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# Physical Activity in Nature and Children's Mental Health

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PHYSICAL ACTIVITY IN NATURE AND CHILDREN'S MENTAL HEALTH

A Thesis Presented

by

Stephanie Marcia Bless

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of

The University of Vermont

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## Abstract

The aim of this study was to determine if there is a relationship between children's physical activity and wellbeing, and if that relationship is enhanced by physical activity in nature. This study was a non-experimental retrospective multi-informant data review conducted at an outpatient pediatric psychiatric clinic in the Northeast. The theoretical framework used to guide this study was the Health Promotion Model, suggesting Advanced Practice Nursing investigate the relationship between health promoting behaviors and personal factors that support mental wellness in children and protect against mental illness. Data collected included age, sex, and exercise and wellbeing subsections of the Vermont Child Health and Behavior Questionnaire (VHBQ): Parent Reports and Self-reports for 11-21 year olds. Data from three sample groups were analyzed: parent participants (n=178, 61% male, 38% female), child participants (n=78, 51% male, 49% female), and parent-child pairs with sex determined by child (n=25, 60% male, 40% female). Physical activity was calculated using a metric for participation in sports.

Two sample t tests were used to analyze children's response to the question "do you participate in sports regularly?" in relation to wellbeing scores. Pearson's correlation coefficient was used to investigate correlations between 1) parent reports of their children's physical activity and wellbeing, 2) children's self-reports of physical activity and wellbeing, 3) parent reports of their children's physical and children's self-reports of physical activity, and 4) parent reports of their children's wellbeing and children's self-reports of wellbeing.

Statistically significant results included positive correlations between parent reports of their children's physical activity and wellbeing item, "his/her living conditions are excellent" ( $r=.34$ ,  $p<0.001$  for overall,  $r=.25$ ,  $p=.002$  for indoor, and  $r=.28$ ,  $p<0.001$  for outdoor). Positive weak correlations were found between parent reports of their children's physical activity and scores on the VHBQ 10-point Worst Life/Best Life bar ( $r=.19$ ,  $p=0.02$  for overall and  $r=.17$ ,  $p=.04$  outdoor). Additionally, results showed significant strong positive correlations for all physical activities between parent reports of children's participation and children's self-report of participation ( $r=0.83$ ,  $p<0.001$  for overall,  $r=0.85$ ,  $p<0.001$  for indoor, and  $r=.67$ ,  $p=0.02$  for outdoor). However, only a single wellbeing item, "Compared with...most peer, [child] is less happy than they are", demonstrated statistically significant positive correlation ( $r=.48$ ,  $p=0.03$ ) when parent reports and self-reports of wellbeing were compared.

These results underscore the need for further research. Among professions, Advanced Practice Nurses may be best equipped to fully understand the lifestyle factors that promote children's mental health. Moreover, because of their background, training and employment settings, Advanced Practice Nurses could play an important role not only in initiating well-being research studies, but also in using the resultant information to develop educational resources and policy.

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## CHAPTER I: INTRODUCTION

Physical activity and exposure to nature are potential contributors to children's mental wellness. Both physical activity and exposure to nature may demonstrate a protective quality to children's mental health and wellbeing, increasing their overall resiliency. Mental illness including suicide, depression, and anxiety affect young people at disproportionate rates (Viner, 2005). If mental illness diagnoses continue at the current rate of increase, by 2020 it is expected to affect 15% of the global population, making it the leading disease burden worldwide (Biddle & Asare, 2011). Research has begun to investigate protective factors against mental illness that will improve the knowledge base of lifestyle choices that may help maintain mental wellness throughout the lifespan.

It is widely believed that physical activity is beneficial for children with respect to psychological outcomes. Children who regularly participate in physical activity are more likely to report higher health-related quality of life status related to physical, mental, and social wellbeing (Gopinath, Hardy, Baur, Burlutsky, & Mitchell, 2012). Similarly, physical activity is associated with lower levels of depression (Jerstad, Boutelle, Ness, & Stice, 2010). Although the benefits of physical activity are well known, the majority of children fail to meet the daily recommendations of 60 minutes of moderate to vigorous physical activity per day. In 2013, only 27.1% of high school students had participated in at least 60 minutes of physical activity on all seven consecutive days before the Youth Risk Behavior Surveillance survey (CDC, 2014). Results of the survey also showed that 15.2% of high school students did not participate in 60 or more minutes of any kind of physical activity on at least one day during the

seven days before the survey (CDC, 2014). These low percentages are especially concerning given that children who get the recommended amount of physical activity are found to have fewer emotional issues (Wiles *et al.*, 2008). It is suggested that there might be developmental, neurological, and psychological factors associated with physical activity that promote higher resilience against mental disorders (Ströhle, 2009).

Along with research that shows an association of physical activity with child wellness, a significant body of research, which has investigated the relationship between nature and children, has begun to emerge showing time spent in nature appears to improve physiological and psychological measures in children. Studies have shown that nature can improve children's coping mechanisms related to stress (Wells & Evans, 2003; Corraliza, Collado, & Bethelmy, 2012). Psychological benefits of exposure to nature include positive impacts on children's sense of self-worth and wellbeing (Wells & Evans, 2003; Maller & Townsend, 2006). Cognitive functions, like attention, also have been shown to improve after children engage with nature (Wells, 2000). These psychological and cognitive benefits are thought to increase children's overall resilience and act as a buffer from life stressors (Wells & Evans, 2003). Thus, to date these early studies of children without psychiatric problems have demonstrated exposure to nature seems to generate protective factors for a child's wellbeing.

The health benefits of physical activity in children seem well established. Among the purported benefits are improvements in psychological health. Similarly, there is a smaller body of evidence supporting the notion that there are psychological benefits of nature. Research investigating the potential combined benefits of engaging in physical activity while being exposed to nature is nearly non-existent.

## **The Purpose of the Study**

The purpose of the present study is to investigate the association between physical activity in nature and children's mental health.

## **Theoretical Framework**

The theoretical framework used in this study is the Health Promotion Model conceived Nola J. Pender (Pender, Murdaugh, & Parsons, 2002). The Health Promotion Model, based on social cognitive theory, explores the factors and relationships that contribute to behaviors that promote health, and in doing so contributes to wellness and quality of life. The Health Promotion Model acts as a framework guiding the investigations into biopsychosocial processes that motivate individuals to engage in health behaviors. Three domains are identified that influence health-promoting behaviors: (1) individual characteristics and experiences, (2) behavior-specific cognitions and affect, and (3) situational/interpersonal influences. Individual characteristics and experiences consist of factors like gender, age, and experiences that inform future behavior. Behavior-specific cognitions and affect include perceived barriers and benefits to behavior, perceived self-efficacy, and affect cues to behavior. Situational and interpersonal influences are the social and environmental factors that influence health behaviors. Using this theoretical framework, the current study considers the domain of perceived self-efficacy and health promoting behaviors as it attempts to help explain the relationship between physical activity in nature and the wellbeing of children with psychiatric problems.

## **Question**

When examining parent report and self-report surveys, do children with mental health issues who regularly exercise outdoors, while being exposed to nature, report increased levels of wellbeing?

## **Hypothesis**

As children's activity levels increase, there are associated improvements to their wellbeing. These improvement effects are enhanced by activity in nature, or in the outdoors.

