

PHYSICAL ACTIVITY AND LONELINESS AMONG ADOLESCENTS WITH
DISABILITIES: EXPLORING POSSIBLE MODERATORS USING THE QUALITY
PARTICIPATION CONCEPTUALIZATION

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ABSTRACT

Adolescents with disabilities (AWD) often experience higher loneliness levels than their peers without disabilities. Physical activity (PA) may be a valuable strategy to mitigate feelings of loneliness among AWD. The purpose of this thesis was to: a) examine the relationship between PA and loneliness among AWD, and b) examine the overall quality of PA, and the six aspects of quality participation (i.e., autonomy, challenge, belongingness, engagement, mastery, and meaning) as possible moderators of this relationship. Quality participation was framed within the quality participation conceptualization. This thesis was a cross-sectional sub-analysis of data from the National Physical Activity Measurement Study. Participants included 40 adolescents, aged 10 to 17, with any type of disability. Loneliness was not found to significantly relate to PA ($r = -.10, p = .54$). The overall quality of PA significantly moderated the relationship between PA and loneliness (95% CI = .002 – .019, $p = .02$), and so did five of the six aspects of quality participation. Results suggest that PA was significantly and negatively related to loneliness among AWD who reported experiencing a high level of overall quality of PA (and high levels of autonomy, challenge, engagement, mastery, and meaning).

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Chapter 1: Literature Review

Wellbeing

Mental health can be defined as “a state of wellbeing in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community” (World Health Organization [WHO], 2014). This definition of mental health given by the World Health Organization is based upon the concept of human flourishing (i.e., eudaimonic perspective). The eudaimonic perspective asserts that a high level of wellbeing is the result of focusing on meaning in life, self-realization, and full integration of one’s life (Waterman, 1993). Alternatively, subjective wellbeing (SWB; i.e., hedonic perspective) is predominately focused on happiness and is defined as “a person’s cognitive and affective evaluations of his or her life” (Diener et al., 2002, p. 63). According to this perspective, a high level of wellbeing (i.e., happiness) is the result of experiencing more positive than negative affect (i.e., affective evaluations) and maintaining a high level of life satisfaction (i.e., cognitive evaluations; Diener et al., 2002). The present thesis indirectly focused on SWB (i.e., hedonic perspective) through the examination of loneliness, a constellation of unpleasant feelings that are known to negatively impact SWB (Brunes et al., 2019; Houghton et al., 2016; Saygin et al., 2015; VanderWeele et al., 2012).

Loneliness and Wellbeing

Loneliness is the *subjective experience* of unpleasant feelings that arise from a person’s perception of lacking quality social engagement (S. Cacioppo et al., 2015; de Jong Gierveld, 1998; Perlman & Peplau, 1981). Although related, loneliness and social isolation are understood to be independent from one another. Social isolation pertains to the objective absence of social relationships, whereas loneliness is the *subjective experience* of lacking *quality* relationships

(Coyle & Dugan, 2012; Matthews et al., 2016). Loneliness is known to negatively relate to life satisfaction (Mellor et al., 2008; Santino et al., 2020; Tu & Zhang, 2015), positive wellbeing (Hombrados-Mendieta et al., 2013), and SWB (Brunes et al., 2019; Houghton et al., 2016; Saygin et al., 2015). Loneliness and SWB negatively relate over time, such that as feelings of loneliness increase, SWB decreases, even after controlling for depressive symptoms, social support, psychiatric conditions, and medication use (VanderWeele et al., 2012). This well-known negative association between loneliness and wellbeing is due to a host of complex inter-related factors discussed throughout the following sections.

Complexity of Loneliness in General

High levels of loneliness can contribute to a multitude of biopsychosocial dysfunctions (Yanguas et al., 2018). Physically, loneliness is a risk factor for lowered immunity (Pressman et al., 2005), elevated blood pressure (J. Cacioppo et al., 2002), stroke (S. Cacioppo et al., 2014), obesity (Lauder et al., 2006), and premature mortality (Luo et al., 2012). Psychosocially, loneliness is a risk factor for suicidal thoughts (Rudatsikira et al., 2007), alcoholism (Akerlind & Hörnquist, 1992), depression (VanderWeele et al., 2012), and cognitive decay and Alzheimer's Disease progression (Wilson et al., 2007). That said, recent literature has suggested that future research should attempt to identify underlying mechanisms of loneliness to help prevent morbidity/dysfunction, as minimal mechanistic research has been conducted (Jeste et al., 2020). Unfortunately, previous loneliness research has predominately focused on aging adults (and has focused minimal attention on mechanisms) while relatively little research has studied loneliness among adolescent populations (Houghton et al., 2016; Jeste et al., 2020).

Complexity of Adolescent Loneliness

Adolescence can be defined as the age range of 10 to 19 years old (WHO, n.d.). For many adolescents loneliness is of serious concern. The percent of eighth grade American adolescents who have reported *feeling lonely a lot of the time* has risen from 22% in 2010 to 28% in 2017 (Twenge et al., 2019). This is also true for 10th and 12th graders (22% to 33% and 27% to 39% from 2010 to 2017, respectively). The experience of loneliness from ages 9 to 15 is thought to follow five trajectories: decreasing, low and stable, moderately increasing, highly increasing, and chronic (Schinka et al., 2013). Of these five trajectories, 40.2% of adolescents experience loneliness along the moderately increasing, highly increasing, and chronic trajectories (Schinka et al., 2013). The high prevalence of loneliness among adolescents is of particular concern because of the susceptibility to pathological consequences adolescents may experience in relation to high levels of loneliness (Galanaki et al., 2008; Hall-Lande et al., 2007).

Adolescent loneliness is accompanied by a wide range of psychosocial challenges that may also contribute to physical dysfunction over time. For example, loneliness in adolescent populations has been associated with low self-esteem (J. Cacioppo et al., 2000), somatic symptoms (e.g., physical pain or fatigue; Lohre, 2012), eating and sleep disturbances (J. Cacioppo et al., 2000), and greater stress levels (Hawkley & Cacioppo, 2003). Adolescent loneliness has also been correlated with alcoholism and low general wellbeing (Krause-Parello, 2008), aggression, suicidal ideation and depression (McWhirter et al., 2002; Schinka et al., 2013), and psychiatric morbidity (Shevlin et al., 2014). Loneliness has also been associated with poor academic performance (Larson, 1999) and higher school dropout rates (Asher & Paquette, 2003). Overall, loneliness during adolescence relates to poor health behaviours (e.g., smoking, poor nutrition), less health promoting behaviours (e.g., low physical activity; Mahon et al.,

2001), and poor later life adjustment (Pavri, 2001). Emerging research has begun to understand that various adolescent groups may experience loneliness differently (Maes et al., 2015).

Adolescents with disabilities (AWD) may be a unique group that experiences loneliness differently as they often face multiple barriers to social participation.

Barriers to Social Participation for Adolescents with Disabilities

More than one in ten youth in Canada, ages 15-24, are living with one or more disabilities (e.g., developmental, physical, cognitive, and sensory; 540,000 youth or 13% of the Canadian population; Statistics Canada, 2018). Compared to their peers without disabilities, AWD often face greater barriers to social participation (Centre for Disease Control and Prevention [CDC], 2019; WHO, 2011). Broadly defined, social participation is the degree of involvement a person has in activities that provide interaction with other people (James et al., 2011; Levasseur et al., 2010). Two common interpersonal barriers to social participation for AWD are attitudes (e.g., stigma, prejudice, and discrimination against AWD) and communication (e.g., not hearing, speaking, reading, writing, and/or understanding as easily as adolescents without disabilities; CDC, 2019; WHO, 2011). Moreover, AWD often experience a variety of systemic barriers to social participation including restrictive physical environments (e.g., natural or built environments that prevent relatively easy access), transportation (e.g., lack of access to affordable, accessible, and convenient transportation), societal issues (e.g., low employment rates, poverty, and violence), programmatic concerns (e.g., non-effective delivery of health care, limited accessible medical equipment, and limited health care provider knowledge on how to assist them), and policy shortcomings (e.g., lack of awareness and/or enforcement of laws that require people with disabilities to have equal opportunity and access to full societal participation; CDC, 2019; WHO, 2011). As such, AWD are at risk of experiencing limited social participation,

which could be a contributing factor to greater experiences of loneliness compared to adolescents without disabilities.

Adolescents with Disabilities and Loneliness

Indeed, compared to their peers without disabilities, AWD experience higher levels of loneliness (Luhmann & Hawkley, 2016; Maes et al., 2017; Pavri, 2001; Pavri & Monda-Amaya, 2000; Poulsen et al., 2007; Storch et al., 2012; White & Roberson-Nay, 2009; Whitehouse et al., 2009). In fact, approximately 50% of parents who have a child with a disability report their child having zero to one friend (Snowdon, 2012). This is often due to the combination of physical, cognitive and/or sensory impairments, and the aforementioned barriers to social participation (CDC, 2019; WHO, 2011), in addition to copious other factors. For example, AWD often experience a high occurrence of lengthy school absenteeism that frequently requires educational modifications (e.g., individualized programs, repeating grades, and special education), which may prevent full participation with peers and foster stigmatization (Emerson et al., 2016; Geist et al., 2003; Shiu, 2001). The stigma of not being equal (i.e., perceived inferiority) often leads AWD to be less accepted by their peers (Haager & Vaughn, 1995) and more likely to experience peer victimization (Storch et al., 2012) compared to adolescents without disabilities. As such, AWD are more likely to experience poor self-perceptions, self-concept, self-esteem, and have inadequate coping strategies (Augestad, 2017; Pavri & Monda-Amaya, 2000). AWD are also more likely to experience anxiety (White & Roberson-Nay, 2009), depression (Whitehouse et al., 2009), and behavioural problems (Lavigne & Eaier-Routman, 1993) related to stigma and victimization. Ultimately, this may create a downward cycle that begins with stigma and victimization and leads to negative psychosocial outcomes. The culmination of negative psychosocial outcomes (e.g., depression, anxiety, and behavioural problems) often results in poor

social skills and difficulty in building peer relationships (Martinez et al., 2011; Piquart & Teubert, 2012; Yu et al., 2005), which frequently translates to significantly less social activities, less friends, and poorer quality friendships than their peers without disabilities (Snowdon, 2012; Solish et al., 2010; Taheri et al., 2016). Eventually this may amount to greater stigma and victimization. Although such a cycle may contribute to high and/or chronic feelings of loneliness among AWD (Heinrich & Gullone, 2006; Schinka et al., 2013), there are various strategies that could be of value in reducing feelings of loneliness among AWD. Physical activity (PA) could be one such strategy available to mitigate feelings of loneliness while offering copious other benefits to AWD.

Physical Activity Among Adolescents

Although PA can be defined by various operationalizations, at the simplest level, PA is “engagement in a physically demanding movement, sport, game, or recreational play” (Coster & Khentani, 2008; Granlund, 2013; Ross et al., 2016, p. 187). The most recent 24-Hour Movement Guidelines for Children and Youth presented by the Canadian Society for Exercise Physiology recommend that children and youth ages 5 to 17 engage in 60 minutes of moderate to vigorous PA per day, with a focus on vigorous PA at least three days per week (Canadian Society for Exercise Physiology, 2016). Only 35% of Canadian children and youth between the ages of 5 and 17 are meeting these guidelines (ParticipACTION, 2018). Participation in moderate to vigorous PA has been shown to steeply decline between the ages of 9 and 15 (Nickelson et al., 2011). Although PA levels are low among adolescents without disabilities (Hills et al., 2007; King, et al., 2010), AWD participate in even less PA overall (Solish et al., 2010; Taheri et al., 2016), less formal and informal PA, and less PA involving peers (Figueiredo et al., 2016). These

differences in rates and *quality* of PA participation between adolescents without disabilities and AWD may be due to a variety of participation barriers AWD experience specific to PA.

Physical Activity Among Adolescents with Disabilities

AWD often experience numerous barriers specific to participating in PA. For example, AWD often experience a lack of accessible transportation (DeFazio & Porter, 2016), a lack of targeted PA information (Bassett-Gunter, et al., 2017), and financial restriction to support the extra costs accompanied with PA participation (Shields & Synnot, 2016). Further, AWD are often provided with limited local PA opportunities (Shields & Synnot, 2016) and often perceive PA as only for able-bodied individuals (Anderson, 2009). Moreover, PA facilities often lack funding for the promotion of play, safety and learning specific to AWD, and often have equipment that is not appropriate nor inclusive for AWD (Mihaylov et al., 2004; Taub & Greer, 2000). Parents of AWD also report uncertainty and confusion around ‘inclusive’ or ‘accessible’ PA terminology, making it difficult to find appropriate information regarding PA opportunities for their child’s specific needs (Bassett-Gunter et al., 2017). The combination of such PA barriers combined with various physical, cognitive, and/or sensory challenges often leads AWD to spend more time alone, doing sedentary activities (Law et al., 2006; Majnemer et al., 2015). In fact, only 1% of the PA that Canadian AWD participate in is comprised of active play, whereas only 27% of PA is sport participation, and 72% is active travel (Arbour-Nicitopoulos et al., 2017).

However, a number of beneficial biopsychosocial outcomes are attainable when AWD regularly participate in PA (Bloemen et al., 2015; Lauruschkus et al., 2015; Maher, 2015; Shapiro & Malone, 2016; te Velde et al., 2018; Wickman et al., 2018). Participating in PA can support AWD in enhancing movement abilities and understanding of physical capabilities, which

often leads to an increased awareness of potential and improved self-efficacy (Bloemen et al., 2015; Taub & Greer, 2000; Wickman et al., 2018), and a reduction of negative stereotypes and stigma (Barg et al., 2010; Martin, 2013). As well, PA participation for AWD is related to positive feelings of athletic competence, exercise self-efficacy, health-related quality of life (e.g., physical, emotional, and social functioning), and positive wellbeing (Shapiro & Malone 2016; te Velde et al., 2018). PA can also provide AWD with empowerment opportunities as participation is linked with increased goal attainment, perceived competence, and social integration (Blinde & Taub, 1999). This is critical as AWD often experience social isolation and a lack of perceived competence, cumulating to a sense of empowerment deficit (Blinde & Taub, 1999). Some PA environments can provide a social network setting that AWD can use to enhance peer interaction and facilitate perceptions of legitimatizing their social identity (Taub & Greer, 2000). The enhancement of these positive socialization qualities through PA *experiences* suggest that PA may also have value in mitigating feelings of loneliness.

