connections of individuals with disabilities, and institutions that govern spaces for physical activity, to create more accessible physical activity opportunities (Van der Ploeg et al., 2004).

Research by van den Akker et al. (2020) used the PAD Model for conceptualizing the interactions among various personal and societal determining factors of physical activity among people with spinal cord injuries, who use wheelchairs. Through interviews, wheelchair users with spinal cord injuries described their experiences with physical activity in terms of barriers and facilitators. The data from the interviews was categorized into the themes of the PAD Model (van den Akker et al., 2020). This model was developed using research related to physical activity participation of people with disabilities, and is the most appropriate theoretical framework to understand physical activity factors that could relate to adapted mountain biking among people living with a spinal cord injury (Van der Ploeg et al., 2004).

In the case of outdoor activities and nature trail use there are many factors represented in the PAD model that reflect the research on barriers and facilitators of physical activity through nature trail use for people with disabilities (Van der Ploeg et al., 2004). For example, Levins et al. (2004) discuss the influence of attitudes on physical activity participation. Ponti et al. (2021) describe the role of equipment access for outdoor

physical activity. McAvoy et al. (2006) emphasized the importance for skill development when using nature trails, as well as the opportunities that exploring nature has on improving technical and personal skills. The PAD model highlights the main themes found in research on physical activity for persons with disabilities, and how the determining factors connect to each other to encourage physical activity participation (Van der Ploeg et al., 2004).

The PAD Model is most suitable for this research because the interactions of the determining factors, both enabling and inhibiting, guide investigations into the lived experiences of people with disabilities engaging in physical activity (van den Akker et al., 2020; Van der Ploeg et al., 2004). In the PAD model, physical activity facilitators are organized in a way that shows the connections to one another. These connections reflect the interaction among these factors and lived experiences for people with disabilities and will guide the creation of the initial themes for data analysis. Based on the current research, this model best represents the lived experiences and variety of factors that determine physical activity participation for people with a spinal cord injury (van den Akker et al., 2020; Van der Ploeg et al., 2004). Through the understanding of facilitators at the societal and personal levels, this model can help to comprehend the holistic lived experiences of people with spinal cord injuries who participate in adapted mountain biking (Van der Ploeg et al., 2004).

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Chapter 2. Literature Review

Engaging in physical activity has a significant positive impact on many measures of mental and physical health, such as mental clarity, reduced stress, muscular strength, cardiorespiratory fitness, flexibility, and more (Caspersen et al., 1985). The outcomes of participating in physical activity help promote and maintain health, as well as help avoid or reduce the effect of many chronic illnesses. There is a dose-response relationship with the amount of physical activity a person engages in and the effect it has on one's health, where more physical activity is associated with more health benefits (Miles, 2007). However, the amount of people engaged in regular physical activity is low, with less than 20% of the Canadian adult population meeting guidelines for regular physical activity (Christie et al., 2021). For some sub-groups of the population, physical activity participation is even lower, for example, people with a spinal cord injury. In Canada, only 12% of the 85,000 people living with a spinal cord injury are meeting physical activity guidelines, (Noonan et al., 2012; Rocchi et al., 2017; Watson et al., 2022).

The spinal cord injury physical activity guidelines for strength training are similar to the Canadian guidelines for adults of the general public, recommending 2 days of strength training per week (Rollo et al., 2020; Watson et al., 2022). For aerobic physical activity, people living with a spinal cord injury are advised to participate in 20-30 minutes of aerobic activity 2-3 days per week. The suggestion of 40-90 minutes of aerobic activity per week involves less time being physically active compared to 150 minutes for the overall population, but still participation is low (Rollo et al., 2020; Watson et al., 2022). The difference in participation rates for people with spinal cord injuries can be attributed to numerous barriers that people experience related to accessibility, as well as perceptions and attitudes about people with disabilities (Martin

Ginis et al., 2010). The low rates of physical activity in people living with a spinal cord injury signifies that more research is needed on the facilitators of physical activity in this population (Orr et al., 2021).

Physical Activity and People with Spinal Cord Injuries

Physical activity encompasses a variety of transportation and occupational-based activities as well as sports and recreational activities that require different skillsets to be able to participate (Caspersen et al., 1985). Participation, especially for recreational and competitive physical activity, requires multiple internal and external conditions or factors that contribute to engagement in activities; such factors can be physical, environmental, social, financial, motivational, and more (Rocchi et al., 2017). Due to experiences with ableism, as a result of negative stereotypes targeted toward people living with disabilities, individuals living with a spinal cord injury experience more barriers and fewer facilitators related to these factors that impact physical activity participation.

Factors Related to Physical Activity Participation for People with Disabilities

In a systematic review of 25 studies, Fekete and Rauch (2012) reviewed the physical activity participation levels and correlates or determinants in people with a spinal cord injury. Physical activity barriers and facilitators were discussed and categorized based on body functions, personal factors, environmental factors, and health conditions, according to the World Health Organization, International Classification of Functioning, Disability, and Health model for physical activity factors (Fekete & Rauch, 2012). A common finding amongst the studies in the review was that pain and distress were reported to hinder physical activity, while facilitators of physical activity were improvements to upper body strength and mobility in body joints (Fekete & Rauch,

2012). The presence of pain is a strong influence on an individual's behaviour, which can make participating in physical activity more challenging for people with spinal cord injuries who often experience more pain (Stevens et al., 2008). The strengthening of muscles and improvements to the range of motion in joints through physical activity helps with increasing pain tolerance, which has been shown to further encourage more physical activity; however, enabling physical activity takes more than knowing these benefits (Fekete & Rauch, 2012). Other personal factors that are important to physical activity participation for people with spinal cord injuries are, having activities that provide enjoyment and fulfillment, and building self-esteem and self-efficacy. Such facilitators are important for addressing the personal barriers to physical activity, such as body dissatisfaction, and fear of injury.

Fekete and Rauch (2012) also reviewed environmental factors related to physical activity participation in people with a spinal cord injury, these included barriers like equipment problems, not having accessible facilities, transportation difficulties, and high costs of programs and equipment. These environmental factors were more strongly associated with physical activity compared to personal factors, as the research emphasizes that people with a spinal cord injury are more affected by barriers within an environment. However, facilitators such as the promotion of social and recreational programs for people with spinal cord injuries, improving the allocation of funding to programs, and providing more accessible forms of transportation are important for enabling physical activity. Engaging in regular physical activity is important for helping regulate primary and secondary health conditions that may be present in people with a spinal cord injury (Fekete & Rauch, 2012). While barriers often still exist, with the

presence of facilitators, the effects of the barriers can be minimized. However, more research is needed on the facilitators that can further limit or remove barriers.

Levins et al. (2004) explored physical activity experiences including barriers and facilitators for people with a spinal cord injury. This study used semi-structured ethnographic interviews to gain insight on experiences of people with a spinal cord injury. The first theme that emerged from this study was, individual influences, such as a "loss of ability" after a spinal cord injury before transitioning to becoming more physically active again. Levins et al. (2004) found that an important step to becoming physically active after a spinal cord injury can be to reframe thinking about having a disability and finding a sense of self-satisfaction. The other theme that was found in this study was societal influences, such as social environmental barriers that affect participation in physical activity; these included the quality of rehabilitation experiences, and societal attitudes that affect the perception of the abilities of people with disabilities. They also found that having a strong bond and support from family has been shown to promote positive perceptions of abilities and levels of confidence among people with disabilities (Levins et al., 2004). It is important to promote positive perceptions and narratives about physical activity early on after a spinal cord injury to mitigate the potential effect of negative narratives. Levins et al. (2004) emphasized the influence of rehabilitation and other early experiences, such as connecting with other people with disabilities soon after a spinal cord injury; these interactions can be important for defining how individuals view their disability.

Arbour-Nicitopoulos et al. (2009) observed the role that action and coping planning has on leisure time physical activity participation, where coping self-efficacy

among people with a spinal cord injury was associated with more physical activity. In this single blind randomized control trial, an experimental group received action and coping strategies for participating in leisure time physical activity, such as learning how to plan out strategies for mitigating barriers to leisure time physical activity. In the control group, participants only received action planning strategies for participating in leisure time physical activity that did not plan around coping strategies for staying engaged in physical activity. The results of the study demonstrated that participants in the action and coping planning group performed more leisure time physical activity and had higher general self-efficacy over time. However, self-efficacy to address barriers decreased over the study period due to the beginners of a new exercise program underestimating the barriers that physical activity can present for people with a spinal cord injury. Overall, this research found that action plans combined with coping plans are more effective than action plans alone for leisure time physical activity initiation and sustainability. It was noted that additional planning and coping strategies may be required for people with a spinal cord injury to mitigate the greater number of barriers that individuals can experience when engaging in physical activity. Building coping or planning skills and self-efficacy can encourage and enable physical activity for people with spinal cord injuries (Arbour-Nicitopoulos et al., 2009).

Tolerico and colleagues (2007) studied mobility characteristics and activity levels of manual wheelchair users, with most having a spinal cord injury, in residential settings and at an event called the National Veterans Wheelchair Games. The study used data loggers on the wheelchairs of participants, to collect data on the distance and speed of individual participants. They found that participants were more physically active,

spending more hours, travelling longer distances and at faster speeds at the National Veterans Wheelchair Games than in the residential environment. Additionally, wheelchair users who were employed at the time of the study were more physically active, likely because people who are employed are more likely to be able to afford to participate in competitive sporting events for physical activity. Having access to opportunities for participation and higher socialization in the environments of organized events enabled physical activity participation that was also more enjoyable (Tolerico et al., 2007). Based on this study, people with a spinal cord injury experience more facilitators for physical activity when there are more social components and organized events that create a sense of community, which are important for one's well-being.

The social environment is important for promoting physical activity, but the physical environment has a particularly significant role in enabling physical activity for people with disabilities. The physical environment includes spaces that are used for physical activity and the physical conditions of the spaces, some of which change day by day, such as the weather (Borisoff et al., 2018). For people living in Canada, the dynamic weather of the four seasons, particularly the cold winter months, means that engagement in physical activity often follows weather patterns, which can put a hold on certain activities at different times of year. The general trend for physical activity uptake is that it is more common in spring and summer months when the weather is warmer and there is no snow on the ground, making it easier to get outside to be physically active (Borisoff et al., 2018). Many of these people who are physically active in the warmer months are individuals with disabilities who experience more challenges with getting around in the cold and snowy winter months. In a longitudinal, mixed-methods study about the effect

of weather patterns on physical activity participation for wheelchair users in Manitoba Canada, Borisoff et al. (2018) found that summer weather was the greatest facilitator to mobility in the community. In contrast, winter months presented more barriers, such as inaccessible public environments, where the snow and cold interferes with mobility.

To accommodate for seasonal barriers, the most common supports described by Borisoff et al. (2018), were private transportation and social supports that facilitated mobility. Participants noted that most trips taken in colder and snowy weather conditions were out of necessity rather than for leisure. Although the weather conditions cannot be controlled, there are ways to facilitate physical activity for people with disabilities living in colder climates (Borisoff et al., 2018). Advocating for the rights of people with disabilities, such as the right to improve one's health through physical activity, is important for holding policy makers accountable for creating spaces that uphold these rights. One such example of these policies is maintaining public spaces by clearing snow and ice from walking paths and parking areas in winter months, so that people with disabilities are able to use outdoor public spaces (Borisoff et al., 2018).

Attitudes About Disability and Physical Activity

There are many factors that contribute to low physical activity participation for people with disabilities, but one highly prevalent factor is the attitudes that people have about physical activities. In a study by Martin Ginis et al. (2017), leisure time physical activity attitudes and other psychological factors were compared between participants with a spinal cord injury who use manual wheelchairs, and those who have a spinal cord injury but do not use a wheelchair. Through a mixed methods approach, attitudes, intentions, and perceived behavioural control were quantitatively measured, and

experiences with barriers and facilitators were the focus of qualitative semi-structured interviews. The results of this study found that attitudes had a positive association with intentions, where participants who used a wheelchair had more positive attitudes about leisure time physical activity than people who did not use a wheelchair. This difference in attitudes was found to be based on experiences with pain-relief benefits and fatigue levels from physical activity. Suggestions made from the study were to focus on interventions that encourage positive attitudes of physical activity by emphasizing fun and pleasant leisure time physical activity, increasing motivation and intention to be physically active (Martin Ginis et al., 2017). This research demonstrates that holding positive perceptions and attitudes is a strong predictor of higher participation or intended participation in leisure time physical activity.

Papathomas et al. (2015) conducted a study that asked participants with a spinal cord injury who were physically active to reflect on experiences and attitudes about their participation in physical activity pre- and post-spinal cord injury. In semi-structured interviews, questions were asked that pertained to barriers and facilitators to having a physically active and healthy lifestyle, as well as benefits that are perceived with leisure time physical activity. Following a narrative inquiry qualitative research design, the focus of this study was on finding meaning through adopting different types of narratives about physical activity for people with a spinal cord injury. The resulting three narratives were assigned based on the descriptions of attitudes and experiences by participants. The first narrative experienced was “exercise is restitution”, that focuses on achieving a grand outcome and that physical activity can be used to “overcome the injury”. This narrative can be effective for a short period of time because it can be motivating to try to achieve a

significant goal but can quickly become a mindset of trying to ‘cure’ or ‘overcome’ the injury, even though it is often a permanent injury. Following this narrative too closely can potentially lead to disappointment when the outcome is not achieved, and the characteristics of a spinal cord injury remain. The second narrative is “exercise is medicine” which uses physical activity as a way to manage secondary health characteristics from a spinal cord injury, such as pain and muscle or joint stiffness. With this narrative, people can use physical activity to sustain and improve quality of life physically and psychologically. The last narrative described in the study was the “exercise is progressive redemption” narrative, which focuses on shifting the perspective on to oneself through a “positive identity change”. This approach includes portraying oneself in a certain light to motivate other people to be physically active. This narrative is meant to encourage participation in physical activity and other areas of life by an individual having higher confidence and security with their identity to feel worthy and capable of self-improvement.

Papathomas et al. (2015) highlighted that there may be changes in the narratives that individuals hold after different periods of time from injury, for example, differences in narratives 6 months, 1 year, and 5 years after a spinal cord injury. The narratives about physical activity that we are surrounded with influence our attitudes, behaviours, and actions. Sharing these narratives has an influence on the story-teller’s own understanding of their physical activity behaviours as well as an influence on the listener’s behaviours. Messaging can be a very influential factor in affecting behaviour and is needed in addition to knowledge and education on the benefits and value of physical activity. Positive narratives about physical activity, health, and sense of self from physically active

people with a spinal cord injury act as a facilitator for physical activity participation (Papathomas et al., 2015).

In an exploratory qualitative study, Musselman et al. (2018) conducted interviews using photo-elicitation to identify factors related to falls for people with a spinal cord injury. The purpose of this study was to understand how the perceived risk of falls influences physical activity and the mobility of people with a spinal cord injury. Participants were provided digital cameras and took photos of situations that they perceived would impact their mobility and risk of falling, and those photos were discussed in semi-structured interviews. Four major themes were found from interviews with the first being that most challenges were perceived as environmental, with some influences of biological and behavioural factors. The next theme was that reasons for experiencing frustration, moving slowly, and avoiding activities involving balance were because of the perceived risks of falls by the participants. Another theme was that fall prevention was often the result of previous experiences with falling, and strategies to avoid falls came with changes in behaviour. Lastly, individual factors like perseverance and the need for independence reduced the perceived risk of falling. Fall prevention strategies that focus on addressing perceptions of risk can be important for enabling the return to physical activity after falls or after a spinal cord injury in general, which can help with establishing life-long physically active individuals (Musselman et al., 2018).

The Meaning of Physical Activity Participation

In a research study by Hammel et al. (2008), people with disabilities, including people with a spinal cord injury, a traumatic brain injury, and stroke, were asked about the values that inform participation in activities of daily living and physical activity.

Using a Grounded Theory approach, this study aimed to understand what participation means for people with disabilities, how participation is conceptualized, and identify the supports and barriers to participation. A common theme was that the conceptualization of participation among participants was different. Hammel et al. (2008) described how participation is affected individually by social, personal, and community factors, that was explained beyond a set of activities, and instead was a reflection of an individual's values. The main values identified by participants were active and meaningful engagement in the actual activity or in the social environment, having a sense of control and a choice in risk-taking activities, access to supports for participation, personal and societal responsibilities, having an impact, supporting others, and experiencing social connections and societal inclusion. An overarching message of this study was described by the author when saying, "the right to and recognition of decisional autonomy (the opportunity to actively be a part of one's decision making) may be more important than the ability to independently perform activities by oneself." (Hammel et al., 2008, p. 1455). Individuals with disabilities all have different experiences, in life, and with their disabilities, which influences their understanding and definitions of what it means to participate in such experiences (Hammel et al., 2008). In terms of physical activity, participation has traditionally been viewed objectively in research and in practice, either someone participates in an activity, or they do not. However, Hammel et al. (2008) describes that physical activity participation includes numerous factors that depend on the values of the individual, such as finding meaning and connection. Therefore, participation allows more freedom for people with disabilities when initiating physical activity, and people do not have the authority to dictate how people with disabilities can participate in

physical activities. Hammel et al. (2008) explains that there does not need to be set parameters for participating in physical activity, and communicating this effectively could enable more people with disabilities to discover what works for them to actively participate.

Martin Ginis et al. (2021) conducted a literature review of meta-analyses and systematic reviews on current knowledge on physical activity participation among people living disabilities. The purpose of this review was to inform physical activity action plans worldwide on the need for physical activity that is resourced, monitored, and enforced to ensure the rights of people with disabilities to fully participate in physical activity. Similar to Hammel et al. (2008), Martin Ginis et al. (2021) found that successful or full participation in physical activity means feeling fulfilled with the extent to which one is participating in physical activity. Participation was found to mean something different to individuals in various contexts. Ultimately this includes physical activity that is valuable to individuals, that encourages a sense of belonging, autonomy, and meaning, and has a reasonable challenge. Whether physically active or inactive, people with disabilities face barriers to full participation in physical activity. Features like autonomy and meaning act as facilitators of physical activity, but individuals with disabilities often require additional supports and accessible environments to experience these facilitators of physical activity participation (Martin Ginis et al., 2021).

Trails and Physical Activity

The importance of the environment in enabling physical activity cannot be understated. Within the general population, people are reliant on spaces that facilitate regular physical activity (Godbey et al., 2005; Siderelis et al., 2010). Individuals engage

in physical activity for a variety of reasons, often related to health and enjoyment, but the low rates of participation in physical activity indicate that enjoyment is missing from many of the activities that people engage in (Christie et al., 2021; Siderelis et al., 2010). This makes the role that the environment plays in physical activity significant, as it contributes to the overall experience that individuals have when being physically active (Tolerico et al., 2007; White et al., 2016). Physical activity experiences that facilitate connection, and meaning are shown to motivate people to engage in more regular physical activity (Hammel et al., 2008; Tolerico et al., 2007). The physical activity interests of individuals are variable, however, research has shown that meaning and connection through physical activity is heightened in outdoor settings, particularly in natural environments that offer a variety of social and health benefits (Mitchell, 2013; White et al., 2016).

Benefits of Natural Environments for Physical Activity

When it comes to facilitating physical activity participation for more people, there are spaces that are more engaging than others, such as outdoor natural environments. In a population-level study by White et al. (2016), a series of cross-sectional analyses were performed in England to estimate the total amount of physical activity within the country's various natural environments. The purpose of this study was to examine the population effect of natural outdoor environments on physical activity nationally. The purpose was also to explore the importance of outdoor spaces for physical activity to increase recreational or unstructured on physical activity for potential benefits to population health. Natural environments largely contribute to recreational physical activity, but there is a need to protect these environments for health as well as

environmental purposes. By making natural spaces more user-friendly while being mindful to protect the natural environment, more people can benefit from the health benefits, thus enabling physical activity without damaging the nature that composes those natural environments.

Mitchell (2013) conducted a study on different environments and how physical activity in natural environments compares to physical activity in non-natural environments, based on mental health benefits and overall well-being. In this study natural environments were considered woods and forest, open spaces and parks, and non-tarmac paths, and/or beach and water-side banks. Non-natural environments included sports pitches and outdoor courts, swimming pools, gyms and sports centres, residential streets, and home gardens. This study found that physical activity in natural environments was associated with a greater reduction in risk of poor mental health, compared to physical activity in other environments. People who used forested areas for physical activity had half the risk of poor mental health compared to non-users and an additional 6% less risk per week with each visit to woods and forests for physical activity (Mitchell, 2013). However, regular use of any natural environment was not clearly associated with overall wellbeing, therefore, this study explained that different types of environments may promote different kinds of positive health and well-being outcomes. Similar to White et al. (2016), Mitchell (2013) emphasised that policy makers and planners need to help protect and promote natural environments which permit and encourage regular physical activity for all. It was suggested that having a choice of a natural environment for physical activity just once a week may be enough to gain health benefits, which for some, may be a more convenient way to use nature trails for physical activity.

Influence of Trail Factors on Physical Activity

Nature trails provide important benefits to users, but in order to be used, the trails need to be well-maintained. In a study by Siderelis et al. (2010), surveys were used to gather land data and on-site user data to address desires for site layout and trail condition of users. The results of the survey indicated that trail users preferred high-quality trails that had more challenges in the routes. However, participants preferred mountain biking trails that were wider, and sites with less soil erosion, root exposure, unavoidable obstacles, and uneven trail grades. Participants emphasized the desire for a balance between non-degraded trail conditions as well as site layouts that offered complexity and challenge. These factors and overall enjoyment of outdoor activities in natural environments were said to facilitate mountain biking, as well as having trails that are monitored and maintained for safe conditions. Having environments that are safe for use enable physical activity, but without elements of challenge, a sense of accomplishment may not be achieved (Siderelis et al., 2010). This can act to demotivate physical activity, making the role of the environment an important component of increasing physical activity participation.

Godbey et al. (2005) reviewed research on both leisure studies and park management with the purpose of emphasizing the importance of using nature trails for increasing physical activity, and identifying areas of improvement in terms of the safety of trail usage. Godbey et al. (2005) found that, while people would prefer that there are not big crowds at parks when engaging in leisure physical activities, having people present at parks also provides a greater assurance of safety for users. Additionally, this review described the influence that nature elements, such as seeing more greenery have

on motivation to be physically active, but in some cases can also be perceived as dangerous, in that having views clear of objects can increase the perceived safety of parks. Through this review, a correlation was found between leisure and recreation, and park management for promoting physical activity. Broadening the scope that governments and organizations have in maintaining parks can help increase population level physical activity more efficiently by providing more comprehensive strategies to optimize the use of parks and maintain their natural integrity (Godbey et al., 2005). Maintenance is key to protect the integrity of the trails for cultural and safety reasons (Botella-Carrubi et al., 2019), especially for people using more hefty equipment, such as people with disabilities using handcycles.

Trails and Physical Activity for People with Disabilities

The benefits and importance of rural nature trails is that they allow for more stimulating and enjoyable physical activity; however, some people are not granted these opportunities (McAvoy et al., 2006). For people with disabilities, there are barriers to accessing nature trails that limit the potential for engaging in more meaningful physical activity (Zeller, 2008). However, when people with disabilities are provided with opportunities and are enabled to experience outdoor physical activity, such as using trails, there are more positive outcomes to individual's health and well-being (Zeller, 2008).

Opportunities for Exploring Nature for People with Disabilities

Participating in wilderness activities is shown to have many health and wellness benefits, but opportunities for people with disabilities to experience the wilderness are scarce. In a study by McAvoy et al. (2006), a wilderness trip that included able-bodied people, and people with disabilities using a wheelchair, asked participants to complete a

questionnaire about the most important outcomes they experienced from their trip. As a result, the most frequent benefits mentioned by persons with disabilities were having an increased awareness of one's abilities, developing relationships with others, experiencing personal growth and challenges, developing an appreciation of nature, and having opportunities to experience something new or different. Through follow-up consultations with participants, values associated with these outcomes transferred to other areas of life, such as self-awareness and improvement or fulfilment, personal or spiritual value, relationships with others, and achieving personal goals. Terrain challenges from wilderness spaces were also part of the appeal for people with disabilities because it made participants feel successful to overcome a challenge. There were some differences between the experiences of participants with and without disabilities when exploring the wilderness. People with disabilities experienced an awareness of their abilities, developed bonds with other people with disabilities, experienced a sense of accomplishment, and built skills that are transferrable to various areas of life. These themes were less prevalent in people without disabilities. Additionally, after follow-up interviews participants reported higher self-confidence and motivation as a result of wilderness experiences. Engagement in the activities led to higher connection to nature, more peacefulness and feelings of relaxation, as well as connections to other people (McAvoy et al., 2006). Families that went on the trip with an individual with a disability improved communication about aspects of their disability and opened up more opportunities for family recreation by increasing confidence in family members regarding safety.

People with disabilities experience a range of positive social and psychological benefits from engaging in wilderness activities, which enables more recreation and

physical activity participation. A quote used in the study mentions that, “We especially, with all our motor and sensory constraints, need activities which focus on the limitless, not the limitations. We need beauty to counteract the grit in our lives. We need novelty and discovery. We need wilderness” – Barry Corbet (1992), a mountaineer, editor, and person with paraplegia (McAvoy et al., 2006, p. 31). There can be a lasting effect of wilderness trips through the promotion of engagement with nature, which emphasizes the importance of people with disabilities using trails as a way to have skills learned in outdoors transfer to different areas of an individual’s life (McAvoy et al., 2006).