## **Significance**

This study adds a contribution to research that considers simultaneous variables of physical activity and nature exposure for child wellbeing – research that currently exhibits a dearth of studies. Positive and significant associations in this study may prompt additional and more extensive studies that investigate said associations.

## **CHAPTER II: LITERATURE REVIEW**

Several studies support the belief that physical activity contributes to children's psychological health (Iannotti, Kogan, Janssen, & Boyce, 2009; Gopinath *et al.*, 2012).

There is also a growing body of literature suggesting there are similar psychological benefits experienced by children when exposed to nature (Barton & Pretty, 2010).

Analogous to research reported for adult populations (Thompson Coon *et al.*, 2011), there may be potentially greater benefits experienced by children who participate in outdoor physical activity, being exposed to nature, than those participating in similar amounts of

indoor activities.

### **Physical activity trends and children's mental health**

Physical activity has been shown to positively impact children's mental health. Higher positive psychological health indicators like increased attention and lower levels of depression are reported by children who are physically active (Iannotti *et al.*, 2009; Hoza *et al.*, 2014; Jerstad *et al.*, 2010). Youth from the US and Canada who participated in physical activity reported higher levels of positive health indicators like self-image, physical health status, quality of life, and quality of family and peer relationships (Iannotti *et al.*, 2009). Those who reported higher levels of physical activity also reported less physical health complaints and lower levels of negative health behaviors like cigarette smoking and marijuana use (Iannotti *et al.*, 2009). Similarly, Gopinath *et al.* (2012) reported in a 5-year longitudinal study that physical activity was positively associated with health-related quality of life in children at age 12-13 and again at age 17-18. Jerstad *et al.* (2010) have also suggested that the relationship of increased physical activity and a sense of social connectedness, efficacy, and enjoyment felt by adolescents may contribute to lower risk of depression onset.

These authors have submitted that regular physical activity offers some protective effects against the onset of major-minor depression (Jerstad *et al.*, 2010). This supposition is supported by findings demonstrating that higher levels of physical activity have been associated with lower levels of depression in adolescents (Wiles, Haase, Lawlor, Ness, & Lewis, 2012; Jerstad *et al.*, 2010). In a prospective study of adolescent girls, physical activity and depression have been found to be linked bidirectionally: those who reported fewer symptoms of depression were more likely to participate in physical

activity, and those who were physically active were less likely to be depressed (Jerstad *et al.*, 2010). Moreover, the results of a cross-sectional study suggested that the amount of physical activity, rather than the intensity, is associated with fewer depressive symptoms (Wiles *et al.*, 2012).

The body of research investigating the relationship between physical activity and children's mental health is actively growing. In a recent study, Dunton, Huh, Leventhal, Riggs, Hedeker, Spruijt-Metz, & Pentz, (2014) investigated the relationship between feeling states and physical activity in 119 children, ages 9-13. Measures of positive affect (feeling joyful or happy), negative affect (feeling stressed, mad or angry, nervous or anxious, sad), and physical feeling states (feeling tired, energetic) were related to objectively measured physical activity using activity monitors that are worn on two occasions over two and half day periods separated by six months. Participants were randomly prompted three to seven times per day to stop their current activity to complete a two to three minute questionnaire on a mobile device. Results indicated that physically active children showed greater stability in positive affect and negative affect. The results also demonstrated that a 14-minute increase in moderate to vigorous physical activity lead to an increase in feeling energetic, and a 30-minute increase in moderate to vigorous physical activity lead to an increase in positive affect.

In a longitudinal study Wiles, Jones, Haase, Lawlor, Macfarlane, & Lewis (2008) found that children who met the recommended levels of 60 minutes per day of physical activity over the course of a year had fewer emotional problems. However, despite the known benefits associated with physical activity, the authors found that many children did not get the recommended amount of physical activity. Wiles *et al.* (2012) objectively

measure physical activity of 2,951 14-year-olds in the UK and found that overall, adolescents undertake an average of 21 mins of moderate/vigorous physical activity (MVPA)/day. Likewise, in an investigation of the relationship between physical activity, body mass index, and mental health of 3,096 Chinese adolescents, ages 11-13, 58.1% of children reported getting insufficient physical activity based on the recommended 60 minutes per day (Wang, Fu, Lu, Tao, & Hao, 2014). Jerstad *et al.*, (2010) found that for adolescent girls, rates of physical activity decline throughout adolescence as rates of depression increase.

Inactivity and increased sedentary behavior has also been associated with poorer mental health in children. Wang, Fu, Lu, Tao, and Hao (2014) found that both insufficient physical activity and obesity were positively correlated with symptoms of anxiety and depression. Youth who reported higher levels of screened-based media use also reported poorer quality of life and quality of family relationships values as well as increases in health complaints and negative health behaviors like cigarette smoking and alcohol use (Iannotti *et al.*, 2009). In Canadian adolescent females, screen-based media use corresponded to lower self-image (Iannotti *et al.*, 2009). Gopinath *et al.* (2012) reported similar findings in their 5-year longitudinal study, demonstrating that excessive recreational screen time, in particular television viewing, was associated with lower quality of life scores. Those adolescents who rarely exercised were more likely to self-report feelings of loneliness and shyness (Gopinath *et al.*, 2012).

As strong as these associations appear to be, there are a surprising number of contradictory findings. For example, Iannotti, *et al.* (2009) found that quality of peer relationships, a positive health indicator, was positively associated with both physical

activity and screen-based media use. The authors also noted that higher levels of aggression were reported by both US and Canadian adolescent males who reported high levels of physical activity as well as by those who reported high levels of sedentary behavior (Iannotti *et al.*, 2009). Additionally, US and Canadian adolescents who reported participating in negative health behaviors like binge drinking, smoking cigarettes, and trying cannabis were more active in terms of both total physical activity and time in moderate/vigorous activity than those who did not report participating in such behaviors (Wiles *et al.*, 2012). Although US adolescents and Canadian females who reported higher levels of physical activity also reported less alcohol use, Canadian males who reported being physically active reported higher levels of alcohol use (Iannotti *et al.*, 2009). The reason for these differences is not clear.

Levels of physical activity have been found to decline with age, beginning as early as preadolescence (Basterfield *et al.*, 2011). Decreases in levels of physical activity and increases in sedentary behaviors were found to take place in children as early as age 7 to 9 years old (Basterfield *et al.*, 2011). This was especially evident in girls and in those with higher BMIs at age 7 (Basterfield *et al.*, 2011). From the results of a 21-year tracking study, being physically active from ages 9 to 18 significantly predicted being physically active as an adult (Telama *et al.*, 2005). To increase the probability of being active as an adult, general intensive participation in physical activity and sports and continuous participation at school age appear more important than participation in a particular activity (Telama *et al.*, 2005). Though it could be argued that some sports such as hiking, swimming, golfing and tennis are more likely to be carried into adulthood than team sports such as football and field hockey.