Physical Activity and Loneliness

Outside of the AWD literature there is mixed evidence of the relationship between PA and loneliness (Pels & Kleinert, 2016). Most cross-sectional research has shown that PA and loneliness significantly and negatively relate (e.g., Netz et al., 2013; Santino et al., 2020; Shankar et al., 2011; Toepoel, 2013), but several studies have not observed a significant association (Pels & Kleinert, 2016). When analyzing longitudinal data of the influence of loneliness on PA, baseline loneliness levels have been significantly associated with less PA over two- (Hawkey et al., 2009; Newall et al., 2012; Theeke, 2010) and six-year periods (Luo & Waite, 2014). A longitudinal study investigating the influence of PA on loneliness over three years also found a significant negative association, such that loneliness decreased as PA

increased (Sundblad et al., 2008). Other longitudinal studies over 11 months (Bohnert et al., 2013) and one year (Findlay & Coplan, 2008) did not find a significant association between PA and loneliness. Intervention studies with PA as the independent variable and loneliness as the dependent variable have also found a significant reduction of loneliness over time when compared to control (Hopman-Rock & Westhoff, 2002; Tse et al., 2014) and other intervention groups (Kahlbaugh et al., 2011), irrespective of how the PA interventions were designed. These mixed results suggest that there may be other variables moderating the relationship between PA and loneliness. Although the cumulative body of existing literature is suggestive of a negative relationship, further research is necessary to explore moderators of this association. Moreover, evidence of such a relationship among AWD has not been as thoroughly researched.

Physical Activity and Loneliness Among Adolescents with Disabilities

There is limited research directly aimed at understanding the relationship between PA and loneliness among AWD. There are two known studies that have been conducted and found a negative relationship between PA and loneliness among AWD (Poulsen et al., 2007; Shapiro & Martin, 2014). One such study compared boys ages 10 to 13 with and without developmental coordination disorder to investigate the relationship between PA and perceptions of loneliness (Poulsen et al., 2007). Lower rates of PA and higher rates of loneliness were observed for the boys with developmental coordination disorder, compared to the boys without. As well, the frequency of team sport participation per week was found to be the only significant predictor of loneliness (i.e., the more one participated in team sports, the less lonely they were; Poulsen et al., 2007). The other study sampled 46 athletes with physical disabilities between the ages of 12 and 21 (Shapiro & Martin, 2014). Results from three regression analyses demonstrated that non-sport friendship quality, sport friendship quality, physical appearance, athletic competence, and self-

worth significantly predicted: social acceptance (31% of variance explained), close friendships (41% of variance explained), and loneliness (57% of variance explained). Athletic competence and self-worth were found to be the most significant predictors of close friendships and loneliness (Shapiro & Martin, 2014). It has also been suggested that PA may act as a normalizing experience for AWD by aiding in identity formation and improving relationships with parents and peers (Moll, 2017; Taub & Greer, 2000). This small body of existing research has provided a foundation upon which to build, but further research is needed to thoroughly explore this relationship among AWD and overcome the current limitations.

Physical Activity and Loneliness Research Limitations

There are many limitations to the existing research regarding the relationship between PA and loneliness, in general, and specific to AWD. Foremost, there is limited research examining such an association among AWD (e.g., Pels & Kleinert, 2016), while the existing studies face major generalizability limitations. For example, Poulsen and colleagues (2007) only considered boys with developmental coordination disorder in a small age range (i.e., only 10 to 13 years of age). As well, Shapiro and Martin (2014) specifically examined athletes with physical disabilities and did not set out to directly assess the relationship between PA and loneliness. This makes it unclear if findings from these studies generalize to the broader AWD population. Further, previous research has failed to thoroughly examine possible moderators beyond a small number of non-evidence-based constructs (Dowd et al., 2014; Newall et al., 2012; Pels & Kleinert, 2016; Randall & Bohnert, 2012; Stanley & Bohnert, 2011). As such, there is a limited understanding of the possible *experiences* within PA (i.e., moderators) that may influence the relationship between PA and loneliness (Pels & Kleinert, 2016).

Moderators of the Relationship Between Physical Activity and Loneliness

Reviews of AWD participation in general (i.e., participation not specific to PA) describe environmental *qualities* (e.g., physical and social) as central roles in creating meaningful *experiences* and therefore positive outcomes (Powrie et al., 2015; Willis et al., 2016). That is, participation alone does not foster positive outcomes but rather high-quality participation experiences are more important for fostering those positive outcomes. As well, the quality of one's experiences can be influenced by various physical and social factors. Given the mixed findings of previous research and limited research on the *experiences* of PA, there is value in further considering potential social and environmental aspects of PA experiences as moderators of the relationship between PA and loneliness (Pels & Kleinert, 2016). A moderator is a variable that when included in an analysis demonstrates that the magnitude or direction of the relationship between two variables depends on the presence of the moderator (Montoya, 2019). As such, moderators of the relationship between PA and loneliness are important for understanding what aspects of PA *experiences* might foster the strongest negative relationship between PA and loneliness. Gender (greater PA participation is associated with lower loneliness levels among female participants; Randall & Bohnert, 2012), happiness (the happier the person, the smaller the correlation between PA and loneliness; Newall et al., 2012), body mass index (the higher the body mass index, the lower the association between PA and loneliness; Stanley & Bohnert, 2011), and being informed of the social benefits of PA (the more one knows about the social benefits of PA, the greater the negative relationship between PA and loneliness; Dowd et al., 2014) have been observed as possible moderators of the relationship between PA and loneliness (Pels & Kleinert, 2016).

The existing literature leaves three substantial gaps calling for further investigation. First, there is limited research focusing on PA and loneliness among AWD. Second, there has been little use of evidence-based constructs (e.g., moderators) when examining the relationship between PA and loneliness. Third, there is little known about *experiential* aspects of PA (i.e., moderators) that influence the association between PA and loneliness. As such, future research should use evidence-based constructs to specifically examine *experiential* moderators of the relationship between PA and loneliness among AWD. To address these existing limitations, the present thesis examined PA and loneliness among AWD and was guided by the quality participation conceptualization (QPC; Martin Ginis et al., 2017).

The Quality Participation Conceptualization: A Guide for Examining the Relationship Between Physical Activity and Loneliness

The QPC was developed to broaden the conceptualization of participation for persons with physical disabilities (Martin Ginis et al., 2017). The main purpose of the QPC is to understand participation in various roles and activities with a limited focus on quantity of participation and performance, and increased focus on *subjective experiences* or aspects of *quality participation* that may foster positive outcomes (e.g., a reduction of loneliness). The QPC was constructed using a systematic, configurative review (Martin Ginis et al., 2017). A total of 10 articles (four editorials/reviews, two focus group studies, one mixed-methods measurement development articles, one concept analysis, one qualitative meta-synthesis, and one quantitative observational study) were analyzed after a two-stage literature search. An inductive thematic analysis of the 10 articles revealed six themes which are autonomy, belongingness, challenge, engagement, mastery, and meaning (Martin Ginis et al., 2017). These six themes are understood to be *experiential* aspects of participation that constitute high *quality* participation and ultimately

promote positive outcomes. The QPC also notes the individualist and dynamic nature of these six experiential aspects of quality participation. As such, individuals may place different values on each aspect, and therefore participation experiences may differ between people, as well as across time (Martin Ginis et al., 2017).

Within the PA context, the QPC can be used to introduce program leaders, administrators, coaches, policy makers, and others to key concepts and tools for creating quality participation experiences for children, adolescents, and adults with disabilities (Canadian Disability Participation Project [CDPP], 2018; Martin Ginis et al., 2017). As such, *when* the six aspects of quality participation are experienced during PA, then the likelihood (and strength) of positive outcomes increases, and vice versa, *when* the six aspects of quality participation are not experienced during PA, then the likelihood (and strength) of positive outcomes decreases (CDPP, 2018; Martin Ginis et al., 2017). Overall quality of participation and each of the six aspects of quality participation were considered as possible moderators of the relationship between PA and loneliness. It was hypothesized that overall quality of PA participation, and each of the six aspects of quality participation, would be significant moderators of the possible negative relationship between PA and loneliness, such that the greater degree of overall quality of participation (and each of the six aspects) experienced during PA, the greater the negative association between PA and loneliness. The following sections go into further detail about each of the six aspects of quality participation (see Appendix A for implementation strategies of the six aspects of quality participation in PA settings).

Autonomy

Within the QPC, autonomy is defined as “having independence, choice, control” (Martin Ginis et al., 2017, p. 399). This does not mean PA participants should be permitted to do as they

wish, but rather when volunteers, coaches, or instructors offer direction and choice, participants are able to feel autonomous while participating in PA. This is important for AWD as their physical, cognitive, and/or sensory disabilities may restrict their ability to perform activities of daily living (Penninx et al., 2001), possibly lowering feelings of autonomy. Autonomy is one of the basic psychological needs specified in self-determination theory and is a critical factor for promoting wellbeing (Ryan & Deci, 2000; Ryan & Deci, 2017). Since autonomy is associated with improved wellbeing and loneliness is associated with reduced wellbeing (Brunes et al., 2019), it was hypothesized that autonomy would be a significant moderator of the possible negative relationship between PA and loneliness, such that the greater degree of autonomy experienced during PA, the greater the negative association between PA and loneliness.

Belongingness

According to the QPC, belongingness is defined as “experiencing a sense of belonging to a group; acceptance/respect from others; included at interpersonal or societal levels” (Martin Ginis et al., 2017, p. 399). In PA settings a sense of belonging can be fostered through relationships with peers, parents, volunteers, and coaches or instructors. Creating a sense of belonging is especially important for AWD because they often feel that PA is only for able-bodied individuals (Anderson, 2009), possibly lowering their sense of belonging to a group that participates in PA. Belongingness is parallel with relatedness, another basic psychological need specified in self-determination theory that is critical for promoting wellbeing (Martin Ginis et al., 2017; Ryan & Deci, 2000; Ryan & Deci, 2017). The feeling of belonging to a group or being respected by others is the opposite feeling of being lonely (S. Cacioppo et al., 2015). Therefore, fostering a sense of belonging may assist AWD in experiencing the social benefits of PA participation. As such, it was hypothesized that belongingness would be a significant moderator

of the possible negative relationship between PA and loneliness, such that the greater degree of belongingness experienced during PA, the greater the negative association between PA and loneliness.

Challenge

Consistent with the QPC, challenge is “feeling appropriately challenged” (Martin Ginis et al., 2017, p. 399). This is of importance for AWD because some activities of daily living may be overly challenging to perform (Penninx et al., 2001), which may lead to feelings of frustration. Alternatively, some AWD may receive more assistance than necessary when completing activities of daily living (Grant et al., 2005), perhaps leading to feeling unchallenged or unaccomplished. To the authors’ knowledge, there has been no known research examining the relationship between challenge and wellbeing or challenge and loneliness. As such, it is not evident that challenge would significantly moderate the possible negative relationship between PA and loneliness. However, given that challenge is an important aspect of *quality* PA experiences, and quality experiences can facilitate positive outcomes (Andrusko, 2018; Shirazipour et al., 2017), it was hypothesized that the possible negative relationship between PA and loneliness would be greater when a higher degree of challenge is experienced during PA (i.e., challenge would be a significant moderator).

Engagement

In agreement with the QPC, individuals are said to be engaged in an activity when they are “motivated; focused, involved; experiencing flow” (Martin Ginis et al., 2017, p. 399). This is of importance for this study as AWD often face PA opportunities that are less engaging than adolescents without disabilities. For example, AWD are more likely to be non-primary participants (e.g., water person or referee) in physical education classes making AWD less

engaged in the actual PA than their peers (Casebolt & Hodge, 2010; Hutzler & Shama, 2017). Further, engagement is of importance as high engagement in activities has shown to relate to positive outcomes such as improved wellbeing (Moll et al., 2015), and lower levels of loneliness (Zhang et al., 2018). As such, it was hypothesized that engagement would be a significant moderator in the possible negative relationship between PA and loneliness, such that the greater degree of engagement experienced during PA, the greater the negative association between PA and loneliness.

Mastery

As stated in the QPC, mastery is “experiencing achievement/competence/sense of accomplishment; self-efficacy” (Martin Ginis et al., 2017, p. 399). Mastery is parallel with competence, the third basic psychological need specified in self-determination theory (Martin Ginis et al., 2017; Ryan & Deci, 2000; Ryan & Deci, 2017). Mastery may be particularly valuable to foster for AWD during PA participation as some AWD experience competence difficulties (Maxey & Beckert, 2017). Since competence has been shown to be critical for promoting wellbeing (Ryan & Deci, 2000; Ryan & Deci, 2017) and loneliness is known to negatively relate to wellbeing (Brunes et al., 2019), it was hypothesized that mastery would be a significant moderator in the possible negative relationship between PA and loneliness, such that the greater degree of mastery experienced during PA, the greater the negative association between PA and loneliness.

Meaning

In keeping with the QPC, a sense of meaning occurs when one is “contributing toward obtaining a personal or socially meaningful goal; feeling a sense of responsibility to others” (Martin Ginis et al., 2017, p. 399). Essentially, meaning occurs when one believes their PA

experiences matter. Meaning is important for AWD as it is for any person. Individuals live a happy and fulfilling life when they are able to find meaning in activities in which they participate in (Ryff & Singer, 1998). Like engagement, meaning is a fundamental characteristic of activities that promote wellbeing (Moll et al., 2015). Since meaning fosters quality experiences which lead to positive outcomes (Moll et al., 2015), it was hypothesized that meaning would be a significant moderator in the potential negative relationship between PA and loneliness, such that the greater degree of meaning experienced during PA, the greater the negative association between PA and loneliness.