In a similar study to McAvoy et al. (2006), Zeller (2008) used a wilderness trip to describe the lived experiences, challenges, motivations, and legislation that influence the participation of people with disabilities in wilderness activities. In this study the author describes their own experiences and feelings as a person with a disability, as well as other participants with disabilities, from being in nature and participating in wilderness activities such as camping, hiking, and canoeing. A focus for this study was on legislation that affects the participation in wilderness activities for people with disabilities. The policies reviewed explained that motorized equipment that use battery power are generally accepted in wilderness preservation areas when used for mobility purposes (Zeller, 2008). This means that people with disabilities can be enabled through certain legislation to experience the benefits of the wilderness by being able to use the necessary equipment for riding nature trails. However, accessibility of nature trails and exploring the wilderness encompasses more than policies that allow motorized equipment to be used on trails.

Organizations like “Wilderness Inquiry” were highlighted as opportunities to enable people with disabilities to experience wilderness and outdoor recreation. This organization and others like it help foster inclusivity and support people with disabilities looking to explore the wilderness, and help people experience the common goal of overcoming challenges through wilderness activities. Through such programs, individuals with disabilities can feel motivated to engage in wilderness activities for their own joy, self-fulfillment, and self-improvement (Zeller, 2008). Having assistance through companions, devices, and services can make a difference in the decision of whether or not to embark on a wilderness journey, to go camping, hiking, canoeing, and more. An important message is that independence and freedom do not mean an individual with a disability must do everything on their own or in the way an individual without a disability does, but needing additional support should not be a barrier to accessible physical activity in the wilderness. Zeller (2008) commented on lived experiences and preferences for wilderness expeditions, where people with disabilities who visit the wilderness go for the challenge. Motivations for exploring the wilderness included wanting to “live life” and have new experiences, while getting to bond with other people with disabilities and share those experiences. While many individuals from this study had experience with using nature trails before their spinal cord injury, they were able to have various new experiences by exploring the wilderness as a person with a disability, which fosters greater curiosity to explore nature.

Hitzig et al. (2012) focused on evaluating a unique outdoor experiential therapy intervention for persons with spinal cord injury known as a Cottage Program to assess the impact that such programs can have on physical activity in people with a spinal cord

injury. Pre- and post-test surveys were completed by participants about their goals and program satisfaction. Additionally, participants and controls both completed the Rosenberg Self-Esteem Scale, Positive Affect and Negative Affect Scale, and the Moorong Self-Efficacy Scale. Participants reported having had previously engaged in various outdoor recreational activities including canoeing, kayaking, sailing, waterskiing, swimming, handcycling, bocce, and archery prior to a spinal cord injury, but few have continued with as many activities post spinal cord injury; however, perceived barriers of participating in these activities with a spinal cord injury decreased slightly from pre to post test. An important finding of this study was that the likelihood of continuing with the outdoor activities experienced at the cottage program, for example handcycling, was high with 47.1% saying they would continue with the activity beyond the program (Hitzig et al., 2012). Participants were highly satisfied with the program overall, where increased self-efficacy, positive affect, and mood were observed over time in participants, which was not seen in controls. Having higher self-efficacy is associated with improved psychological, social, and physical outcomes, which is important to promote early into post-injury to increase physical activity participation for health and well-being (Hitzig et al., 2012). Additionally, a variety of outdoor recreation opportunities is beneficial for increasing physical activity participation to find a purpose and enjoyment.

Loeffler and White (2022) used a duo-ethnography research design to present shared experiences and stories from an outdoor trail adventure. One of the authors is an outdoor instructor, and the other author is a person with a disability, working as a community-based organization manager and sought participation in outdoor adventure activities. Through back-and-forth dialogue, and the use of photographs, both authors

explore narratives that arose from the learning experience of participating in outdoor adventure activities. Through this research, perceptions about accessibility, inclusivity, public and self-perceptions about capabilities and acceptable risk engagement were included. The equipment used for exploring the nature trails was a “TrailRider”, which is a device that seats an individual in the middle of the equipment, and often has a single wheel on the bottom. The TrailRider requires the assistance of at least one other individual who is able to push or pull the trail rider for the person sitting by using handlebars, allowing the individual to explore nature using comfortable equipment (Loeffler & White, 2022). There was a need for collaboration using the TrailRider to navigate trails, but the authors explain that the collaboration of people with and without disabilities provided insight into the overall outdoor experience.

There was a role of interdependence in exploring outdoor environments, where the people helping out, as well as the person with a disability, share the responsibility for making sure the individual with a disability experiences a well-rounded exploration of nature (Loeffler & White, 2022). However, living without risk reduces independence, and the authors described that it is a risk to put trust in others and to engage in challenging activities, but risks are typically taken less often for persons with a disability. It was highlighted that the idea of disability needs to be separated from fragility. The authors noted that there should be a reasonable risk because individuals can miss out on opportunities without it. Risk was described as a natural part of life for everyone and there needs to be a shift in the value of risk, allowing individuals with disabilities to define what risk means to them. A common theme in the challenges faced during the outdoor adventures was that people can have the best of intentions but without being

informed, can undermine the purpose of participation. There needs to be consideration of barriers and experiences of people with disabilities by asking people with disabilities what are those barriers and experiences.

Trail Preferences of People with Disabilities

Brown et al. (1999), carried out a study that explored the preferences and perceptions of parks and nature spaces of people with mobility disabilities and their companions, for encouraging positive leisure experiences for people with disabilities. A survey was completed by the participants and another by the companion that would visit trails with the participant who had a disability. The study used photo questionnaires where surveys included photographs of a variety of natural parks in Michigan and Ohio, and participants were asked to rate the scenery of each photo as if taking a hike through each trail, assuming there were no accessibility problems. In the responses to the surveys, minimal differences in preferences were observed between participants with disabilities and their companions, and preferences were not significantly different for various degrees of mobility limitation, or the extent of perceived barriers to going on outings. Overall, forests were preferred to open spaces even though forested areas were more challenging to navigate, the presence of trees was more enjoyable and were perceived to provide shade from the sun, and shields from other weather elements (Brown et al., 1999). Even when accessibility was meant to be assumed for each trail, forest spaces with more clear paths and more light were preferred. The perceptions of the natural environment were strongly impacted by the greenery and smoothness of the ground surfaces, as well as the clear visibility along the trails, as these are qualities that foster exploration. This study highlighted that individuals with mobility limitations have many similar preferences to

people without disabilities in the kinds of settings they would like to experience. Although the majority of users had similar preferences for trail conditions, such as being in forested areas, variability in the types of natural spaces available is important, since Brown et al. (1999) explained that open spaces were also ranked high in preference among participants. The physical activity needs of people with disabilities can be supported by using photographs of trails to assess features of the spaces to help people to determine whether they would feel enabled to use the space for physical activity (Brown et al., 1999).

Moore et al. (1996) explored comparisons of trail preferences between people with and without disabilities from 3 different rail trails, which are unused railroads, with hard, flat surfaces for multi-use and recreational trails. Interviews were held on-site, and participants were asked questions about trail settings and preferences with a Likert scale. People with disabilities who were interviewed expressed that the trails that were accessible were often more populated, likely because there are a limited number of trails that people with disabilities can access. While there still was not a proportionate amount of people using the trails, the crowded accessible trails indicate a need for more nature trails to be made more accessible for people with disabilities. In addition to the access of trails, people with disabilities were interviewed on their preferences for trail conditions. Some of the preferences described were, the inclusion elements of historic interest, long straight paths, drinking water and restroom facilities, and having accessible signage and information for the trails. These preferences for trails were not very different for people with disabilities and without disabilities. However, Moore et al., (1996) explains that people with disabilities may not have had much experience using many accessible trails,

so it is possible that people with disabilities may not know what is missing from trails and how valuable certain trail features can be. It is important that the accessibility of trails is elevated, so that the physical activity needs of people with disabilities are being met.

Equipment

E-Bikes

Literature on biking equipment has been expanding with the growing cycling technology. Recent advances in electrical-assist technology is being used for bikes and scooters, to help with increasing physical activity through active modes of transportation (Jenkins et al., 2022). Jenkins et al. (2022) conducted a scoping review on the emerging pedal-assist e-bikes that are being used for leisure and active commuting. From the results of this study, there were reported gaps in the literature regarding the use of pedal e-assist for handcycles (Jenkins et al., 2022). The missing research on handcycles with e-assist is an important component of adapted sports, as the technology that helps able-bodied riders be more physically active may have a role in facilitating physical activity for people living with a spinal cord injury as well. For the sport of adapted mountain biking, more research is needed to understand the role that e-assist plays in making handcycles more accessible for participation.

Summary of Literature

The results of this literature review highlight that there is minimal research on the factors that facilitate nature trail use for people with spinal cord injuries, specifically individuals who engage in adapted mountain biking (Zeller, 2008). More research has been done on the barriers, but there is a need to have more in depth descriptions on what enables adapted mountain biking for people with a spinal cord injury. This is an important perspective, as it can provide a more thorough understanding of how factors

enable physical activity, and how they can be broadly implemented for people with spinal cord injuries to be more physically active (Hitzig et al., 2012; Loeffler & White, 2022). The factors that enable general physical activity for people with disabilities are present in the literature. The majority of physical activity participation is influenced by the accessibility of opportunities to participate, or the level of motivation and other personal variables that influence physical activity at the individual level (Fekete & Rauch, 2012; Levins et al., 2004; Tolerico et al., 2007). Based on the literature there are many personal, societal, and environmental factors that influence physical activity, but the effect that each of these types of factors has on physical activity when using trails for adapted mountain biking is unclear for people living with spinal cord injuries (Hitzig et al., 2012; McAvoy et al., 2006; Moore et al., 1996). In order for more people living with a spinal cord injury to get the most out of what riding trails has to offer, research is needed to understand the facilitators adapted mountain biking (Zeller, 2008). The following research questions to address the gaps and help guide this study are:

1. What are the facilitators of adapted mountain biking related to the lived experiences of people living with a spinal cord injury?
2. How does equipment facilitate adapted mountain biking for people living with a spinal cord injury based on their lived experiences?

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Chapter 3. Facilitators of Adapted Mountain Biking According to the Lived Experiences of People with a Spinal Cord Injury

Abstract

Purpose: The purpose of this qualitative study was to describe the facilitators of adapted mountain biking for people living with a spinal cord injury.

Methods: Ten adults with a spinal cord injury were recruited using purposive and snowball sampling strategies. Following a descriptive phenomenological methodology, individuals participated in an online one-on-one semi-structured interview. The transcription of audio-recorded interviews was supported with Otter a.i. software. NVivo software helped to analyze and organize the data into themes.

Results: There were five main themes related to the facilitators of adapted mountain biking that emerged through an iterative process of data analysis. The themes are *motivation, human connection, personal facilitators, organizational facilitators, and accessible physical environment facilitators*. All of the facilitators were described as important to the experience and accessibility of adapted mountain biking for participants.

Conclusions: This study's findings indicate that the facilitators of adapted mountain biking described by participants work together to increase participation. The motivators of adapted mountain biking were described as the reasons *why* individuals participate, which was distinct from the other facilitator themes that explained *how* individuals were enabled to participate. Results indicate that there is some progress being made with facilitators of the sport, but barriers still exist. More efforts to implement facilitators from this study are needed to facilitate participation for current and future riders.

Introduction

Physical activity encompasses any voluntary movement of the skeletal muscles in the body, for a variety of purposes (Caspersen et al., 1985). Participation in physical activity is not only important for physiological and mental benefits, it is also an outlet to connect with other people, tackle challenges, and find purpose for oneself (Rocchi et al., 2017). Notwithstanding the known benefits to being physically active, not enough people are engaging in physical activities on a regular basis (Christie et al., 2021). With approximately 20% of the Canadian population participating in the recommended amount of physical activity per week, there is a large gap between the knowing, and doing, of being active (Christie et al., 2021). While approximately one fifth of the general population engages in physical activity, an even lower percentage of people with spinal cord injuries are physically active (Rocchi et al., 2017). Of the roughly 85,000 Canadians living with a spinal cord injury, approximately 10,000, or 12%, are regularly physically active (Noonan et al., 2012; Rocchi et al., 2017). This low engagement with physical activity means that a high proportion of this population is not getting the benefits of regularly participating in physical activity (Martin Ginis et al., 2010).

People living with a spinal cord injury often experience significant challenges with mobility, most often requiring the use of mobility aids such as wheelchairs (Stevens et al., 2008). The independence of individuals living with a spinal cord injury is commonly affected, which has been shown to impact physical and psychological well-being (Jetha et al., 2011). However, there are Canadians living with a spinal cord injury who do participate in physical activities regularly, and have the lived experience that is important to explore in research. The personal experience of being physically active, as a

person living with a spinal cord injury, gives insight into the factors that contribute to their participation, otherwise referred to as enabling factors or facilitators (Orr et al., 2021). In the context of physical activity, facilitators are environmental, societal, or personal features that enable participation in physical activity (Carty et al., 2021). Facilitators of physical activity are important for individuals living with a spinal cord injury because they increase the accessible opportunities for participation in meaningful and healthy physical activities (Levins et al., 2004).

Whatever the physical activity goals, expectations, and needs are of individuals living with a spinal cord injury, there are ways to facilitate participation (Rocchi et al., 2017). All people, especially those living with a spinal cord injury, deserve more societal and environmental efforts to be made, to create opportunities to fully participate in physical activities, at recreational and competitive levels (Carty et al., 2021). Both indoor and outdoor environments are used in adapted sports by individuals living with a spinal cord injury, but outdoor environments are often not accessible (Burns et al., 2008). While many outdoor spaces for physical activity are not considered to be inclusive for people living with a spinal cord injury, there are benefits of engaging specifically in physical activity in nature, such as increased cardiorespiratory fitness and boosts in mental health (Mitchell, 2013; Stieb et al., 2016; White et al., 2016).

One outdoor adapted sport for people living with a spinal cord injury that provides the health benefits of being in nature, as well as the physical benefits of cycling, is adapted mountain biking. Adapted mountain biking is a sport similar to mountain biking, but is designed for people with disabilities who require adapted equipment to participate (Dickson et al., 2020). The uptake in adapted mountain biking has grown in recent years,

as the sport has gained more traction and attention in the disability and adapted sport communities (Dickson et al., 2020). With the increase in attention, there is a greater focus on the elements of this sport and what makes it an important activity for people with disabilities (Dickson et al., 2020). There has been research on the benefits to outdoor trail use, particularly for leisure, among people with disabilities, emphasizing the importance of connecting with nature, socializing with people, and developing a sense of autonomy (Zeller, 2008). However, there is a lack of research on the sport of adapted mountain biking specifically for people with spinal cord injuries. While the current research on activities in nature lend insight into the benefits of being physically active outdoors (McAvoy et al., 2006), there is a lack of understanding about the facilitation of the growing sport of adapted mountain biking in research.

The outdoors have long been thought of as inaccessible for people with disabilities (Burns et al., 2008; Moore et al., 1996), but individuals who do participate in adapted mountain biking have personal lived experiences with being able to access nature trails. Mountain-biking hand-cyclers with spinal cord injuries in Canada have been an understudied group in research (Loeffler & White, 2022; Zeller, 2008). Currently, the research on the experiences of people with spinal cord injuries participating in adapted mountain biking primarily revolve around the barriers that individuals face (Burns et al., 2008; Moore et al., 1996). There is no research that has specifically focused on the facilitators of participation in adapted mountain biking for people with spinal cord injuries (Zeller, 2008). While the challenges with participation are still a part of the disability experience, research focusing specifically on the facilitators is critical to understanding the overall lived experiences of people living with a spinal cord injury (Orr

et al., 2021). This study describes the facilitators of adapted mountain biking as told by individuals living with a spinal cord injury who have lived experiences with participating in this sport. The following research question sought to address this study's purpose.

> What are the lived experiences of people living with a spinal cord injury, related to facilitators of adapted mountain biking?

Methodology

Methodological Framework

The qualitative methodology of descriptive phenomenology was selected for this research. Descriptive Phenomenology is a research methodology that presents a phenomenon, as described by participants, to explore the lived experiences of people based on a particular topic of interest (Creswell & Poth, 2018). This methodology was used as a framework for inductively exploring the phenomenon of people living with a spinal cord injury experiencing facilitators of adapted mountain biking, through thematic analysis. The descriptive phenomenological approach is important for qualitative research in which there is little to no research (Matua & Van Der Wal, 2015). Instead of the meanings behind the participants' words being interpreted, as with interpretative phenomenology, the descriptive phenomenological methodology was chosen to describe the participants' experiences through direct explanations, to provide new knowledge on the phenomenon (Matua & Van Der Wal, 2015).

Eligibility

This study was approved by the Ontario Tech Research Ethics Board under REB Certificate Number 17005 (see Appendix 1). To be eligible for this study, participants needed to be adults 18 years old or older, living with a spinal cord injury, who ride nature

trails using adapted mountain biking equipment. In order to participate in this research, participants needed to have self-declared lived experiences with biking rural nature trails for physical activity, competitively or recreationally, after the onset of their spinal cord injury. They also needed to speak and read English, have accesses to computer technology and the internet, to be interviewed using the Google Meet Videoconferencing platform (Archibald et al., 2019). The participants who met these criteria completed and signed a consent form to indicate their written consent to participate.

Recruitment

Ten participants with a spinal cord injury, 1 woman and 9 men, were recruited. Based on previous qualitative research of this nature, a range of 6-10 participants is standard for achieving enough data to support the research questions (Creswell & Poth, 2018). The data reached a point of saturation with the research themes that arose, based on the ten interviews with participants. The professional social media accounts of the lead supervisor, Dr. Meghann Lloyd, were used to post the recruitment materials to her professional connections, as well as to the public (see Appendices 2 and 3). Snowball sampling recruitment for this research was also fostered through the help of a professional connection of Dr. Lloyd (Creswell & Poth, 2018). The professional connection helped distribute the recruitment flyer and letter to his network of mountain-biking hand-cyclers.

Participants read and signed an online Google Forms consent form before being sent a link for a Google Meet interview at the time and date discussed between the researcher and the participant. After signing the consent form, all participants also completed a demographic information form to provide context on the individuals being

interviewed. Once the informed consent was given through the signed consent forms and the interview had taken place, participants received a $50 Amazon gift card.

Study Design and Data Collection

The purpose of conducting interviews was to have participants describe their lived experiences with nature trails and specifically what has facilitated their adapted mountain biking experiences (Creswell & Poth, 2018). This study used individual virtual semi-structured interviews, following an interview guide that was pilot-tested. The pilot-tested interview session fell within the expected semi-structured interview timeframe of 60-90 minutes, where the feedback provided was taken into consideration and incorporated into the interview guide.

Ten semi-structured interviews were held during the months of November and December 2022. Each interview was approximately 60 minutes long, with a range from 45-80 minutes, following a semi-structured interview format (see Appendix 6) (Matua & Van Der Wal, 2015). Interviews took place using a virtual video call platform, Google Meet, for the convenience of the participant, and to be able to interview individuals from a broader geographical range (Archibald et al., 2019). The interviews were audio recorded using Otter.ai. computer software, and transcribed verbatim for each participant by listening to the audio recording to catch and correct any errors; this method has been used in other published studies (Abu Itham et al., 2023). Right after the interview, reflexive journaling and field notes were written by the researcher to identify key ideas that participants described.

Data Analysis

Verbatim transcripts were analyzed inductively, using NVivo 12 computer software for the coding of themes. NVivo 12 was used to organize quotes from interviews into codes to represent the results of this research (Zamawe, 2015). Thematic analysis was the qualitative research method used in this study to iteratively develop codes, based on the content of the interviews as they related to the phenomenon of this study. (Sundler et al., 2019; Zamawe, 2015). A codebook of the themes was developed for use by the primary researcher, and later for a second student researcher for assessing intercoder reliability (Zamawe, 2015). To code the interview transcripts, the researcher read through the documents to highlight sections and quotes from the participants. Codes were created and selected that represent the common themes that emerged from the descriptions of the participants (Zamawe, 2015). Once all the transcripts were coded, a second round of coding was performed to make sure all the themes were captured in each transcript as they emerged. After the coding process was completed, the lower level codes were organized and grouped into several main themes before being further categorized into the finalized themes presented in the results of this study. Throughout the development of the coding process, the researcher received input from the lead supervisor and continued to be immersed in the research by using the data to describe the phenomenon as explained by each participant (Green et al., 2007).

Reliability and Validation Strategies

One way the results of the study were validated was by having the researcher engage in reflexivity, by acknowledging her part in the research process. Creswell and Poth (2018) explain that reflexivity addresses the confirmation bias that the researcher

holds about this research, such as the beliefs about the values of physical activity, adapted mountain biking, and the facilitators of the sport that could be common for people with spinal cord injuries. Additionally, the researcher consulted with the research supervisor on the themes that emerged, to make sure they were true reflections of the participants' descriptions. Being reflexive throughout the process of data analysis helped to identify where the researcher's bias intertwined with the data and assisted in reducing this bias. Reflexive journaling is a validation strategy that uses bracketing of data to address where biases of the researcher may be found, and to attempt to ensure the research is as true to the participant's descriptions as possible (Creswell & Poth, 2018). A reflexive journal was used by the researcher to detail the explanations for decisions made related to the coding process, to ensure the intentions of the researcher are clear. The researcher used verbatim quotes in combination with field notes to provide rich descriptions about the data that represents the phenomenon (Creswell & Poth, 2018). Having rich descriptions of the data provides context that is important for the research to be transferable to the contexts of other research (Creswell & Poth, 2018).

The researcher was involved at each stage of the research process, including the data collection, data analysis, and writing stages of this research study (Creswell & Poth, 2018). Participants were sent their transcripts as a form of member checking, for making any additions or deletions, or for leaving their transcript as it is. This step is important for openly communicating about the results of the study and helped with avoiding miscommunications about the analysis of the interview data, helping to validate the results of the research (Creswell & Poth, 2018). After analyzing the results of this study, the researcher touched base with the professional connection who aided in the process of

recruitment, to get insight on the direction of the discussion points. This consultation provided feedback that was integrated into the themes and language used in this research, as a quality check.

The reliability of qualitative research is strengthened with the comparison of coding analyses between researchers (Creswell & Poth, 2018). To increase the reliability of the results of this study, another student researcher was asked to analyze a portion of the transcribed interviews using a codebook that was created by the primary researcher. The primary researcher coded the transcribed interviews first, before demonstrating the coding process to the secondary coder, to have the knowledge to code the interviews with the same approach as the primary researcher. This analysis process is used to validate that the phenomenon is being described true to the participants description from their interview, to reduce bias from the primary researcher (O'Connor & Joffe, 2020). The secondary coder had a practice session on how to use NVivo 12 software and became familiar with the codebook before performing the coding for the assessment of reliability. The secondary coder coded 10 percent of the transcripts, which is considered a reliable portion of the data for intercoder reliability to be assessed (O'Connor & Joffe, 2020). Upon completion, the coding done by the secondary coder was analyzed through NVivo 12 by the primary researcher, for determining the reliability. In the first round of assessing intercoder reliability, the agreement percentage was 84 percent between the codes or themes that were used by both or either of the primary and secondary coders. Miles et al. (2014) explains that an 85 to 95 percent agreement between the coding of the primary coder and secondary coder is acceptable. If the reliability score is lower, then the coding process is reviewed, and the secondary coder codes the transcripts again until

meeting an acceptable agreement (Miles et al., 2014). Even though the coding agreement was high and almost within the most agreeable range, after meeting with the secondary coder again, another round of secondary coding was performed to strengthen the validity. In the second round of coding, an agreement of 92% was reached for the sections coded by both participants. This agreement demonstrates a high similarity between the coders, and the codebook that was used for data analysis is reliable for the intercoder reliability process. Taking this measure helped to demonstrate that the analysis done by the researcher is understandable and replicable for other people (Creswell & Poth, 2018).

Positionality and Bracketing

Throughout the research process, particularly qualitative research, the researcher is involved and immersed along the way, at every step (Creswell & Poth, 2018). The researcher of this study made the decision to select descriptive phenomenology as a qualitative methodology, to best capture the descriptions of participants' lived experiences, with minimal personal bias (Creswell & Poth, 2018). Additionally, in order to help construct meaning from the participants' descriptions, the constructivist framework, a philosophical perspective, was applied to inductively analyze the data. This philosophical framework enforces the idea that the reality of individuals is crafted through a collection of their lived experiences (Hopkins et al., 2017). This perspective is fitting for the current study as it highlights the importance of gaining knowledge from the lived experiences with participating in adapted mountain biking as a person with a spinal cord injury, which have shaped the reality of physical activity for the participants (Hopkins et al., 2017).

To demonstrate bracketing, the researcher identifies how she positioned herself in the context of this research.