As a result of research highlighting the associations between physical activity and children's mental health, interventions are being developed and their impact on children's mental health is being evaluated. In a recent study, Hoza *et al.* (2014) investigated the effects of a physical activity based intervention versus a sedentary intervention (moderate-vigorous activity v. art) on ADHD symptoms. Early elementary school students (n=202), ages 4-8, were randomly assigned to 31min/day of an intervention over 12 weeks. Parents and teachers rated children's symptoms of inattention, hyperactivity and impulsivity, oppositional behavior, moodiness, behavior towards peers, and reputation with peers. It was found that there was greater reduction in ADHD symptoms in the physical activity intervention group compared to the sedentary intervention group for ADHD-risk children. Parents of ADHD-risk children who participated in the physical activity intervention group reported reductions in oppositional symptoms as well as improvements in peer functioning. Although these parents also reported improvements in moodiness the results were not statistically insignificant.

### **Nature and mental health**

Exposure to nature has been shown to increase positive mental health characteristics like wellbeing and self-worth as well as helps to improve symptoms related stress. Maller and Townsend (2006) investigated how children's (ages 5-12) health and wellbeing were affected by the addition of hands-on nature-based activities to their school curriculum. Data regarding the impacts to children's health and wellbeing were gathered through surveying the principals and teachers in urban primary schools in Australia. Results from the study indicated that teachers and principals perceived that the addition of nature-based activities to curricula had positively impacted children's

wellbeing and health in the following areas: connectedness, learning, life skills, environmental awareness, social skills, and physical health. The authors concluded that children's mental health and wellbeing were positively impacted by learning activities in nature. Wells and Evans (2003) showed significant findings when investigating the correlation between connection to nature and self-worth of children living in small rural communities. Children's self-worth was found to be higher when there was increased nearby nature. Their overall findings suggested that the relationship of stressors and self-worth was weaker for those children with greater exposure to nature. These results of these studies lend support of nature's potential buffering effect against the impacts of stressful events for children.

In their exploration of how the location of nature in small rural communities can act as a buffer or moderator against life stressors for children, Wells and Evans (2003) suggest that suggest nature can be a protective factor against adverse conditions and can increase children's resiliency. Although the study found that children of higher socioeconomic status tend to have significantly lower levels of psychological distress, it also found that those with more nature near their homes exhibited the least psychological distress. As expected, the study found that those children who were exposed to greater stressful life events (i.e. family relocation, being picked on or punished, arguments with parents, or being subject to peer pressure) experienced greater psychological distress, however having nearby nature (i.e. views of nature from common living spaces, indoor plants, and access to a yard) was found somewhat ameliorate the effects of these stressful life events. The authors concluded that the impact of stressors on children varied depending on their levels of nature exposure and the greater the exposure to nature the

less the impact of the stressors.

Nature has also been shown to be a moderator for stress in populations of urban children. Corraliza, Collado, and Bethelmy (2012) collected data from children in four primary schools with differing amounts of nature existing in and surrounding the schools. The children, ages 10 -13, from the schools were also surveyed regarding their perception of the amount of nature connected to their school. The children self-reported perceived stress and frequency of stressful events (i.e. not spending enough time with parents, not having enough money, exposure to parental arguments). The study demonstrated significant relationships to the amount of stress perceived by the children nearby nature, as well as with objective measures of nearby nature at each school. The study went on to show a significant correlation between higher amounts of nearby nature and lower levels of stress. The results supported the conception that nearby nature positively affects children's wellbeing by mitigating stress impacts. Congruent with results reported by Wells and Evans (2003), this study found that children with increased access to nature were better able to cope with stress and as a result had lower levels of stress than children exposed to similar stressors with less access to nature.

Perhaps the most well researched topic related to the relationship of nature and children's mental health is that of the impact of nature on cognitive functioning of children with regard to attention. Exposure to nature has been shown to increase the attention of children with and without attention deficit/hyperactivity disorder. A primary example is that of Wells (2000) longitudinal study of the effects of exposure to nature on low-income children's ability to focus. Participants were 17 children (ages 13-17), living in urban environments, whose families were participating in a self-help housing program.

Families in the program helped to construct and then purchase a new home. In the first phase, children were visited while they lived in substandard housing with typically little exposure to nature. In the second phase, families were visited one year later after they had relocated to better housing. To assess the characteristics of the housing, a 10-item naturalness scale was used which asks about items regarding nature from window views, built environment in window views, and existence and material of outdoor yard. The children's cognitive function was examined at each location with parental surveys that assessed the children's ability to focus attention. The results of the study suggested that exposure to nature within the home greatly impacted the ability to focus attention in low-income children. Children who experienced the greatest change or increase in natural elements tended to have the greatest ability to direct their attention several months after moving to their new home.

Kuo and Taylor (2004) began to explore how nature impacts symptoms of children diagnosed with attention deficit hyperactivity disorder (ADHD). Kuo and Taylor (2004) surveyed parents of children (ages 5-18) diagnosed with attention deficit hyperactivity disorder (ADHD) through an online questionnaire that asked them to rate the after effects of 49 common after-school and weekend activities on their children's symptoms: difficulty focusing on unappealing tasks, difficulty listening and following direction, and difficulty resisting distractions. Surveys were collected from 452 participants from across the United States with children living in a range of settings, from rural to urban. Parents were asked to rate their child's symptoms as better or worse than usual within the hour following the activity. They were also asked to identify any activity that stood out to them as having a positive effect. The results of the study

showed that parents found activities in green natural outdoor settings to positively impact their children's ADHD symptoms in comparison to activities in built outdoor settings or indoor settings.

Subsequently, Kuo and Taylor (2009) went on to explore the inconsistent nature of ADHD symptoms that many children display. Although children diagnosed with ADHD usually perform below their same-age peer counterparts on tasks involving attention, there are times when such tasks are done with great attention. Kuo and Taylor investigate how exposure to different physical environments impacted attention in children (ages 7-12) with ADHD. Participants included 17 children, who are exposed to 3 types of walking settings: an urban park, a downtown area, and a residential area. Each area was well maintained with flat terrain, quiet noise level and minimal pedestrian traffic, and walks were done at similar times of day in similar weather conditions. To assess for levels of attention, children first completed a series of puzzles prior to their walk which was designed to create attention fatigue. They then went on a 20-min individually guided walk, and finally were assessed for concentration and impulse control. The results of the study showed that children with ADHD had higher levels of concentration after a walk in the park than they did after a walk in an urban or residential setting. The children rated the park setting as more relaxing and fun in comparison to the other settings. Kuo and Taylor (2009) stated the effects on concentration of walking in the park were comparable to peak effects of extended-release methylphenidate. The results of this study reinforced the studies suggesting health benefits of natural settings exposure on ADHD symptoms.

In a similar study on how exposure to a natural setting and a built setting affect

ADHD symptoms, Van den Berg and Van den Berg (2010) studied two groups of six children with ADHD (ages 9-17) who stayed at care farms for children within a rural setting in the Netherlands. The children were observed, questioned, and tested during visits to a wooded area and to a small town. During each visit, the children's social behavior, cooperation, enthusiasm, aggressive behavior, inattention, and impulsivity were observed. In addition, the children's connection to nature and mood were surveyed, and their concentration was tested. The results demonstrated that both groups had higher levels of concentration in the woods compared to concentration in the town.