Purpose

The primary purpose of this thesis was to examine the relationship between PA and loneliness among AWD. Guided by the QPC and previous research findings, the secondary purpose was to examine the overall quality of PA participation experiences (and the six aspects) as possible moderators of the relationship between PA and loneliness among AWD. Although guided by the QPC and previous research, the nature of this thesis was exploratory as existing studies have not directly examined the relationship between PA and loneliness among AWD nor have they used the overall quality of PA participation experiences, and the six aspects as framed within the QPC, as a set of moderators when examining the relationship between PA and positive outcomes (e.g., low loneliness levels).

The present thesis had three specific research objectives:

- 1) Among AWD, determine if PA is significantly and negatively associated with loneliness.
- 2) Among AWD, determine if the overall quality of PA participation experiences significantly moderates the relationship between PA and loneliness.

- 3) Among AWD, determine which (if any) of the six aspects of quality participation significantly moderate the relationship between PA and loneliness.

Hypotheses

Guided by the QPC (Martin Ginis et al., 2017) and previous research findings, it was hypothesized that:

- 1) PA will be significantly and negatively associated with loneliness.
- 2) The overall quality of PA participation experience will significantly moderate the negative relationship between PA and loneliness, such that the negative association between PA and loneliness will be heightened when a greater degree of overall quality participation is experienced during PA.
- 3) Each of the six aspects of quality participation will significantly moderate the negative relationship between PA and loneliness, such that the negative association between PA and loneliness will be heightened when a greater degree of each of the six aspects of quality participation are experienced during PA.

Chapter 2: Method

Design

This thesis was a cross-sectional sub-analysis of data collected through the National Physical Activity Measurement (NPAM) study (Principal Investigator Dr. Kelly Arbour-Nicitopoulos). The NPAM study is a national Canadian study spanning five years (2017 to 2022), and is funded by Canadian Tire's Jumpstart Charities. The purpose of the NPAM study is to measure current trends in movement behaviours (i.e., PA, screen time, and sleep), and wellbeing among Canadian children and adolescents, ages 4 to 17 years, with disabilities. The NPAM study consists of a 30 to 45-minute telephone/video interview or online survey concerning PA, screen time and sleep behaviours, as well as wellbeing. Depending on their needs, participants and their parent(s) were asked to select which method of participation they prefer. The telephone/video interview was administered by a trained research assistant (R.S.) and the online survey was hosted on REDCap (Research Electronic Data Capture; Harris et al., 2009; Harris et al., 2019). REDCap "is a secure, web-based software platform designed to support data capture for research studies" (REDCap, n.d.; Harris et al., 2009; Harris et al., 2019). The NPAM study was approved by the ethics committees of the University of Toronto, York University, the University of British Columbia, and the Interdisciplinary Center for Research in Rehabilitation and Social Integration at Laval University through the governing research ethics board, the Integrated University Health and Social Services Center. All NPAM materials, including the online survey, were professionally translated into French. The telephone/video interviews were conducted in English only.

Participants

Participants of this sub-analysis of the NPAM study included AWD between the ages of 10 to 17 years. This was done to fit within the World Health Organization's definition of adolescence (i.e., 10 to 19 years of age; WHO, n.d.). To recruit participants across Canada, organizations that offer sport, PA, and general recreation programs to AWD were systematically identified by the research team in each province and territory. These organizations were then contacted by a member of the research team and asked to share study recruitment materials via their social media and within their networks (see Appendix B for recruitment materials). The NPAM study does not provide participants (or their parents) with a specific definition of disability. Rather, participants (or participants' parents) self-identified their disability and completed a demographics form to provide further details about their disability. While the larger study includes youth and adolescents with any type of disability (e.g., developmental, physical, cognitive, and/or sensory), the research assistant (R.S.) followed up with the adolescent and their parent(s) via email and/or telephone to determine whether they would be eligible to participate in the interview or online survey for this sub-analysis. Inclusion criteria for this sub-analysis were to: a) be between the ages of 10 to 17 years, b) have a disability, c) be able to speak and/or read in English or French, and d) live in Canada. Given the nature of participation (interview or online survey), individuals were excluded from the study if a disability or impairment compromised one's ability to consent, understand, and respond to questions in a meaningful way, as indicated by the parent(s) or adolescent. Based on power calculations using G*Power, a total sample size of 65 participants was needed for 80% power to detect a medium-large effect size at $p < .05$. Since this was exploratory research, previous data was not available and therefore, a standard level of power and significance was used (Dupont & Plummer, 1998; Kadam & Bhalerao, 2010).

Procedure

Following recruitment and verification of eligibility based on inclusion and exclusion criteria, participants and their parent(s) were asked to sign and return the consent/assent forms, indicating which parts of the larger study they will participate in. Alternatively, the participant and their parent(s) could provide verbal consent via telephone, which was documented by the research assistant (R.S). Then, participants were directed to complete the online survey on REDCap. Prior to beginning the survey, participants were prompted to answer screening questions (see Appendix C), view the letter of information and assent (see Appendix D), and provided their electronic assent to complete the survey. Although possibly redundant, this procedure was a safeguard for adolescents who may have become aware of and attempt to participate in the online version of the study without parental awareness and consent. Participants were also given the option to connect with a research assistant (R.S.) by telephone or video chat to complete the screening questions and the series of questionnaires. Participants received five volunteer hours for their contribution to the study. Data from the NPAM study will be stored at the University of Toronto for five years after publication on password-protected computers.

Chapter 3: Measures

Although the NPAM study consists of multiple questionnaires, the following measures discussed are specific to this sub-analysis (see Appendix E).

Socio-demographics

Participants were asked to self-report their age, gender, ethnicity, province or territory of residence, the type of disability they have (e.g., developmental, physical, cognitive, sensory, other), if their disability is congenital or acquired, and if they use any mobility or communication devices. These socio-demographic items are not the main variables of interest, but were analyzed to better characterize the sample and determine if differences in PA participation and loneliness exist between groups of individuals.

Physical Activity

PA levels were assessed using the International Physical Activity Questionnaire for Adolescents (IPAQ-A: (Hagströmer, et al., 2008). The original IPAQ questionnaire was developed to measure health-enhancing PA in adult populations (Hagströmer et al., 2005). The IPAQ-A was derived from combining this original questionnaire with data from interviews and experiences of adolescents from nine European countries (Hagströmer, et al., 2008). IPAQ-A data has been found to significantly correlate with accelerometer data for time spent walking, and doing moderate, vigorous and overall PA ($r_s = 0.17-0.30, p = 0.05$). This questionnaire covers four domains of PA: 1) school-related PA (including physical education), 2) transportation, 3) housework, and 4) recreation, sport and leisure time (Hagströmer, et al., 2008). Items from part four (i.e., recreation, sport, and leisure time) of the IPAQ-A were used to measure PA levels for this thesis. This was done in order to get a better understanding of the value of PA that AWD *choose* to do during their free time. This is essential as activities one

chooses to do are the most likely to foster high engagement, and activities that foster high engagement are known to significantly relate with lower levels of loneliness (Zhang et al., 2018). Participants were asked to recall *how many days, out of the last seven, they participated in: a) walking or wheeling (i.e., mild PA; not as a means for transportation), b) moderate physical activities (i.e., PA that takes moderate effort and makes them breathe somewhat harder than normal), and c) vigorous physical activities (i.e., PA that takes a lot of effort and makes them breathe much harder than normal)*. Answers were responded to on a scale from zero to seven (0 = no days, 7 = all 7 days). For each question, participants were asked to indicate *on average, how much time they spent (in minutes) during those days participating in PA at each intensity*. The IPAQ-A was created to obtain self-report data from adolescents; therefore, no wording modifications were needed for these items. The final PA variable was constructed as the overall average minutes of PA per day (i.e., the sum of the average minutes of mild, moderate, and vigorous intensities).

The Quality Participation Conceptualization

Participants' *experiences* of PA (i.e., the six aspects of quality participation) were measured using the Measure of Experiential Aspects of Participation (MeEAP; Caron et al., 2019). The MeEAP was created to conceptually align with the six aspects of quality participation from the QPC (Martin Ginis et al., 2017; Caron et al., 2019). Two items were given to each aspect of quality participation, resulting in six subscales and 12 total items. The overarching question of the items were, *when engaging in physical activity, I feel...* Participants were asked to respond to each item on a seven-point scale (1 = strongly disagree to 7 = strongly agree) and were permitted to opt out of answering any item by selecting the option "99." This scale demonstrates a strong model fit (Satorra-Bentler scaled $\chi^2_{(39)}=58.26, P<.001$, comparative fit

index=.98) and meets requirements of convergent and discriminant validity (Caron et al., 2019). The final variables consist of an average overall score for the entire scale and average scores for each subscale.

This particular questionnaire was chosen for three reasons. First, the MeEAP was created for the purpose of measuring the six aspects of quality participation in the QPC (Caron et al., 2019). Second, it is known that the MeEAP can be used as a set of mechanisms to understand broader outcomes (e.g., moderating the relationship between PA and loneliness; Caron et al., 2019). Third, the MeEAP has been significantly correlated with life satisfaction (predicts between 10% and 29% of the variance in life satisfaction; Caron et al., 2019). This is important as loneliness, the dependent variable in this thesis, is known to negatively relate to life satisfaction across cultural groups in Canada ($r = -.34$ to $-.54$, $p < .01$; Goodwin et al., 2001). This knowledge gave the researchers confidence that the overall MeEAP and its subscales may significantly moderate the possible negative relationship between PA and loneliness (i.e., when the six aspects of quality participation are *experienced* during PA, the less lonely one will feel).

Although the MeEAP was meant to assess adults, wording has been examined and the research team believes that comprehension issues are not of concern for adolescent participants. Furthermore, the MeEAP was created for measuring experiential aspects of participation for people with physical disabilities, but the combination of non-specific wording and the self-identification of disability used in this study gives the researchers confidence that the validity and reliability of the measure was not compromised.

Loneliness

Loneliness levels were measured using the 3-item UCLA Loneliness Scale (UCLA-LS-3; Hughes et al., 2008), which was adapted from the Revised 20-item UCLA Loneliness Scale (R-

UCLA; Russell et al., 1980). Participants read the statement *the next questions are about how you feel about different aspects of your life. For each one, tell us how often you feel that way.* Specific questions were: 1) *how often do you feel that you lack friendship?*, 2) *how often do you feel left out?*, and 3) *how often do you feel isolated?* Each item was responded to on a three-point scale (1 = hardly ever, 2 = some of the time, 3 = often; Hughes et al., 2008). The final loneliness variable is the average loneliness levels across all three items.

The UCLA-LS-3 was chosen for multiple reasons. This scale was tested with and created for in-person or telephone interviews, which are methods of administration used in this study (Hughes et al., 2008). Although the scale is comprised of only three items, it maintains adequate internal consistency (Cronbach $\alpha = .72$). While the UCLA-LS-3 has not previously shown psychometric soundness among adolescents, the research team does not have concerns of issues with data collection as the UCLA-LS-3 is highly correlated with the R-UCLA ($r = .82, p < .001$; Hughes et al., 2008), which has shown psychometric soundness among adolescents (e.g., Cronbach $\alpha = .78 - .82$; Lasgaard, 2007; Mahon et al., 1995). Further, the UCLA-LS-3 is concise and therefore is a way to minimize the length of the survey and limit participant burden. Lastly, this particular measure was positioned at the end of the survey. Knowing that fewer participants answer items at the end of a survey compared to the beginning, and that participants who do fully complete surveys are more likely to answer questions quicker and more uniformed toward the end of a survey (Galesic & Bosnjak, 2009), the succinct UCLA-LS-3 is believed to be the best option. The research team examined the scale and indicated that the original word “companionship” be changed to “friendship” to increase the understandability of the scale for adolescent participants.

Statistical Analyses

All statistical analyses were performed using SPSS (v26; IBM SPSS Statistics c/o IBM Corp. Armonk, NY, USA). Data cleaning and assumption testing occurred to ensure accurate data and appropriate statistical analyses were used. Only one participant in the original data set was excluded from the analyses as they were the only participant with more than one missing data point (participant only completed approximately 50% of the survey). A sample of 40 participants was used for the analyses. Four missing data points were present in the resulting data set (i.e., one mild PA data point, one moderate PA data point, one belongingness data point, and one challenge data point). Little's MCAR tests were run to determine if the missing data were missing completely at random (Little, 1998). Results of Little's MCAR tests were not found significant, indicating that the data were missing completely at random. Five imputations (with 10 iterations) using the Mersenne Twister number generator were conducted on each of the variables with missing data (Carpenter & Kenward, 2007; Sterne et al., 2009). For each variable the average score of the five imputations were used to replace the missing values. Data points more than 1.5 interquartile ranges from the median (using SPSS boxplot outputs) were deemed outliers, and were replaced by the next highest or lowest value within a 1.5 interquartile range. Outliers existed among the following variables: mild PA (n = 2), moderate PA (n = 1), vigorous PA (n = 2), overall PA (n = 1), overall quality participation (n = 2), autonomy (n = 1), belongingness (n = 5), challenge (n = 2), mastery (n = 3), and meaning (n = 1). Skewness and kurtosis values of ± 1 were deemed excellent, and values of ± 2 were deemed acceptable (see Appendix F for skewness and kurtosis values for main variables of interest [George & Mallery, 2012]).

Preliminary analyses were conducted to provide a description of the sample. Pearson's (r) correlations were used to examine the bivariate association between PA and loneliness, and determine which main variables of interest are significantly related to one another. A critical alpha level of .05 was considered for statistical significance.