> *While qualitative research cannot be completely bias-free, I approached the interviews and data as an outsider to the knowledge that participants shared, in order to separate my perspectives and beliefs from the new knowledge and true descriptions of the participants (Matua & Van Der Wal, 2015). To assist with reducing personal bias, while also bringing the participant's descriptions of their experiences to the forefront, I distinguished and extracted, or bracketed my own experiences related to physical activity and nature trail use from those of the participants by comparing the data itself to the notes I made related to the data. While the facilitators were identified through the descriptions of participants, experiences with facilitators are still not very common. The barriers to adapted mountain biking, especially environmental and organizational, still largely exist, according to participants who actually participate in the sport. However, the select facilitators described by participants in this study can help inform strategies to address the barriers; that the facilitators experienced based on participants' lived experience can inform solutions to equal but opposite barriers.*
>
> *From previous years of education with an undergraduate degree in Kinesiology, the knowledge I had gained, primed me to expect that people's experience with disability is individual to each person (Patton, 2019). This perspective was helpful during the interviews and data analysis process, yet I was still cognizant to not assume that all participants, and more generally people with spinal cord injuries, have the same lived experiences, although there are*

similarities (Patton, 2019). To reduce the biases I held related to adapted mountain biking and people living with spinal cord injuries, such as perceptions of how risky or safe the sport is, I read and made notes on an array of research articles that pertain to the phenomenon of this study. This helped to educate myself on how to address some of my biases about adapted sports, and ground my knowledge background in factual and comprehensive research (Patton, 2019). Additionally, the literature search process helped to frame the interview questions in a way that minimizes confirmation bias and seeks to address gaps in the literature. Through interactions with participants, some of my preconceived notions were challenged, such as some of the terminology used related to the phenomenon. In particular the term "adapted mountain biking" was used by participants during their interviews and was deemed the most all-encompassing term to describe the sport. However, through continued research and discussion with participants, the equipment used was decidedly referred to as a handcycle, to emphasize that the handcycle is ridden by cranking the pedals with one's hands (Kraaijenbrink et al., 2021).

It is important to note that I, as the researcher, do not have a spinal cord injury, or another self-identified disability, nor do I have close relatives or friends with a spinal cord injury. From the perspective of being an outsider to the lived experiences of having a spinal cord injury, as well as participating in the sport of mountain biking, adapted or otherwise, the descriptions from participants are potentially less biased due to the absence of conflicting lived experiences. However, I have had experience working at an overnight summer camp for youth

and young adults, most of them living with cerebral palsy and other physical disabilities. Through this experience I interacted with campers for personal care needs, as well as to facilitate their involvement and participation in artistic and athletic activities. Two summers spent at this camp as a counselor impacted my views on disability, particularly on the role of accessibility in the day-to-day lives of people living with mobility challenges. As this was a fully wheelchair-accessible camp, it has distinguished itself from some establishments in both urban and rural environments, and instilled in me the value of accessible and fulfilling physical activity experiences for people with disabilities.

Results

Ten individuals with a spinal cord injury, nine men and one woman (n=10), participated in a one-on-one virtual interview with the researcher. Five participants self-identified as white, three as black, one as bi-racial, and one as Canadian with a European background. Based on the trails described by the participants in their demographic form and descriptions from interview transcripts, nine of the participants reside and engage in adapted mountain biking in Ontario, Canada, and one participant lives and rides in Alberta, Canada. This study population encompasses a variety of mountain-biking hand-cyclers, some with 5 or more years of experience who ride more than 10 times a year, and others who have just recently adopted the sport and ride a few times in the year. The age range of participants was 26-61 years old. Those over the age of 50 who reported on their income were in the middle to high income range (Statistics-Canada, 2023), and made up 50% of participants for this study. The 30% of participants between 26-29 years of age who reported their income were in a lower to middle income bracket (Statistics-Canada,

2023). The remaining 20% of participants chose to not disclose the range of their annual income in the demographic form. The purpose of asking participants to report on their income was to give contextual information on the affordability of the sport of adapted mountain biking.

Table 1

Demographic Information as reported by Participants

Participant	Sex	Age Range (years)	Frequency of Biking
1	Male	50-61	> 10 times/ year
2	Male	50-61	> 10 times/ year
3	Male	50-61	7-9 times/ year
4	Female	50-61	> 10 times/ year
5	Male	50-61	> 10 times/ year
6	Male	50-61	> 10 times/ year
7	Male	26-37	7-9 times/ year
8	Male	26-37	> 10 times/ year
9	Male	26-37	4-6 times/ year
10	Male	26-37	1-3 times/ year

Participants were asked to describe their adapted mountain biking experiences and the factors that have influenced their participation in adapted riding. The lived

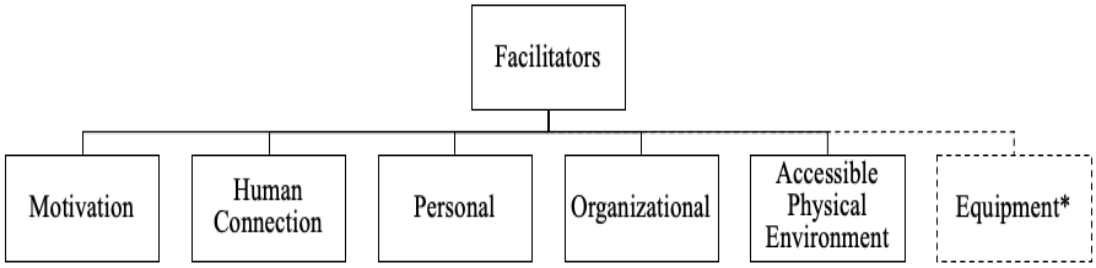
experiences of participants were explained through the facilitators of adapted mountain biking.

Facilitators

The Facilitators described by participants have been categorized into Motivation, Human Connection, Personal Facilitators, Organizational Facilitators, and Accessible Physical Environments.

Figure 1

Facilitators of adapted mountain biking for participants



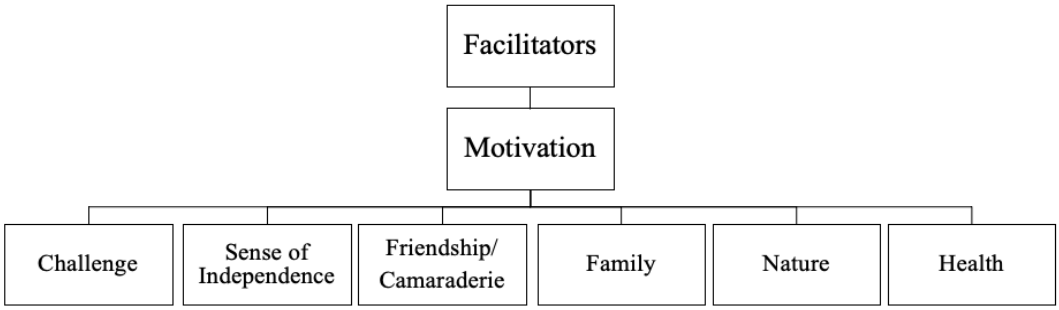
** The category of "Equipment" is a comprehensive theme that is united with the themes under the Facilitators of adapted mountain biking; this theme is further discussed in Chapter 4 of this thesis.*

Motivation

The intentions with which individuals engage in adapted mountain biking, were described by participants as reasons for "why" they ride, or what motivates them to participate.

Figure 2

Motivation Facilitators of adapted mountain biking



Challenge: A prominent motivation addressed by participants was the interest in challenge and seeking a sense of accomplishment through adapted mountain biking.

> "So, if you go through a trail for the first time, and you can't do it all clean, by clean, meaning no assistance, then you keep striving towards that goal, and then when you achieve that goal, there's definitely a sense of accomplishment" (P2).

Participants described how striving for personal goals and competing with oneself is a motivator for adapted mountain biking.

> "If you fail the first time, then you go back and do it until you can actually, you know, do that climb without having to stop or getting any help, those types of things, so that's the competitive side as far as, competing with yourself, not necessarily competing with others, it's about being, competing with yourself and being, setting, putting yourself in a mindset that 'hey, you know, you can do this' or 'you know what, I did this different, I, I'm going to do it differently this time', and it's, it's almost like solving problems, problem-solving" (P5).

Sense of Independence: Independence means different things to different people. Some participants described experiencing a sense of independence as being free to roam.

> "It just gives me the freedom to get outside and, you know, I've always loved the outdoors and you know that the ability to go fast and you know, the freedom to go where I want, it's, you know, you can't really say, you can't really understate the importance of that" (P4).

Some participants viewed independence as the ability to do things for themselves, on their own.

> "I love the fact that I'm independent and completely independent. I've got no help, and I'm doing it on my own, and I'm getting through and I, you know, it's a sense of accomplishment to, to have done that on your own, solo" (P6).

Friendship/Camaraderie: A sense of camaraderie and friendship was described as important factors in their participation in the sport of adapted mountain biking.

> "It's one of those things that it, it brings me and my buddies together. So, it's, it's the impetus for things that are social. It drives social interaction with other guys who are paraplegic to become great friends, so we don't get together every two weeks to have lunch, but we do, in the summer we try to get together every two weeks to ride" (P1).

Family: The influence of family in motivating participants to get involved in adapted mountain biking were described.

> "A few of my family members, yeah, they are bikers, yeah by profession, so they're the ones who motivated me" (P10).

Nature: Participants described their interest in riding stemming from an enjoyment in nature and being outdoors.

> "The peace that comes from, from riding in the trees in the forest, and, you know, in the fall, we all just took note again, although we do a lot of rides together, um we had some really beautiful days where, you know, just the smell of nature was there, we stopped and just, just took it all in" (P3).

Health: As with any sport, participants described the role that adapted riding has on their health, both physical and mental, and how that encourages them to participate.

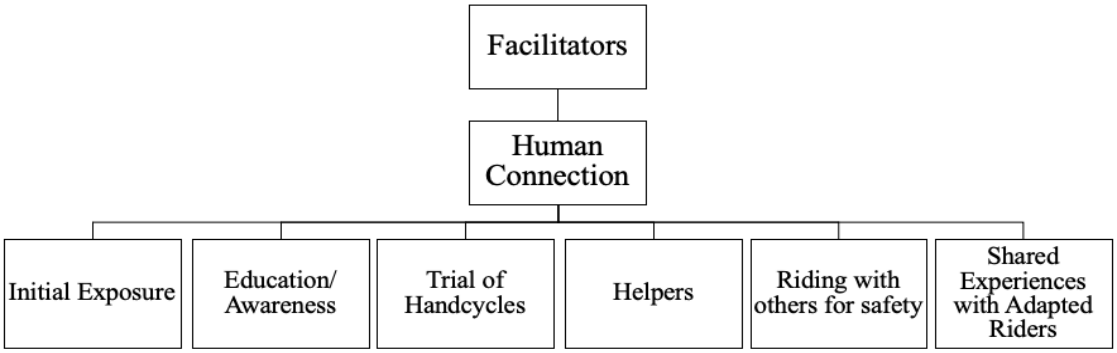
> "For me, honestly, it's, a lot of it has to do with mental health. So, the nice thing about when I'm out there, I can escape reality for a little while. So, for those that have spinal cord injuries, we deal with a lot of stuff… for me going out on the trails with my friends is a bit of normalcy. Yes, it's different, I'm on a different bike, but I'm still being able to go out with them, be in the trails, enjoy my day, enjoy the scenery, and it's good for my mental health" (P5).

Human Connection

Connecting with other people was described as an important part of facilitating adapted mountain biking for the participants. How people have influenced the participants in their adapted mountain biking experience has been described in the subthemes of initial exposure, education/awareness, the trial of handcycles, helpers, riding with others for safety, and advice from adapted riders.

Figure 3

Human Connection Facilitators of adapted mountain biking



Initial Exposure: Participants all had their unique path to discovering adapted mountain biking, but at the root of the exposure to this sport, they described a connection to other people as an initial outlet.

> "Yeah, there is actually, [name of acquaintance], who I think you know, I got connected through him through this cycle shop that I used to deal with. And when I got injured, they had said 'hey, you know, you should talk to [name of acquaintance]'" (P5).

Education/Awareness: Having awareness of opportunities for adapted mountain biking in the community and among stakeholders was described as a component of the facilitation of adapted mountain biking for participants.

> "I really sort of want to help other people that, you know, with Handcycling Club of Canada, and that's basically our biggest mandate is to get people, new people sort of into the sport and help them discover how awesome it is" (P6).

Trial of Handcycles: Having opportunities to try riding a mountain-biking handcycle, particularly those of friends and acquaintances, before purchasing one was described as a facilitator to participating in the sport of adapted mountain biking.

> "I reached out to [name of acquaintance] and him and I had a chat and I went over to his house and tried his bike, he said 'come on over the house and try my bike to see if you like it', and it was like it was probably one of the best things I've done, and it put a huge smile on my face like it did before, and so I, I knew right there and then after I got on the bike that that's absolutely something I wanted to come back and do again" (P5).

Helpers: Participants described the influence of other people helping them prepare for a ride or having individuals, particularly able-bodied riders, accompany them on the trails.

> "Having that able-bodied person when that's happened to us, you know, we've always, we always want to explore new trails, but it depends who's with us at the time, that'll determine if, if we're able to do that. If they're strong enough to lift the back of the bike and, and move us around, or if there might be an obstacle, which we've come across where it was a fallen tree, that makes it completely impassible, um that's again when you need that buddy to help you out" (P3).

Riding with Others: For some participants, riding with other people is a way of staying safe on the trails in case they need assistance.

> "Depending on how many able-bodied people we have, or if we have able bodied people we'll be more adventurous in the sense where we'll try some different things. If it works, it works. If it doesn't, we might need help, or we might have to be picked up and turned around or something" (P6).

Shared Experiences with Adapted Riders: Connecting with individuals through adapted mountain biking by sharing advice and experiences was described as a facilitator to participation.

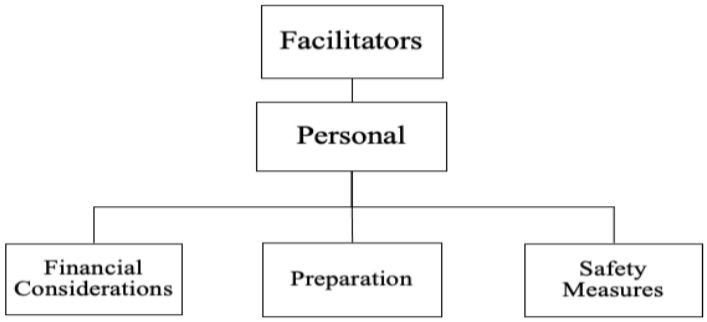
> "what you also find is that, you know, for some guys, a lot of guys in chairs, getting together to go for a bike ride, you have conversations about challenges you might be having that are related to your injury, that you wouldn't pick up a phone and ask, but while the guy sitting there, you're having a beer, like, 'has this happened to you?', and "what did you do about that?', and so there's that peer, peer mentoring stuff that goes on informally" (P1).

Personal Facilitators

Another way that adapted mountain biking is facilitated, as described by participants, is through personal facilitators, which reflect the individual actions taken or opportunities. The theme of personal facilitators is further divided into categories of financial considerations, preparation, and safety measures.

Figure 4

Personal Facilitators of adapted mountain biking



Financial Considerations: Participants having access to financial resources, in relation to the cost of equipment and transportation, was described as a facilitator to

participating in adapted riding.

> "I think the success of, success of our business as well over the last 15 years has given me a little bit more financial freedom, and that's made it a lot simpler to make the purchase for a bike that's $20,000" (P3).

Preparation: Personal steps taken by participants to prepare to ride through nature trails were described as facilitators to their participation in adapted mountain biking. "Checking the weather and those notification systems would be the best method I have to know whether or not I should ride that day" (P8). A majority of participants also emphasized the need to have adequate nutrition for biking. "to prepare…you would also bring hydration and, and nutrition for just as long as you're going out, accordingly" (P7).

Safety Measures: When it comes to adapted mountain biking, the majority participants described the importance of safety. Participants describe the risks that are associated with adapted mountain biking, and how taking certain precautions is a way to facilitate their participation. Individuals explained that taking steps to reduce the chance of injury by mitigating risk is a way that they stay safe while mountain biking.

> "I have become so careful, and I have to be more careful because of my, my injury, I can't ride without being, concentrating on this thing because it's so painful to fall again, while, while you had a chance to prevent it, and I had the chance to not come again… I put myself first and make sure that I don't make, get my body injured. If it's just a little injury it's okay, not a quite serious one" (P9).

Some participants described how they stay safe while mountain biking by being alert and focused on what they are doing and what lies ahead.

> "You need concentration to be able to be riding the trail system safely and efficiently, and not, to be in tune to your surroundings, which is also um, kind of a nice thing as well, so if you have to be I guess, you have to be alert" (P8).

Organizational Facilitators

The role of organizations in facilitating adapted mountain biking has been described in the facilitator subtheme of organizational facilitators. The groups that make up organizational facilitators are mountain-biking handcycle organizations, adapted sports organizations, bike shops, and trail organizers.

Figure 5

Organizational Facilitators of adapted mountain biking

Mountain-Biking Handcycle Organizations: Some participants described the importance of mountain-biking handcycle organizations that have facilitated their involvement in adapted mountain biking. "Even HCC, which is the hand cycling club of Canada, you know, those guys have been really, really great as far as, you know, connecting and talking about hand cycling and, and get a better understanding of the sport" (P5).

Adapted Sports Programs: Programs that cater to adapted sports were described by some participants as opportunities to promote participation in activities such as adapted mountain biking.

> "Rocky Mountain Adaptive…they do everything, they do like summer programs, every, every sport, like you can't imagine what they do, and if somebody wants to go on the mountain, like the big mountains, they're like, let's do it, they figure out a way. They take anybody to do anything that they want to do. No Limits, that's their, that's their motto" (P4).

Bike Shops: All participants emphasized the importance of having bike services, such as bike shops, available and accessible for general tune ups or larger repairs to their bikes.

> "...once you find a bike shop or two that, that are, you'll find certain ones that are stoked about it, they love it, they, they think it's so cool, they love that you're coming there and that you're, they're challenged by it, they, it's different, they enjoy it. So, I've been lucky enough to find two shops that I use, and I have a couple of mechanics that are really helpful" (P6).

Trail Organizers: The cooperation and effort from trail organizers to improve trail accessibility was mentioned as a facilitator to adapted mountain biking.

> "What we've been doing now is, all those parks I mentioned, we actually set up dates and met some of the sort of senior people, whether they're trail builders, or the guys who are involved with racing or whatever, and we actually were kind of trying to pioneer what's accessible in those parks. So, we're kind of helping them

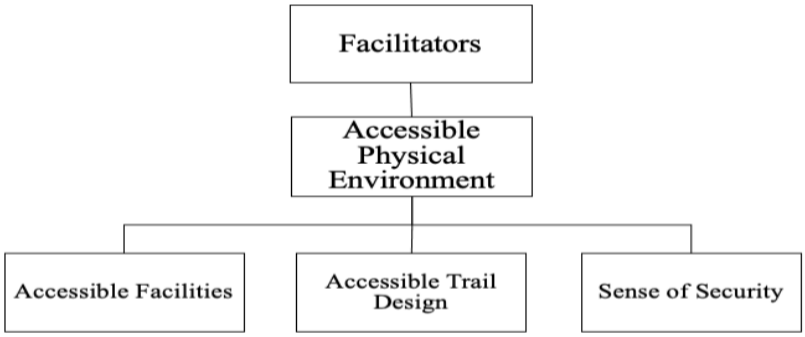
out and helping ourselves out in terms of mapping what works for our adapted bikes" (P6).

Accessible Physical Environment

Accessibility of the environment was described as a factor in the facilitation of adapted mountain biking and was explored further within the categories of accessible facilities, accessible trail design, and a sense of security.

Figure 6

Physical Environment Facilitators of adapted mountain biking



Accessible Facilities: Accessible facilities at the trail sites were described as facilitators to adapted mountain biking for participants.

"... having a washroom on site that's accessible, you know, a porta potty usually, which is fine, but an accessible one makes a huge difference" (P6).

Washroom and parking were noted as common facilities that should be accessible to mountain-biking hand-cyclers.

"Parking is very important, because you need, you need to be able to park your vehicle and then have enough equipment around it to get in and out of your vehicle whatever side you're on, as well as load and unload your equipment and have enough space to get on and off the equipment. So, like accessible parking or

large parking spaces on, on flat terrain, as opposed to on uneven terrain, slanted terrain, which makes it, everything you're doing, that much more difficult, is very important" (P8).

Accessible Trail Design: Considerations for accessible trail design were described as important facilitators for mountain-biking hand-cyclers when riding trails.

"they're trails that are cut out and some of them are pretty wide, especially in the Dundas Valley, that's where I ride, try to ride the most because it just has the most accessible trails that I can go on" (P5).

Sense of Security: Some participants described how having a sense of security within the environment is an important factor in facilitating adapted mountain biking. "I was preferring like, if there were first aiders or, or if there is a facility, a facility where when you encounter such an, an accident, you can be treated there" (P7).

The facilitators of adapted mountain biking expressed in this study encompass a continuum of themes that increase the accessibility of the sport based on the descriptions of participants living with a spinal cord injury.

Barriers

While the focus of the interview questions was on the facilitators, as expected, participants also discussed the barriers as a part of their overall lived experience with adapted mountain biking. Based on the responses from participants, there is an almost equal but opposite barrier to facilitator of adapted mountain biking (see Appendix 7). Some of the reoccurring barriers mentioned by participants were, inaccessible facilities at trails, narrow trail widths, a lack of education and awareness of the sport, and limited access to funding and transportation opportunities, among others. The barriers reflected

opposite themes to the facilitators, with emphasis from participants on the need to address these barriers, through solutions to facilitate adapted biking. The barriers of adapted mountain biking and other adapted sports are more well-established in research than facilitators. The intention, based on the research questions, was to highlight the facilitators as a way to address barriers that still exist.

Discussion

The intention of this research was to understand what the facilitators of adapted mountain biking are, based on the lived experiences of people with a spinal cord injury. The results of this study reflect the guiding research question, and provided insight into the current facilitators of adapted mountain biking as well as the future suggestions for making the sport and physical activity more accessible to people living with a spinal cord injury. The five secondary themes, *Motivation*, *Human Connection*, *Personal Facilitators, Organizational facilitators,* and *Accessible Physical Environments* are further explained in this discussion.

Motivation

Motivation for physical activity can be very personal to the individual (Pryor, 2019), but the motivators described by participants in this study, in relation to adapted mountain biking, had underlying similarities to those of the other participants. Whether it was a drive to participate in thrilling sports for a sense of accomplishment, seeking a sense of independence, improving one's health and fitness, forming friendships with peers, or being in nature, participants in this study emphasized the importance of having the desire to participate. Participant's descriptions about the value of camaraderie through adapted mountain biking demonstrates the role of socialization in physical activity and

this sport (Goodwin et al., 2009; Levins et al., 2004). In relation to the importance of friendships formed through adapted mountain biking, Participant 2 describes how "some of my friends share the same passion and experience the same benefits of um, of being outdoors. So we've continued our friendship on the trails with our bikes". Being present in nature with friends was described as a facilitator of participating in adapted mountain biking, as it was a motivation for participants to experience relatedness from connecting with others (Lundberg et al., 2011; Pryor, 2019). It is important that people living with a spinal cord injury, who participate in adapted mountain biking, experience connectedness through shared lived experiences and challenges, because it facilitates a sense of belonging, through an opportunity to be a part of a community (Lundberg et al., 2011).

It is particularly important for people living with spinal cord injuries to sustain physical activity participation, as it is an outlet for improving health, establishing camaraderie, and increasing self-efficacy, which are important factors that impact quality of life and well-being (Levins et al., 2004; Martin Ginis et al., 2010). The social cognitive theory uses the idea of self-efficacy, a confidence in one's own abilities, to explain motivation behind participation and adherence to certain behaviours (Bandura, 1991). Adherence to physical activity through the lens of the social cognitive theory has been well documented in the research; the findings from the current study support the concepts of the social cognitive theory (Young et al., 2014). In the case of adapted mountain biking, most participants stated that they were mountain bikers and enjoyed the sport before their spinal cord injury, which they described was a contributing factor to their decision to continue with adapted mountain biking. Having self-efficacy in adapted mountain biking was an important factor in motivating participants in this study to

maintain physical activity adherence, especially because the sport of adapted mountain biking is deemed as challenging and encompasses thrill-seeking elements (Young et al., 2014). Participating in adapted mountain biking increases self-efficacy, because the risk-taking involved builds high self-confidence in one's abilities to go through challenging experiences and improve their skills. Adapted mountain biking facilitates engagement in risk-taking to motivate individuals with a spinal cord injury to take on challenges to strive for a sense of accomplishment (Tangen & Kudlacek, 2014).

Adapted mountain biking provides not only physical, but mental challenges that participants described they can work towards time and time again. The appeal of adapted mountain biking for people with a spinal cord injury is that it is reported to be a source of risk-taking, which individuals might not otherwise experience in their daily lives (Tangen & Kudlacek, 2014). When explaining how risk-taking through adapted mountain biking is enjoyable, Participant 3 said, "I do enjoy things like, like speed and going fast and, and having a little bit of risk involved, the sport of mountain biking gives me that". Taking risks helps people to develop skills and traits, such as independence, confidence, and decision-making, that support them in their daily lives (Little & Wyver, 2008). However, the risks that participants describe are within their own established limits, taking calculated risks as to not hurt themselves. It is important that individuals living with a spinal cord injury have opportunities to engage in calculated risk-taking with adapted mountain biking (Musselman et al., 2018; Tangen & Kudlacek, 2014). There are many stereotypes that people living with a spinal cord injury are fragile and cannot engage in risk-taking behaviours, which has contributed to the inaccessibility of the sport due to these ableist prejudices (Cheung et al., 2021; Goodwin et al., 2009; Loeffler & White,

2022). What the current study, and existing research demonstrate, is an opposing reality that challenges these stereotypes; that many people living with a spinal cord injury are not delicate and are quite capable of participating in sports that encourage risk-taking, such as adapted mountain biking (Cheung et al., 2021; Goodwin et al., 2009). The opportunity to engage in risk-taking is a critical human experience (Loeffler & White, 2022), as it helps individuals develop life skills and a sense of independence that is important for people living with a spinal cord injury.