Interestingly, behavior and emotional functioning differed between the two groups. One group liked the natural environment of the woods better than the town, displaying more positive behaviors and feelings. The other group liked the natural environment of the woods and the small town equally. That group showed positive behaviors and feelings in both settings, but more non-social, aggressive, inattentive, impulsive, and hyperactive behaviors in the town. Overall, the natural environment was found to have a more consistent positive buffering affect against ADHD symptoms than exposure to the built environment.

Kuo and Taylor (2011) expanded on their investigations into the relationship between ADHD symptoms in children and exposure to nature by collecting data on 421 children diagnosed with ADHD. They investigated usual daily play setting through use of an internet-based survey of parents living across the United States from varying environmental settings. Examples of daily play settings included: places with big trees and grass, paved or built outdoor space, waterfront, indoor space that looks like outdoor space, public indoor spaces, and deep indoors. Parents were also given example pictures

to illustrate what the play spaces on the survey might look like. The results of the survey suggested that children who regularly played in green outdoor spaces (places where there was a lot of grass) had milder ADHD symptoms than children who played indoors or in built outdoor settings. Those with symptoms of hyperactivity were not found to improve by exposure to generally “green” outdoor settings, but were positively impacted in settings of “open grass”. In addition to the isolated benefits to ADHD symptoms from exposure to nature, this study suggested that exposure to nature could have ongoing benefits lessening ADHD symptoms. Additional findings by Kuo and Taylor (2011) suggested that the majority of children with ADHD routinely play outdoors, and that this could be that children with ADHD self-medicated through choice of play setting.

A summary of Taylor and Kuo (2001, 2011) work illustrates an increasing awareness of the benefits of exposure to nature on the mental wellbeing of children. They found that children who routinely played in green outdoor settings experienced milder ADHD symptoms than children who played indoors or in built outdoor environments. They also demonstrated that boys and girls across all income levels who played in “open green” space had significantly lower ADD and ADHD symptoms. Regular doses of green space may be a valuable supplement to medication and behavioral treatments. Through parent reports, it was found that activities taking place in green outdoor settings were more likely to reduce ADD and ADHD symptoms, while conversely activities exacerbating symptoms were likely to take place in non-green outdoor settings. The authors reported children functioned better than usual after participating in activities in green settings and that the “greener” a child’s play area, the less severe his/her attention deficit symptoms. Children who played in windowless

indoor settings had significantly more severe symptoms than children who play in grassy outdoor spaces with or without trees. The authors concluded that the study established a strong nature-attention relationship. Finally, collectively these findings seem to support the notion that contact with nature may improve attention functioning in a population who need attention support.

### **Nature and Exercise on Mental Health**

Research has begun to investigate possible synergistic impacts of physical activity and exposure to nature. While the synergistic impacts of physical activity and exposure to nature on the mental health of adult populations has been reported, little research exists that investigates this relationship in children.

In a multi-study analysis conducted to assess the impact of green exercise on self-esteem and mood, Barton and Pretty (2010) aimed to determine the most effective regimens for a dose of green exercise. The authors aggregated the outcomes from 10 studies conducted over six years at the University of Essex involving 1252 participants. Data from the 10 studies were pooled to estimate overall effects of the interventions taking into account varying cohorts, types of green space, exposure duration, and exercise intensity. Self-esteem and mood were measured immediately before and after each intervention. Subgroups identified and used in analysis included: 1) Exposure duration: 5min, 10-60min, half-day, whole-day 2) Exercise intensity: low, moderate, and vigorous 3) Type of green space: urban green, countryside/farmland, forest/woodland, waterside, and wilderness-type habitats 4) Gender: male or female 5) Age groups: <30, 31-50, 51-70, >70 6) Starting health status: healthy or with existing mental health problems.

The results showed that acute, short-term exposures to facilitated green exercise

improves both self-esteem and mood irrespective of duration, intensity, location, gender, age, and health status. Self-esteem and mood demonstrated the greatest changes for the least duration (5min), suggesting that there is rapid effect at the start of green exercise. Less improvement in self-esteem and mood were found when activities lasted for greater than an hour to half-day in length. The greatest improvements occurred when the activity lasted the entire day. Relative to exercise intensity, improvements in self-esteem declined as the intensity of the activity increased. Mood improvements were greatest for light and vigorous activity, suggesting there may be health benefits from any short engagement in green exercise. Finally, in the investigation of type of green space, all green environments improved both self-esteem and mood. In addition, the presence of water was found to generate the greatest improvements. Both men and women participants reported similar improvements in self-esteem after green exercise. The studies suggested that younger people had more self-esteem improvements, middle aged had more improvements to mood, while the over-70 age group experienced the least change. Finally, the participants with some sort of psychiatric disturbance were found to have one of the greatest improvements in self-esteem resulting from participation in green exercise. The overall findings of these 10 studies aggregated by Barton and Pretty (2010) indicated positive mental benefits from short engagements in green exercise, in particular for those who reported being mentally unwell.

In a related study, Thompson Coon *et al.* (2011) investigated controlled trials that compared the effects of outdoor and indoor exercise on mental and physical wellbeing outcomes. Most of the participants in the studies include university students. Wellbeing was assessed through self evaluation of individuals' moods and feelings after

walking or running indoors and outdoors. Compared to physical activity indoors, physical activity outdoors was associated with greater feelings of revitalization, positive engagement, and increased energy, as well as decreased tension, confusion, anger, and depression. Conversely, feelings of calmness were higher after indoor activity (Thompson Coon *et al.*, 2011).

Gopinath *et al.* (2012) concluded a 5-year longitudinal study of children, which was somewhat parallel to the adult studies. They looked at children at age 12-13 and again at 17-18 in order to investigate the relationship between children's mental health, physical activity, and exposure to nature. They concluded that in the long term frequent participation in outdoor activity in the long term is associated with better health-related quality of life in adolescents.

The extent of the potential advantages of children's participation in physical activity while being outdoors, exposed to nature, to their mental health and wellbeing is unclear. It is unknown if the benefits are from the synergism between nature and activity, the amount of activity in nature compared to indoor activities, the greenness of the environment or some inherent demographis. Nevertheless, as the body of research continues to investigate these associations, and determines dosage of nature and exercise it could further the development of effective, low cost, and accessible interventions that promote children's mental health and wellness.

## **CHAPTER III: METHODS**

### **Design and Procedures**

This study was a non-experimental retrospective multi-informant data review that examined correlations between children's physical activity in nature and their

wellbeing, as self-reported and as reported by a parent or guardian. Inclusion criteria included children and youth between 11-22 years of age who were undergoing outpatient psychiatric treatment and had completed the Vermont Child Health and Behavior Questionnaire (VHBQ) Self-report and Parent Report on intake, and the subsections exercise and wellbeing. Exclusion criteria included children and youth who met the age criterion but were missing necessary items related to exercise and wellbeing sub-sections of the VHBQ Self-report and Parent Report on intake. Participants included two initial groups: parents reporting on their children and children self-reporting. Within these groups, parent-child pairs were identified to form an additional group. Initial samples identified and analyzed consisted of one hundred and seventy eight (178) parent subjects, seventy-eight (78) child subjects, and twenty-five (25) parent-child pairs. Subjects were drawn from database obtained from an outpatient pediatric psychiatric clinic (OPPC) in the northeast designed to assist children, youth, and families.