Moderation analyses via Process Macro (Hayes, 2018) were used to examine: a) if the overall quality of PA participation experiences significantly moderates the relationship between PA and loneliness, and b) which (if any) of the six aspects of quality participation significantly moderate the relationship between PA and loneliness. Mean-centering of variables was used to make the coefficients more meaningful and easier to interpret (Hayes, 2018). A 10,000 bootstrap was used and a confidence interval of 95% was considered. Although multiple comparisons of moderation analyses were used, increasing the risk of type one error, this research was exploratory and therefore the adjustment of the alpha-level was not deemed necessary for inference (Rubin, 2017). Further, possible covariates were not included in the moderation analyses, and probing of significant interactions was not conducted as these were believed to be beyond the scope of this exploratory research (Hayes, 2018).

Chapter 4: Results

Descriptive Results

Participants ($N = 40$) included AWD who were, on average, 12.85 ($SD = 1.69$) years of age with the majority of participants being male ($n = 24$, 60.0%), Caucasian ($n = 32$, 80.0%), and residing in British Columbia ($n = 12$, 30.0%; see Table 1). The majority of participants were born with their disability (i.e., congenital; $n = 36$, 90.0%), living with a developmental disability ($n = 16$, 40.0%), and did not require a mobility ($n = 37$, 92.5%) or communication device ($n = 35$, 87.5%).

The median loneliness score among participants was 2.00 ($IQR = 1.00 - 2.00$), while the median minutes of PA per day was 32.1 ($IQR = 10.7 - 44.8$). The median score for overall quality of PA participation was 5.4 ($IQR = 4.8 - 6.0$). Participants reported experiencing fairly high levels of autonomy ($Med = 6.0$, $IQR = 5.0 - 6.9$), belongingness ($Med = 5.5$, $IQR = 5.0 - 6.0$), challenge ($Med = 5.5$, $IQR = 4.5 - 6.0$), engagement ($Med = 5.0$, $IQR = 3.1 - 6.0$), mastery ($Med = 5.5$, $IQR = 4.5 - 6.0$), and meaning ($Med = 5.5$, $IQR = 4.5 - 6.4$) during their PA.

Table 1.
Descriptive Analyses

	<i>n</i>	%	Median	<i>IQR</i>
Loneliness			2.00	1.00 – 2.00
PA			32.1	10.7 – 44.8
Quality Participation				
Overall			5.4	4.8 – 6.0
Autonomy			6.0	5.0 – 6.9
Belongingness			5.5	5.0 – 6.0
Challenge			5.5	4.5 – 6.0
Engagement			5.0	3.1 – 6.0
Mastery			5.5	4.5 – 6.0
Meaning			5.5	4.5 – 6.4
Age (<i>M, SD</i>)			12.85	1.69
Gender				
Male	24	60.0		
Female	15	37.5		
Transgender	1	2.5		

Ethnicity			
	Caucasian	32	80.0
	Mixed	4	10.0
	East Asian	2	5.0
	Black, Afro-Caribbean/American	1	2.5
	Prefer not to Reply	1	2.5
Region of Residence			
	British Columbia	12	30.0
	Ontario	11	27.5
	Alberta	10	25.0
	New Brunswick	5	12.5
	Prince Edward Island	1	2.5
	Yukon Territory	1	2.5
Disability Type			
	Developmental	16	40.0
	Physical	8	20.0
	Sensory	2	5.0
	Combination	12	30
	Other	2	5.0
Congenital Disability		36	90.0
Acquired Disability		4	10.0
Mobility Device			
	Yes	3	7.5
	No	37	92.5
Communication Device			
	Yes	5	12.5
	No	35	87.5

Note. PA = Overall physical activity, measured in average minutes per day.

Research Objective One: Determine If PA Is Significantly and Negatively Associated with Loneliness

Significant bivariate associations were found among several of the main variables of interest. Loneliness was not found to significantly relate to PA ($r = -.10, p = .54$), but was significantly and negatively related to overall quality of PA participation ($r = -.50, p = .001$). Loneliness was also significantly and negatively correlated with belongingness ($r = -.36, p = .02$), challenge ($r = -.41, p = .009$), engagement ($r = -.48, p = .002$), mastery ($r = -.50, p = .001$), and meaning ($r = -.45, p = .003$), but not autonomy ($r = -.10, p = .52$).

Table 2.
Pearson r Correlations Among Main Variables of Interest

	1	2	3	4	5	6	7	8	9
1. Loneliness	1.00								
2. PA	-.10	1.00							
3. Overall QP	-.50**	.14	1.00						
4. Autonomy	-.10	.06	.71**	1.00					
5. Belongingness	-.36*	-.05	.82**	.59**	1.00				
6. Challenge	-.41**	.19	.81**	.52**	.83**	1.00			
7. Engagement	-.48**	.16	.84**	.50**	.50**	.56**	1.00		
8. Mastery	-.50**	.11	.85**	.56**	.58**	.55**	.71**	1.00	
9. Meaning	-.45**	.13	.87**	.59**	.63**	.58**	.71**	.82**	1.00

Note. PA = Overall physical activity, measured in average minutes per day. QP = Quality participation.

* $p \leq .05$. ** $p \leq .01$.

Research Objective Two: Determine If the Overall Quality of One’s PA Participation Experience Significantly Moderates the Relationship Between PA and Loneliness

The moderation analyses are presented in Table 3. The results of this moderation analysis were significant, demonstrating that overall quality of PA participation significantly moderated the relationship between PA and loneliness (95% CI = .002 – .019, $p = .02$). This suggests, among AWD who reported experiencing a high level of overall quality of PA participation, that greater PA rates were significantly and negatively associated to loneliness. This result also suggests that among AWD who reported experiencing a low level of overall quality of PA participation, that greater PA rates were positively associated to loneliness.

Research Objective Three: Determine Which (If Any) of the Six Aspects of Quality Participation Significantly Moderates the Relationship Between PA and Loneliness

Results of these moderation analyses were mostly significant. Autonomy (95% CI = .003 – .026, $p = .01$), challenge (95% CI = .002 – .016, $p = .02$), engagement (95% CI = .0007 – .011, $p = .03$), mastery (95% CI = .0009 – .013, $p = .03$), and meaning (95% CI = .002 – .016, $p = .02$) all significantly moderated the relationship between PA and loneliness. These results suggest,

among AWD who reported experiencing a high level of autonomy, challenge, engagement, mastery, and meaning during PA participation, that greater PA rates were significantly and negatively associated to loneliness. These results also suggest that among AWD who reported experiencing a low level of autonomy, challenge, engagement, mastery, and meaning during PA participation, that greater PA rates were positively associated to loneliness. Belongingness did not significantly moderate the relationship between PA (95% CI = -.002 – .016, $p = .11$). This suggests, among AWD who reported experiencing a high level of belongingness during PA participation, that greater PA rates were not significantly associated to low loneliness levels. See Figures 1 – 7 (in Appendix G) of the interaction plots of each of the 7 moderation analyses.

Table 3.

Moderation Analyses of Quality Participation Variables via Process Macro

	<i>F</i> (3, 36)	<i>P</i>	<i>R</i> ²	<i>Coeff</i>	<i>t</i>	<i>p</i>	<i>R</i> ² - <i>Chng</i>
Overall QP							
Overall Model	6.95	.008	.37				
PA				-.002	-.51	.61	
Overall QP				-.22	-2.48	.02	
Interaction				.01	2.54	.02	.11
Autonomy							
Overall Model	2.57	.07	.42				
PA				-.006	-1.30	.20	
Autonomy				-.05	-.46	.65	
Interaction				.015	2.62	.01	.16
Belongingness							
Overall Model	3.04	.04	.20				
PA				-.003	-.74	.47	
Belongingness				-.22	-2.35	.02	
Interaction				.007	1.64	.11	.06
Challenge							
Overall Model	5.01	.005	.29				
PA				-.0006	-.14	.89	
Challenge				-.18	-2.34	.03	
Interaction				.009	2.54	.02	.13
Engagement							
Overall Model	5.96	.002	.33				
PA				-.03	.07	.94	
Engagement				-.11	-1.8	.03	
Interaction				.006	2.29	.03	.10

Mastery							
Overall Model	6.50	.001	.35				
PA				-.003	-.80	.43	
Mastery				-.21	-3.22	.03	
Interaction				.007	2.32	.03	.10
Meaning							
Overall Model	5.63	.003	.32				
PA				-.004	-.92	.36	
Meaning				-.21	-2.86	.007	
Interaction				.009	2.45	.02	.11

Note. PA = Overall physical activity, measured in average minutes per day.
 QP = Quality participation. Coeff = Coefficient. Chng = Change.

Chapter 5: Discussion

This was this first known study to directly examine the relationship between PA and loneliness among AWD. It is also the first known study to use the QPC (Martin Ginis et al., 2017) as a set of evidence-based constructs to explore experiential aspects of PA that may influence the relationship between PA and loneliness among AWD. The research findings, theoretical and pragmatic implications, limitations, and suggestions for future research are discussed in the following sections.

The Relationship Between Physical Activity and Loneliness

The primary objective of the current thesis was to examine the relationship between PA and loneliness among AWD. It was hypothesized that PA and loneliness would significantly and negatively relate. This hypothesis was not supported as PA and loneliness were not significantly related. There are multiple possible explanations as to why PA and loneliness were not significantly related. First, measurement issues were present in the current thesis. Participants were asked to report how lonely they felt in general, across all aspects of their life, and were not asked to report how lonely they felt during PA. Loneliness is a complex human experience that can be caused by a variety of daily activities or lack thereof (Rokach et al., 2002). It is possible that PA and loneliness would have significantly related if participants were explicitly asked to report their feelings of loneliness during PA. A caveat to this notion being that the current thesis did not set out to measure the relationship between PA and experiences of loneliness during PA. The purpose of this analysis was to examine the relationship between PA participation and overall feelings of loneliness across all aspects of life. As well, it is possible that PA and loneliness were not significantly related as PA was strictly measured using frequency (i.e., participation rates). Within the context of this analysis, it was not possible to determine the

quantity or quality of social interactions during PA (e.g., the number of people participating in PA together; the quality of relationships with other PA participants). Although experiences of loneliness are not fully dependent on the quantity of social interactions one has, the hypothesis that PA and loneliness would be significantly related is scaffolded upon the idea that social interaction during PA would need to occur at some level (Coyle & Dugan, 2012; Matthews et al., 2016). As such, it is possible that PA and loneliness would have significantly related among participants who reported a high quantity and quality of social interaction during PA, if this was accounted for and analyzed. Further, participants were asked to strictly report the quantity of PA they participated in outside of school. It is possible that a significant amount of the sample could have participated in high quality in-school PA, thus strengthening the relationship between PA and loneliness and possibly making the relationship significant if accounted for and analyzed. Additionally, previous cross-sectional studies that found a significant negative relationship between PA and loneliness included PA that was much more general (e.g., cultural activities, shopping, and voluntary work) and examined elderly populations (Netz et al., 2013; Shankar et al., 2011; Toepoel, 2013). Therefore, the difference in the specificity of PA and sample characteristics may partially explain the discrepancy in results between previous cross-sectional research and the current thesis.

Second, it is believed that issues concerning the statistical power of the sample likely contributed to a non-significant finding of the relationship between PA and loneliness. Power calculations indicated that a sample size of 65 participants was needed to achieve 80% power and identify a medium to large effect size. The current thesis consisted of 40 AWD, meaning that the likelihood of detecting a true significant effect for a small correlation was low among this sample (Button et al., 2013). Although the current thesis faces issues of power, it is the authors'

belief that the finding that PA and loneliness negatively relate is still of importance as the relationship between the two is quite complex.

Third, the relationship between PA and loneliness is complex and likely moderated by other variables as indicated by mixed findings in previous literature. The majority of existing cross-sectional studies examining this relationship have found a significant negative association between PA and loneliness (e.g., Netz et al., 2013; Shankar et al., 2011; Toepoel, 2013), but several other studies have not (for a review see Pels & Kleinert, 2016). Although existing experimental and longitudinal studies have been more consistent than cross-sectional studies in identifying a significant negative association between PA and loneliness (e.g., Kahlbaugh et al., 2011; Newall et al., 2012; Theeke, 2010; Tse et al., 2014), mixed results are still present (e.g., Bohnert et al., 2013; Findlay & Coplan, 2008). Within the AWD literature, evidence concerning the relationship between PA and loneliness is limited to two cross-sectional studies, both of which used hyper specific samples and did not directly examine this association. This makes the findings of these two studies incomparable with previous research not including people with disabilities and the current thesis (Poulsen et al., 2007; Shapiro & Martin, 2014). The mixed results observed across all types of previous research highlights the complexity of this relationship and likely suggests that other factors (e.g., moderators) may influence the relationship between PA and loneliness. For this reason, the current thesis set out to examine if the overall quality of PA experiences and the six aspects of quality participation provided by the QPC significantly moderate the relationship between PA and loneliness (Martin Ginis et al., 2017).

The Overall Quality of Physical Activity Participation Experiences

The secondary objective of the present thesis was to determine if the overall quality of

PA experiences significantly moderates the relationship between PA and loneliness among AWD. The hypothesis was supported in that the overall quality of PA experiences significantly moderated the negative relationship between PA and loneliness. The nature of the moderation was such that greater PA rates were significantly and *negatively* associated with loneliness among AWD who reported experiencing a high level of overall quality PA participation. Alternatively, greater PA rates were *positively* associated with loneliness levels among AWD who reported experiencing a low level of overall quality PA participation. Recent literature has suggested that the quality of participation (i.e., participation including but not limited to PA) is crucial in creating positive outcomes among AWD (Powrie et al., 2015; Willis et al., 2016). Therefore, the current thesis provides parallel and novel evidence that the overall quality of participation experience may significantly influence the relationship between PA and positive outcomes (i.e., loneliness). This is a critical finding as this is the first known study to consider the influence of overall quality of PA experiences on the relationship between PA and loneliness, both within and outside of research concerning AWD (Pels & Kleinert, 2016).