Overcoming challenges helps to create a sense of accomplishment, by achieving goals that are attainable to the individual (Tangen & Kudlacek, 2014). Participant 2 referred to adapted mountain biking as a way to create goals by saying, "you keep striving towards that goal, and then when you achieve that goal, there's definitely a sense of accomplishment". The problem-solving aspect of adapted mountain biking was described as a motivator by participants, as it has helped to facilitate engagement in the thrilling aspects of adapted mountain biking for a challenging and rewarding experience (McAvoy et al., 2006). Finding intrinsic rewards through adapted mountain biking is important for motivating individuals living with a spinal cord injury to continue participating in this particular physical activity (Tangen & Kudlacek, 2014). Striving toward goals creates a lasting interest and adherence with adapted mountain biking, increasing the physical, mental, and social well-being of individuals with a spinal cord injury throughout the lifespan (Tangen & Kudlacek, 2014). Adhering to goals is an important indicator of overall adherence to the sport, as the motivation to create and stick with goals facilitates continued participation in adapted mountain biking for fulfilment and well-being.

Human Connection

A prominent theme that emerged from this research was the importance of human connections to other people. As humans, we are social beings looking for connection and meaning through other people who we can relate to (Goodwin et al., 2009; Hammel et al., 2008). For the participants in this study, sharing experiences around adapted mountain biking involved the giving and receiving of advice with other adapted riders, or just telling stories about their biking adventures. According to participant 5, "it's nice to be able to go out and [ride] with people that have done it… it gives you a little bit more confidence… to know you can bounce that stuff off of people that are in the same situation". Connecting with other adapted riders through shared experiences about adapted mountain biking *and* living with a spinal cord injury was described as a way to create a sense of relatedness and belonging for individuals, somewhat like a support group to share lived experiences (Lundberg et al., 2011).

Research by Lundberg et al., (2011) mirrors the descriptions of participants in this study, as the researchers emphasized the importance of having a sense of community with a group of individuals in similar situations, to support connection with others and a sense of belonging. The Paralympic Games, formerly known as Stoke Mandeville Games, were the first of its kind to introduce community sporting events for people with disabilities (Gold & Gold, 2007). Through these types of events and organizations, people with disabilities have had opportunities to socialize and connect with other athletes through shared lived experiences (Gold & Gold, 2007; Tolerico et al., 2007). Supportive physical activity and social settings for adapted sports helps to facilitate connection and

relatedness among individuals living with disabilities, to continue engagement in accessible physical activity opportunities (Gold & Gold, 2007; Lundberg et al., 2011).

Adapted mountain biking was described as an outlet for participants in this study to not only share stories about their biking experiences, but also their experiences with a spinal cord injury and rehabilitation. After experiencing a traumatic injury, the physical therapy rehabilitation process can be exhausting, but rehabilitation can, and should, also encompass returning to sports for those interested (Jaarsma et al., 2016; Nas et al., 2015). Through the actual biking and the connections made with other people living with a spinal cord injury in rehabilitation sessions, participants explained how there is a sense of camaraderie that can develop and facilitate the post-injury rehabilitation process (Levins et al., 2004). Knowing that there are other people in a similar situation helps encourage the rehabilitation process and return to physical activity, through awareness that there are other people with spinal cord injuries riding mountain-biking handcycles and it could be something for them to pursue (Levins et al., 2004; Wu & Williams, 2001). Encouraging a timely return to physical activity for individuals living with a spinal cord injury is important as it can be part of a long-term, ongoing rehabilitation process, that helps maintain and promote both physical and mental health (Jaarsma et al., 2016).

The more people know of others personally who have similar lived experiences to them, such as participating in activities like adapted mountain biking, the more likely it is they will see themselves as potential mountain-biking hand-cyclers (Lundberg et al., 2011). Participants described the role that socialization plays in their adapted mountain biking experience, indicating that learning from other people impacts how they participate in the sport (Hammel et al., 2008). In the sport context, bonding with other

people around shared experiences within that activity can elevate the quality of that experience, by offering insight into similarities and differences among individual lived experiences (Hammel et al., 2008; Zhou & Kaplanidou, 2018). When people connect on a human level, it brings a sense of cohesion and inclusion, which creates a healthy and supportive community, and adds meaning to the lives of individuals (Lundberg et al., 2011).

The findings from this research emphasize the importance of human connection via adapted mountain biking for people living with a spinal cord injury (Lundberg et al., 2011). Building a supportive space by forming a community of individuals who participate in adapted mountain biking can help grow a network for raising awareness and educating more people on the opportunities for the sport (Wu & Williams, 2001). Some participants described how there are initiatives taking place to extend outreach to more people interested in adapted mountain biking and those wanting to support the sport, but that more efforts are needed. Having more recognition of adapted mountain biking can help form more associations directly between individuals who ride mountain-biking handcycles, as well as organizations that can expand the connections between riders (McCormack, 2018). Spreading awareness about the sport also connects individuals who have not had experience with adapted mountain biking to individuals and organizations who have, to give them insight into what the sport is about and how to optimize their experience (Wu & Williams, 2001).

Personal Facilitators

The actions individuals take to prepare for adapted mountain biking were described as personal facilitators, highlighting the steps that have been taken to improve

the accessibility participating in the sport. These steps can be personalized to the individual, such as the type of warm-up routines that one follows, or how they ensure they receive proper nutrition. The initiatives taken to plan and prepare for adapted mountain biking contributed to the safety of the participants. However, the descriptions of the measures taken to prepare for an adapted mountain biking ride could provide important insight for other riders into the demands of the sport, and how to be proactive in optimizing the riding experience by planning in advance. Research by Bandura (1991) describes how self-regulatory skills are determinants of behaviour, according to the social cognitive theory. This means that planning, goal setting, and preparation skills determine behaviour, and facilitate participation (Arbour-Nicitopoulos et al., 2009; Bandura, 1991; Young et al., 2014). This also highlights the role that planning and preparation has in physical activity adherence by understanding the extent of preparation that is involved outside of the riding time itself (Arbour-Nicitopoulos et al., 2009; Bandura, 1991; Young et al., 2014). Having an understanding of how to prepare for adapted mountain biking means that individuals can be ready for riskier trail riding, while staying safe. Being motivated to engage in risk-taking is associated with a motivation to plan, thus individuals with a spinal cord injury being motivated to plan helps facilitate participation in adapted mountain biking.

Individuals engaging in adapted mountain biking in this study described their personal approach to risk, specifically the safety measures taken by individuals to increase their own sense of safety while biking trails (Loeffler & White, 2022; Musselman et al., 2018). The concept of risk and safety of adapted mountain biking was described as very important by all participants in this study. Taking calculated risks and

mitigating the risk of injury through personal safety measures, such as only riding familiar trails and being mindful about going down trails by assessing them first were described as ways to advocate for oneself while biking. The individual participants' ratio of risk to safety while participating in adapted mountain biking is an important determinant of the accessibility of their riding experience (Musselman et al., 2018). Participant 5 describes: "I look at the trail… if I don't know what's coming up next I'll slow down so I can have a look… or I'll send someone out in front to have a look… to see if it's too steep". Personalized approaches for safety and risk-mitigation are an important part of the process of preparing to participate in adapted mountain biking (Musselman et al., 2018; Tangen & Kudlacek, 2014).

Taking personalized safety measures also helped to promote more independence and sense of autonomy for participants in this study, as they could take actions themselves to make sure they stay safe, increasing the amount of risk they can take (Hammel et al., 2008; Tangen & Kudlacek, 2014). A sense of autonomy and independence is an important component of adapted sports for people living with a spinal cord injury, as it puts the well-being of individuals into their own control (Hammel et al., 2008; Heo et al., 2008). Having ownership over one's health and well-being means that they can ensure they are participating in activities in a way that is safe and enjoyable to them (Arbour-Nicitopoulos et al., 2009; Heo et al., 2008). Participants expressed that they try to do as much as they can themselves to prepare to go adapted mountain biking, so being involved in the planning is a way to build autonomy in multiple aspects of sport participation (Arbour-Nicitopoulos et al., 2009; Heo et al., 2008). Building a sense of independence through adapted mountain biking is important because that feeling can

transfer to other aspects of life, and contribute to the overall quality of life (Heo et al., 2008).

Organizational Facilitators

Organizations that currently exist, such as handcycling clubs and bike shops that that repair handcycles, while few in numbers, were described by participants as important facilitators for helping individuals be better prepared to participate in adapted mountain biking. Some participants mentioned that through handcycling clubs they have found a source of connection to other riders as well as a central location for educating oneself about the current news and information that is important to the sport. Being aware of the opportunities related to adapted mountain biking helps create a network for people living with a spinal cord injury to be a part of, to eventually form communities of mountain-biking hand-cyclers (Hammel et al., 2008; Wu & Williams, 2001). This is an important aspect of adapted sports, as the services that organizations provide motivate and facilitate people with a spinal cord injury to connect, in order to facilitate participation in the sport and community, by developing a sense of belonging (Hammel et al., 2008; Lundberg et al., 2011).

As the sport of adapted mountain biking has grown, participants in this study described how some bike shops have expanded their servicing to pedal e-assist mountain-biking handcycles. An increase in the bike shops that provide servicing and repairs for adapted equipment facilitates the growth of mountain biking for people living with a spinal cord injury, by simplifying the preparation involved with adapted mountain biking (McCormack, 2018). Bike shops have a role in tuning up and repairing a variety of bikes, but they are also a source of exposure to the greater biking community (McCormack,

2018). Bike shops are an important part of mountain biking culture as they have a role in increasing community outreach through their employees and other riders using the shop as a way to spread awareness of opportunities, in order to facilitate adapted mountain biking participation (McCormack, 2018). Participants described how, currently, there are limited bike shops that are accessible for mountain-biking handcycle repairs, and as the sport is not yet mainstream, the mechanisms of the handcycles are not common knowledge in biking communities. However, bike shops with employees who are educated on mountain-biking handcycles, both e-assist and manual varieties, can help normalize the experience of using services for repairs for people with a spinal cord injury. Having this support can help facilitate increased participation in adapted mountain biking by making the repair service more inclusive and accessible (Okayasu et al., 2010).

Accessible Physical Environment

When nature trails are designed to be accessible, it facilitates mountain biking for people using adapted equipment (Dickson et al., 2020). A prominent facilitator of adapted mountain biking described by participants was accessible trail design, particularly trail width. The width of trails was noted as a significant factor because the width of the mountain-biking handcycles are wider than conventional non-adapted two-wheeled mountain bikes. When trails are wide enough for mountain-biking handcycles to ride on, it makes the trails more inclusive for people living with spinal cord injuries using handcycles, as well as other trail users such as families pushing strollers (Olsen et al., 2016). Participants described how riding trails that are made to be accessible, whether that is trails that are wider or with tracks that have been maintained, facilitates their

participation in adapted mountain biking by accommodating the specialized features of mountain-biking handcycles to fit the trails.

According to participants, accessible trail designs are the result of measures that are taken to ensure inclusion and sense of security. In the context of this research, participants described a sense of security as having peace of mind that if they were to be stuck on a trail, that they would not be stranded for hours, but would have access to assistance from the trail sites to help them out in the case of any mishaps. Sense of security in this sense refers to having contact with the personnel employed at the trail site. Participants expressed that having a sense of security also encompasses the trail sites taking measures to address barriers by maintaining the trails and removing physical obstacles along paths that make them inaccessible to mountain-biking handcycles (Botella-Carrubi et al., 2019; Brown et al., 1999; Godbey et al., 2005). Additionally, having well-lit trails and emergency response teams are some of the potential measures that participants suggested can be incorporated into the design of trails (Brown et al., 1999). Trail site amenities, such as washrooms and parking, were also suggested by participants to be an area of focus for inclusive trail designs, as there is much room for improvement with increasing the accessibility and sense of security at nature trails.

For individuals using pedal e-assist mountain-biking handcycles, trails that have electrical charging stations are important facilitators related to the physical environment. Participants in this study who used mountain-biking handcycles with e-assist explained how they often take breaks halfway through riding to charge their batteries, before getting back to riding the trails. This means that the trails that have the resources to support the recharging of electric batteries, used on mountain-biking handcycles, encourage greater

participation in adapted mountain biking for people living with a spinal cord injury. Zeller (2008) emphasized that there is legislation that allows motorized equipment use in nature for the purpose of mobility. Having these policies in place is an important facilitator that applies to adapted mountain biking because it makes the benefits of being physically active in nature more accessible for people with spinal cord injuries (Burns et al., 2008; McAvoy et al., 2006; Siderelis et al., 2010; Zeller, 2008).

When there are efforts made towards a safe and secure environment, more people will feel comfortable with exploring the trails, contributing to the growth of the sport of adapted mountain biking (Godbey et al., 2005). The physical environment is highly important in the participation and engagement in physical activities, (Glazier & Davids, 2009). Developing a welcoming environment creates a space that supports individuals in their physical activity pursuits (Glazier & Davids, 2009). For people with spinal cord injuries who ride mountain-biking handcycles, having a physical space to support their endeavours encourages continued participation in the sport, and would also invite more beginner mountain-biking hand-cyclers to the trails (Siderelis et al., 2010). Accessible physical environments are significantly important to the involvement of people with spinal cord injuries in inclusive sports and physical activity.

Some participants articulated that compared to adapted road-cycling, the lack of cars speeding by has made adapted mountain biking more safe for people living with a spinal cord injury. However, it is important to note that participants described the current state of most rural trails as being *not accessible* to individuals, even using mountain-biking handcycles. Individuals who described themselves as advanced mountain-biking hand-cyclers are sometimes limited in the trails that they can ride due to inaccessible trail

designs, such as when trails are too narrow for mountain-biking handcycles. While there are elements of trails that have been made accessible, there is much room for improvement in the efforts that are made toward trail designs, as many barriers can be minimized through strategies that target such limitations (Fekete & Rauch, 2012).

With low physical activity participation levels among people with a spinal cord injury, it is important that individuals have access to physical activity that is challenging but not limiting (Rocchi et al., 2017). While the participants in this study are part of the population of people with a spinal cord injury who are physically active through adapted mountain biking, there are still many physical obstacles, that for some people are barriers to participation altogether. Addressing the physical environmental barriers is essential to the facilitation of adapted mountain biking and all its benefits for people living with a spinal cord injury.

Strengths and Limitations

A strength of conducting online interviews is that they connect the researcher to a larger pool of participants, through the increase in access to the internet and videoconferencing technology (Archibald et al., 2019). The virtual interview method did potentially exclude individuals who do not have access to the internet or necessary technology, thus this could have influenced the diversity of the study population (Archibald et al., 2019). However, for this research, the online interviews helped with the recruitment of participants from a broader outreach than if they were held in-person, because there is no travel time involved, making it simpler to arrange meeting times with the participants living with a spinal cord injury.

In qualitative research, a study population of ten participants is a strength. Creswell & Poth (2018) explain that a sample size of 6-10 is ideal for descriptive phenomenological research, as it is usually the number of people it takes to reach saturation of themes in the data, which is what happened for this study. With qualitative research, the subjective experiences of individuals may not reflect the experiences of everyone, and the conclusions should be held within the context of the specific study (Creswell & Poth, 2018). However, the facilitators of adapted mountain biking among the ten participants in this study who live with a spinal cord injury reflect commonality in the actions that can be taken to facilitate participation.

Most participants were male, so a gender bias could have been present, potentially not reflecting the population of mountain-biking hand-cyclers with a spinal cord injury. However, statistically adventure sports such as adapted mountain biking are male-dominated (Hardiman & Burgin, 2013). This can explain the ratio of 9:1 men to women for this study, even though female mountain-biking hand-cyclers are participating in the sport. Interviewing more females for this study would have been ideal for more equal representation of the sexes, but having even one female participant is a strength of this research, due to the majority of mountain biking populations being male (Hardiman & Burgin, 2013).

A limitation with recruitment is that only those who wanted to share about their experiences chose to do so, where a self-selection bias could skew perceptions about the sport more positively (Robinson, 2014), as these are individuals who do participate, even with existing barriers. Participants enrolled in the study were offered $50 Amazon gift cards to try to mitigate this bias (Abu Itham et al., 2023). However, there is an inherent

bias with this research; that although barriers are discussed by participants, the emphasis on existing facilitators may be magnified. The facilitators that participants experience may not be reflective of everyone's experiences with adapted mountain biking, and there could be a different set of facilitators needed for people who have not had experience with participating in the sport (Rocchi et al., 2017). The focus with this research was not to exaggerate the facilitators nor negate the barriers. The aim of investigating facilitators of adapted mountain biking, based on the lived experiences of participants, was intended to provide mountain-biking hand-cyclers and the public with an understanding of how to increase quality participation.

Conclusions

This study reported on the lived experiences of people living with a spinal cord injury, in relation to facilitators of adapted mountain biking. Participants expressed that one of the main reasons they participate in adapted mountain biking is because it brings them joy, that being enabled to ride nature trails as someone living with a spinal cord injury plays an important part in their well-being. The main facilitators were categorized into themes, which were described as motivations, human connection, personal facilitators, organizational facilitators, and accessible physical environments. Many of the adapted mountain biking facilitators described were connected to one another. While several facilitators helped explain how participants engage in the sport, these facilitators also contributed to the reasons why people were motivated to participate. Some examples of how the facilitators described in this study are interconnected include, the theme of human connection relating to the motivation to experience camaraderie, and the motivations of challenge connecting to personal safety measures that are taken to engage

in thrill-seeking. This demonstrates that all aspects of adapted mountain biking need to be facilitated for full participation in the sport. There are facilitators of adapted mountain biking that need to be improved upon. Understanding these facilitators through research can help to better apply solutions to facilitate adapted mountain biking for people with spinal cord injuries.

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Chapter 4. Understanding How Equipment Facilitates Adapted Mountain Biking for People Living with a Spinal Cord Injury Based on Lived Experiences

Abstract

Purpose: The purpose of this study was to qualitatively describe how mountain-biking equipment facilitates adapted mountain biking for participants living with a spinal cord injury.

Methods: Using purposive and snowball sampling techniques, ten adults living with a spinal cord injury who actively ride trails were recruited as participants for this study. One-on-one semi-structured interviews were conducted with participants, using descriptive phenomenology as the methodology. Through the support of Otter a.i. software, the audio-recorded interviews were transcribed. Themes arose from data analysis and organization, using the NVivo software platform.

Results: Adapted mountain biking equipment facilitators were categorized into five themes. Those themes were *handcycle descriptions, e-assist, handcycle maintenance, handcycle accessories, and accessibility*. The themes presented in the discussion focus on the overall handcycle accessibility and the use of e-assist.

Conclusions: The findings of this research emphasize the importance of equipment in the facilitation of adapted mountain biking for people living with spinal cord injuries. Mountain-biking handcycles used by participants were either fully manual or used pedal e-assist. Pedal e-assist features facilitate adapted mountain biking by adjusting the electric motor intensity to mitigate overexertion, navigate uneven terrain, reduce injuries. Mountain-biking handcycles make the outdoors more accessible to people living with a spinal cord injury, by increasing the opportunities to explore nature and travel further, which is not replicable while using a wheelchair.

Introduction

Most sports need some sort of equipment, whether it is clothing items such as shoes, or an object to manipulate like a tennis racquet or ball, the equipment used in sports has a dominant role in how they are played (Bandura, 1991). Many sports require high quality equipment to participate at a certain standard whether it is at a personal or professional level, sports equipment is fundamental to the activity and aids in the quality of performance (Shan, 2008). High quality biking equipment plays an important role in the mountain biking experience, as the bike is nonnegotiable for participation in the sport (McEwan et al., 2018). Mountain biking is a sport that involves bike riding through forested trails, over obstacles, up and down hills, often at high speeds (Hardiman & Burgin, 2013). The bikes used by mountain bikers have specific features that differentiate them from road bikes, such as wider tires for traction, and more suspension to accommodate for the uneven riding conditions (Hardiman & Burgin, 2013). Mountain bikers of all abilities and skill-levels have specific equipment needs and wants, depending on their personal riding goals and skill level. Based on an individual's equipment needs and preferences, mountain bikers often form communities based on the bikes they ride, connecting people to a larger culture of mountain biking.

The culture and community connected to mountain biking invite mountain bikers to share their experiences and keep each other in the loop (Huybers-Withers & Livingston, 2010; McEwan et al., 2018), especially with updates on the bikes and other equipment with which they use to participate. Huybers-Withers and Livingston (2010) found that there is a strong identity that mountain bikers have related to mountain biking. When it comes to the socialization around mountain biking, the equipment that bikers

have correlates to social standing, as the complexity of the biking technology contributes to the performance and quality of the biking experience, particularly in competitions (Huybers-Withers & Livingston, 2010; McEwan et al., 2018). Even in recreational pursuits, equipment functionality is important, and with mountain biking in particular, there is a sense of identity tied to the bikes that individuals use, based on how functional and technologically advanced they are (McEwan et al., 2018). Although the aim of mountain biking is not to display the quality of equipment that individuals use, there is value in having well-made equipment to keep pace with other mountain bikers while biking the trails (McEwan et al., 2018).

In the sport of mountain biking, access to equipment is just as important as the equipment itself, particularly for people with disabilities (Dickson et al., 2020). Adapted mountain biking is a growing sport for people with disabilities, such as people living with a spinal cord injury, where the equipment is often tailor-made for the individual specifications of the person living with mobility challenges (Dickson et al., 2020; LeMay, 2019). The adapted mountain biking equipment that people living with a spinal cord injury use are called handcycles, because individuals pedal or crank with their hands instead of their feet (Kraaijenbrink et al., 2021). The handcycles are usually three-wheeled, but there are different styles of handcycles that have been designed for adapted biking, such as recumbent, seated upright, and kneeling handcycles (Kraaijenbrink et al., 2021). Despite the different types of models that exist, mountain biking handcycles are less readily available due to the uniqueness and specialization of the equipment. Additionally, the cost of the handcycles is very high and can be financially inaccessible to many people, especially with the combined price of a conventional mountain bike paired

with the price of adapted sport equipment all in one piece of equipment (Diaz et al., 2019; Hall et al., 2019). When there is limited equipment available, there is a smaller population of individuals participating in the sport which requires that specialized equipment (Bandura, 1991). Consequently, access to economical, modern, and innovative adapted mountain biking equipment of high quality is important for encouraging more people with spinal cord injuries to participate in the sport (LeMay, 2019).

Pedal-assist e-bikes have emerged in the last decade as a novel form of active transportation and commuting, as well as for physical activity and recreation purposes (Jenkins et al., 2022). Pedal-assist e-bikes are a form of micro-mobility, referring to modes of transportation that are not mainstream (Stehlin & Payne, 2023). These bikes use an electric motor to provide pedal assistance to users to help people to be more active in their transportation (Ling et al., 2017). The pedal-assist feature helps to support being more physically active for longer durations and at a manageable intensity, such as using e-assist to navigate hills (Jenkins et al., 2022). A scoping review by Jenkins et al. (2022) found that there is minimal research on pedal e-assist handcycles for use in sports like adapted mountain biking, as the majority of research on pedal-assist e-bikes pertains to those used in urban settings, for active commuting on a traditional bike.

As pedal-assist e-bikes have gained popularity, and technology is evolving, more research is needed to understand the role they play in mountain biking participation (Jenkins et al., 2022). People living with a spinal cord injury face barriers to participating in physical activity and accessing adapted sports equipment to be physically active. However, individuals in this population could use the technologically advanced equipment the most, in order to facilitate physical activity participation (Carty et al.,

2021; Levins et al., 2004; Orr et al., 2021). Equipment access and accessibility are fundamental to adapted sports (Dickson et al., 2020), therefore this study aimed to help fill the research gaps related to the accessibility of pedal e-assist mountain-biking handcycles, and more generally, equipment as a facilitator. The intended purpose of this research was to understand how equipment facilitates adapted mountain biking, based on the lived experiences of adults living with spinal cord injuries.

Methodology

Methodological Framework

Utilizing a methodological framework for qualitative research is important for grounding the purpose of the research in an overarching philosophical discussion related to the research topic. In this qualitative study, the methodology that was used to frame the research purpose was descriptive phenomenology. Through descriptive phenomenology, the participants in a study provide descriptions about a specific phenomenon based on their lived experiences related to that phenomenon (Creswell & Poth, 2018). In the context of this research, the phenomenon reflects the research question and purpose, that is, the equipment facilitators of adapted mountain biking based on the lived experiences of people with a spinal cord injury. The inductive thematic analysis of this phenomenon through descriptive phenomenology provided new knowledge about the topic, that was not previously researched (Matua & Van Der Wal, 2015). Descriptive phenomenology allows participants to describe their experiences with minimal interpretation from the researcher (Creswell & Poth, 2018). This makes it an ideal approach for this study, as the direct descriptions from individuals with lived experience provides the opportunity to

share their authentic narratives on an otherwise unfamiliar phenomenon in the research (Matua & Van Der Wal, 2015).

Eligibility

The Ontario Tech Research Ethics Board approved this study under the REB Certificate Number 17005 (see Appendix 1). Participants needed to be 18 years or older, speak and read English, be living with a spinal cord injury, and ride nature trails using adapted mountain biking equipment to be eligible for this study. Participants were required to have lived experience with adapted mountain biking along rural nature trails after their spinal cord injury. Interviews took place over the Google Meet Videoconferencing platform, so participants required computer technology and internet access to participate (Archibald et al., 2019). Participants who expressed interested in participating, and met the above criteria, completed and signed an online consent form using Google Forms, giving their written consent to participate.