The study was approved by the University of Vermont's Institutional Review Board (IRB) for Human Subjects Research. Confidentiality was protected by de-identifying data during collection and providing unique codes to each patient's dataset. Data was stored on a secure password accessed network. Eligible records selected met the stated inclusion criteria. Subject demographic data on age and sex were recorded in addition to *exercise* and *wellbeing* subsections of the VHBQ Self-report and Parent Report.

## **Instruments**

This study used the VHBQ Self-report for 11-21 years old and Parent Report instruments (see Appendix A & B). The specific subsections used from the VHBQ Self-

report included exercise, q. 85 & 86, and wellbeing, q. 94 & 95. The specific subsections used from the VHBQ Parent Report included exercise, q. 106, and wellbeing, q. 115 & 116.

The VHBQ Self-report and the VHBQ Parent Report were developed by the OPPC as part of their family-based-approach to measure aspects of children's health and behavior at the initiation of outpatient psychiatric treatment. The 2010 version of the VHBQ questionnaire was used in this study. The VHBQ Self-report consists of 124 questions, and the VHBQ Parent Report consists of 167 questions. The child's self-report exercise subsection consists of two items. The first item is a dichotomous question about his/her regular participation in sports. The second item on the child's self-report exercise subsection corresponds to the parent's exercise subsection. It asks the participants to quantify the child's participation in 19 types of common sports plus one open entry based on the following timescales: number of years, number of months per year, number of times a week, and average time spent participating in each sport.

The wellbeing subsection of the self-report and parent report consists of two measures. The first measure assesses nine items on the self-report and eight corresponding items on the parent report. The measure is based on two components of wellbeing. The first five items are based on the Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985) and the remaining items are based on the Subjective Happiness Scale (Lyubomirsky and Lepper, 1999). These measures have been shown to have both reliability and construct validity (Pavot, Diener, Colvin, & Sandvik, 1991; Lyubomirsky & Lepper, 1999). Items are answered on a 7-point agreeability Likert scale ranging from 1 = "strongly disagree" to 7 = "strongly agree". The second Wellbeing

measure assesses general quality of life using the Cantril Ladder (Cantril, 1965). The ladder is made up of sections from 0 to 10, 0 = “the worst life imaginable” and 10 = “the best life imaginable”. The participants are asked to place where they perceive their or their children’s lives to be in general. Cantril’s Ladder has been used in previous research with adolescents showing good reliability and significant associations with other wellbeing measures (Levin and Currie, 2014)

## Definitions

*Physical Activity:* For the purposes of this study, physical activity was defined by the exercise subsection of the VHBQ self-report (q. 86) and parent report (q. 106). The nineteen sports listed in the section include ballet/dance, baseball, basketball, working out/fitness, football, gymnastics, hiking, hockey, horseback riding, running/jogging, lacrosse, martial arts, skiing, soccer, swimming, tennis, wrestling, volleyball, and golf, with a space to enter other sports not listed.

*Physical Activity in Nature:* For the purposes of this study, physical activity was defined as the sports listed in the exercise subsection of the VHBQ self-report (q. 86) and parent report (q. 106) designated as most likely to occur outdoors. These include baseball, football, hiking, horseback riding, running/jogging, lacrosse, skiing, soccer, tennis, and golf.

*Wellbeing:* For the purposes of this study, wellbeing was defined as mental, emotional, and environmental satisfaction, happiness, and quality of life in general as reported by the wellbeing subsection of the VHBQ.

## Data Analysis

De-identified data was entered into a computerized spreadsheet and evaluated using Statistical Analysis System (SAS) software. To evaluate exercise, two different measures were analyzed:

1. *Yes vs. No* response on the question “Do you participate regularly in sports?”
2. Total participation in indicated sports. This was calculated for each participant as follows:

- a. Ainsworth Compendium of physical activity (Ainsworth, *et al.*, 2000) was used to assign a standard metabolic equivalent (MET) score to each physical activity, which reflected the energy cost of the physical activity at a moderate intensity in an average participant.
- b. MET scores (hr/wk) were calculated for each sport in which a child participated based on the estimated months/year, sessions/week, and minutes/session of participation. The following equation was used:

$$\text{MET} = \frac{m (\text{Months/year})(\text{session/week})(\text{minutes/session})}{(12*60)}$$

$m$  = MET constant for a particular sport

\* The formula used to calculate MET scores was consistent with that used by OPPC when evaluating similar data.

- c. For each participant, 3 total weekly MET scores were calculated 1) across all physical activities, 2) across all physical activities in nature, and 3) across all indoor physical activities.

To evaluate *wellbeing*, three measures were analyzed:

1. Responses to each of the nine wellbeing items in the Self-report questionnaire and each of the eight wellbeing items in the Parent Report that measure 1) satisfaction

with life and 2) subjective happiness. Reverse scoring was used to evaluate items “g” and “i”.

2. A mean score, 1-7, was created for each child and parent participants based on the wellbeing items.
3. An indicated score, 0-10, on the 10-point Worst Life/Best Life bar of the Cantril Ladder was used to measure quality of life in general.

Individual wellbeing scores were compared to the *Yes vs No* sports question using two sample t tests. Wellbeing was compared to three categories of exercise using Pearson’s correlation coefficients. Analyses were conducted based on each child participant’s self-report and each parent participant’s report of their child.

Datasets of parent-child pairs were compared using Pearson’s correlation coefficients. Parent reports of their children’s exercise were compared to their children’s self-reports of exercise. Parent reports of their children’s wellbeing were compared to their children’s self-reports of wellbeing.

## **CHAPTER IV: RESULTS**

Initial data included 78 child participants, 178 parent participants, and 25 parent-child pairs. As shown in Table 1, 77 child participants met initial inclusion criteria. As also shown in this table, parents reported on 178 children ranging from 6-19 years old, mean age of  $11.6 \pm 3.7$ , 61% males, 38% female.

Of the 77 self-report participants, 32 (56% male, 44% female) provided a *Yes* or *No* response to the first exercise measure: “Do you participate regularly in sports?” As shown in Table 2, 21 (62% male, 38% female) participants responded *No*, and 11 (45% male, 55% female) participants responded *Yes*. This exercise measure was compared to

the 32 self-report participants' responses to each of the nine wellbeing items in Table 3. Table 3 also shows the mean wellbeing score and the indicated 0-10 score on the 10-point Worst Life/Best Life bar of the Cantril Ladder.

Two-sample t tests demonstrated that there were no statistically significant differences in wellbeing between those who regularly participate in sports and those who did not. Nor did the results show any trends towards significance. Results varied; five of the nine wellbeing variables were reported slightly greater for children who do not regularly participate in sports, while three of the nine were slightly greater for regular sports participants, and the remaining variable was the same for both groups. Although statistically insignificant mean wellbeing was a little higher for children who reported no to regular participation in sports

Descriptive statistics of the 32 child and 178 parent samples for participation in physical activity, mean MET calculations, and wellbeing scores are depicted in Table 4. Data completeness varied across the measures. Of the 77 children participants, sufficient data was available to calculate overall MET scores for 20 participants based on the children's participation in all physical activities, indoor activity MET scores for 18 participants, and outdoor activity in nature MET scores for 16 participants. Of the 178 parent participants, data was sufficient to calculate 149 overall MET scores for their children, 157 MET scores for indoor physical activity, and 158 MET scores for outdoor activity in nature (Table 4).