The finding that overall quality of PA experiences may significantly moderate the relationship between PA and loneliness is a vital one as the two variables were not significantly related at the bivariate level. This discrepancy in findings regarding research objective one and two furthers our understanding of the mixed results found in previous literature (Pels & Kleinert, 2016) by demonstrating that simply participating in PA may not be enough to mitigate feelings of loneliness. Rather, the current thesis suggests that the *quality* of PA experiences influences the negative relationship between PA and loneliness. These results can be understood within the context of self-determination theory (Ryan & Deci, 2000; Ryan & Deci, 2017) which suggests that one's levels of wellbeing can be promoted or thwarted by their PA environment (e.g.,

Brunes et al., 2019; Davies et al., 2016; Gunnell et al., 2014). Wellbeing was indirectly assessed through the examination of loneliness and PA environment was assessed through the overall quality of PA experiences. Based on the application of self-determination theory, AWD who reported experiencing high quality PA participation should also report low loneliness levels the more they participated in PA (i.e., promotion of wellbeing). Alternatively, AWD who reported experiencing low quality PA should also report high loneliness levels the more they participated in PA (i.e., thwarting of wellbeing; Ryan & Deci, 2017). These theoretical predictions grounded in self-determination theory were supported by the findings regarding the significant moderating role of quality participation in the present study. An important next step is to understand what aspects of quality participation are most important for supporting positive outcomes such as low loneliness levels.

The Six Aspects of Quality Physical Activity Participation

The third objective of the present thesis was to determine which (if any) of the six aspects of quality participation significantly moderate the relationship between PA and loneliness among AWD. The hypothesis was partially supported as autonomy, challenge, engagement, mastery, and meaning all significantly moderated the relationship between PA and loneliness. The nature of the moderated relationship observed was such that greater PA rates were significantly and *negatively* associated with loneliness levels among AWD who reported experiencing high levels of autonomy, challenge, engagement, mastery, and meaning during PA participation.

Alternatively, greater PA rates were *positively* associated with loneliness levels among AWD who reported experiencing low levels of autonomy, challenge, engagement, mastery, and meaning during PA participation. Such results parallel the current finding that overall quality of PA experiences significantly moderates the relationship between PA and loneliness as they are

the composite of overall quality participation (Martin Ginis et al., 2017). The results also corroborate with previous studies that highlight the importance of these five aspects of quality participation to contribute to positive outcomes (Martin Ginis et al., 2017; Moll et al., 2015; Ryan & Deci, 2017; Ryff & Singer, 1998). These findings further extend the understanding of what may influence the negative relationship between PA and loneliness by highlighting specific experiences during PA participation that may be most valuable for mitigating feelings of loneliness among AWD.

Unexpectedly, belongingness did not significantly moderate the relationship between PA and loneliness. That said, that trend of results regarding belongingness was similar to the other variables. Greater PA was *negatively* associated with loneliness among AWD who reported experiencing a high degree of belongingness. As well, greater PA was *positively* associated with loneliness among AWD who reported experiencing a low degree of belongingness.

Belongingness is understood to be the opposite feeling of loneliness (S. Cacioppo et al., 2015) and is parallel with relatedness, a basic psychological need stipulated in self-determination theory, known to positively relate to a wide variety of positive outcomes (Ryan & Deci, 2000; Ryan & Deci, 2017). Based on the definition of belongingness provided by the QPC (Martin Ginis et al., 2017) and previous findings within the self-determination theory literature (Ryan & Deci, 2017), it is believed that belongingness may not have been significant while the other aspects of the QPC were because of the aforementioned issues with statistical power. As such, it is possible that belongingness would have significantly moderated the relationship between PA and loneliness within a larger sample. Therefore, the role of belongingness in understanding the relationship between PA and loneliness must be further explored in future research.

Theoretical Implications

The present thesis emphasizes the importance of research with a strong evidence-based foundation. A concern within the extant literature is the mixed findings regarding the relationship between PA and loneliness, possibly due to a lack of theoretical or guiding frameworks. Previous research has often overlooked the importance of a theoretical or guiding framework, which has led to minimal research on possible mechanisms that may influence the relationship between PA and loneliness (i.e., moderators and mediators; Pels & Kleinert, 2016). A strength of the current thesis was the use of the QPC (Martin Ginis et al., 2017) as a framework to guide the research process, assist in data interpretation, and promote extrapolation and comparison of extant literature (Maxwell, 2005). As such, the application of the QPC furthered our understanding of the relationship between PA and loneliness beyond simple correlational analyses and toward moderation analyses that shed light on variables that may influence this relationship. The value of using the QPC is evident when comparing the results of research objectives one and two. PA and loneliness were not related when considering only those two variables (i.e., research objective one). If the current analysis stopped there then we might conclude that there is no relationship between PA and loneliness and fail to consider a possible avenue for supporting wellbeing among AWD. However, the relationship between PA and loneliness was further explored (i.e., research objective two) by considering how the overall quality of participants' PA experiences might influence this relationship. Specifically, PA and loneliness were *significantly* and negatively related but only when participants reported experiencing high quality PA participation. This suggests that the quantity of PA participation alone (i.e., participation rates) may not significantly relate to AWD's experiences of loneliness. Rather, greater PA rates may

only be advantageous in relation to loneliness levels when the *quality* of PA experiences are high.

A further exploration of the six individual aspects of quality participation (as determined by the QPC framework) was valuable in order to further understand the role of specific aspects of PA experiences in generating positive outcomes among AWD. It is not a surprise that PA and loneliness significantly and negatively related when participants reported experiencing high levels of five of the six aspects (i.e., autonomy, challenge, engagement, mastery, meaning), as they are the composite of overall quality participation. As well, each of the six aspects had a varying degree of influence on the negative relationship between PA and loneliness. As such, the current thesis expands on the goal of the QPC to “provide a starting point for clinicians, researchers, and policymakers to conceptualize and measure the participation concept more consistently and more broadly” (Martin Ginis et al., 2017, p. 395). The present thesis expands on this “starting point” by providing further evidence that supports the notion that participation (including but not exclusive to PA) should not only be measured using frequency and intensity but also using quality of experience as well. Therefore, it is anticipated that the current thesis will be one of many research studies (e.g., Andrusko, 2018; Shirazipour et al., 2017) that provides evidence of the robustness of the QPC as a framework to guide researchers in the examination of positive outcomes derived from a variety of participation contexts (e.g., work, school, family life).

Pragmatic Implications

The results from the present thesis may be of value to PA program leaders, administrators, coaches, policy makers, and other stakeholders who work within PA settings focused on supporting the AWD population. Previous research has shown that PA participation

is associated with improved self-efficacy, health-related quality of life (e.g., physical, emotional, and social functioning), and can provide AWD with empowerment opportunities (Blinde & Taub, 1999; Shapiro & Malone 2016; te Velde et al., 2018), as well as copious other benefits (Bloemen et al., 2015; Lauruschkus et al., 2015; Maher, 2015; Wickman et al., 2018). There is limited research directly aimed at examining possible experiential moderators that may influence the multitude of positive outcomes related to PA participation among AWD (Pels & Kleinert, 2016). It is important to consider moderator variables to get a better understanding of *when* and for *whom* PA is most likely to positively relate to positive outcomes and negatively relate to negative outcomes. The current thesis focused on experiential aspects of PA (i.e., within the framework of the QPC) and suggests that the *quality* of PA experiences is likely instrumental in facilitating positive outcomes of PA participation (e.g., reduced loneliness). In fact, the results suggest that PA may even be related to lowered wellbeing (e.g., high loneliness) when AWD report low-quality PA participation experiences. As such, the current thesis provides preliminary and novel evidence to leaders and key stakeholders of PA programs for AWD with specific knowledge of possible experiences (i.e., the six aspects framed within the QPC) that may thwart or promote loneliness, and other positive and negative outcomes of PA participation. Future research should consider examining *how* to generate PA experiences that foster the six aspects of quality participation using manipulation via an intervention research design (some examples of ways to foster these experiences during PA can be found in the Blueprint for Building Quality Participation provided by the CDPP; see Appendix A for examples on how to implement such experiences).

Limitations and Future Direction

Although the current thesis provides novel research findings and advances the understanding of the relationship between PA and loneliness among AWD, the findings must be considered with certain limitations. First, the sample used in the analyses was under powered as a total of 40 participants completed the study. Power calculations revealed that a sample of 65 participants was needed for 80% power to detect a medium to large effect size at $p < .05$. Future research should attempt to recruit larger samples in order to have greater power, reduce the probability of type two error, and increase the ability to detect a true significant effect. Second, data was collected cross-sectionally and therefore causation cannot be established. Rather, this thesis provides preliminary evidence for future researchers to use to conduct longitudinal experiments or intervention studies in order to provide causation of these interactions. An example of such research would be an intervention study where the six aspects of the QPC are targeted and manipulated in a PA setting, and changes in wellbeing outcomes such as loneliness are measured. Such a research design would permit the use of an additive moderation analysis (Montoya & Hayes, 2017), which would allow for the comparison of relative influence that the six aspects of quality participation have on wellbeing outcomes like loneliness. Third, the social context of participants' PA experiences was not reported (e.g., the number of people participating in PA together; the quality of relationships with other PA participants). Although loneliness is not dependent on the quantity of individuals with whom one interacts, the quantity and quality of social interaction will influence loneliness (Coyle & Dugan, 2012; Matthews et al., 2016). Future research should measure the quantity and quality of social interaction for AWD participating in PA to improve our understanding of what social contexts may be best for mitigating feelings of loneliness within PA settings. Fourth, the quality of one's PA participation

and loneliness are subjective experiences and therefore strictly using objective questionnaires to measure these variables limits the ability of the thesis to completely understand the context in which these variables interact with PA rates. Future research should consider utilizing a mixed-method (i.e., quantitative and qualitative) research design as it would be a more rigorous approach for examining these quality-based variables. Fifth, the exploratory nature of this thesis led to the exclusion of covariates and controls in the moderation analyses, no probing of interactions, and no adjustment of *p*-values. Each of these were excluded as they were believed to be outside the scope of the research. It is recommended that future experimental research include covariates and controls in the moderation analyses, probe interactions, and adjust *p*-values if necessary. Despite these limitations, it is still believed that this thesis contributes to the extant literature in a meaningful way and provides a conceptual basis for which future research can build upon.

Conclusion

This present thesis was the first known study to directly examine the relationship between PA and loneliness among AWD. This is also the first known study to use the QPC and its six aspects (Martin Ginis et al., 2017) as a set of moderators to explore how the quality of PA experiences may significantly influence the relationship between PA and loneliness among AWD. PA and loneliness did not significantly relate at the bivariate level. However, the overall quality of PA experiences was a significant moderator of the relationship between PA and loneliness such that greater PA rates were significantly and *negatively* associated with loneliness among AWD who reported experiencing a high level of overall quality PA participation. Five of the six aspects of the QPC (i.e., autonomy, engagement, challenge, mastery, and meaning) were found to be significant moderators of this relationship. Although belongingness was not found to

be a significant moderator, the trends were consistent with those of the other aspects of quality participation as framed within the QPC. PA programs that include AWD should consider this exploratory and preliminary evidence when discussing best practices for generating positive outcomes via PA participation. As well, this research can be used as evidence to spur further mechanistic (i.e., moderation and mediation) studies with causal data to provide more robust findings on the value of PA to mitigate feelings of loneliness among AWD.

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Appendices

Appendix A – Implementation Strategies for the Six Aspects of Quality Participation in Physical Activity Settings

Autonomy

Suggested strategies for fostering autonomy include: a) if a AWD sometimes needs to withdraw from a group, permit it and slowly attempt to guide them back into the group activity when they are comfortable, b) allow participants to do things on their own (i.e., do not immediately rush over to show them how to do something, let them try it a few times before intervening), and c) provide choice in specific activities or drills so they can participate in the activities they find most enjoyable (CDPP, 2018).

Belongingness

Suggested strategies recommended to facilitate a sense of belonging during PA are: a) ensure all participants and coaches or instructors have set a specific time to a meet and get to know each other on a personal level, b) promote socialization through creating smaller groups and rotating participants through groups so they can learn more about each other, and c) have post PA huddles or meetings that allow participants to talk about their time being active (CDPP, 2018).

Challenge

Suggested strategies for providing challenge in PA settings are: a) recognize when an individual has developed a skill to a certain point and modify the activity so they find new ways to complete it, b) if an individual always tries the same activity, introduce them to something similar yet different enough to provide extra challenge, and c) keep things variable, in that you are not always providing the same activities with the same accessories (CDPP, 2018).

Engagement

To keep AWD engaged in PA, it is suggested to: a) avoid elimination games that result in participants watching on the side-line, b) create activities that reduce wait-times or lineups so participants can actively participate as much as possible, and c) ask participants to think about certain aspects of the activities or maybe practice the activities while away from the actual site of participation (CDPP, 2018).

Mastery

Suggested strategies offered to improve feelings of mastery during PA are: a) to ensure they feel confident in their abilities at first interaction with the activity (i.e., it is not overly difficult), b) celebrate their initial achievements and provide supportive feedback throughout, and c) slowly help them progress by increasing task difficulty over time (CDPP, 2018).

Meaning

To increase meaning through PA, it is suggested that activities: a) provide an opportunity for AWD to think about how the activity relates to their goals in life, b) provide advancement from participant, to volunteer or staff, and c) allow individuals to alternate roles to determine how they believe they best fit into various activities (CDPP, 2018).

Appendix B – Recruitment Materials

Online Recruitment Flyer



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\$10 gift card and volunteer hours!

[Ages: 4 – 17 years]

We are inviting you and your child to take part in the “**National Physical Activity Measurement [NPAM] Study**” that is currently being conducted by Researchers at the University of Toronto, York University, and the University of British Columbia.

The purpose of the NPAM study is to measure current trends in physical activity, sleep, and screen-time behaviour among children and youth, ages 4 to 17 years, with disabilities across Canada. We are also hoping to examine the psychological well-being of children and youth with disabilities and the parental support they receive to be active.