Recruitment

According to existing descriptive phenomenological research, the standard number of participants for reaching data saturation is 6-10 (Creswell & Poth, 2018). This study recruited ten individuals, which was appropriate for this research as saturation of the data was achieved based on the emergence of common underlying research themes. The professional social media accounts of Dr. Meghann Lloyd, the lead supervisor, were used to distribute the recruitment flyer for this study. One of Dr. Lloyd's professional connections helped to share information about this study by circulating recruitment materials to mountain-biking hand-cyclers in his social network (see Appendices 2 and

3). This individual helped connect the researchers to participants through snowball sampling recruitment strategies (Creswell & Poth, 2018).

The researcher and participants individually arranged a meeting date and time for their interview on Google Meet, after the consent form was read and signed by the participant. Attached with the consent form was a demographic information form that participants were asked to complete at the same time. The questions asked on the demographic form were intended to give context the individual participants. Participants received a $50 Amazon gift card upon completion of the consent and demographic information forms.

Study Design and Data Collection

Interviews were held with the purpose of learning about the lived experiences of participants with regards to adapted mountain biking, particularly the facilitators of the sport. A pilot-tested interview guide was followed during the one-on-one virtual semi-structured interviews (Creswell & Poth, 2018). Feedback from a pilot-testing session was consolidated into the interview guide. Ten participants were interviewed by the researcher in a semi-structured interview format with pre-planned questions in an interview guide from November to December 2022 (see Appendix 6). (Matua & Van Der Wal, 2015). Hosting interviews virtually expanded the geographical reach to be able to interview more participants (Archibald et al., 2019). The interviews varied in length, lasting between 45-80 minutes, while most averaged 60 minutes. Ottter.ai. computer software was used to assist with the verbatim transcription of the audio-recorded interviews. In similar published qualitative studies, this transcription software has been used to supplement the transcription process, where the researcher reviewed the

transcripts to correct any errors, as was done in the current study (Abu Itham et al., 2023). The researcher engaged in reflexive journaling and taking field notes immediately after each of the interviews concluded, as a way to write out the significant descriptions that resonated from the interview (Creswell & Poth, 2018).

Data Analysis

Interview transcripts were analyzed using NVivo 12 software, a qualitative research computer program that was used to code the descriptions of participants into themes (Zamawe, 2015). For the current study, NVivo was used to inductively organize the descriptions of the coded sections into hierarchical themes (Zamawe, 2015). The thematic analysis method used was based on the facilitators of adapted mountain biking described by participants. Through thematic analysis, the codes were initially created to be detailed, to capture the essence of the phenomenon, before being categorized more broadly into common themes (Sundler et al., 2019). The themes that arose from the iterative coding process also reflects those of the theoretical model known as the Physical Activity for Persons with a Disability (PAD) model (Van der Ploeg et al., 2004). Inductive analysis was used to create the themes, and the PAD model helped guide the development of some themes and was used after the completion of data analysis to compare the themes from this study to those in the model (Van der Ploeg et al., 2004).

As a part of the journaling process, the researcher made notes on the codes that were created and with the reasoning behind the codes. This helped with the creation of a codebook that was used in the coding process by both the researcher and a secondary coder to check the intercoder reliability of the analysis (Zamawe, 2015). Descriptions from the transcripts were highlighted and assigned to a code created by the researcher to

reflect the common themes that emerged from the data (Zamawe, 2015). Two rounds of coding were performed to complete the thematic analysis, based on the accumulation of codes created from the start of the coding process. The final overarching themes that are displayed in the results of this research were developed from the organization of all the smaller codes into larger groupings. Data analysis consisted of the researcher being immersed in the data, focusing on the lived experiences related to facilitators of adapted mountain biking, while receiving guidance and input from the lead supervisor of this study (Green et al., 2007).

Reliability and Validation Strategies

Having strategies for reliability and validity is important to the authenticity of research, and thus common qualitative research procedures have been implemented (Creswell & Poth, 2018). Firstly, in qualitative research, it is important for the researcher to be immersed in the data, as such she was a part of all parts of the research process, including literature searches and reviews, data collection and analysis, as well as writing about this research (Creswell & Poth, 2018; Green et al., 2007). A common qualitative validation and reliability strategy is to involve the participants in member-checking (Creswell & Poth, 2018). Each participant was given access to their interview transcript for the purpose of clarifying any responses and making necessary edits to the answers they intended to give during their interview time. This step was taken to reduce any misunderstandings between the participant and the researcher about the descriptions provided (Creswell & Poth, 2018). Upon completion of data analysis, the researcher met with the professional connection who helped with recruitment to get feedback on the interpretation of the results in this study's discussion. This step was taken to check the

quality of the researcher's understanding of the themes as well as the terminology and language that best reflects these themes.

Part of the immersion into the data by the researcher also involves distinguishing the role of the researcher, and identifying where there could be bias (Creswell & Poth, 2018). With research using qualitative methods, it is crucial to identify the potential biases that the researcher may hold about the phenomenon of focus (Creswell & Poth, 2018); in this case, the benefits of physical activity, more specifically adapted mountain biking, and the role that the equipment plays in the sport. Using reflexivity, the researcher attempted to identify any preconceived notions and made sure to focus on expressing the descriptions of participants directly with support from existing research related to the phenomenon (Creswell & Poth, 2018). A method used to engage in reflexivity was reflexive journaling, which consisted of explanations of decisions made around the analysis of data, including the grouping and organization of codes into themes. Supplementing the research with context is a way of providing rich descriptions about the data, to provide relative understanding of the results in relation to the specific research purpose (Creswell & Poth, 2018).

Intercoder reliability is a strategy used in qualitative research, which involves coding data to assess how reliable the researcher's analysis was in comparison to a secondary coder (Creswell & Poth, 2018). For this study, a masters of health science student was recruited as a secondary coder to analyze and code 10 percent of the transcripts, based on existing intercoder reliability research that suggests a range of 10-25% of the data is acceptable (O'Connor & Joffe, 2020). Using a codebook that the primary researcher prepared from her rounds of coding, the secondary coder analyzed the

assigned transcript. Before the secondary coder began their analysis on a portion of the transcripts, the researcher gave a run-down of the research questions, what the themes were, and how to use the NVivo software for coding the transcripts. After the secondary coder completed their coding, the primary researcher performed the intercoder reliability assessment through NVivo to compare the analyses. According to Miles et al. (2014), the standard range for reliability scores in qualitative research is a similarity score of 85-95%. For this study, the similarity between the two coders indicated by a percentage of reliability was 84% in round 1 of coding. The secondary coder engaged in a second round of coding, with feedback after a discussion between the primary and secondary coders. Upon review of round 2 of coding, 92% agreement was reached. This means that the reliability of the researcher's codebook and coding was in accordance with the qualitative intercoder reliability standards (Miles et al., 2014). Intercoder reliability is used to validate that the research is less biased by having another coder who is not so strongly tied to the research analyze the data with less bias, aiming to capture to the authentic descriptions of participants (Creswell & Poth, 2018).

Positionality and Bracketing

The immersion of the researcher in the data is imperative to qualitative research, for the purpose of reliably relaying the narrative and experiences of the participants (Creswell & Poth, 2018). In this study, the researcher was involved with deciding on the methodology to approach this research, in which descriptive phenomenology was chosen. Based on the purpose of the research being to understand what the facilitators of adapted mountain biking are, descriptive phenomenology was selected as a methodology to best comprehend the participants' lived experiences with a phenomenon that they describe

themselves (Creswell & Poth, 2018). To supplement the methodological approach assigned to this study, a philosophical framework called constructivism was implemented to clarify the primary purpose of this research (Hopkins et al., 2017). A constructivist perspective explains how meaning is built from a series of experiences, that when shared by participants can help illuminate and understand one's reality (Hopkins et al., 2017). In this study, the lived experiences in relation to the facilitators of adapted mountain biking for participants living with a spinal cord injury have helped shaped their reality of physical activity. This perspective is therefore appropriate for the methodological approach, as it emphasizes exploring a phenomenon to better understand the reality and lived experience of people (Hopkins et al., 2017).

The researcher sought to identify the potential biases that she could have integrated into the research by bracketing her experiences and beliefs.

> *As the researcher for a study on the benefits of participating in a specific adapted sport, the education I have received has put me in a position to consider the physical activity barriers for various populations (Patton, 2019). With the completion of an undergraduate degree in Kinesiology at Ontario Tech University, I learned about some of the physical activity experiences for people living with disabilities. A significant lesson I learned about adapted sports, and the realities for people with disabilities in general, was to not group everyone with a particular disability together; that individuals apart of certain populations are more nuanced than any identifying label. This mentality was valuable throughout the research process as it helped to remind myself that common experiences can be shared among individuals with spinal cord injuries, but each*

person's experience is unique and adds to the understanding of the phenomenon (Patton, 2019).

Through continued education into a master's degree in health science, learning about the phenomenon has expanded and led to literature searches and reviews that have played a part in constructing an understanding of the importance of adapted sports for people living with a spinal cord injury. Looking at the research about adapted mountain biking for people with spinal cord injuries has helped to identify the gaps in the literature that informed the purpose of this research (Patton, 2019). Also, thoroughly researching the phenomenon of this study helped to minimize the bias that I potentially held about people with spinal cord injuries or adapted sports by addressing any pre-conceived notions I had, relying on the evidence rather than on stereotypes. As there is minimal research on the facilitators of adapted mountain biking for people living with a spinal cord injury, an important part of exploring this understudied topic was learning from participants about the terminology they use, and comparing it to what has been used to talk about aspects of the phenomenon, particularly the naming of equipment. As a result of the iterative nature of this research, discussions around terminology resulted in the use of "mountain-biking handcycles" and "pedal e-assist mountain-biking handcycles" to most accurately reflect the equipment used, and "adapted mountain biking" to represent the sport (Kraaijenbrink et al., 2021).

As an outsider to the focus of this research, being an individual with no self-identified disability or no family or friends with a disability, and no

experience with mountain biking, there is minimal subjective analysis of the data. Being separated from the mountain biking culture prior to this research was potentially an asset, as it is likely for the data to be tainted with personal beliefs about the sport. However, my connection to people living with disabilities and the importance of physical activity was carried into this research. With experience working as a summer camp counselor for children and youth with physical disabilities, I have witnessed the role of adapted sport opportunities in evoking joy and gratification. By interacting with campers and their parents it helped to understand the importance of inclusive opportunities, like this fully accessible overnight camp, as well as the equipment that can enable participation in physical activities.

Bracketing is an important aspect of qualitative research that was implemented in this study. Differentiating and separating the participants' descriptions from the researcher's ideas and beliefs reduces bias from the researcher because the descriptions of participants are expressed authentically (Matua & Van Der Wal, 2015). No research can be completely free of bias, but to decrease the influence of external opinions, the researcher approached the data as an outsider to the phenomenon, working inductively to analyze the research as it was. The participants described the barriers as well as facilitators of the sport, and how the facilitators only go so far and do not necessarily outweigh the barriers; that there is much room for improvement with accessibility of adapted mountain biking according to participants. Despite the persistent barriers, focusing on the facilitators helped to comprehend the ways that adapted mountain biking has been, and can be facilitated based on real lived experiences.

Results

Semi-structured virtual interviews were held one-on-one with ten individual participants who live with a spinal cord injury. Nine participants were men and one participant was a woman (n=10), (26-61 years old). Based on self-identified racial backgrounds, five participants were white, three were black, one was bi-racial, and one was Canadian with a European background. One of the participants rides their mountain-biking handcycle in Alberta Canada, while nine participants ride their handcycles and reside in Ontario Canada, according to the trail descriptions from both the interview and the demographic information form. Some of the individuals who participated in this study have recently taken up the sport of adapted mountain biking in the past few years, while other participants have more than 5 or 10 years of experience with adapted mountain biking. Those who have been riding for longer also tended to ride their handcycle more than 10 times in the year, while participants who are newer to the sport may go for a handcycle ride a few times a year.

In addition to the frequency of biking, participants stated their preferences for the types of trails they visit, with some enjoying the slower technical paths, while others have more fun on the fast and smooth paths. Whether the participants identified as a beginner, intermediate, or advanced mountain-biking hand-cycler, all participants have ridden their mountain-biking handcycle for recreational purposes, but around half have also had experiences with competitive adapted mountain biking. A mixture of group and solo adapted mountain biking experiences were reported by participants. Some individuals had experience with mountain biking prior to their spinal cord injury, while some people were introduced to the sport for the first-time post-injury. However, all participants described

themselves as physically active individuals pre and post-injury, often engaging in additional activities to adapted mountain biking. Participants were asked about their income in ranges to gauge the affordability of the sport of adapted mountain biking in context with annual income.

Table 2

Demographic Information as reported by Participants

Participant	Sex	Age Range (years)	Frequency of Biking
1	Male	50-61	> 10 times/ year
2	Male	50-61	> 10 times/ year
3	Male	50-61	7-9 times/ year
4	Female	50-61	> 10 times/ year
5	Male	50-61	> 10 times/ year
6	Male	50-61	> 10 times/ year
7	Male	26-37	7-9 times/ year
8	Male	26-37	> 10 times/ year
9	Male	26-37	4-6 times/ year
10	Male	26-37	1-3 times/ year

Participants were asked to describe the facilitators of their adapted mountain biking experiences. The lived experiences of participants in relation to adapted mountain biking largely revolved around the equipment they used to participate. The third chapter

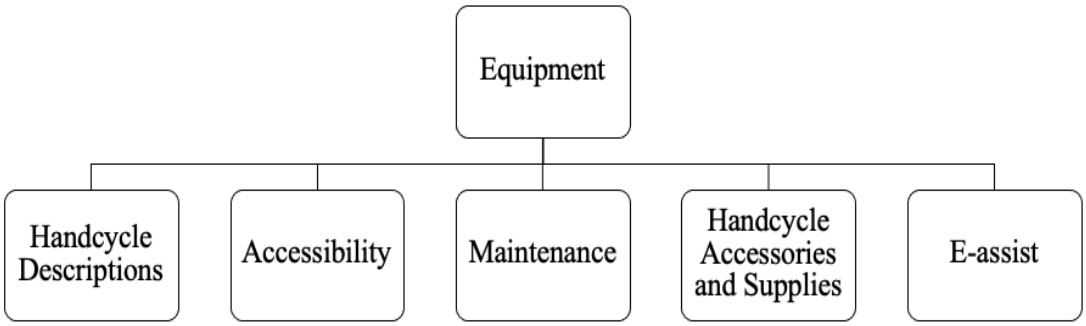
reports on the general facilitators of adapted mountain biking, while this chapter focuses specifically on the equipment used for the sport.

Equipment

The equipment used in the sport of adapted mountain biking was described by participants as being of critical importance to facilitating trail riding. The mountain-biking handcycles that participants used were either traditional manual mountain-biking handcycles or pedal e-assist mountain-biking handcycles.

Figure 7

Themes of Equipment as described by participants

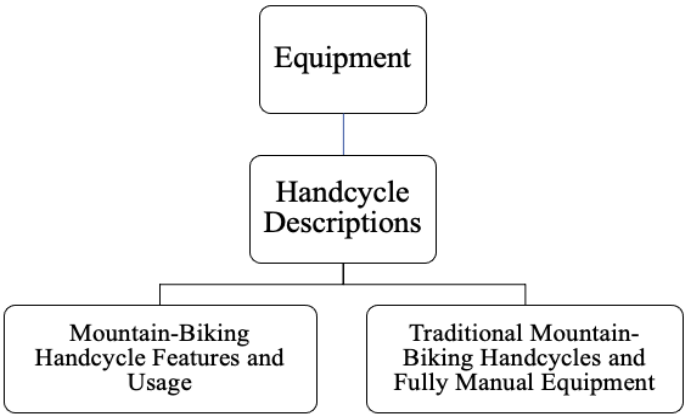


Handcycle Descriptions

General Descriptions of the handcycles were provided by participants to help with understanding how mountain-biking handcycles are used by participants, and what features contribute to the operation of the equipment.

Figure 8

Descriptions of mountain-biking handcycles



Mountain-Biking Handcycle Features and Usage: Some features of the mountain-biking handcycles were described as being supportive to the overall operation of the equipment.

> "It's a trike… obviously three wheels, powered by the rear wheel, two in the front, one in the back, and you sit kind of in a motorcycle position where you're leaning forward, just like an able bodied bike, but with your legs kind of tucked back behind you" (P6).

Participants described how they use and operate the mountain-biking handcycle to optimize their experience.

> "it pedals, like with two hands like this [gestures arms in forward circular motion], both hands going at the same time. I guess you could change the cranks to like alternate, like you do with your feet, but I think most people ride with like, two, two hands at the same time going the same direction, obviously the same direction but going at the same time in the same way as opposed to alternately" (P4).

Traditional Mountain-Biking Handcycle and Fully Manual Equipment:

Some participants use a traditional handcycle and find that this type of equipment works well for their biking needs. “Yeah, it’s a manual bike. My, my family member was trying to convince me to use [an electric-powered] machine, but I did not like that. I just want this manual one” (P9). Additionally, some participants can use their wheelchair with an attachment to ride less rough terrain.

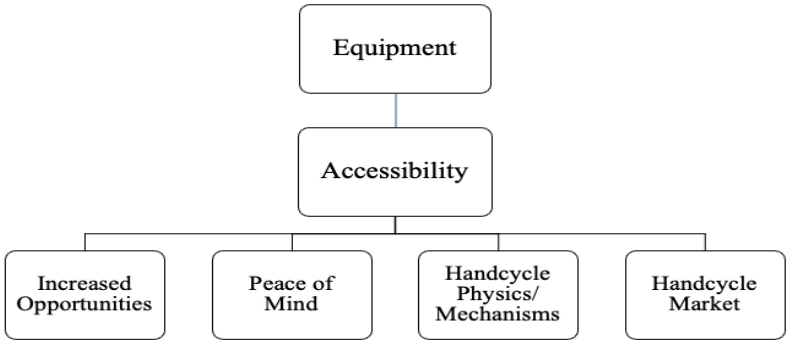
> “I have like a wheelchair attachment that I just pedal with my arms… or I push with my arms with no electric assist on my wheelchair… so I am able to access some trails that are like, of the more accessible type, without electric assist, and it's still an enjoyable experience” (P8).

Mountain-Biking Handcycle Accessibility

The overall accessibility of the equipment used was described by participants through the enjoyment of riding, the increased opportunities to biking trails, providing some peace of mind to hand-cyclers, the mountain-biking handcycle physics and mechanisms, and the growing mountain-biking handcycle market.

Figure 9

Accessibility of adapted mountain biking equipment



Increased Opportunities: Adapted mountain biking was described by participants as being a particular sport that increases the number of opportunities available to people with spinal cord injuries. “So yeah, it’s, it’s a sport like no other, really, it opens doors that, that you can’t, you can’t open or access through any other activity. So, it’s, it’s got its own special place” (P3). Additionally, it was described to be a sport that empowers individuals. “I tried a bunch of different adapted sports and the sport that I felt the most empowered by was handcycling” (P8).

Peace of Mind/Reduced Preparation: Equipment used by participants was described as a facilitator in offering peace of mind while adapted mountain biking, such as with the reduced need for stretching and warm-ups.

> “what’s great about this sport versus many other sports I’ve done, uh is I don’t have to do a lot of body prep. So, I pack the right clothes and gear that I have here to wear… what’s great about this bike is, I just transfer on, and because the position and because just the, the way you’re on it, I don’t have to do any pre body prep” (P3).

Some participants described adapted mountain biking as a uniquely straightforward sport to prepare for based on the equipment used. “It's one of the few sports you can literally go to your garage, get on the bike, and go. Not very many other sports like that you can do just by opening your door” (P2).

Handcycle Physics/Mechanisms: Participants described how certain design features and mechanisms on the mountain-biking handcycles make adapted mountain biking much more effective and accessible to individuals with spinal cord injuries.

> "We lean forward onto the handlebars, and we have a chest pad that we can rest our chest on because, because of our spinal cord injuries, we don't have, myself don't have trunk balance that I, I would be able to balance without it" (P8).

Handcycle Market: Manufacturers and retailers for handcycles have been starting to help grow the market for the types of mountain-biking handcycles being sold. Some participants described the role that the mountain-biking handcycle market plays in the facilitation of adapted mountain biking, by having access to a growing variety of handcycles on the market.

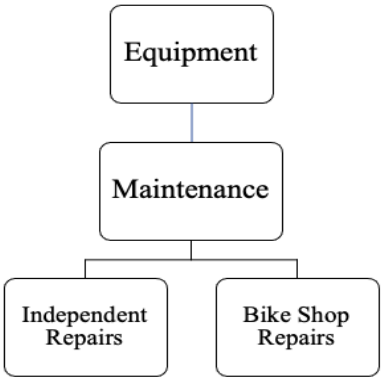
> "I think it's amazing, this sport is exploding right now, and there's so many different bikes being built, and a lot of people are, sort of coming up with new ideas, so there's definitely, I'm, I'm really excited about the future, because I think in the next two or three years, I think there's going to be some really cool bikes that are gonna basically, sort of fix a lot of the things that these bikes sort of can't do or don't do well" (P6).

Maintenance

Maintenance of the mountain-biking handcycles was highlighted by participants as an important aspect of adapted mountain biking, as it ensures more enjoyable and safer riding experiences. Participants either described the independent pursuit of repairing their own handcycles or the use of bike shops to assist with equipment repairs and maintenance.

Figure 10

Theme of maintenance for mountain-biking handcycles



Independent Repairs: Some participants described the ways in which they complete their own repairs or general mountain-biking handcycle maintenance.

> "I'm changing brake pads, I'm maybe putting some fluid in the, in the brakes. Um, yeah, you're checking, just because of the nature of our bikes, you kind of have to check it. Yeah, you don't want to get into a situation where something happens" (P6).

Bike Shop Repairs: Some participants described how they only use bike repair shops or how they use them for more complicated repairs.

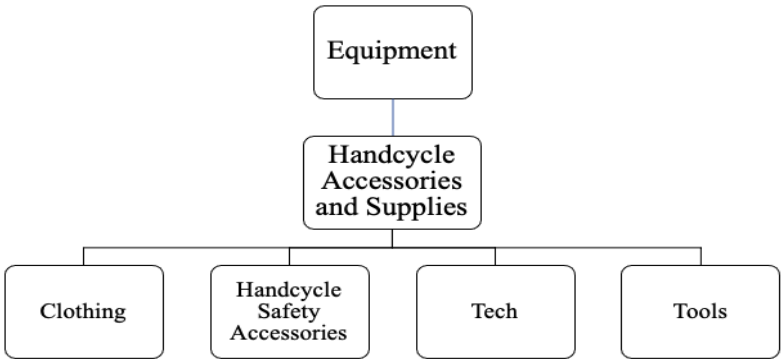
> "I have a, a hub repair that needs to be done now, and I will take the back wheel off and take it to the gentleman that's specialized in that, that hub design, because that's something that's just, I don't have the time to invest to, to learn it and do it" (P3).

Handcycle Accessories and Supplies

Equipment that is supplementary to the mountain-biking handcycles themselves were described as important elements of the adapted mountain biking experience, as they provide support to the handcycle and the participants to have better quality rides.

Figure 11

Theme of Handcycle Accessories and Supplies, in addition to the handcycle



Clothing: Clothing worn by participants while riding was described to provide a sense of the type of gear that supports the sport of adapted mountain biking. “I ride with my, my bike clothing, I can’t ride without wearing my bike clothing, such as my helmet, and my body suit” (P9).

Handcycle Safety Accessories: Additional features on the mountain-biking handcycles were described by participants as components that contribute to the overall quality of the riding experience.

> “I also ride with lights, so I have a, a front light and I have a rear light as well, just at some point, you’re gonna have to cross the road or you’re gonna have to go across something, so you want to make sure you’re visible to everybody” (P5).

Tech: The use of technology was described by participants as a way to be prepared while riding trails. “A good example of that mental checklist would be like, do I

have my phone with me so that if something did go wrong, I could be located or could call for help" (P8).

Tools: Having the essential tools was expressed by participants as an important aspect of riding, as they can complete repairs as needed on the trails, to be more efficient with their riding time.