When compared to self-reported wellbeing, self-reported MET scores showed weak to moderate correlations but did not reach statistical significance (Table 5). Seven of nine wellbeing measures were positively correlated to MET scores. However, two

wellbeing items, “If I had to live my life again, I would do more or less the same” and “Compared with most of my peers, I’m less happy than they are”, negatively correlated to self-reported MET scores.

Parent reports of child participation in physical activity for the most part did not correlate to parent reports of child wellbeing (Table 6). Two items in this comparison were statistically significant. “His/her living conditions are excellent” demonstrated significant positive correlations to all calculated MET scores ( $r=.34$ ,  $p<0.001$  for Overall MET,  $r=.25$ ,  $p=.002$  for Indoor MET, and  $r=.28$ ,  $p<0.001$  for Outdoor MET). Indicated 0-10 score on the 10-point Worst Life/Best Life bar of the Cantril Ladder also demonstrated fairly weak, but significant, positive correlations to overall MET scores ( $r=.19$ ,  $p=0.02$ ) and MET Outdoor ( $r=.17$ ,  $p=.04$ ).

Parent reports of children’s participation in overall physical activity, indoor physical activity, and outdoor physical activity in nature were compared to children’s self-report of physical activity in Table 7. Only 12 of the 25 parent-child pairs were used for the comparison due to missing MET self-report data. All 3 comparisons showed statistically significant strong positive correlations ( $r=0.83$ ,  $p<0.001$  for overall,  $r=0.85$ ,  $p<0.001$  for indoor, and  $r=.67$ ,  $p=0.02$  for outdoor).

When comparing parent reports of children’s wellbeing to children’s self-reports of wellbeing, correlations ranged from none to moderate. Seven of eight wellbeing items were statistically insignificant. A single wellbeing item, “Compared with...most peer, [child] is less happy than they are”, demonstrated statistically significant positive correlation ( $r=.48$ ,  $p=0.03$ ).

## CHAPTER V: DISCUSSION

This study was motivated by literature suggesting that children who regularly participate in physical activity are more likely to report higher health-related quality of life status related to physical, mental, and social wellbeing (Gopinath, et al 2012; Jerstad et al, 2010; Wiles et al, 2008;), and similarly that children who spend time in nature demonstrate improved physiological and psychological measures (Wells and Evans, 2003; Corraliza et al, 2012; Maller and Townsend, 2006). A logical extension of these studies is that the combination of engaging in physical activity while being exposed to nature might have a powerful impact on mental health, particularly in those individuals with mental issues. We hypothesized that, as these children's activity levels increase, there would be associated improvements to their wellbeing. Contrary to expectations, this hypothesis was only limitedly supported by our data. Children's self-reported physical activity did not significantly correlate with self-reported wellbeing, however, correlations were found within parent reported data. Parent reports and self-reports of physical activity strongly correlated while little correlation was found between self-reports and parent reports of wellbeing.

### **Children's Self-reports**

The results of the first exercise query, demonstrated that children who responded *Yes* to "do you participate in sports regularly?" did not report higher wellbeing scores, than those who did not participate regularly in sports. This result was surprising considering the vast amount of literature suggesting the opposite finding. As an example, Gopinath *et al.* (2012) found that children who regularly participate in physical activity are more likely to report higher health-related quality of life status related to physical,

mental, and social wellbeing. There are several possible reasons for this discrepancy such as differences in measurements, instruments, and population sample.

The children participating in this study suffered from mental health issues and were undergoing outpatient psychiatric treatment. Although much of the literature examines psychiatric symptoms in populations of children and adolescents (Hoza, *et al.*, 2014; Wiles, *et al.*, 2012; Jerstad, *et al.*, 2010) few study sample groups of children with diagnosed mental illness (Kuo & Taylor, 2004). No control sample was used in the current study for comparison. Additionally, the initial sample size of the children's self-report group (n=78) was much smaller than the parent report group (n=178). This was in part due to the age of the children at the onset of psychiatric treatment. If a child was younger than 11-years-old when his/her treatment began, he/she did not complete the VHBQ Self-report; only a VHBQ Parent Report was completed.

Additionally, the differences in measurements and instruments that have been used raise questions about how well the studies can be compared. Clearly, there are a multitude of factors that can contribute to children's reported wellbeing including, but not limited to connectedness, learning, life skills, mood, social skills, physical skills (Maller & Townsend, 2006), resiliency against stress (Wells & Evans, 2003), satisfaction with life (Diener, Emmons, Larson, & Griffin, 1985), and subjective happiness (Lyubomirsky & Lepper, 1999). Although these factors are likely to be related, it is not clear that they are measuring the same thing. In order to best relate the current study to existing literature more descriptive data may have been helpful. Information about the sociological, educational, psychological, and physical skill profile of children participating in this study and socio-economic levels were not available for comparison. It is possible that for

some children the act of not participating in physical activity has its own reward because they have more time for other activities.

Results of the MET score reflecting energy expended in physical activity demonstrated that those children who exhibited increased physical activity showed weak to moderate positive trends in correlation with seven out of nine wellbeing items, average wellbeing scores, and indicated scores on the best life/worst life scale. Although children with increased physical activity levels may have associated improvements to their wellbeing, however correlations were weak with regard to enhanced wellbeing from increased physical activity in nature. These results are inconsistent with literature stating increased physical activity in nature correlates with increased wellbeing and frequent participation in outdoor activity in the long term is associated with better health related quality of life in adolescents (Gopinath, Hardy, Baur, Burlutsky, & Mitchell, 2012). Discrepancies in results are difficult to explain. The results reported here were from a snapshot in time, unlike the Gopinath *et al.*, (2012) study there was no longitudinal data. The physical activity in nature may not have been long enough, or had adequate dosage, to make a difference, and also may not have been sufficiently green. The majority of studies used for comparison were done ADHD or children without mental challenges, all of which may have contributed to differences in response. Further, the results may have been at least in part related to the low sample response rate. Sample participation may have suffered as a result of response burden to the portion of the exercise subsection of the VHBQ Self-report. This question falls on page 10/16 of the VHBQ and requires detailed written response. As depicted in Table 4, only 16-20 of the 32 children provided sufficient data to calculate MET score whereas 29-31 of the 32 children completed the

different items of the wellbeing subsection.

### **Parent Reports**

Parent reports of children's exercise demonstrated significant moderate positive correlations with one of the eight wellbeing items, "his/her living conditions are excellent". Outdoor physical activity in nature had a slightly greater correlation to this wellbeing item than indoor activity. Thus, the hypothesis is generally supported in relation to this single wellbeing item. From the parents' perspective those children with increased activity levels had improved living conditions. These improvement effects are slightly enhanced by activity in nature, or in the outdoors, but were not obviously synergistic as described in the literature for other populations of children. The connection between physical activity in nature and living conditions is only touched upon in the literature. Wells and Evan (2003) found that children's self worth was found to be higher when there was increased nature nearby; in particular children with nature near the home exhibited less psychological distress.