Parents will be asked to complete a **30-minute online survey** about their child’s physical activity, screen-time, sleep, and well-being. **Children and youth** will be asked to wear a **Fitbit for 30 days**. If eligible, **youth between the ages of 10 and 17 years** will be asked to complete **one, 45-minute telephone/video interview or online survey**, where they will be asked to complete a 24-hour recall and a series of questionnaires on their physical activity, screen-time, sleep, and well-being.

In addition to wearing the Fitbit, participants will be randomly selected to wear an activity measuring device, called an accelerometer, for a 7-day period, for at least 10 hours a day. This will help us understand how the Fitbit works and will inform how the Fitbit can better measure the activity patterns of children and youth with disabilities.

Parents will receive a \$10 gift card for completing the online survey. Children and youth will get to keep the Fitbit. Youth will be provided with **five community service hours**. Participation in this study is voluntary and individuals may choose to withdraw at any time. All information collected for the study will be kept confidential. Your input is a vital part of the NPAM study, therefore the researchers are asking you to consider taking part in this study.

If you would like to participate in the study, please visit: <http://j.mp/2wrjYgs>

If you have any questions, contact the Research Coordinator (Ritu Sharma) at:

ri.sharma@mail.utoronto.ca

CDPP Newsletter:

WHAT HAVE WE BEEN UP TO?

In this issue, we provide an update on the work of the CDP's Family Focused Sport and Exercise Team.

Research Update: A first look at the preliminary findings from the National Physical Activity Measurement (NPAM) study

In our first newsletter, we shared a few findings from the first phase of the NPAM study. Since then, we have launched the larger version of the NPAM study and have been collecting more information on the typical movement behaviours of school-aged children and youth with disabilities. This information will help with the development of evidence-based policies and programs to better serve and support kids with disabilities.

An Overview of the NPAM Study

The NPAM Study was designed to capture the typical movement behaviours (i.e., physical activity, sedentary activity, and sleep) of Canadian school-aged children and youth (ages 4 to 17 years) with any type of disability.

Online Survey	Interview	Fitbit®
<ul style="list-style-type: none">Parents complete one, 30-minute online survey about their child's daily activities, well-being, how they support their child to be active.The impact of Jumpstart?	<ul style="list-style-type: none">If able and over the age of 10, kids complete one, 45-minute interview about their daily activities, well-being, and perceived parental support.	<ul style="list-style-type: none">Kids are asked to wear a Fitbit for 30 days.We are gathering daily heart-rate and step data to understand active and sedentary behaviour.Accelerometers are worn by a subsample of kids.

IN THIS ISSUE

- Exciting updates from the NPAM study
- **Gearing up for the fall:** Planning to support your child's physical activity
- **Family Advisory Committee meeting:** What did parents have to say?
- Get involved and help us succeed!
- Upcoming conferences



Email Example

Dear [name of organization],

My name is [name] and I am a [master's student/etc] from [institution]. I send this email in collaboration with Dr. Kelly Arbour-Nicitopoulos, [your supervisor's name], and Ritu Sharma.

After learning about your organization, I am connecting with you to share information related to a national study for Canadian children and youth with disabilities. The project is called the National Physical Activity Measurement (NPAM) Study and it is funded by Canadian Tire's Jumpstart Charities.

We are looking to understand the physical activity, screen time, and sleep behaviours of **children and youth (ages 4 to 17 years) with disabilities**. With over 400 participants thus far, we are eager to gain further representation of all disability types throughout Canada and would greatly appreciate if our information could be shared through your networks.

Participation in the study involves:

- The parent completing a 30-minute online survey on their child's daily activities and well-being. Parents will receive a **\$10 e-gift card**.
- Eligible children and youth will be asked to wear a **Fitbit for one month** to help us better understand their typical movement patterns. Participants will also be randomly selected to wear an accelerometer along with the Fitbit. Children and youth will have the opportunity to **keep the Fitbit after participating in the study!**
- Youth over the age of 10 years will also be asked to participate in a telephone/video interview or online survey, during which they answer questions about their daily activities and well-being. **Youth will receive 5 volunteer hours for participating in the interview.**

Would it be possible to share our study information with families, children, and youth who take part in your programs/services? Our study recruitment flyer is attached. We have also created an accessible recruitment video – would you be willing to share this video through your social media networks? The link is: <https://youtu.be/j1Y5Lh1CGJ8>.

Please direct any questions about the NPAM study to our Research Coordinator (Ritu Sharma), who is cc'd on this email. She would be more than happy to answer any questions you may have and discuss this further.

Thank you in advance for your time and support. We look forward to connecting with you.

Sincerely,
[name]

Recruitment Video Script

Welcome to the National Physical Activity Measurement Study by Jumpstart and the Canadian Disability Participation Project!

Research supports that active kids are healthy kids. Active kids have better heart health. They have stronger muscles and bones. Active kids have better academic skills.

And kids that are active are even happier and less stressed than kids who are less active.

Now – this is true for all kids, including kids with disabilities. But sometimes... kids with disabilities have less opportunities to play and have less access to recreation and sport. As a result, kids with disabilities are often less active than kids without disabilities – and that's not good for their health!

That's where the National Physical Activity Measurement Study comes along. We want to understand how children and youth from across Canada with disabilities spend their time being active and engaging in daily activity.

Our study will help us know more about how kids with disabilities sweat, step, sleep, and sit.

At the end of the study, we hope to know a bit more about how kids with disabilities in Canadian are getting active. We want to help promote more inclusive, quality programs that support kids and their families.

So – want to participate in our study? Contact our amazing Research Coordinator, Ritu Sharma. The email is here. It's easy! You will complete an online survey and brief phone meeting, and then we will mail you a Fitbit to measure your activity. That's it! And, you get to keep the Fitbit and we'll send you a \$10 gift card once you've completed the study.

Thanks for your interest in the National Physical Activity Measurement Study.

Feel free to share this video! Keep moving and having fun!

Appendix C – Screening Questions

Please answer the following questions to determine if you are eligible to participate in the NPAM study.

1. I am between the ages of 10 and 17 years.

Yes *OR* *No*

2. I have a disability (e.g., developmental, physical, sensory, other).

Yes *OR* *No*

Appendix D – Letters of Information, Consent, and Assent

Adolescent Form



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The National Physical Activity Measurement (NPAM) Study for children and youth with disabilities: Assent Form

WHY ARE WE DOING THIS STUDY?

We are doing this study to find out more about the sleep, physical activity, and screen-time patterns of children and youth (ages 4 to 17 years) with any type of disability across Canada. We are also trying to understand more about your well-being. I am inviting you and your parent to be part of this study!

WHAT WILL HAPPEN DURING THE STUDY?

If you choose to take part in this study we will ask you and your parent to do the following:

- Your parent will complete one online survey about your typical day-to-day behaviours, such as your sleep, physical activity and screen-time. Your parent will also be asked a few questions about your feelings and emotions. Although you won't be completing these questions, it is important that you know your parent will be.
- You will be asked to wear a Fitbit (a small device worn on the wrist) for 30 days so we can understand your typical movement patterns on a day-to-day basis. We will set-up an anonymous Fitbit account for you to register and sync your device – this will help guarantee your privacy. If you wish to use your personal email address, you should know that this will not guarantee or protect your privacy. It is up to you how you want to set up your Fitbit device.
- If you are between the ages of 10 and 17 years, and are able to participate in a telephone/video interview, you will be asked to complete one, 45-minute telephone interview about your usual physical activity, screen-time, sleep, and well-being. The questions will be similar to those your parent answers during the online survey. If you prefer, you can opt to complete an online version of the survey.
- If randomly chosen, wear an accelerometer (a small device which measures your physical activity levels), along with your Fitbit, for 7 days for at least 10 hours each day. This will help us understand a little better how the Fitbit works.
- Keep a diary log of how long you wear the accelerometer (for example, at what time it was put on or taken off).
- If you live in Ontario, you will be contacted again in one year, and your parent will be asked to complete the same online survey again. You will also be asked to wear your Fitbit again for 30 days. You can choose not to do the second part of the study if you wish.

DO I GET ANYTHING FOR PARTICIPATING?

Yes! You will get to keep the Fitbit after you wear it for 30 days. If you also complete the telephone/video interview or online survey, you will get five volunteer hours for participating. Your parent will also get a \$10 gift card for their time.

ARE THERE GOOD AND BAD THINGS ABOUT THIS STUDY?

Some of the questions we ask you about the support you receive to be physically active and about your feelings and emotions may make you feel uncomfortable because of your personal experiences. You do not have to answer any questions that make you feel this way, and you don't have to tell us why you don't want to answer certain questions. You can still take part in our study, even if you skip some questions. You should also know that while all of your Fitbit data will be anonymous and can only be accessed by our research team, your anonymous data will be stored on Fitbit Inc.'s servers in the United States, as this is part of their data policy. This data is anonymous though and nobody will know that you wore the Fitbit or that it is your data. If you have more questions about this, we encourage you to talk to your parents or ask the researchers. Other than that, we do not think there is anything bad about this study. The good thing is that your ideas will help us understand more about what youth like yourself are doing during their daily routines.

WHO WILL KNOW ABOUT WHAT I DID IN THE STUDY?

No one will know your or your parents' answers to the surveys other than the researchers involved in the study.

DO I HAVE TO DO THIS? WHAT IF I'M NOT SURE?

It is up to you if you want to be in the study or not. Nobody will be angry or upset if you do not want to be in the study. The researcher will talk to your parents or guardians about the study. You should talk to them about it too. If you have any questions or concerns about your rights as a research participant please contact the Office of Research Ethics at ethics.review@utoronto.ca or call 416-946-3273. **Please reference study number 31862.**

You can also contact the Research Participant Complaint Line in the UBC Office of Research Services at 1-877-822-8598 or the UBC Okanagan Research Services Office at 250-807-8832. You can also contact them by email: RSIL@ors.ubc.ca. Please reference the study number H17-02514 when calling so that the Complaint Line staff can better assist you.

ASSENT:

I, _____ (print name) agree to participate in the following parts of the NPAM research study.

- Fitbit for 30 days
- Accelerometer for 7 days, if randomly selected
- For eligible participants between the ages of 10 and 17 years (please select one)
 - Telephone interview
 - Video interview
 - Online survey

Participant's Signature: _____ Date: _____

Witness Signature: _____ Date: _____

Parental Form



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National Physical Activity Measurement (NPAM) Study for children and youth with disabilities: Letter of Information and Informed Consent

RESEARCH TEAM

Principal Investigator: Dr. Kelly Arbour-Nicitopoulos

Co-Investigators: Dr. Rebecca Bassett-Gunter (York University)
Dr. Kathleen Martin Ginis (University of British Columbia)

WHO IS ELIGIBLE TO PARTICIPATE?

We are looking for children and youth ages 4 to 17 years with a disability and their parents.

PURPOSE OF RESEARCH

You and your child are invited to participate in the National Physical Activity Measurement (NPAM) Study. The purpose of this study, which has been approved by the University of Toronto's Research Ethics Board and funded through Canadian Tire's Jumpstart Charity and a Social Sciences and Humanities Research Council of Canada Partnership Grant, is to measure current trends in physical activity, sleep, and screen-time behaviour among children and youth (ages 4 to 17 years) with disabilities across Canada. A secondary purpose is to assess the psychological well-being of children and youth with disabilities.

The first part of this study will involve you completing one online 30-minute survey about your child's physical activity, sleep, and screen-time behaviours, and psychological well-being.

Next, your child will be asked to wear a Fitbit for one month. A Fitbit is a small watch-like device that measures daily movement patterns. This will be sent to your child via mail to measure their physical activity behaviour for the duration of the study. While wearing the Fitbit device for the month, your child will be asked to sync and charge their Fitbit every couple of days with the online account that we have created for you. You and/or your child will need to regularly charge the Fitbit during the study (approximately twice a week for a few hours). You and your child can view their physical activity data via your Fitbit account online.

If your child is between the ages of 10 and 17 years, and does not have a cognitive or hearing impairment, they will be asked to complete one, 45-minute telephone or video interview with the Research Coordinator. They will be answering questions similar to those you complete in the online survey. He or she will also be receiving a Fitbit, and will be asked to wear it for one month. Your child will also have the option of completing the questions in an online survey format if they prefer.

In addition to wearing the Fitbit, a random group of participants in the study will be selected to wear a small device, called an accelerometer, for seven days. The accelerometer will be worn around the waist. This will help us understand how the Fitbit works to collect the physical activity data of children and youth with disabilities. You can opt out of your child wearing the accelerometer or Fitbit.

If you live in Ontario, you and your child will be contacted for a follow-up in 12 months. You will be asked to complete the online survey again. Your child will be asked to wear the Fitbit again for one month, and if eligible, to complete the 45-minute telephone/video interview.

WHAT WILL ME AND MY CHILD BE ASKED TO DO?

The following outlines what will happen during the study:

1. Verify that you and your child are eligible to participate in the study based on the inclusion criteria outlined on the online survey or provided by the Research Assistant. Once eligibility is confirmed, you can proceed to the online survey.
2. You will be directed to an online consent form. You will be asked to provide your electronic consent to complete the online survey.
3. During the online survey, you will be asked to answer questions relating to your child's demographics (e.g. age, type of disability), their sleep, physical activity, and screen-time behaviours. You will also be asked questions relating to the support you provide your child to be or while engaging in physical activity, and questions relating to the psychological well-being of your child.
4. Your child will be asked to wear a Fitbit for one month. If your child is between the ages of 10 and 17 years and does not have a cognitive or hearing impairment, they will be asked to complete a telephone or video interview with the Research Coordinator. During the telephone/video interview, your child will be asked to complete a 24-hour recall of

the activities they did the previous day (e.g., travelling to and from school, playing with friends, watching television, etc.), and for how long they participated in these activities. Next, your child will complete a set of questionnaires relating to their sleep, physical activity, and screen-time behaviours, one questionnaire relating to their psychological well-being, questionnaires about the parental support they receive to be or while being physically active, and a questionnaire about the quality of their physical activity participation. If your child opts to complete the online version of the survey, they will only complete the set of questionnaires and not the 24-hour recall.