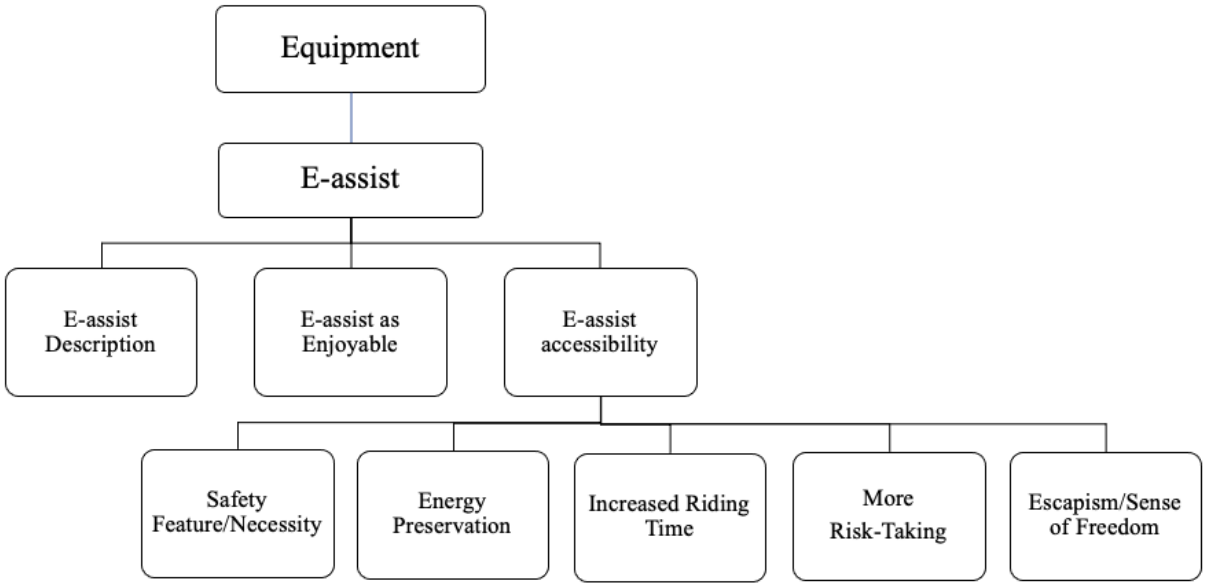
> "I'll have tools with me, we call the basic tools, multi tool, chain tool, I'll have spirit chain, master links, spirit tubes, spare like air, compressed air, uh so I can change tires, change tubes if I get a flat tire, that's the bulk of what I have" (P1).

E-assist

Electrical assist or e-assist is an electrical motor feature on some mountain-biking handcycles that helps to propel them further and faster. Participants described their use of pedal e-assist mountain-biking handcycles that they use for adapted mountain biking, as well as how e-assist makes trail riding more accessible and enjoyable.

Figure 12

Themes of e-assist mountain-biking handcycles



E-assist Description: Descriptions of adapted e-assist mountain-biking handcycles were expressed by participants to explain how the handcycles are used and operated. “It’s got a hand crank with e-assist, so you can use it as a hand powered vehicle only, or with e-assist, either top up your performance or run 100% on electric” (P2).

Some participants described the variation in how much they use the electrical motor on their mountain-biking handcycles.

> “It's, yeah, it's on the entire ride. The way it works is it allows assist from zero to nine and so I’ll likely have it in the middle, like 50% 60% of assist. So not too fast, but if I put it on full, I'll get, like I have a 1000 watt motor, so I can do like 45 kilometers of power, just battery. So that's fast in the forest” (P1).

E-assist as Enjoyable*:* Participants who use pedal e-assist mountain-biking handcycles described how the use of this feature contributes to their enjoyment of adapted mountain biking.

> “100% It is. It is, it allows you to enjoy the ride with the electric assist, as opposed to, feel like you’re just struggling through the ride… So, the electric assist is, I would say a huge, plays a huge role in the overall enjoyment of riding nature trails” (P8).

The enjoyability of adapted mountain biking was expressed by participants as being a result of the mountain-biking handcycle that they use to ride trails.

> “it’s exhilarating … when I’ve been riding my bike, like I was catching myself, like just like, screaming out loud in joy about like an experience or like something that happened that, that you thought, ‘Oh, I can’t believe that whatever happened’, and you’re able to like, be in this area of a trail or go up an incline that, that you

wouldn't think was possible and you can do it and it's, so it's, as far as what it has provided that's, that's one of the big things that it has provided … just pure enjoyment of nature" (P8).

E-assist Accessibility: Mountain-biking handcycles that have e-assist were described as a facilitator for making adapted mountain biking more accessible, through the use of an electrical motor system.

Safety Feature/Necessity: Using the electrical motor on the mountain-biking handcycles is more than a convenience, but was described as a necessity for some participants to stay safe on the trails.

"So it's got the battery and the motor, and most of us have throttles on the bikes as well so we can maneuver the bike without having to pedal which is a kind of a required thing for safety when you go into the technical stuff, where you need both hands on the bike to balance yourself to get up or you need power to get up in around a hill" (P1).

Energy Preservation: By having an electric motor on the mountain-biking handcycles, less energy is spent by participants to manually cranking the handcycle with just their arms, which they explained helps to preserve energy and prevent overuse injuries.

"it gives me the ability not to have, like major shoulder injuries or shoulder issues or arm issues because you're using it all the time, because I do have to use my arms to transfer in and out of my wheelchair all the time, and so, you know, if I'm sore, that impacts my daily routine on everything that I have to do all day, so it's

nice to be able to have the, the assist to get me around and, and do stuff that I need to do so" (P5).

Increased Riding Time: Pedal e-assist mountain-biking handcycles help to propel users along trails, and as participants described, this increases the frequency and amount of time they spend riding. "Yeah, that just allows me to go out more often, but I will definitely go longer, longer distances" (P1).

More Risk-taking: Participants described how having the e-assist on the mountain-biking handcycles has allowed them to ride at a higher intensity and take more risks when riding trails.

> "It's, it's night and day. So the original bike I had didn't have any power or suspension, and we used it… but we couldn't do the hard stuff. We stayed mostly on the double track. And it's such a workout because the bikes are quite heavy and getting traction, all those things, with the addition of the e-assist, it's totally changed the game because it's so much more fun. We have to wait up for able bodied friends now as opposed to them just walking beside us is what they used to do up a hill. Yeah, so it's, it's made a huge difference" (P1).

Some participants described how the equipment used helps to make the biking experience more accessible, and thus increases the opportunity to take more risks. "There's definitely accessible trails that are riskier. I mean, when you say accessible, I mean, they're doable and because of the equipment that we have" (P4).

Escapism/Sense of Freedom: The participants using pedal e-assist on their mountain-biking handcycles described how the electrical feature allows them more freedom when riding trails.

> "Oh, it just gives me the freedom to get outside and, you know, I've always loved the outdoors and you know that the ability to go fast and you know, the freedom to go where I want, it's, you know, you can't really say, you can't really understate the importance of that" (P4).

Participants also mentioned how their mountain-biking handcycles with pedal e-assist provide them access to more places, particularly in nature, compared to the use of their wheelchair.

> "That's pretty cool about the bikes that we ride, they're pretty versatile and you can go many places on, on different types of terrain, which is also a pretty empowering thing to go places that you can't, you couldn't access even with your own wheelchair" (P8).

The services, maintenance, and equipment itself were described by participants in this study as contributors to the facilitation of adapted mountain biking.

Discussion

The research question and purpose of this study led to an understanding about the equipment facilitators of adapted mountain biking. Based on the lived experiences of participants living with a spinal cord injury, the equipment for adapted mountain biking, namely the mountain-biking handcycle, was described as a critical facilitator. This discussion expands on the descriptions of mountain-biking handcycle functions and features, which participants expressed help to facilitate the sport and make it more accessible. In this discussion, the themes related to the accessibility of mountain-biking handcycles in general, as well as e-assist use with mountain-biking handcycles, will be

emphasized and expanded upon; with more context provided on the facilitation of adapted mountain biking, based on the equipment used.

Mountain-Biking Handcycle Accessibility

Participants described the features of their individual mountain-biking handcycles as well as the usage and operation of the handcycles and the features. Most of the handcycle features were similar among the mountain-biking handcycles described by participants, such as the hand cranking motion and seat positioning. Most participants described how their mountain-biking handcycle resembles the posture of a conventional mountain bike, in that the rider is in a kneeling position and leaning forward on a chest pad, while cranking the pedals with their hands. Based on the descriptions of participants in this study, the major difference between traditional two-wheel bikes and handcycles is that three-wheeled mountain-biking handcycles require cranking pedals with one's hands instead of their legs (Kraaijenbrink et al., 2021). Another difference is that the weight of some mountain-biking handcycles ranges from 35-50 pounds, which is twice as heavy as conventional two-wheeled mountain bikes (Beck, 2004). Since there are these differences between conventional bikes and mountain-biking handcycles, the descriptions of handcycles used by participants provides insight into how the equipment is optimized and the purposes of the mountain-biking handcycle features.

According to participants, the designs of mountain-biking handcycles have changed over the years to be more accessible and help optimize the riding experience for people living with a spinal cord injury. The importance of equipment in the facilitation of adapted mountain biking was described by participants in relation to the physics and mechanisms of the handcycle, such as the prevalence of full suspension for increased

comfort and control (Steyn et al., 2014). Participants explained how the equipment is also gradually being made more accessible with increased stability of the mountain-biking handcycles, such as preventing the handcycles from flipping over with the rider strapped in, while making them narrow enough to pass through tight points along trails. There are still areas in which the physics of the mountain-biking handcycle could be improved, however, the mountain-biking handcycles that are available and on the market have increased in quality (Dickson et al., 2020). Participant 6 articulated how "there's other bikes that when you're turning a corner that's off camber, they articulate, so they level off so that you're not off level and flip over, and that's being incorporated into a lot of other bikes right now". There is room for improvement with the way mountain-biking handcycles are designed, such as minimizing the odds of tipping the handcycles over when taking sharp turns, where the efforts to optimize the physics of the mountain-biking handcycle can help to increase the maneuverability and accessibility of the equipment. It is important that there are initiatives to make equipment more functional, but also to facilitate positive and fulfilling adapted mountain biking experiences for people living with a spinal cord injury (Dickson et al., 2020).

Without the mountain-biking handcycles, many people with spinal cord injuries would not have the chance to explore nature trails, because the trails that participants ride are inaccessible to traditional wheelchairs (Burns et al., 2008). The participants of this study explained how the mountain-biking handcycles have enabled them to go places they would not be able to go with their wheelchair. In reference to the limitations of wheelchairs, Participant 8 stated, "it is great to experience more than just concrete and

pavement paths everywhere, which is what we're limited to. So it's nice to explore like going on grass and surfaces that you can't really wheel on".

The mountain-biking handcycles used by participants were also described as facilitators for experiencing joy while engaging in nature, simultaneously creating sport opportunities for people with spinal cord injuries. Having the chance to be immersed in nature while being physically active was described as being important for people living with a spinal cord injury (McAvoy et al., 2006; Zeller, 2008). This is because adapted mountain biking is one of the few opportunities to enjoy the wilderness, just as an able-bodied person can, in an environment that is most often not designed to be accessible (Burns et al., 2008). Connecting more people to the outdoors through adapted equipment, like mountain-biking handcycles, is important for facilitating access to the benefits of the outdoors, such as improved cardiorespiratory health and an increase in a positive mental health status through the joy of being in nature (Mitchell, 2013; White et al., 2016). As some participants described, adapted mountain biking empowers them to be physically active like no other adapted sports, and that the equipment determines the experience. For the participants in this study, riding mountain-biking handcycles provided them with the critical equipment needed for experiencing the outdoors in a holistic and meaningful way.

Having knowledge about the handcycle features used by current mountain-biking hand-cyclers can help to provide beginner riders with an understanding of how the equipment works. Understanding more about the equipment usage and operation from actual experienced mountain biking hand-cyclers is helpful for people starting out in the sport because it reduces the trial and error, and risk of injury, that might dissuade people from participating (Wilhite & Shank, 2009). When people are more knowledgeable about

how to operate the equipment with some guidance, it is more likely they will have more confidence as they are starting out (Wilhite & Shank, 2009). As the social cognitive theory suggests, having more self-confidence and self-efficacy could make it more likely for individuals to participate in adapted mountain biking more regularly (Young et al., 2014). There is a cyclical nature to the increased participation and boosts in confidence or self-efficacy, that the more individuals participate the more they will have the confidence in themselves to participate, and this pattern repeats, keeping people motivated (Young et al., 2014). Having the confidence and the understanding of how to ride a mountain-biking handcycle can help to optimize the usage, making the equipment more accessible and thus the equipment facilitates sport participation. When individuals living with a spinal cord injury are primed with an understanding of the standard equipment used for adapted mountain biking, they can be introduced to more advanced equipment, like electric-assist.

E-assist

The majority of the participants in this study used mountain-biking handcycles with an e-assist feature, more specifically, pedal e-assist. Pedal e-assist on the mountain-biking handcycles used by participants were described to have an electric motor and battery, to provide power and speed to the user while hand-cycling or cranking the pedals. The idea is that, once powered on, the individual starts up the electric engine as they begin pedaling, so it is a hybrid of manual cranking and using e-assist to reduce the resistance. Even though the pedal e-assist mountain-biking handcycles require the use of the hands and not the feet to pedal, they operate similarly to the traditional pedal-assist e-bikes that Jenkins et al. (2022) describes, as the pedals are cranked manually, but the e-assist helps reduce the load while pedaling. Each participant with a pedal e-assist mountain-biking

handcycle used the e-assist function differently, with some individuals using the engine set to full-grade power the entire time, and others used it partially, with about half the power depending on the intensity of the ride.

As some participants described, being a wheelchair user can be very strenuous on the arms and shoulders, often leading to overuse injuries (Samuelsson et al., 2004). Having equipment that alleviates some of the mechanical load on the arms while still providing a workout to increase strength, endurance, and cardiorespiratory fitness is ideal. E-assist was also described as an energy preservation strategy to increase the time participants spent riding, as it reduces the physical effort needed. The weight of these mountain-biking handcycles is twice as heavy as any bike that an able-bodied mountain biker would ride. Conventional mountain bikes weigh approximately 17.5-30 pounds (8-14 kilograms), compared to a weight of 35-50 pounds for the handcycles that participants use (Beck, 2004; Gupta & Rao, 2016); making the e-assist essential for providing physiological relief and support. When riding mountain-biking handcycles, using e-assist provides individuals with an opportunity to be physically active by reducing fatigue and overexertion. For people living with spinal cord injuries, thermoregulation is less manageable, so mitigating overexertion through the support of e-assist is important for the safety and health of individuals, thereby facilitating their participation in the sport (Grossmann et al., 2021).

With e-assist use, some participants described how it helps to not only preserve energy, but minimize the potential for overuse injuries, particularly of the shoulder. Reducing some of the physical load from the hand cranking motions with e-assist was said to alleviate potential pain from participants when they compared it to previously

riding a traditional manual handcycle (Samuelsson et al., 2004). Additionally, some participants described how there is a safety aspect to having e-assist for maneuvering along challenging technical parts of trails. There is very little steering capability with the flexible chest pad on the mountain-biking handcycles, so the majority of steering is done with the use of the handlebars. With the way the mountain-biking handcycles are designed, when sharp steering is involved, individuals' hands need to be on the handlebars, making it difficult to crank the pedals that are located below the handcycle's chest pad. This means that propulsion forward along intricate and winding trails is facilitated through the use of e-assist, when the person's hands are unable to pedal and steer. In situations where the trails are more even and straight participants explained how it is more likely that they will pedal while using e-assist to reduce the resistance on the handcycle, instead of only using e-assist to propel forward. When using mountain-biking handcycles with e-assist, it facilitates exploration of nature in a more accessible way for people with spinal cord injuries.

In addition to the physiological support that e-assist on the mountain-biking handcycles provides, there is also psychological relief that e-assist offers. The theme of freedom and escapism was referenced throughout the participants' interviews, where individuals described the impact of the e-assisted equipment on their sense of freedom. Participant 6 described, "I demoed the bike that I bought now… and when I did that bike with a full suspension, with a bit of e-assist, it was a completely different ballgame… I felt so free in the forest". While there is a continuum of independence that individuals with a spinal cord injury may have (Pryor, 2019), participants described that it is more important that they experience a *sense* of independence or freedom with e-assist

mountain-biking handcycles. This is an important distinction for people with spinal cord injuries participating in sports, as independence is not only measured by doing something all by oneself, but that freedom is subjectively experienced (Pryor, 2019). Independence may be experienced subjectively, but most participants described how e-assist objectively facilitates participation and exploration through adapted mountain biking.

Pedal e-assist mountain-biking handcycles were described by participants as facilitators for people living with a spinal cord injury to develop a sense of freedom by exploring nature, that other sports may not provide. The use of e-assist with these mountain-biking handcycles was described by some participants as an escape from the places that are not accessible. While the outdoors are not considered to be the most accessible of environments (Glazier & Davids, 2009), the use of e-assist adds to the feeling of freedom while being in nature; that the pedal e-assist mountain-biking handcycles can take people places other equipment cannot. The feeling of escapism with e-assisted adapted mountain biking has encouraged further exploration of nature, facilitating increased distance and time spent riding trails. The exploration of the outdoors creates a sense of escape from the day-to-day routines of living with a spinal cord injury, and offers a sense of freedom that is expanded with the support of e-assist (Pryor, 2019).

Mountain biking handcycles were described as facilitators to adapted mountain biking participation, under the condition that there is access to this equipment. Participants described how one of the biggest determinants of participation in adapted mountain biking is financial means. The mountain biking handcycles are expensive, and even more so with e-assist, meaning that individuals need to have funding to support their involvement in the sport. The study sample described themselves as having the financial

means to participate, or they received external funding. It is important to acknowledge this prominent barrier as an area of focus to improve upon, to facilitate participation through financial support.

In sum, e-assist provides both psychological and physiological support for mountain-biking handcycles through increased exploration and sense of freedom, and reduced mechanical load, respectively. Through the pedal e-assist mechanisms of the handcycles, adapted mountain biking is facilitated due to a lighter intensity arm workout that preserves energy and reduces the chance for overuse shoulder injuries. Having e-assist on the mountain-biking handcycles is important for providing individuals with a spinal cord injury the opportunity to be physically active while trying to avoid overexerting oneself. It is important that individuals who wish to participate in the sport learn about the equipment so that they can have the knowledge to be able to optimize their biking experience. The handcycles play a major role in facilitating adapted mountain biking, as they provide the opportunity to access all that nature has to offer, like health boosts and enjoyment for individuals with a spinal cord injury. While the data from participants in this study provides a thorough understanding of facilitators of adapted mountain biking, more research is needed to understand the applications of e-assist for mountain-biking handcycles.

Strengths and Limitations

A strength of this study is that it is the first of its kind to investigate the equipment facilitators associated with adapted mountain biking, specifically the use of pedal e-assist mountain-biking handcycles. This novel research can help fill the gap in the literature

regrading equipment used to facilitate the sport of adapted mountain biking for people living with a spinal cord injury.

The sample size that was used for this qualitative study was ten adults who live with a spinal cord injury who participate in adapted mountain biking. For descriptive phenomenological studies like this one, a study population of ten participants is a strength because the data reached a point of saturation where the themes that arose demonstrated commonality in the facilitators described (Creswell & Poth, 2018). The prevalence of these common themes from the ten individuals who participated in this study has helped to understand the important shared facilitators, that can be implemented to make adapted mountain biking more accessible.

The sample size was a testament to the participants' interest in this research, as individuals reached out that they were keen on making this research happen. This interest can however be seen as a limitation in the form of a self-selection bias (Robinson, 2014). Since participants were individuals who were eager to share their experiences, it can alter how this research was approached by participants. To invite more people that may have been less eager to share their experiences, a $50 Amazon gift card was offered and given to participants as an incentive to participate, and as a token of appreciation for their time and insight (Abu Itham et al., 2023).

There is an inherent bias in this research, which is that there is a strong focus on facilitators that may not be proportional to the barriers individuals experience. There are barriers that exist and only looking at facilitators does not tell the whole story of individuals' experiences. However, focusing on facilitators is a strength as it helps fill the gap in the literature about the all-encompassing lived experiences of people living with a

spinal cord injury participating in adapted mountain biking. The aim with this research was to understand the facilitators of adapted mountain biking, not to dismiss the barriers, but to bring light to the ways that more people living with a spinal cord injury can participate in the sport to help reduce the population of individuals who are not physically active (Rocchi et al., 2017).

Participants were also more likely to participant if they were male, because the sport of adapted mountain biking, and thrill-seeking sports in general, typically have a male-dominated population. For this research, 90% of the participants were male, and 10% or one participant was female, which reflects the reality of the adapted mountain biking population being mostly males who participate. Future studies on this topic that can recruit more female participants may be ideal for strengthening the research on the perspectives of women in adapted mountain biking. However, having one female participant is a strength of this research because even one female being represented in a small proportion of mountain biking hand-cyclers helps to reduce the gender bias.

In a time where technology is connecting a larger network of people together, virtual research has gained popularity (Archibald et al., 2019). This study used an online videoconferencing platform to interview participants about the research topic. While not everyone has access to the internet or computers with technology that supports virtual interviews, the online platform also broadened the population that could be part of the study (Archibald et al., 2019). Since participants did not need to travel to be involved in this research, the virtual interviews created flexibility that helped recruit a larger scope of individuals than if interviews were held in-person.

Conclusions

The findings of this research reflect the participants perceptions of the equipment that they use for adapted mountain biking. These perceptions are largely positive, in that the mountain-biking handcycles that participants use facilitate participation in a way that would not be possible without them. the results from this study were grouped into themes that were described as mountain-biking handcycle features and usage, mountain-biking handcycle accessibility, maintenance, handcycle accessories, and e-assist. The themes around accessibility and e-assist were expanded upon in relation to how the themes described facilitate adapted mountain biking for participants. The equipment used in adapted sports plays a major role in the accessibility of participation. Mountain-biking handcycles provide individuals living with a spinal cord injury the opportunity participate in an activity that encourages individuals to take risks, explore nature, and can provide a strong sense of freedom.

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Chapter 5. Thesis Conclusions

Overview

The primary purpose of this research was to describe the facilitators of adapted mountain biking for people living with a spinal cord injury. The secondary purpose was to understand the role of sport-specific equipment as a facilitator for people living with a spinal cord injury participating in adapted mountain biking. The primary and secondary purposes were discussed in Manuscript 1 (Chapter 3) and Manuscript 2 (Chapter 4), respectfully.

The research on adapted mountain biking for people living with a spinal cord injury is minimal, as no research has explored the facilitators of participation from lived experiences of participants. This lack of research led to the focus on facilitators of adapted mountain biking and on pedal e-assist mountain-biking handcycles. Through the literature search and review process for this research, as well as through conversations with participants, it was apparent that a large part of the reason why facilitators of adapted mountain biking have not been well-researched is because many barriers still exist and overpower the conversation about facilitators (Moore et al., 1996). While participants described their experiences with facilitators of adapted mountain biking, more work is needed to increase the accessibility of the sport. The researchers believe that by highlighting the facilitators, the sport can move forward in being accessible to all (Fekete & Rauch, 2012). The aim of this descriptive phenomenological research was to illuminate clear and direct descriptions from participants living with a spinal cord injury, to get a sense of their experiences with facilitators of adapted mountain biking and how they can be amplified (Creswell & Poth, 2018). The themes were organized into groups

and categorized based on the purposes of both manuscripts, to reflect the facilitators of adapted mountain biking for people living with a spinal cord injury.

Adapted mountain biking is a sport with unique motivations, such as being active outside in nature, which many adapted sports do not encompass (Burns et al., 2008; Siderelis et al., 2010). While personal facilitators, like preparation and individualized safety measures, were described as important for participants in this study, more large-scale facilitators have a significant role to play in the accessibility of adapted mountain biking. Participants emphasized important societal and environmental factors such as having outlets for people to connect to one another on a human level, having organizations more involved in the promotion and support of adapted mountain biking, and advocating for accessible trails. These factors can help to facilitate participation in the sport of adapted mountain biking for more people living with a spinal cord injury.

Participants clearly expressed how adapted mountain biking is not the same without the relatively new mountain biking handcycles; that the improvements in technology have enhanced the experience and facilitated participation for more people living with a spinal cord injury. The equipment used by participants, particularly the pedal e-assist mountain-biking handcycles, has helped individuals living with a spinal cord injury explore nature in a way that no other equipment has enabled them to do. E-assist is a growing mode of transportation, and the integration into adapted sports like adapted mountain biking is a novel and important scope of research that needs to be better understood in relation to how the bikes can be further optimized for sport performance (Jenkins et al., 2022). Through this study, pedal e-assist was described as a facilitator to adapted mountain biking, which highlights the value of the efforts made

with advancing technology and innovations for increasing physical activity and sport for people living with a spinal cord injury. Looking at the equipment that facilitates adapted mountain biking should not be done in isolation, but the factors involved with participation should be observed in an all-encompassing manner.