The hypothesis was further supported by significant, but weak positive correlations between parent reports of children's overall physical activity and outdoor physical activity compared to the best life/worst life scale. Parent reports that their perception of their children's activity levels were high had associated perception that their child's life on the best life/worst life scale was better. These perceptions of the child's best life/worst life scale were enhanced by activity in nature, or in the outdoors. These findings are congruent with those of Thompson Coon *et al.* (2011), who found that physical activity outdoors was associated with greater feelings of revitalization, positive

engagement, and increased energy, together with decreased tension, confusion, anger, and depression.

### **Parent and Child Pair Reports**

When examining the paired parent-child samples, parent reports of their children's physical activity demonstrated significant strong positive correlations to children's self-report of their physical activity, but interestingly had only a single significant correlation between reports on one wellbeing item, "compared with...most peer, [child] is less happy than they are". This implies that parent and children perspectives on objective factors physical activity are in greater agreement than subjective factors like wellbeing. Additionally it supports a theme continuously documented throughout the literature asserting that the relationship between parent ratings of their children and children's ratings of self are in greater agreement for observable/external measures like physical activity, and in less agreement for non-observable/internal measures like wellbeing (Eiser & Morse, 2001). Such findings could call into question the accuracy of the results in the study by Maller and Townsend (2006) who derived conclusions about children's wellbeing based on teacher and principal reports after the introduction of nature-based activities to the curricula. Although positive correlations were found, the children's perspective may not have concurred with those of the teachers and principals. Even though the assessments may be different, Eiser & Morse (2001) as well as Jokovic, Locker, & Guyatt (2003), have stated that although parental knowledge of their children's social and emotional wellbeing may be limited, it is no less valuable perspective. In fact, at some of the younger age levels parents may have more accurate perceptions of their children's activities than the child

himself/herself. Conversely, older children may be more independent and spend less time in the presence of their parents possibly diminishing the accuracy of parent responses.

### **The Health Promotion Model**

Factors within Pender's Health Promotion Model reflected in this study include health promoting behaviors (physical activity), situational influences (indoor and outdoor exercise), and personal factors (wellbeing). Additional personal factors that impacted the results include the mental health of the participants in this study. The results of the study confirm the interaction of these factors depicted within the model. The results may also provide a starting point for professionals, such as nurses, to educate and counsel children and their families on specific health promoting behavior changes that contribute to wellbeing and mental wellness.

### **Implications in Advanced Practice Nursing, Education, Health Care Policy**

As childhood mental illness continues to rise (Biddle & Asare, 2011), there is increased need for effective preventative tools and techniques that enhance wellbeing and promote mental wellness. Advanced Practice Nursing's unique perspective is equipped to fully understand the lifestyle factors that promote children's wellbeing, protect their mental health, and potentially aid in prevention of mental illness in children and later in adulthood. Exercise and sports participation and exposure to nature, are two lifestyle factors shown to have psychological benefits in children (Wells & Evans, 2003; Maller & Townsend, 2006). Nursing could play an important role in encouraging these factors through education, research, and policy. For example, nurses might act as support

personal to help promote healthy lifestyle factors that promote mental health. Action by nurses could take place on a policy level within the community promoting physical education in schools or green space within communities.

Because of the variety of employment settings (clinics, hospitals, schools, camps, homes) in which nurses treat children, they can potentially directly influence children and their parents on the importance of nature and exercise and the potential synergism between the two. Nurses often have access to children's families and are trained to communicate with all members of family. These lines of communication could be used to help educate children and their families directly about lifestyle factors that promote mental wellness. If children build skills that can protect against mental illness in youth, they are more likely to use such skills throughout their life into adulthood. It has been shown that levels of physical activity decline with age (Basterfield *et al.*, 2011); however, intensive and continuous physical activity from age nine to eighteen greatly increases the likelihood of being active as an adult (Telama *et al.*, 2005). These findings should be emphasized in education materials to help provide motivation for physical activity. One could also argue that based on such studies as those by Barton and Pretty (2010), that physical activity in nature should be an important part of school curriculum and family activities because of its positive impact on mood and self-esteem. The variety of settings and positions in which nurses find themselves, also places them in an ideal position to develop and promote policies concerning lifestyle factors that protect against mental illness.

## **Conclusion**

This study highlights the need for further research into lifestyle factors that promote mental wellness in children and protect against mental illness. Although not well supported in this study, promotion of physical activity and nature exposure in children may aid their mental wellness and aspects of their wellbeing.

## **Limitations**

There were several limitations in the study. First and foremost was the limitation in sample response rate. The children sample and parent-child pair sample were small as a result of low response rate to the wellbeing and exercise subsections of the VHBQ. This limited interpretation of the results. The study was a retrospective data review, which limited data to that which was available in the VHBQ database. The children sampled in this study came from a population seeking outpatient mental health treatment, and there was no control group, which limited direct comparisons to extent literature.

The individual instruments assessing physical activity and wellbeing were imbedded in a long questionnaire designed for a larger study that may have compromised responses due to possible participant fatigue. The exercise instrument also may have been difficult for some children to fill out because of age or comprehension level. Although not all of the items listed in the exercise subsection were typical sports like hiking and ballet, the use of the word “sports” versus a more general exercise term may have compromised participants’ answers. The term “sport” implies some form of organization. Some children may not think of their physical activity as a “sport” and may have refrained from including it in the open entry for that measure.

Significantly, there is no timeframe within the exercise question. As a result, it is unclear if responses about physical activity refer to current or past participation. Moreover there is not data about sustained and continuous activity, which might be critical in relation to mental health. The study reported here focused on the Northeast where outdoor activity in nature may be influenced by seasonality; data collected in winter vs. summer may be different. Because the participants were in an outpatient mental health setting where they completed the forms, there also may have been a Hawthorne effect whereby they responded to queries in a way they felt might please their mental health care providers. In addition to the Exercise and Wellbeing subsections, it may have been useful to include data on sedentary behavior from the VHBQ.

### **Future Research**

Although this study had significant limitations, it raises many questions and suggests future avenues of study. It would be interesting to expand study on the relationship between physical activity in nature and wellbeing to a larger cohort. Such a study would benefit not only from a larger prospective sample, but also from a control group, a shortened questionnaire designed specifically to address the specific question, do children who regularly exercise outdoors, while being exposed to nature, report higher levels of wellbeing and longitudinal follow-up.

Future research involving similar instruments designed to measure wellbeing and exercise might benefit from investigating the relationship between exercise intensity and wellbeing. Barton & Pretty (2010) showed that light and vigorous exercise had the greatest positive impacts on mood. It would also be appealing to do an experimental prospective study using objective pre-post measures in children engaging in activities.

Future research on children's physical activity in nature and wellbeing might prove more complete if the physical activity measure included items that are more distinctly outdoor or indoor. Wellbeing is a broad concept. It may be useful to narrow the focus to more specific indicators of mental health.

Future research could also focus on interventions based on physical activity in nature on different populations with childhood disorders, on dosages of activities relative to age, and on influencing variables such as pre-morbid personality and academic achievement. Because of their background, training and employment settings, Advanced Practice Nurses could play an important role not only in initiating well-being research studies, but also in using the resultant information to develop educational resources and policy.