5. If your child would like to participate and are randomly selected for the accelerometry subgroup, your child will wear the accelerometer, along with the Fitbit. Your child will wear the accelerometer for at least 10 hours a day, and keep a log of their wear-time. After wearing the accelerometer, you and your child will be reminded to mail the device back to the Research Coordinator in a pre-postage paid envelope included in the original package.
6. If you are an Ontario resident, you and your child will be contacted in one year to complete a follow-up online survey. Your child will also be asked to wear their Fitbit device again for one month, and if eligible, to complete the 45-minute telephone/video interview or online survey.

HOW WILL THE INFORMATION GATHERED FROM THE STUDY BE KEPT CONFIDENTIAL?

All information that is shared with the research team will be *kept strictly confidential*, stored in Drs. Arbour-Nicitopoulos, Bassett-Gunter, and Martin Ginis' locked laboratories on a secure, password-protected computer. The data obtained through the telephone/video interview (*if your child is eligible for this part of the study*) will be shared with the developers of the self-report instrument at the School of Health Sciences at the University of South Australia, strictly for the purpose of data analysis. All shared data will be completely de-identified, meaning that there will be no information disclosing the identity of your child or your family. This data will be stored on their secure server, on password-protected computers in the locked laboratory of Dr. Timothy Olds. Only by permission of you and your child will the de-identified recall data be retained in Dr. Olds' laboratory for future data analyses. You can choose to opt out of having your child's data retained, and it will be destroyed immediately upon completion of the NPAM Study. Data will only be accessible to the research staff involved on this project. No information that discloses the identity of your child or your family will be released or published without consent, unless required by law. This legal obligation includes a number of circumstances, such as suspected child abuse, where research documents are ordered to be produced by a court of law and where researchers are obliged to report to the appropriate authorities. After data analysis is complete data cannot be withdrawn. Data will be stored by the NPAM research team for 5 years after publication on a secure, password-protected computer in Drs. Arbour-Nicitopoulos, Bassett-Gunter, and Martin Ginis' laboratories.

HOW WILL STUDY RESULTS BE SHARED?

You should know that the researchers intend to publish the findings of the study and to make public presentations based on the research. You and your child's name will not be given in any verbal or written reports or publications made by the researchers. A summary of the results will be provided on the websites of participating centres and organizations once the study is complete.

WILL MY CHILD BE COMPENSATED FOR THEIR INVOLVEMENT IN THE STUDY?

As a token of appreciation, you will receive a \$10 e-gift card for completing the online survey (Ontario residents will receive another \$10 gift card for completing the follow-up survey). Your child will have the opportunity to keep the Fitbit device at the end of the study, and if they completed the interview/online survey (participants aged 10 to 17 years), they will also receive five volunteer hours for participating.

ARE THERE POTENTIAL RISKS I SHOULD BE AWARE OF?

You and your child will be asked questions about your child's sleep, physical activity, and screen-time behaviours, and their psychological well-being. You will both also be asked about parental support and the quality of your child's physical activity participation. There is a very small chance that you and/or your child may feel apprehensive to answer some of these questions because of your and your child's personal experiences. However, you and/or your child do not have to respond to any questions in the online survey that you/they feel uncomfortable answering and do not have to provide an explanation for why you/they chose not to answer.

As per Fitbit Inc.'s data privacy and retention policies, your child's physical activity Fitbit data will be stored by Fitbit Inc. on their server in the United States. As such, we cannot guarantee what happens to your activity data or how safe it is. However, we will not use your real information (i.e., name, date of birth) when we create your Fitbit account, so nobody will be able to know that the physical activity data is yours. We will also create an anonymous email account for you through which you can access your Fitbit account, unless you prefer to use your own. Please note that if you use your own email account, Fitbit or others may be able to identify you by your email address. You can find the Fitbit Terms of Service and their data privacy policy online (<https://www.Fitbit.com/en-ca/legal/terms-of-service>) and we will be happy to answer any further questions you may have regarding the privacy of your Fitbit physical activity data. Despite these steps that will be taken to protect your child's identity, please be aware that your IP address may be submitted to Fitbit's server when logging in from home with the email account set up for your child.

WHAT ARE THE BENEFITS OF ME AND MY CHILD PARTICIPATING?

You and your child will not benefit directly from participating in the study. The information gained from this study will help to inform the scientific community's

understanding of the physical activity, screen-time and sleep behaviours and well-being of Canadian youth with disabilities. These data will support the development of effective, evidence-based policies and programs to serve Canadian children and youth with disabilities.

VOLUNTARY PARTICIPATION AND EARLY WITHDRAWAL

Your and your child's participation in this study is voluntary and involves no risk to him/her as a person. You and your child may refuse to participate or answer any questions asked without penalty or explanation. You and your child may withdraw your consent and their assent to participate in the study at any time. If you or your child chooses to withdraw from the study, you will also have the option to withdraw the information provided. However, your and your child's data cannot be withdrawn after data analysis is complete. Contact the researcher by phone at 416-978-2725 or by e-mail at kelly.arbour@utoronto.ca if your child would like to withdraw their information.

If you have any questions or concerns about your rights as a research participant and/or your experience while participating in this study you may contact:

1. The University of Toronto's Office of Research Ethics at ethics.review@utoronto.ca or call 416-946-3273. Please reference the study number 31862.
2. The Research Participant Complaint Line in the UBC Office of Research Services at 1-877-822-8598 or the UBC Okanagan Research Services Office at 250-807-8832. You can also contact them by email: RSIL@ors.ubc.ca. Please reference the study number H17-02514 when calling so that the Complaint Line staff can better assist you.

ACCEPTANCE OF THE CONDITIONS OF THE RESEARCH PROCESS AND CONSENT

By signing this form, I acknowledge that:

- a) The research team has given me and my child the opportunity to ask questions regarding the NPAM research study and its procedures and that these questions have been answered to my satisfaction.
- b) At any time during the study, I may request further clarification from the research team. I can do this by contacting the Principal Investigator (Dr. Kelly Arbour-Nicitopoulos) by phone (416) 978-2725 or by e-mail at kelly.arbour@utoronto.ca.
- c) I understand that this study is investigating the movement behaviours (i.e., sleep, physical activity, and sedentary behaviour) among children and youth with disabilities across Canada.
- d) Researchers would like me to complete one, 30-minute online survey about demographics, sleep, physical activity, and screen-time behaviours of my child, the

parental support I provide to my child to engage in physical activity, and my child's psychological well-being and quality of physical activity participation.

- e) I understand that if I provide permission for my child to contribute to the study, my child will be asked to wear a Fitbit for one month to measure their typical movement behaviours, and if eligible, complete one, 45-minute telephone/video interview with the Research Coordinator, or an online survey similar to the one I completed.
- f) I understand that if my child participates in the interview, they will be asked to complete one 24-hour recall interview and questionnaires about demographics, sleep, physical activity, and screen-time behaviours, parental support to engage in physical activity, psychological well-being, and quality of physical activity participation. I understand that only the recall data collected during the interview will be shared with Dr. Timothy Olds at the University of South Australia, strictly for the purpose of data analysis, and that all shared data will not in any way disclose the identity of my child or our family. I understand that my child's recall data obtained through interview will be retained in Dr. Timothy Olds' archives/database at the University of South Australia, strictly for the purpose of future data analyses. I understand that I and/or my child can opt out of the retention of this data in Dr. Olds' database.
- g) I understand that the researchers are providing the option of creating an anonymous email address to register my child's Fitbit online account to protect their identity, or that we can opt to use a personal email address, which does not guarantee the protection of my or my child's identity when data is saved on Fitbit's server as per their data privacy and retention laws.
- h) I understand that all Fitbit data collected during the study and stored by the researchers on their secure server will remain anonymous and will not reveal the identity of my child.
- i) I understand that despite the steps being taken by the researchers to protect my child's identity and maintain confidentiality, the data collected by the Fitbit is subject to Fitbit Inc.'s data privacy and retention laws. Further, I understand that the IP address of the computer being used to log in to my child's Fitbit account may be shared with Fitbit Inc.'s server. The Research Assistant has provided me with a link to Fitbit Inc.'s data privacy and retention laws.
- j) I understand that Fitbit Inc. reserves the right to continue collecting data for as long as my child has a registered account with Fitbit Inc., beyond their participation in the NPAM Study.
- k) I understand that my child's data obtained through the telephone interview (if they are eligible) will be retained in Dr. Timothy Olds' archives/database at the University of South Australia, strictly for the purpose of future data analyses. I understand that I and/or my child can opt out of the retention of this data in Dr. Olds' database.

- l) I understand that, if randomly selected, the researchers would like my child to wear an accelerometer for 7 days for at least 10 hours/day, during which my child will keep a log diary of wear time. I understand that I or my child can opt out of this part of the study if we wish to.
- m) I understand that if I am an Ontario resident, I will be contacted for a follow-up online survey one year from now. I also understand that my child will be asked to wear the Fitbit device again for one month, and if eligible, complete the 45-minute telephone interview again.
- n) I or my child are under no obligation to participate in the research study and are free to withdraw from the study at any time, without explanation and that I am free to withdraw my permission and consent at any time during the research study. However, my and my child's data cannot be withdrawn after data analysis is complete.
- o) I am free now, and in the future, to ask any questions about the study.
- p) I have been told that all collected information will be kept confidential, except where release of information is required by law, e.g., suspected child abuse, public health.
- q) I understand that no information that would identify me or my child will be released or printed.
- r) The possible risks and benefits of the NPAM research study have been explained to me, and in no way does signing this consent form waive my legal rights nor does it relieve the researchers or involved institutions from their legal and professional responsibilities. I have been given a copy of this consent form for my records.

Consent

I, _____ (print parent/guardian's name), agree to participate in the online survey and allow my child _____ (print child's name) to participate in the following parts of the NPAM Study:

- Fitbit for 30 days
- Accelerometer for 7 days, if randomly selected
- For eligible participants between the ages of 10 and 17 years (please select one):
 - Telephone interview
 - Video interview
 - Online survey
- None of the above – my child will not be participating and I only consent to completing the online parent survey

_____ (signature) _____ (date)

Appendix E – Measures

Socio-demographics

Please complete the following demographic questionnaire.

1. How old are you? For example, if you are 12 years old, you can write the answer “12.”

2. Please indicate your gender.

Male *Female* *Transgender* *Prefer not to answer*

3. Which of the following best represents the ethnicity/background you identify with?

Select those that apply.

- Black, Afro-Caribbean, African American*
 Caucasian
 First Nations
 Hispanic (e.g., Central American, South American, Mexican, Spanish)
 East Asian (e.g., Chinese, Japanese, Korean, Taiwanese)
 South Asian (e.g., Indian, Pakistani, Sri Lankan)
 Southeast Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
 Western Asian (e.g., Afghani, Armenian, Egyptian, Iranian, Iraqi, Saudi Arabian Turkish)
 Other
 Prefer not to answer

4. Which Province or territory do you live in?

- | | | |
|-----------------------------------------------------------|-------------------------------------------------|----------------------------------------------|
| <input type="checkbox"/> <i>British Columbia</i> | <input type="checkbox"/> <i>Alberta</i> | <input type="checkbox"/> <i>Saskatchewan</i> |
| <input type="checkbox"/> <i>Manitoba</i> | <input type="checkbox"/> <i>Ontario</i> | <input type="checkbox"/> <i>Quebec</i> |
| <input type="checkbox"/> <i>New Brunswick</i> | <input type="checkbox"/> <i>Nova Scotia</i> | <input type="checkbox"/> <i>P.E.I</i> |
| <input type="checkbox"/> <i>Newfoundland and Labrador</i> | <input type="checkbox"/> <i>Yukon Territory</i> | <input type="checkbox"/> <i>N.W.T</i> |
| <input type="checkbox"/> <i>Nunavut</i> | | |

5. Please tell us more about your disability.

Developmental *Physical* *Sensory* *Other*

If you selected other, please tell us more about your disability.

6. Is your disability congenital (i.e., since birth) or acquired?

Congenital *OR* *Acquired*

7. Do you use a mobility device?

Yes OR No

8. Do you use any assistive device for communication purposes?

Yes OR No

Items from Physical Activity Questionnaire for Adolescents (IPAQ-A)

Part 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the *last 7 days* solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned!

During the last 7 days on how many days did you do one of the following *in your leisure time*?

1. *WALK or WHEEL* (not as a means of transportation)

None 1 days 2 days 3 days 4 days 5 day 6 days 7 days

How much time did you usually spend on one of those days *walking or wheeling* in your leisure time?

_____ *minutes per day*

2. *MODERATE* physical activities, *that take moderate physical effort and make you breathe somewhat harder than normal*, like dancing, swimming at a regular pace, and doubles tennis...

None 1 days 2 days 3 days 4 days 5 day 6 days 7 days

How much time did you usually spend on one of those days *on moderate physical activity* in your leisure time?

_____ *minutes per day*

3. *VIGOROUS* physical activities, *that take hard physical effort and make you breathe much harder than normal*, like aerobics, running, fast bicycling, or fast swimming...

None 1 days 2 days 3 days 4 days 5 day 6 days 7 days

How much time did you usually spend on one of those days *on moderate physical activity* in your leisure time?

_____ minutes per day

Measure of Experiential Aspects of Participation (MeEAP)

On a scale of 1 (strongly disagree) to 7 (strongly agree), when engaging in exercise or physical activity I feel:

	1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Neither agree or disagree	5 Somewhat agree	6 Agree	7 Strongly agree	99 Prefer not to answer
1. That I do what is desirable for me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Free to make my own choices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. That I fit in	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. That my skills match the level of difficulty of the activity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Accepted by others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. That I get just the right amount of challenge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. A sense of purpose	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Entirely focused on what I am doing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. That time passes very	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

quickly								
10. That I can achieve their goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. A sense of responsibility to others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Confident in my skills/abilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3-item UCLA Loneliness Scale (UCLA-LS-3)

The next questions are about how you feel about different aspects of your life. For each one, tell me how often you feel that way.