Physical Activity for persons with a Disability (PAD) Model

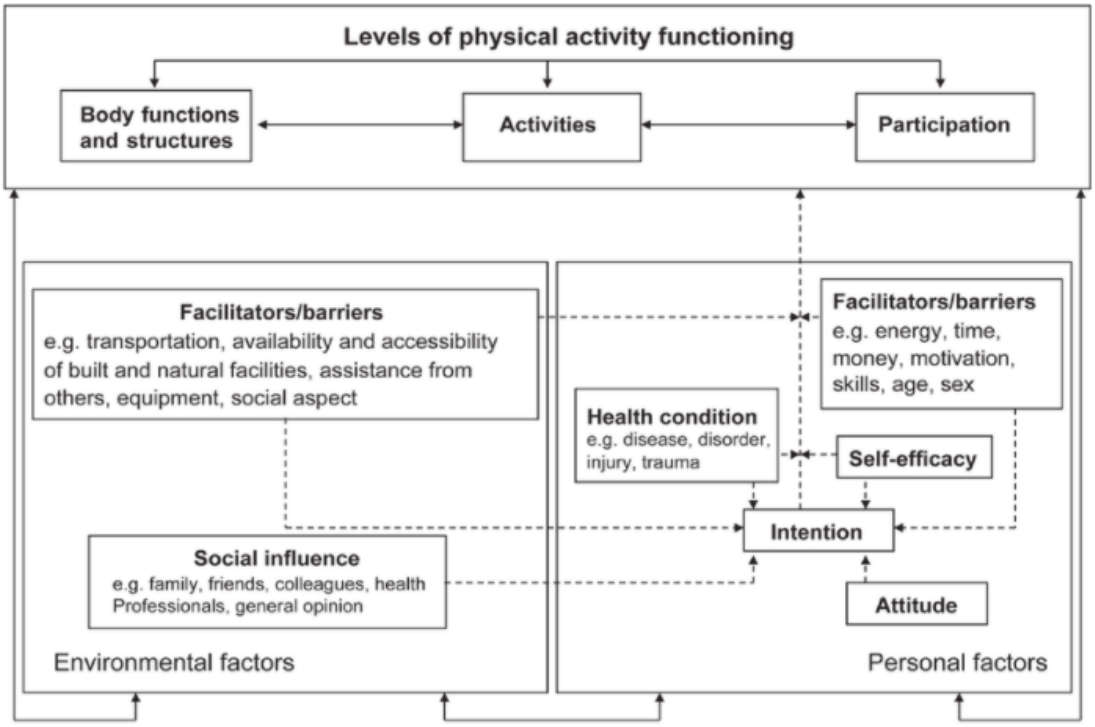
To help guide the focus and analysis of this research, the Physical Activity for persons with a Disability (PAD) model was used (seen in Figure 13). The PAD model is a theoretical framework that explores sport and physical activity participation of people living with a disability through the lens of environmental and personal barriers and facilitators (Van der Ploeg et al., 2004). This model was used to guide the analysis of the data, to understand the results within the context of existing physical activity models for individuals living with a disability (Van der Ploeg et al., 2004). There were a few unique ideas related to the facilitators of adapted mountain biking for people living with spinal cord injuries that surfaced from the data of the current study, but there were also some congruent themes that reflect the facilitators described in the PAD model, which inductively emerged from this research.

Some of the similarities between the findings regarding facilitators from this research, and the facilitators described in the PAD model included, having a desire and motivation to participate, having self-efficacy, social influence with support from friends and family, equipment, accessible facilities such as trail sites, access to resources, high energy levels, skill levels, time, money, and flexible personal circumstances (Figure 13). There is more research on the barriers of physical activities for people living with a disability (Fekete & Rauch, 2012; Zeller, 2008), but this research supports the

understanding that many of the barriers have “opposite” facilitators. The PAD model helps to frame the facilitators of adapted mountain biking found in this research as critical to the implementation of solutions that address barriers of participation for people living with a spinal cord injury (Fekete & Rauch, 2012; Zeller, 2008).

Figure 13

Physical Activity for persons with a Disability (PAD) Model



Physical Activity for People with a Disability (PAD) model. Published with permission from the author H. P. van der Ploeg (12).

(Van der Ploeg et al., 2004)

One of the concepts that participants mentioned in their interviews in this study, which is not detailed in the PAD model, is the role of planning that individuals living with disabilities engage in as preparation for participation. Factors like planning to ride based on who is available to ride with them, checking the weather in advance, and

making sure they have the necessary nutrition and hydration with them were all personal preparation facilitators that were described by participants (Arbour-Nicitopoulos et al., 2009). Being properly hydrated is important for people living with a spinal cord injury to manage difficulties with thermoregulation when adapted mountain biking along rural trails, especially when there is not quick access to food and water at the rural trail sites (Dubon et al., 2019; Grossmann et al., 2021; Kirkindall, 1999). Additionally, participants described how riding with other people, often able-bodied riders, is an important safety measure that individuals take, because there is someone around to help get them loose if their handcycle does get stuck in a narrow opening along a trail. While most participants described being part of an established mountain biking group, arranging to have an able-bodied rider join each trail ride takes coordinating and planning skills that individuals should possess (Marcus & Simkin, 1994).

While the majority of the focus of adapted sport facilitators is on the societal and environmental measures that can increase the accessibility of the sport, it is important that individuals with spinal cord injuries who are new riders know how to plan for engaging in adapted mountain biking along rural nature trails (Arbour-Nicitopoulos et al., 2009). Checking the weather ahead of time, packing necessary tools and supplies, like food and water, and stretching are important steps that participants described assisted with preparation for adapted mountain biking. As with any sport or physical activity, the measures taken and routines followed to prepare for participation in adapted mountain biking are important facilitators for people living with a spinal cord injury engaging in the sport (Arbour-Nicitopoulos et al., 2009). The theme of preparation identified in this

study is not included in the PAD model, but it does have an impact on participation in physical activity for people with disabilities.

Similarly, the PAD model does not include the application of safety measures for participating in adapted sports. The safety measures taken by individuals in the current study were described as important facilitators for engaging in the sport of adapted mountain biking, and more specifically, the thrill-seeking aspects of the sport. Some examples that participants provided about the ways they stay safe while adapted mountain biking include, researching trails in advanced or having someone else check them out to know if they are accessible for them. Other examples of ways to stay safe include using the pedal e-assist feature on mountain-biking handcycles to navigate rugged terrain, and being aware of one's personal skill-level for exercising caution when riding a new trail. Participants explained that the more they ride trails, the more skilled they become, which in turn provides them with improved safety measures that facilitates their continued participation. While the PAD model is comprehensive in highlighting the facilitators of physical activity for people living with a disability, it does not seem to account for physical activity or sports that are more competitive and involve more risk-taking. Even though safety considerations are more important for high-risk sports, it is still a component of the PAD model that is missing and important to understanding lower-risk physical activity participation (Arbour-Nicitopoulos et al., 2009). For people living with a spinal cord injury, it is important that the safety measures taken by individuals facilitate calculated risk-taking, in order to fully experience all that adapted mountain biking has to offer.

Using this theoretical model was important for framing the types of facilitators of adapted mountain biking in a disability sport context. The PAD model encompasses a variety of factors related to participation that relate to the lived experiences of individuals living with a spinal cord injury who were participants in this study. In terms of practical applications of this framework, it can be used to provide individuals living with a spinal cord injury in rehabilitation, a guide to adapted physical activity participation. It can also be used in adapted sports organizations or leagues to tailor to the specific sport. For the sport of adapted mountain biking, it can highlight the multi-disciplinary role of the personal and the environmental responsibilities for advocating for accessible physical activity participation, but does not encompass all the facilitators outlined by participants in this study. The implications from this research center around the expanding engagement of organizations involved in handcycling or mountain biking in general, as well as for trail organizers to increase the trail accessibility and sense of safety and security (Dickson et al., 2020; McCormack, 2018).

Recommendations and Future Research

Adapted Mountain Biking Recommendations

From this research, participants explained that there first needs to be advocacy for people living with a spinal cord injury, and for people living with disabilities in general, in adapted sports. For the sport of adapted mountain biking, more representatives and individuals living with spinal cord injuries need to be involved with the planning and organization of trail designs, as well as mountain biking competitions. Advocacy for people living with a spinal cord injury participating in adapted mountain biking is important for making sure that the needs and best interests of people participating are

being met. Educating bike shop employees, trail designers, and policy makers can help with advocating for the adapted mountain biking needs of people living with a spinal cord injury. Some features that accommodate the needs of participants include accessible washroom access at trail sites, wider trails, and access to organizations that connect individuals to adapted mountain biking resources (Dickson et al., 2020; McCormack, 2018). Spreading awareness to traditional mountain biking event organizers is another important way to advocate for people with spinal cord injuries who have the desire to compete in mountain biking races.

The sport of adapted mountain biking has been branching out into competitions, where some of the participants in this study have had experience racing competitively with other mountain-biking hand-cyclers. However, participants described how, with the growth of e-assist handcycle use, there are unclear rules and classifications for the handcycles that are allowed in competitions. A large barrier to participation in competitive mountain biking events, according to some participants, is the unclear rules around pedal e-assist mountain-biking handcycles being used in races. Even though the mountain-biking handcycles have generally made the sport more accessible, the accessibility of the handcycles has been increased even more with pedal e-assist. The e-assist does more than just make the pedaling lighter in intensity, it is a safety feature used for steering along uneven forest trails.

Not all participants, and not everyone with a spinal cord injury who participates in adapted mountain biking for recreation wants to ride competitively, but for those who do want to compete, these kinds of misunderstandings about the role of pedal e-assist create barriers to participation in community mountain-biking events. To address these barriers

of higher-level participation in adapted mountain biking, there are a number of solutions that can be introduced to facilitate participation among people living with a spinal cord injury. Some participants described the importance of creating different cohorts or groups within mountain biking competitions for people with varying degrees or levels of spinal cord injuries, to compete at a level playing field (Bhambhani et al., 2010). The equipment used by participants is related to their level of spinal cord injury. Therefore, having competitions that reflect the heterogeneity of individuals living with a spinal cord injury can help to make the sport and competitions more accessible to more people (Bhambhani et al., 2010). More research is needed to explore the categorization of adapted mountain biking competition groups that are most representative of the skill level of riders.

Recommendations for addressing the inequities in competitive adapted mountain biking for people using handcycles is to educate stakeholders in the operation and functionality of the equipment, the existing barriers, and the benefits and necessities of using pedal e-assist handcycles in the sport. Sharing lived experiences is important for bringing attention to the needs of individuals wanting to ride the trails. Along with educating organizations, a suggestion is to arrange for the people from those organizations to collaborate with individuals living with a spinal cord injury, to make sure the requirements for adapted mountain biking are being accommodated. The recommendations from participants about making competitions and adapted mountain biking overall more accessible to more people, encompass a variety of societal, institutional, and environmental changes to facilitate adapted mountain biking. Challenging the stereotypes that limit participation in sport competitions is an enormous

undertaking, so community efforts are critical to making strides in the facilitation of adapted mountain biking inclusion in mainstream sporting events.

Some of the community efforts participants described that would be helpful to facilitating adapted mountain biking include making the trails wider, as well as assessing and assigning a classification system for trail difficulty levels. The purpose of the classification systems is to include signs at trail sites that communicate how accessible the trails are, in relation to the maintenance of the trails, as well as the trail width compared to the width of the handcycles. Making sure that people with spinal cord injuries who participate in adapted mountain biking are aware of the trails that are and are not accessible for mountain-biking handcycles is important for facilitating safe and responsible adapted mountain biking. Having wider trails is ideal for creating a sense of security among individuals riding mountain-biking handcycles through forested areas. However, since accessible trail designs can take many years to actualize, having signs and information to provide general indications about the difficulty level and accessibility of the trails is a measure that can be implemented in a more timely manner. More research is needed to understand how to optimally introduce cohesive signage and rating systems for trails that are used for adapted mountain biking.

According to participants, bike shops with the resources to repair mountain-biking handcycles are rare. To encourage bike shops to take part in the servicing of mountain-biking handcycles, the shops could be subsidized to incentivize making accommodations to the services that they provide. By having subsidies in place, bike shop workers can be supported to take on the learning and labour of working on mountain-biking handcycles through potential workshops on the intricacies of the mechanics of the handcycles. Bike

shops have the potential to provide connections to organizations for financial support for equipment, as well as other community supports. Creating community spaces, like bike shops that provide an inviting environment for mountain-biking hand-cyclers can help to facilitate inclusion, to make adapted mountain biking more accessible for more people to participate (McCormack, 2018).

A major barrier to participating in adapted mountain biking for many people living with a spinal cord injury is the cost of equipment. Since mountain biking handcycles are very expensive, those who cannot afford it do not have the opportunity to ride. However, participants explained how the benefits of adapted mountain biking can be experienced by more people through bike sharing hubs. Jenkins et al., (2022) reflected on research about the use of e-bike hubs that rent out bikes, which could be implemented for adapted mountain biking as well. While mountain biking handcycles are often tailor-made, there is still a benefit to having a collection of mountain-biking handcycles at a shared hub for people living with a spinal cord injury to try out and use. Whether users of the handcycles at the hub decide to repeatedly rent, or purchase a handcycle themselves, having this option to test them out was described as a facilitator by participants in this study. Having central locations for mountain-biking handcycles near trails can make the cost, storage, and transportation much more accessible to more people living with a spinal cord injury. This idea of ride sharing hubs for mountain-biking handcycles needs to be studied to understand the logistics of implementing this service.

Most of these recommendations call for community involvement in the promotion of adapted mountain biking, but currently a common limitation to these recommendations is an absence of funding (Fekete & Rauch, 2012). The handcycles, particularly the pedal

e-assist mountain-biking handcycles, are expensive and the cost to own this equipment was described by participants as a potential barrier. In order to facilitate participation in adapted mountain biking for more people living with a spinal cord injury, participants explained how more funding towards handcycles is needed in communities. Participants suggested that funding can come from an increase in scholarships that the government offers, as there are a few that do currently exist. Another source of funding participants described was being involved in fundraising events. Public events with large crowds, such as mountain biking competitions, is an important way to bring awareness and funding to adapted mountain biking. Expanding the sources of funding for the sport can make a significant impact in the growth of adapted mountain biking, where recruiting even a few mountain-biking hand-cyclers at a time can positively affect the lives of individuals who have the opportunity to participate in this meaningful physical activity.

Future Research

If handcycle hubs were to become commonplace, studying the perceptions of handcycle hub users would be an important perspective to the understanding of equipment access for mountain biking handcycles. Having insight based on first impressions of the handcycle's accessibility through nature trails, as well as the access to handcycles through the hub would be an important indicator into the effectiveness of shared handcycle services. Although handcycle hubs would first need to be implemented before looking into perceptions of them, research could start by exploring the potential benefits to having hubs for mountain-biking handcycles and where they could be located for optimal use among people living with a spinal cord injury.

In general, more research should also be focused on the equipment used for adapted mountain biking. Knowing how the equipment is optimized can help newcomers to have the resources and knowledge they need to safely participate in the sport. Another aspect of the equipment that can be further explored is the market for e-assist mountain-biking handcycles, as it is important to be keeping up with the evolving technology and how the increasing variety of handcycles can help to extend the outreach to more people with different riding goals and purposes, to continue growing the sport.

To understand the overall group culture of adapted mountain biking, similar research could be conducted using a focus group methodology. A focus group with individuals who all have the experience of living with a spinal cord injury could be an important approach to better understanding the importance of the sport and all it offers, but also to get a chance to understand group dynamics. Getting a sense of the way participants would interact in a group interview setting can provide insight into the ways to build group cohesion among riders.

The current study could be used to initiate new research on the perceptions of facilitators for adapted mountain biking, by interviewing individuals with a spinal cord injury who have not had experience with the sport. There may be different facilitators described by people with spinal cord injuries who do and do not ride mountain biking handcycles. Understanding the differences can help to identify what potential facilitators could be missing from this research. This understanding could help enable current non-users to start participating, as opposed to relying only on the facilitators described by participants in this study, who do have experience with adapted mountain biking.

On the more quantitative side of research, there could be a focus on the physiological differences between manual and e-assist mountain-biking handcycle use. While the lived experiences of participants in this study emphasize the dramatic difference between using and not using e-assist, it could be important to understand how much of a difference it can make in terms of mitigating the chance of overexertion or overuse injuries.

The focus of the current study is a novel topic in the research, and has much potential to be further explored, both qualitatively by interviewing people with spinal cord injuries, and quantitatively by taking physiological and/or biomechanical measurements of adapted mountain bikers. There are many adapted mountain biking facilitators that participants described throughout the interviews, which have provided recommendations for solutions to the inaccessibility of the sport. The aim with this research was that it would reach the organizations that can help create opportunities for adapted mountain biking. Spreading awareness about the facilitators of adapted mountain biking is important for encouraging participation in fulfilling physical activity for people living with a spinal cord injury.

Conclusions

Participants involved in this research described the facilitators of adapted mountain biking for people living with a spinal cord injury. All of the themes that emerged from this study provide insight into the interconnectedness of adapted mountain biking facilitators. While the PAD model illustrates some of the connections between facilitators of physical activity for people living with a disability, not all of the themes from this study are included in this model (Van der Ploeg et al., 2004). This emphasizes the

importance of having models that specifically reflect the essential facilitators for that particular sport. This study highlighted some of the unique characteristics that facilitate adapted mountain biking for people living with a spinal cord injury. Based on the research purpose to understand the facilitators of adapted mountain biking, including the specific equipment used, this study highlights the importance of participating in adapted sports like adapted mountain biking, and identifying the facilitators that make the sport accessible to people living with a spinal cord injury.

The practical application of facilitators, such as the future recommendations described, is important for the growth of adapted mountain biking. More work is needed to facilitate the sport for people living with a spinal cord injury to have more fulfilling physical activity experiences. The current study provides direction through some recommendations that can make adapted mountain biking more accessible, but more research is needed to understand how to optimally apply the suggestions for facilitating the sport into practice.

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Chapter 6. Appendices

Appendix 1: Letter of Approval from Ontario Tech University Research Ethics Board

Date: *November 16, 2022*
To: *Meghann Lloyd*
From: *Ruth Milman, REB Chair*
File # & Title: *17005 - Exploring the Lived Experiences of Adults with Spinal Cord Injuries with Respect to Rural Nature Trail Use for Physical Activity*
Status: ***APPROVED***
Review Type: ***Delegated Review***

REB Expiry Date: ***November 01, 2023***
Documents Approved:

Document Type	Document Name	Version Date
Communication	Appendix 11 - Member Checking Email (Revised and CLEAN version). Version date: 10-11-2022	2022/11/10
Consent Letter	Appendix 9 - Consent Form (Revised and CLEAN version). Version date: 10-11-2022	2022/11/10
Communication	Appendix 8 - Participant Thank You Email (Revised and CLEAN version). Version date: 10-11-2022	2022/11/10
Data Management Plan	Appendix 2 - Data Management Plan (Revised and CLEAN version). Version date: 11-11-2022	2022/11/11
Recruitment Materials	Appendix 6 - Sample Social Media Post (Revised and CLEAN version). Version date: 10-11-2022	2022/11/10
Recruitment Materials	Appendix 5 - Networking Recruitment Letter (Revised with version date). Version date: 10-11-2022	2022/11/10
Recruitment Materials	Appendix 4 - Participant Recruitment Letter (Revised and CLEAN version). Version date: 10-11-2022	2022/11/10
Recruitment Materials	Appendix 3 - Recruitment Poster (Revised and CLEAN version). Version date: 10-11-2022	2022/11/10

Data Collection Materials	Appendix 2 - Demographic Information Form (Revised and CLEAN version). Version date: 10-11-2022	2022/11/10
Data Collection Materials	Appendix 1 - Interview Guide (Revised and CLEAN version). Version date: 10-11-2022	2022/11/10
Recruitment Materials	Appendix 3: Recruitment Poster	2022/11/01
Consent Letter	Appendix 4: Participant Consent Form (Revised)	2022/11/01
Consent Letter	Appendix 9: Participant Consent Form	2022/08/04
Communication	Appendix 11: Member Checking Email	2022/08/02
Confidentiality Agreements	Appendix 10: Research Assistant Confidentiality Agreement	2022/08/02
Data Management Plan	Appendix 7: Data Management Plan	2022/08/04
Data Collection Materials	Appendix 1: Interview Guide	2022/08/03
Communication	Appendix 8: Participant Thank You Email	2022/08/02
Recruitment Materials	Appendix 6: Sample Social Media Post	2022/08/02
Data Collection Materials	Appendix 2: Online Demographic Information Form	2022/08/03

Notwithstanding this approval, you are required to obtain/submit, to Ontario Tech Research Ethics Board,
any relevant approvals/permissions required, prior to commencement of this project.

The Ontario Tech Research Ethics Board (REB) has reviewed and approved the research study named above to ensure compliance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2 2018), the Ontario Tech Research Ethics Policy and Procedures and associated regulations. As the Principal Investigator (PI), you are required to adhere to the research protocol described in the REB application as last reviewed and approved by the REB. In addition, you are responsible for obtaining any further approvals that might be required to complete your project.

Under the TCPS2 2018, the PI is responsible for complying with the continuing research

ethics reviews requirements listed below:

Renewal Request Form: All approved projects are subject to an annual renewal process. Projects must be renewed or closed by the expiry date indicated above ("Current Expiry"). Projects not renewed 30 days post expiry date will be automatically suspended by the REB; projects not renewed 60 days post expiry date will be automatically closed by the REB. Once your file has been formally closed, a new submission will be required to open a new file.

Change Request Form: If the research plan, methods, and/or recruitment methods should change, please submit a change request application to the REB for review and approval prior to implementing the changes.

Adverse or Unexpected Events Form: Events must be reported to the REB within 72 hours after the event occurred with an indication of how these events affect (in the view of the Principal Investigator) the safety of the participants and the continuation of the protocol (i.e. un-anticipated or un-mitigated physical, social or psychological harm to a participant).

Research Project Completion Form: This form must be completed when the research study is concluded.

Always quote your REB file number (**17005**) on future correspondence. We wish you success with your study.

Sincerely,

Dr. Ruth Milman
REB Chair
Ruth.Milman@ontariotechu.ca

OntarioTech UNIVERSITY

Do you or someone you know have a spinal cord injury and ride nature trails?

We are looking for English-speaking adults with a spinal cord injury who use a wheelchair and ride rural nature trails to take part in an optional research study led by Ontario Tech University researchers. Participation in this study is voluntary and will involve one 60-90 minute online interview where individuals can talk about their experiences with trail riding as a person with a spinal cord injury. Participants will receive a $50 Visa E-Gift Card for their time.

For more information, please contact Sarah or Meghann:

Student Lead: sarah.wildish@ontariotechu.net

Principle Investigator: meghann.lloyd@ontariotechu.ca

This study has been reviewed by the Ontario Tech Research Ethics Board [REB # 17005] on [November 1].

If you have any questions regarding your rights as a participant or have any concerns about this study, please contact the Research Ethics Office at researchethics@ontariotechu.ca or 905.721.8668 x3693.

2000 Simcoe Street North, Oshawa L1H 7K4 Canada | 905.721.8668 ontariotechu.ca Version date 10-11-2022

Appendix 3: Recruitment Letter from Researcher

Date to be sent: November 16th 2022

Sender: Sarah Wildish

Target audience: Adults with a spinal cord injury who responded to social media advertisements AND adults with a spinal cord injury who responded to word of mouth (snowball) recruitment.

Subject line: Optional Research Study: Exploring the Lived Experiences of Adults with Spinal Cord Injuries with Respect to Rural Nature Trail Use for Physical Activity

Header: Research study for adults with a spinal cord injury who use a wheelchair and ride nature trails

Body:

Hello [potential participant name],

Thank you for your interest in our study! This is a research study for Sarah Wildish's Master's thesis. Below you will find a short overview of this virtual study and attached you will find the consent form as well as a flyer with some more information. This form is included to provide you with additional information about this **optional** study, you are not required to print or fill out the consent form at this time.

You are invited to participate in an online video call interview to talk about your lived experiences with riding nature trails as a person with a spinal cord injury. The interview will last approximately 60-90 minutes and be conducted on an online video call.

Rural nature trails are environments in nature that provide space for physical activities. There are a variety of health benefits such as more efficient breathing and boosts in positive moods that are increased when using rural nature trails for physical activities, like hiking and biking. Certain environments have a larger effect on the promotion of physical activity and increasing the benefits individuals experience. However, not all people are able to experience environments equally. People with disabilities, such as a spinal cord injury, are more likely to experience barriers to trail use and are less likely to use nature trails because of inaccessibility. There is limited research on the lived experiences for people with disabilities using nature trails, and there is no research specifically on enabling factors of trail use for people with spinal cord injuries. We are interested in hearing the "voice" of individuals with a spinal cord injury who do ride nature trails to better understand the factors that help enable physical activity and trail use for people with a spinal cord injury. This information may help to inform better community programming, improve park and trail management, and provide direction for future research surrounding trail use for more people with a spinal cord injury.

The purpose of this research study is to ask you to describe the factors that have enabled or facilitated your use of nature trails as a person with a spinal cord injury, as well as your overall lived experience with riding nature trails.

To participate in this study, we will ask you to set up an interview time for an online Google Meets video conferencing call. You will be compensated for your time with an $50 Visa E-Gift Card which will be sent to your email address. Participation in this study is completely voluntary. You may withdraw from the study at any time by telling the researchers, and you are not required to provide a reason for doing so.

If you have any questions about this study, please contact Sarah Wildish at sarah.wildish@ontariotechu.net or my supervisor Dr. Meghann Lloyd at Meghann.lloyd@ontariotechu.ca or 905-721-8668 ext. 5308. This study has been reviewed by the Ontario Tech University Research Ethics Board REB [REB#17005] on **[November 1, 2022].** The Ontario Tech University Research Ethics Board is a committee of the university whose goal is to ensure the protection of the rights and welfare of people participating in research. The Board's work is not intended to replace your own judgement about what decisions and choices are best for you.

Any questions regarding your rights as a participant, complaints or adverse events may be addressed to Research Ethics Board through the Research Ethics Office – researchethics@uoit.ca or 905.8668 x. 3693.