1. How often do you feel that you lack friendship?

- Hardly ever* *Some of the time* *Often*

2. How often do you feel left out?

- Hardly ever* *Some of the time* *Often*

3. How often do you feel isolated from others?

- Hardly ever* *Some of the time* *Often*

Appendix F – Skewness and Kurtosis Values for Main Variables of Interest

Table 4.
Skewness and Kurtosis Values for Main Variables of Interest

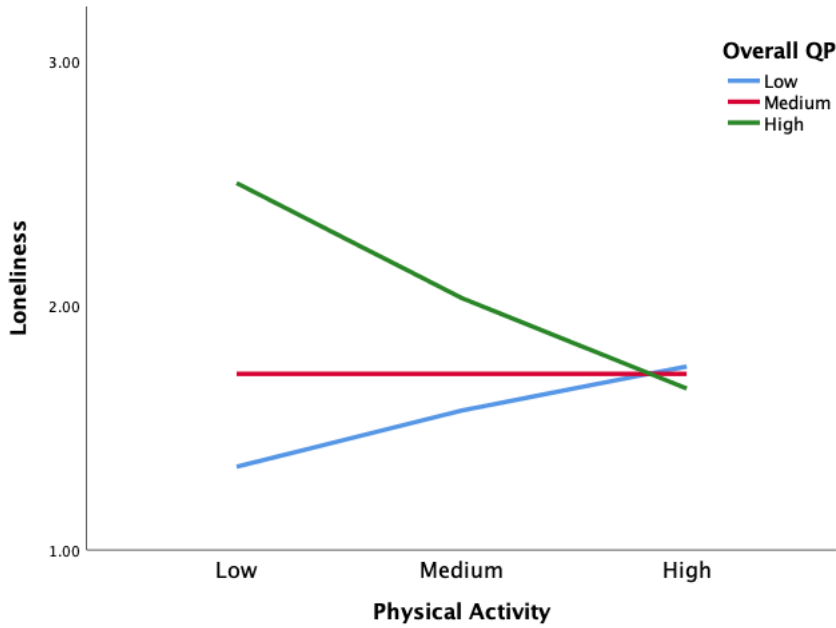
	Skewness	Kurtosis
Loneliness	.21	-.93
PA	.35	-.50
Overall QP	-.72	-.21
Autonomy	-.46	-.53
Belongingness	-.45	-.38
Challenge	-.55	-.26
Engagement	-.53	-.85
Mastery	-.72	-.38
Meaning	-.62	-.18

Note. PA = Overall physical activity, measured in average minutes per day. QP = Quality participation.

Appendix G – Interaction Plots

Figure 1

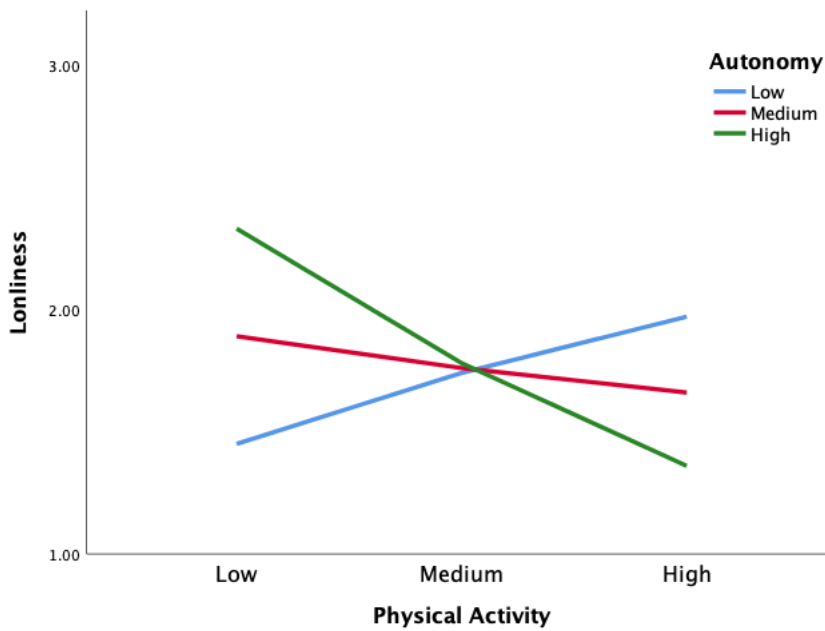
The Interaction Between Physical Activity, Overall Quality Participation, and Loneliness



Note. Physical activity = Overall physical activity, measured in average minutes per day.

Figure 2

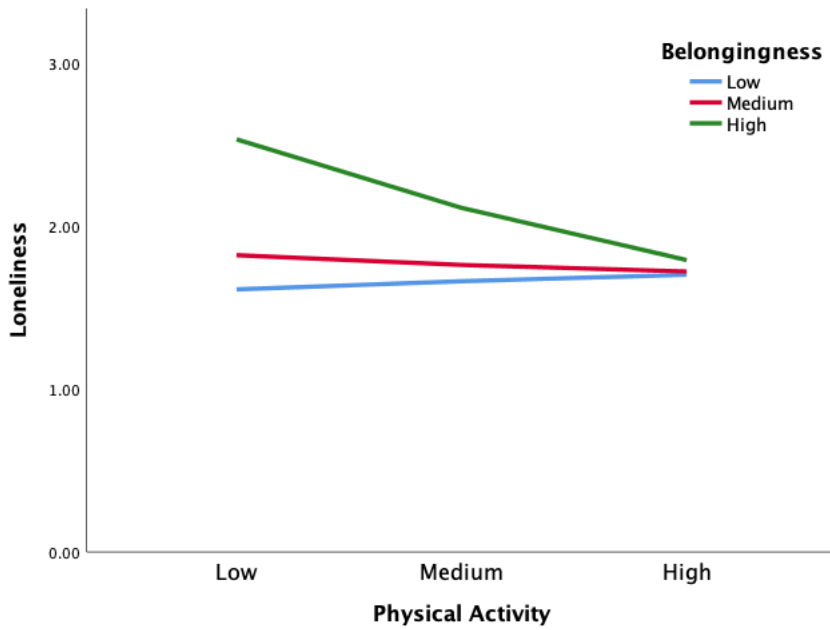
The Interaction Between Physical Activity, Autonomy, and Loneliness



Note. Physical activity = Overall physical activity, measured in average minutes per day.

Figure 3

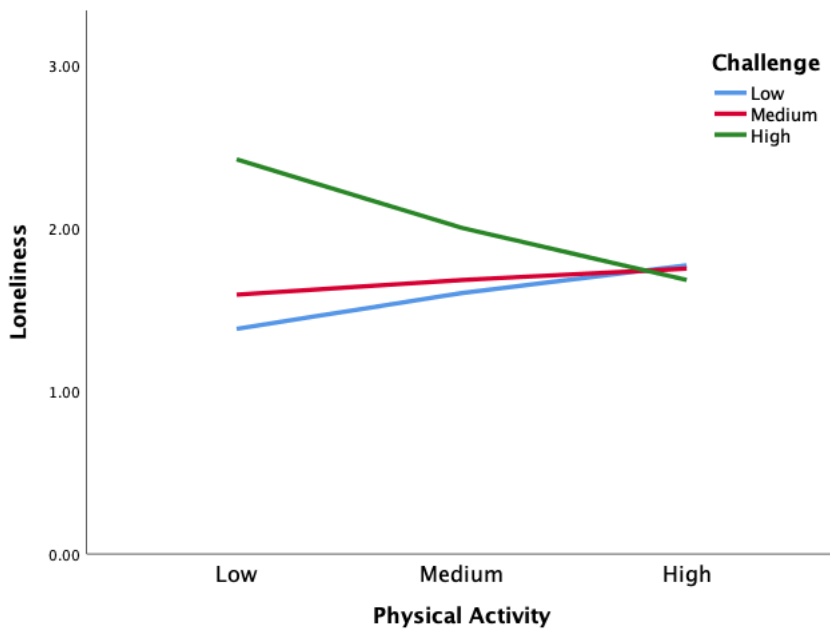
The Interaction Between Physical Activity, Belongingness, and Loneliness



Note. Physical activity = Overall physical activity, measured in average minutes per day.

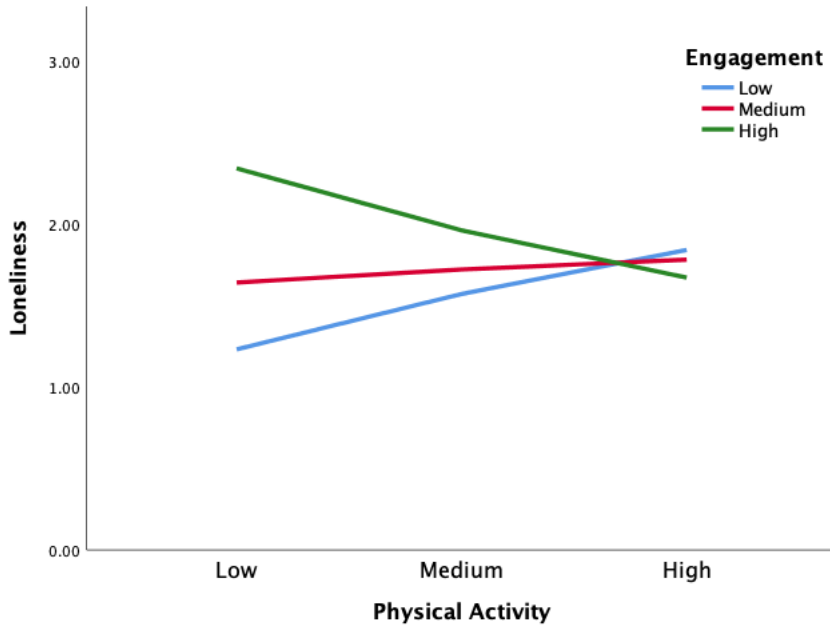
Figure 4

The Interaction Between Physical Activity, Challenge, and Loneliness



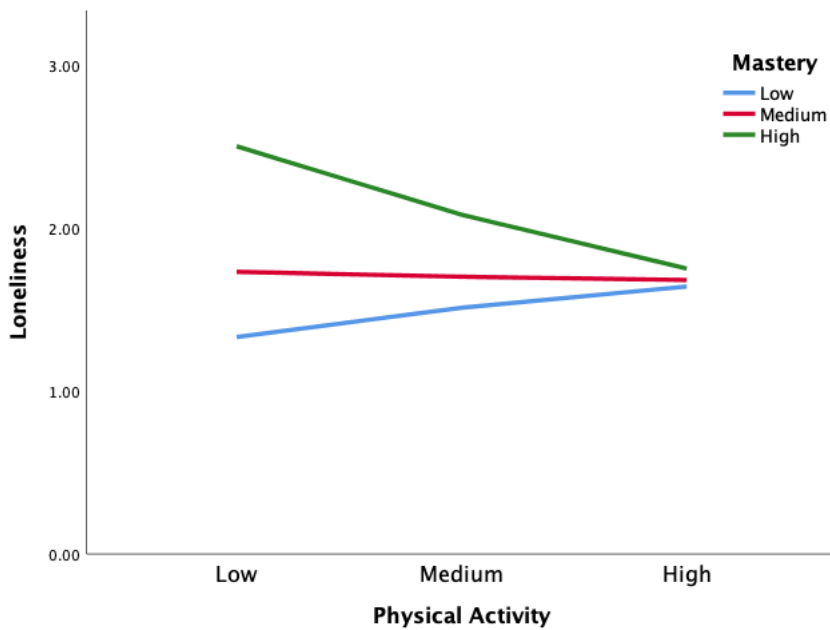
Note. Physical activity = Overall physical activity, measured in average minutes per day.

Figure 5
The Interaction Between Physical Activity, Engagement, and Loneliness



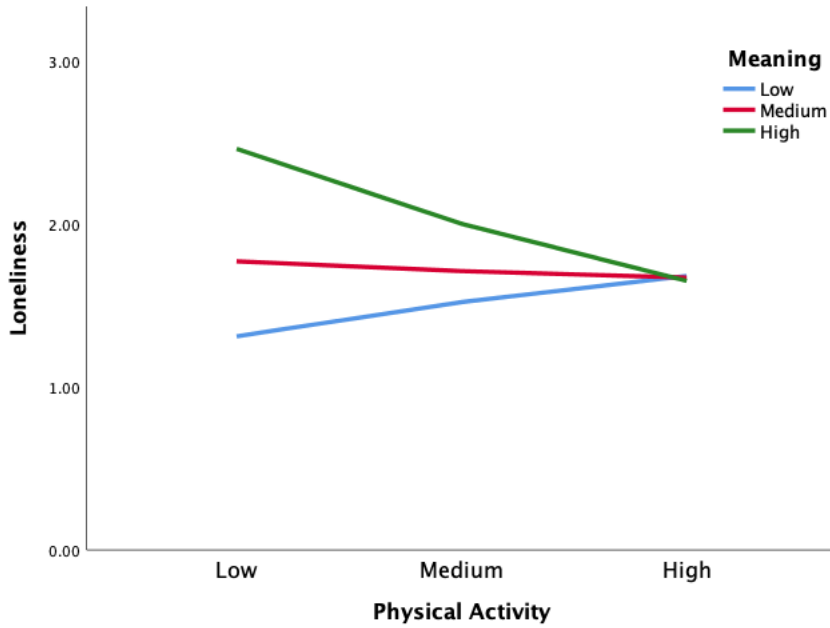
Note. Physical activity = Overall physical activity, measured in average minutes per day.

Figure 6
The Interaction Between Physical Activity, Mastery, and Loneliness



Note. Physical activity = Overall physical activity, measured in average minutes per day.

Figure 7
The Interaction Between Physical Activity, Meaning, and Loneliness



Note. Physical activity = Overall physical activity, measured in average minutes per day.