Thank you,

Sarah Wildish
Ontario Tech University
sarah.wildish@ontariotechu.net

Appendix 4: Participant Consent Form

Title of Research Study:
Exploring the Lived Experiences of Adults with Spinal Cord Injuries with Respect to Rural Nature Trail Use for Physical Activity

Name of Principal Investigator (PI): Meghann Lloyd, PhD

Contact Information: Email: meghann.lloyd@ontariotechu.ca

Phone: 905-721-8668 ext. 5308 (office)

Name of Student Lead: Sarah Wildish, BHSc

Contact Information: Email: sarah.wildish@ontariotechu.net

Departmental and institutional affiliation(s):

Kinesiology, Faculty of Health Sciences, Ontario Tech University

Name of Committee Member: Nick Wattie

Contact Information: Email: nick.wattie@ontariotechu.ca

Phone: (905)-721-8668 ext. 2248

Introduction

You are invited to participate in a research study titled: *Exploring the Lived Experiences of Adults with Spinal Cord Injuries with Respect to Rural Nature Trail Use for Physical Activity*. **To be eligible for this research study, you must have a spinal cord injury, use a wheelchair, and have experience riding rural nature trails.**
You are being asked to take part in an interview for a research study. Please read the information about the study presented in this form. The form includes details on study's procedures, risks and benefits that you should know before you decide if you would like to take part. You should take as much time as you need to make your decision. You should ask the Principal Investigator (PI) or study team to explain anything that you do not understand and make sure that all of your questions have been answered before signing this consent form. Before you make your decision, feel free to talk about this study with anyone you wish including your friends and family. Participation in this study is voluntary.

This study has been reviewed by the University of Ontario Institute of Technology (Ontario Tech University) Research Ethics Board [REB#17005] on [November 1, 2022]. Please read this consent form carefully and feel free to ask the researcher any questions that you might have about the study. Any questions regarding your rights as a participant, complaints or adverse events may be addressed to the Research Ethics Board through the Research Ethics Office – researchethics@ontariotechu.ca or 905-721-8668 x. 3693

Purpose and Procedure:

Purpose:
Using nature trails for physical activities, like hiking and biking, provides people with a variety of health benefits. Rural nature trails are pathways in rural or remote areas within nature, such as parks, that are unpaved. Being physically active in rural nature trails increases respiratory and mental health, which is important for increasing the overall health and well-being of all people. However, people who live with a spinal cord injury, are less likely to use nature trails since they are more likely to experience barriers to trail use because of inaccessibility. Barriers that make trail use inaccessible for people with a spinal cord injury limit the physical activity opportunities that are available. There is limited research on the lived experiences for people with disabilities who do use nature trails, and there is no research specifically on factors that facilitate and promote trail use for people with spinal cord injuries. The purpose of this research is to describe the lived experiences of adults living with a spinal cord injury, who use a wheelchair and ride rural nature trails. We also hope to be able to identify factors that facilitate and promote rural nature trail use for adults living with a spinal cord injury using a wheelchair.

Procedures:
We are recruiting 6-10 adults with a spinal cord injury who ride rural nature trails. As a participant, you will be interviewed during an online video conferencing call with Sarah Wildish (student researcher), with the interview lasting approximately 60-90 minutes. Questions will be centered on each participant's lived experiences with riding rural nature trails and factors that promote and facilitate nature trail use for a person with a spinal cord injury. The interview will take place over Google Meet and the researcher will be in a private, secure location. You will also be asked to fill out a demographic form to provide us with information about you, including some personal health information (e.g. the level of spinal cord injury). The purpose of this information is to be able to accurately describe the group of people who participated in our study, for context.
Interviews will involve questions about your lived experiences, and the factors that have facilitated and enabled your use of nature trails. Interviews will be recorded so they can later be accurately typed out word-for-word. These transcripts will be the main form of data used in data analysis.

Potential Benefits:
You may not benefit directly from participating in this study. However, this study may help us, and groups who support people who live with a spinal cord injury to better understand the factors that facilitate and enable nature trail use for people with a spinal cord injury. This information may help improve the management and design of nature trails, help support better community programming, and provide direction for future research about physical activity opportunities in nature for people with a spinal cord injury.

Potential Risk or Discomforts:

There is a chance that strong memories or feelings may be recalled during the interview process. There is a slight probability that these memories may cause emotional or psychological discomfort. Participants are free to end, or pause, the interview session at any time, without providing a reason for doing so. Participants may also choose not to answer any questions they do not want to answer.

Use and Storage of Data:

The interview will be recorded and transcribed word-for-word. Interview recordings and transcripts will be anonymized (participant names removed), encrypted and stored on Ontario Tech University's Google Drive. This Google drive has restricted access to only Sarah Wildish and Dr. Meghann Lloyd. Both individuals require their own personal account and password to access the Google Drive. All information will be securely stored throughout the duration of the study, and all the data will be deleted after 7 years once data is collected. All information collected during this study, including participant personal information, will be kept confidential and will not be shared with anyone outside the study unless required by law. You will not be named in any reports, publications, or presentations that may come from this study.

Confidentiality:

This research study involves the disclosure of personal information from the research participants. To protect participants' right to confidentiality, all personally identifying information will be removed from quotes included in any published work, and all participants will be given pseudonyms to identify them during each stage of data analysis after the initial interview is complete. The purpose of this study is not to investigate personal health information. During your interview, please refrain from disclosing any personal health information as there is no need for this information to be shared within this study. We are only asking you about your nature trail riding experiences, not about personal health information. If you do disclose any personal health information in your interview, it will be removed from your interview transcript by the researchers. Due to the specific focus of this study and the relatively small number of potential participants, please know that there is a small risk that you may still be identifiable in a published document, even when personally identifying information has been removed. This research study includes the collection of demographic data which will be aggregated (not individually presented) in an effort to protect your anonymity. Despite best efforts it is possible that your identity can be determined even when data is aggregated. All data collected will be stored on a secure online server, and only necessary personal information will be collected. All information will only be accessed by the primary research team. Throughout the research process, your privacy will be respected. No information about participant identity will be shared or published without your permission, unless required by law. Confidentiality will be provided to the fullest extent possible by law. Any data that you receive will be through a link that is emailed to you. You are receiving the consent form and demographic information via a link to a google form that has been sent to your provided email. All your information is saved to Ontario

Tech's password protected Google Drive. For interview data, a link to a specific password protected file will be sent to your email, for you to view your transcript. All forms and documents sent as a link to your specified email will be sent from an Ontario Tech institutional email.

Voluntary Participation:

Your participation in this study is voluntary and you may take part in only those aspects of the study in which you feel comfortable. You may also decide not to be in this study, or to be in the study now, and then change your mind later. You may leave the study at any time without affecting your right to compensation for your time. You will be given information that is relevant to your decision to continue or withdraw from participation. Such information will need to be provided later. You may refuse to answer any question you do not want to answer, or not answer an interview question by saying, 'pass'.

Right to Withdraw:

If you withdraw from the research project, you can do so at any time up until your name is removed from the data, and individual data has been coded in NVivo and cannot be linked back to your identity. If you withdraw up until this point, any data that you have contributed will be removed from the study and you do not need to offer any reason for making this request. Once your data is organized into themes, it would no longer be feasible to link specific quotes from your interview back to you. So participants who wish to withdraw need to withdraw their interview from inclusion in the study at the stage that member checking is completed. Additionally, the decision to withdraw will have no effect on compensation that you are to receive for taking part in the study. Once you complete the consent form, providing informed consent to be in this study, you are eligible for the specified compensation, even if you withdraw before completing the study. The information that is shared will be held in strict confidence and discussed only with the research team. You will be given information that is relevant to your decision to continue or withdraw from participation. If you decide you do not want to fill out the demographic form, you are still eligible to participate in the interviews. You may exit the web browser tab at any point before pressing 'submit' without any of your demographic data being collected.

Conflict of Interest:

Researchers have an interest in completing this study. Their interests should not influence your decision for you to participate. No members of the research team have any conflicts of interest that may influence the completion of this study.

Compensation, Reimbursement, Incentives:

Participants will not be directly compensated for expenses associated with their participation but will receive a $50 Visa E-Gift card as a token of appreciation.

Debriefing and Dissemination of Results:

Upon completion of data analysis, a report of the findings will be written for publication. We will notify you via email of the completion of this report and send a copy to you to read.

Participant Rights and Concerns:

Please read this consent form carefully and feel free to ask the researcher any questions that you might have about the study. If you have any questions about your rights as a participant in this study, complaints, or adverse events, please contact the Research Ethics Office at (905) 721-8668 ext. 3693 or at researchethics@uoit.ca. If you have any questions concerning the research study or experience any discomfort related to the study, please contact the researcher Sarah Wildish at sarah.wildish@ontariotechu.net or the faculty supervisor of this project Dr. Meghann Lloyd at 905-721-8668 ext. 5308 or meghann.lloyd@ontariotechu.ca. By signing this form, you do not give up any of your legal rights against the investigators, sponsor, or involved institutions for compensation, nor does this form relieve the investigators, sponsor, or involved institutions of their legal and professional responsibilities

Consent to Participate in the research study titled: ***Exploring the Lived Experiences of Adults with Spinal Cord Injuries with Respect to Rural Nature Trail Use for Physical Activity***

Online consent to participate in this research study

To participate in this research study, you will need to consent to each of the following statements by clicking each box.

1. ☐ I have read the consent form and understand the study being described.

2. ☐ I have had an opportunity to ask questions and my questions have been answered. I am free to ask questions about the study in the future.

3. ☐ I freely consent to participate in the research study, understanding that I may discontinue participation at any time without penalty. A copy of this Consent Form has been made available to me.

4. ☐ I give consent for my **online** interview to be **video recorded** as part of the study

Once you have selected each of these boxes, click the 'submit' button to submit this consent form. Clicking 'submit' confirms your informed consent to participate in this research study.

Appendix 5: Online Demographic Form

Link to Demographic Information Form:

https://forms.gle/nUnRre91PY66FmVt8

This form is a part of an Ontario Tech University research study (REB #17005) entitled: Exploring the Lived Experiences of Adults with Spinal Cord Injuries with Respect to Rural Nature Trail Use for Physical Activity. This demographic form includes questions about you that will help to describe our sample and provide context for the information we learn through this study. Please feel free to ask questions if you would like further clarification. All questions are optional.

Version date: 10-11-2022

i. Full Name: [Full name of participant]

ii. Email: [Email of participant]

iii. What is the gender you identify with?

_____

iv. What is your age in years?

_____

v. What is your ethnicity? **Please use the options below: (consistent with Statistics Canada, 2011)**
   - Indigenous
   - Chinese
   - Korean
   - Southeast Asian
   - Arab/West Indian
   - Filipino
   - Latin American
   - White
   - Black
   - Japanese
   - South Asian
   - Undeclared

- Bi-Racial
- Other:

  If other, please identify:

vi. What category is most reflective of your current personal income?
- Less than $25,000/year
- $25,000 - $50,000/year
- $50,001 - $75000/year
- $75,001 - $100,000/year
- More than $100,000/year
- Prefer not to say

vii. Rural nature trails are unpaved trails that are located in rural areas within nature, for example trails in conservation areas, national parks, and provincial parks. Based on this description of rural nature trails, how often do you use rural nature trails?
- Less than 3 times ever
- 1-3 times per year
- 4-6 times per year
- 7-9 times per year
- More than 10 times per year

viii. What are the names of the rural nature trails that you have ridden most?

Appendix 6: Interview Guide

Question	Probe
1. Based on the criteria for participating in this study, you are living with a spinal cord injury, and you are a user of nature trails, so how about we start with you telling me a bit more about yourself?	· How often do you ride rural nature trails? · Do you use trails once per year, once per month, per week? · How many trails or trail networks do you regularly visit? · Do you ride competitively or for recreation? · How would you classify your trail riding experience; are the trails you ride mostly beginner (green circle), intermediate (blue square), advanced (black diamond) level, or some sort of combination? · Approximately how long are your rides? (How many kilometers? How much time?) · How long have you been riding nature trails? · Are there other physical activities or sports that you take part in?
2. What got you started in using nature trails?	· Did you use trails before your spinal cord injury? · Who was most influential in motivating you to use trails? · What opportunities did you have to learn about riding trails after your injury?

3. Tell me about your experiences accessing rural nature trails.	· What are the names of trails you use? · Are there trails that you use most often? · What are some of the geographical features of the trails you ride? Do they have steep hills, are they heavily forested? · How far are the trails from where you live? · How important is it that you are close to the nature trails you use? · How do you travel to the trails? (i.e. by bus, car ride from others, driving yourself, etc.) · What do you do to prepare for going to a trail? · How important is the availability of accessible facilities, such as washrooms, and parking spaces, when you use nature trails?
4. Can you describe the equipment you use when riding trails?	· Do you use an electric pedal-assist feature on your equipment when you ride trails? · Does using the pedal-assist e-bike make riding trails more accessible? · Would you be riding trails if you didn't have a pedal assist e-bike? · At what times are you using the electric assist when riding trails? · In addition to your bike, what other equipment do you use when riding (gear, clothes, food/water, tools, electronics, etc.)? · What are the benefits of using the equipment you ride with? · If you could design the perfect equipment for riding trails, what features would it include?

5. Why is trail riding important to you?	• What did you hope to get out of riding trails when you started? • What are your intentions or goals when using nature trails? • Do you prefer to spend your time using nature trails with other people or by yourself? • What is it about going to nature trails on your own/with other people that makes them a place you want you return to?
6. Could you tell me about your best or most favourite trail experience?	• What made this best trail experience such a good day? Why was it so great? • Were there parts of trail riding that you enjoyed compared to other trail experiences? (i.e., the people, the challenge, the success, etc.)
7. Some people would say that as a person with a spinal cord injury who uses a wheelchair, racing along steep and rough trails is risky, but what are your thoughts on risk-taking and thrill-seeking being a part of riding trails?	• Is it important to you that trails encourage thrill-seeking and risk-taking? • How often do you find trails that involve risk-taking that are also accessible?
8. How do you stay safe while riding trails?	• Are there other people you ride with? • Do you have a checklist (mental or written) you use before riding trails? • Do you bring tools with you on your rides? If so what tools? • How does your riding change based on the weather? • Do you use any alerts/announcements for assessing trail conditions or do you use your own judgement, or is it a combination?

	• How does your riding change with differences in your energy levels?
9. What has made accessing trails simpler for you?	• Have equipment services, transportation services, etc. made trails more accessible for you? • In any instances of technical problems with equipment, what has been helpful in resolving the equipment issue? • How often do you have a tune-up for your bike? • In your opinion what more can be done to make trails more accessible?
10. Do you have advice for other people with a spinal cord injury looking to get into riding trails?	

Appendix 7: Codebook

Themes regarding the lived experience of people with spinal cord injuries participating in adaptive mountain biking are listed below.

Name	Description
Barrier	Any description of the barriers that exist for adaptive mountain bikers to use trails, including physical, social, and policy barriers
Barrier - Environmental	Any descriptions of the barriers to trail riding that participants encounter, related to environmental limitations.
Delayed accessible trail design	Any description of accessible trail design being delayed, due to time, money, etc.
Inaccessible Facilities	Any description of facilities, such as parking at trails or other bike related services off-site of the trails (i.e., bike shops) being inaccessible to the adaptive riders using them
Physical Barrier	Any description of there being physical barriers at the trails that limit the use of trails for adaptive riders
Barrier - Human Disconnection	Any descriptions of the barriers to trail riding that participants encounter, related to interpersonal limitations.
Lack of awareness	Any description of the participant explaining how there is a lack of awareness around the sport of adaptive mountain biking and the needs of adaptive riders that act as a barrier to accessible trail riding
Others perceptions of adaptive riding theme	Any description of the perceptions of other trail users or non-adaptive riders that act as a barrier to accessible trail use for adaptive riders
Barrier - Organizational	Any descriptions of the barriers to trail riding that participants encounter, related to organization based limitations.
Equipment Mechanisms and Physics	Any description of the participants experiencing limitations with the physics and mechanisms of the equipment they use to ride nature trails.
Barrier - Limited Access and Opportunities	Any description of the limited opportunities for adaptive trail riding, to be active, and participate in competitions
Barrier - Personal	Any descriptions of the barriers to trail riding that participants encounter, related to individual limitations.

Name	Description
Energy level impact	Any description of the energy levels of participants, particularly low energy levels, impacting the quality of their riding
Fear	Any description of the participant experiencing fear as a hesitant or barrier trail riding.
Financial and Transportation Logistics	Any description of the participant experiencing personal barriers to trail riding due to logistics, such as funding and transportation limitations.
Equipment theme	Any description of the equipment used for adaptive mountain biking, including bike and non-bike equipment.
Bike Descriptions	Any description from the participants about the bikes that are used for adaptive mountain biking, including the features and how they are used.
Bike Features	Any description of the features of the bike that the participants use for adaptive mountain biking.
Bike Usage and Operation	Any description of the ways that participants used their adaptive mountain bikes, such as how they operated them.
Traditional Handcycle Description	Any description of the participant using a traditional hand-cycle (non e-assist) bike for adaptive mountain biking.
E-assist	Any descriptions from participants related to e-assist equipment used on their adaptive mountain bikes.
E-assist accessibility	Any description about the accessibility of e-assist features used while adaptive mountain biking. Descriptions about how e-assist contributes to an increase in accessibility of the sport
More Risk Taking	Any description of the participant engaging in increased risk-taking while adaptive mountain biking because of the accessibility that the e-assist on the bike provides.
Safety Feature	Any description of the e-assist being a safety measure, in some cases as a necessity for staying safe while adaptive mountain biking along rough trail conditions.
Energy Preservation	Any description of the participants experiencing energy preservation from the use of e-assist, contributing to the accessibility of the equipment
Increased Riding Time	Any description of the participants increasing their time spent adaptive mountain biking by using e-assist.

Name	Description
Escapism/Freedom	Any description of the e-assist on the participant's adaptive mountain bike providing a sense of freedom and escapism for the individual.
E-assist as enjoyable	Any description of the participants experiencing joy while using the e-assist while riding their adaptive mountain bike.
E-assist description	Any description of the e-assist that the participants use on their adaptive mountain bikes.
Accessibility	Any description about how the equipment the participants use makes riding more accessible for them
Adaptive Bike Market	Any description of the participant explaining that adaptive riding can be grown through the expansion of the types of bikes available, with a variety of bikes opening up the sport to more people
Bike Mechanisms and Physics	Any description of the mechanisms or physics of how the bike operates adding to the accessibility of the equipment
Increased Opportunities	Any description of the equipment used by participants increasing the accessibility of adaptive mountain biking by providing increased opportunities.
Peace of Mind	Any description of the equipment used by participants increasing the accessibility of adaptive mountain biking by offering peace of mind to users.
Maintenance	Any description of the maintenance involved with the participants' riding equipment (i.e. repairs, tune ups, frequency of maintenance).
Bike Repair Services	Any description of participants using bike repair services such as bike shops to complete maintenance and repairs on their adaptive mountain bike.
Independent Repairs	Any description of participants doing repairs on their adaptive mountain bike independently, without the service of a bike repair shop.
Non-bike/Biking Accessories	Any description of the equipment that the participant uses that is supplementary to the bike, including riding clothing and gear, tools, etc.
Clothing and gear	Any descriptions of the participants wearing certain clothing items or gear that support their adaptive mountain biking experience

Name	Description
Bike accessories	Any description of the participants using features or accessories on their bike that contribute to their biking experience, such as riding with lights to luminate the trails.
Tech	Any description of the participants using technology to support their riding experience, such as tracking their distance and using a global positioning system (GPS) to bike the trails.
Tools	Any description of the participants brining tools that they might need to make adjustments on their bike while at the trails.
Facilitator	Any description of facilitators of adaptive mountain biking that the participants currently implement or suggest implementing to encourage more accessible trail riding.
Facilitator - Environmental	Any descriptions of the participant experiencing facilitators to trail riding through environmental enabling factors
Accessible facilities theme	Any description of accessible trail facilities making trail riding more accessible
Accessible Trail Design	Any descriptions of the participants experiencing facilitators to trail riding through trails with accessible design, including classification systems and maintenance and updates to trails
Facilitator - Sense of Security Theme	Any description of trails being more accessible with a greater sense of security, and the actions that have and can be taken to promote a better sense of security along trails.
Facilitator - Human Connection	Any descriptions of the participant experiencing facilitators to trail riding through interpersonal connections with other people. Descriptions explain HOW others facilitate trail riding for the participants.
Education and Awareness	Any description of the participants explaining that adaptive riding can be expanded by raising awareness and educating people about the opportunities and ways to promote accessibility for adaptive riding
Helpers	Any description of the participant being enabled to ride trails from the assistance of "helpers", who are other people that support the participant in preparing to ride.
Initial Exposure Theme	Any descriptions of the outlets where participants were initially exposed to adaptive mountain biking.
Riding with others for safety	Any description of the participant adaptive mountain biking with other people for safety, as a precaution.

Name	Description
Shared experiences with adaptive riders	Any description of adaptive mountain biking being facilitated by connections that participants make with other adaptive riders. Shared experiences among adaptive bikers includes sharing anecdotes, and advice on how adaptive mountain biking can be facilitated.
Trial of an Adaptive Bikes	Any description of the participant trying an adaptive bike before purchasing their own as a facilitator to getting involved in the sport.
Facilitator - Motivation	Any descriptions of the motivators of trail riding for participants; descriptions of the reasons they participate in adaptive mountain biking
Challenge	Any description of the participants being motivated to ride nature trails because of the challenge that the sport offers.
Family	Any description of the participant's family motivating them to ride trails
Friendship-Camaraderie	Any description of the participants being motivated to ride trails to develop friendships and a sense of camaraderie with other riders.
Health	Any description of the participants being motivated to ride trails for obtaining health benefits associated with participation in the sport
Independence	Any description of the participants being motivated to ride trails to maintain a sense of independence
Nature	Any description of the participant being motivated to ride to experience nature.
Facilitator - Organizational	Any descriptions of the participant experiencing facilitators to trail riding through organization based enabling factors, such as bike shops and trail organizers
Adaptive Bike Organizations	Any descriptions of Adaptive bike organizers or organizations facilitating trail riding for the participants
Adaptive Sports programs	Any description of adaptive riding being facilitated by adaptive sports programs
Bike Shops	Any description of bike shops playing a role in facilitating adaptive mountain biking by offering support in the form of outreach to users.
Trail Organizers	Any descriptions of the trail organizers or organizations facilitating trail riding for the participants

Name	Description
Facilitator - Personal	Any descriptions of the participant experiencing facilitators to trail riding through personal enabling factors
Financial Considerations	Any descriptions of the participants experiencing facilitators of trail riding through access to financial resources, including funding for equipment and accessible transportation
Preparation	Any description of the personal steps taken by participants to prepare for going adaptive mountain biking, such as researching trail conditions and weather in advance, and planning with adequate nutrition.
Safety Measures	Any descriptions of the participants taking safety precautions or measures to mitigate risk and injury, and facilitate their trail riding. Safety measures taken by participants reflect their personal risk-safety ratio, making sure that risks taken are calculated to increase safety.
Participant Description of Riding Patterns	Any description of the riding patterns of participants, related to the seasonal patterns and how competitively they ride
Competitive Riding	Any description of the participant riding trails to be competitive or for competition.
Description of trails	Any description of the environment of the trails that participants use to ride, related to the track, scenery, etc.
Level of riding	Any description of the participants level of riding, such as beginner, intermediate, or advanced.
Advanced level of riding	Participant describes themselves as an advanced trail rider, with a high ability level based on time spent riding.
High technicality of trails	Any description of the trails as being very technical in how the participant rides them.
Intermediate level of riding	Participant describes the trails they ride as intermediate level
Mixture of trail difficulty levels	Participant describes how they ride a mix of beginner, intermediate and some advanced trails.
Slow technical riding	Description of riding slower over highly technical parts of trails, with more attention on tire position and optimal power to maintain traction without tipping
Recreational Riding	Any description of the participant riding trails for recreational purposes.

Name	Description
Seasonal and Weather Dependent Riding	Any description of the participant's riding patterns being affected by weather conditions or changing seasons
Trail or Track Preference	Any description of the preferences of the types of trails or the track type of trails
Preference for fast and flowy trails	Descriptions of the participant preferring the elements of trail riding with more speed and flow compared to aspects of riding with more technical navigation
Preference for less smooth trails	Participant describes how they prefer to ride trails that are not as smooth and that are more like "actual mountain bike trails"
Personal Characteristics	Any description of the participant describing characteristics about themselves in general and about the way they ride or their riding experience
Additional Activities	Any description of the participant participating in additional physical activities or sports, before or after their injury
Demographic Information	Any description of the participant's demographic information related to race, gender, age, etc.
Age	Age of participant in years
Being a parent to a child or children	Participant states that they have a kid or kids
Cause of Injury Theme	Any description of the cause of injury of the participants.
Experience with and View on Disability	Any description of the participants' view or outlook about their injury or disability
Gender or sex	The participant states their gender or biological sex
Name of the country the participant is living in	Participant states the country they are living in
Race or ethnicity description	Participant states their race or ethnicity

Name	Description
Years with a spinal cord injury	Participant states how long, in years, they have had a spinal cord injury
Group riding Theme	Any description of the participant riding their adaptive bike in a group with other people riding their own bikes together
Proximity to Trails	Any description of the distance or time to get to trails
Riding Experience	Any description of the participants experience with riding nature trails.
Post-injury	Any description of the participant's experience with adaptive mountain biking post spinal cord injury.
Previous	Any description of the participant's experience with mountain biking and similar activities pre spinal cord injury.
Solo riding Theme	Any description of the participant riding their adaptive bike on their own, without riding in a group.
Volume Theme	Any description of the volume of riding that the participants engage in, relate to time and distance.
How often participants ride trails	How many times per year/month/week are participants riding trails.
Number of regular trail networks	How many trails participants regularly visit and ride.
Personal factors associated with riding time	Descriptions of the personal factors that influence their time spent riding.
Riding distance travelled	The distance travelled (in kilometers) by the participant in an average singular ride, and/or total annual distance travelled in a year.
Time spent riding	The amount of time spent riding trails per session (i.e. the number of hours is the participant rides the trails on an average singular ride).