**Table 1: Sample characteristics**

Demographic Variables	Parent report without self-report	Self report without Parent Report	Parent Report and Self-report
Sample	n= 178	n=77	n=25
Age: Mean (range)	11.3 ±3.7 (6-19)	15.1 ±2.5 (10-22)	13.8 ±2 (11-17)
Sex: Male n %	108 61%	37 47%	15 60%
Female n %	68 38%	40 51%	10 40%

**Table 2: Self-report Respondents to "Do you participate in sports regularly?"**

	Total Respondents n=32	No n=21 65.6%	Yes n=11 34.4%
Male n %	18 56%	13 62%	5 45%
Female n %	14 44%	8 38%	6 55%
Mean Age±SD (range)	14.9±2.5 (11-22)	15±2 (12-18)	14.9±3.3 (11-22)

**Table 3: Self-report of Regular Sports Participation vs. Wellbeing Results**

Wellbeing	Do you participate in sports regularly?		
	No n=21 66% Mean ± SD	Yes n=11 34% Mean ± SD	p-value
For each statement: Agree or Disagree (1-7) <i>1 = Strongly Disagree, 7 = Strongly Agree</i>			
Q94a. My life is going more or less as I wished.	n=20 3.7 ±1.6	n=11 3.7 ±1.7	0.96
Q94b. My living conditions are excellent.	n=20 5.2 ±1.4	n=11 4.6 ±1.6	0.33
Q94c. I'm satisfied with my life.	n=19 4.1 ±1.6	n=11 3.8 ±1.8	0.66
Q94d. Until now I have always gotten the most important things I wanted in life.	n=19 4.2 ±1.5	n=10 3.9 ±1.4	0.67
Q94e. If I had to live my life again, I would do more or less the same.	n=20 3.2 ±1.8	n=11 3.7 ±2.0	0.42
Q94f. On the whole I'm a happy person.	n=20 4.7 ±1.7	n=11 3.9 ±2.0	0.24
Q94g. Compared with most of my peers, I'm less happy than they are*.	n=20 4.0 ±1.6	n=11 4.5 ±1.6	0.41
Q94h. On the whole, I'm very happy. I enjoy life, Come what may, I always make the best of things.	n=19 3.8 ±1.7	n=11 3.1 ±1.6	0.24
Q94i. On the whole, I'm not very happy. Although I'm not depressed, I never seem to be as happy as I could be*.	n=20 4.3 ±1.6	n=11 4.4 ±1.2	0.84
Q94. MEAN of Q94a-Q94i	n=20 4.1 ±0.9	n=11 3.9 ±0.9	0.60
Q95. Where on the bar would you say your life generally stands? 0-10, 10 means the best life imagined, 0 means the worst life imagined	n=20 6.5 ±1.5	n=11 6.3 ±1.8	0.77

\*Results have been reverse scored.

**Table 4: Self-report and Parent Report Mean Descriptive Statistics for each variable**

Variable	n		n miss (incomplete data)		Mean Response		Std Dev		Min		Median		Max	
	self	parent	self	parent	self	parent	self	parent	self	parent	self	parent	self	parent
Age	32	178	0	0	14.9	11.3	2.5	3.7	11	6	15	11	22	19
Overall MET	20	149	12	29	93.7	23.4	227.4	30.8	1.5	0	20.8	13.1	1033.1	147.8
MET Indoor	18	157	14	21	51.5	10	128.5	18.1	1.5	0	16.3	2.3	560.0	103
MET Outdoor	16	158	16	20	59.2	12.1	116.5	19.7	2.3	0	18.8	3.5	473.1	104.4
Q94/115a. Life is going more or less as wished	31	160	1	18	3.7	3.3	1.6	1.8	2	1	4	3	7	7
Q94/115b. Living conditions are excellent	31	163	1	15	5.0	5.6	1.5	1.5	1	1	5	6	7	7
Q94/115c. Satisfied with my life	30	161	2	17	4.0	3.9	1.7	1.8	1	1	4	4	6	7
Q94/115d. Until now, always gotten the most important things wanted in life	29	158	3	20	4.1	4.8	1.5	1.8	1	1	4	5	6	7
Q94e. If had to live life again, would do more or less the same	31		1		3.4		1.9		1		3		6	
Q94/115f. On the whole a happy person	31	164	1	14	4.4	4.4	1.8	1.9	1	1	5	5	7	7
Q94/115g. Compared with most of peers, less happy than they are	31	161	1	17	4.1	3.7	1.6	1.8	2	1	4	3	7	7
Q94/115h. On the whole, very happy. Enjoy life, Come what may, always make the best of things	30	163	2	15	3.6	3.4	1.7	1.8	1	1	4	3	6	7
Q94/115i. On the whole, not very happy. Although not depressed, never seem to be as happy as could be	31	162	1	16	4.3	3.8	1.5	1.9	2	1	4	3	6	7
Q94/115. MEAN	31	165	1	13	4.1	4.1	0.9	1.2	2.1	1.4	4	4.3	6.3	7
Q95. Where on the bar would you say life generally stands?	31	162	1	16	6.4	6.2	1.6	1.9	3	1	6	6	9	10

**Table 5: Correlations between Self-report of Physical Activity and Wellbeing**

	Q94a. Life is as wished	Q94b. Excellent living conditions	Q94c. Satisfied with life	Q94d. Gotten the most important things wanted in life	Q94e. If to live my life again, would do the same	Q94f. I'm a happy person	Q94g. Compared to peers, I'm less happy*	Q94h. On whole, I'm very happy. Always make the best	Q94i. On whole, I'm not happy*	Q94. MEAN	Q95. On bar, life stands where? 0-10
<b>Overall</b>											
<b>MET</b>	0.04	0.20	0.25	0.26	-0.13	0.33	-0.27	0.23	0.14	0.22	0.24
(N=20)	0.87	0.39	0.28	0.27	0.59	0.16	0.24	0.33	0.56	0.35	0.31
<b>MET</b>											
<b>Indoor</b>	0.07	0.28	0.27	0.18	-0.18	0.40	-0.31	0.26	0.13	0.23	0.29
(N=18)	0.78	0.27	0.27	0.47	0.48	0.10	0.21	0.30	0.62	0.36	0.24
<b>MET</b>											
<b>Outdoor</b>	-0.07	0.18	0.15	0.38	-0.12	0.25	-0.34	0.24	0.04	0.15	0.17
(N=16)	0.79	0.51	0.59	0.15	0.66	0.36	0.20	0.37	0.89	0.58	0.54

\*Results have been reverse scored.

**Table 6: Correlations between Parent Report of Physical Activity and Wellbeing**

	Q115a. Life is as wished	Q115b. Excellent living conditions	Q115c. Satisfied with life	Q115d. Gotten the most important things wanted in life	Q115f. He/she a happy person	Q115g. Compared to peers, he/she less happy*	Q115h. On whole, he/she very happy. Always make the best	Q115i. On whole, he/she not happy*	Q115. MEAN	Q116. On bar, life stands where? 0-10
<b>Parent Report MET scores</b>										
<b>Overall MET</b>	0.00	0.34	0.08	0.10	-0.04	0.06	0.01	0.06	0.09	0.19
(N=140)	0.97	<0.001	0.37	0.24	0.63	0.44	0.92	0.49	0.27	0.02
<b>MET Indoor</b>	0.03	0.25	0.05	0.04	-0.03	0.10	0.05	0.00	0.08	0.12
(N=145)	0.71	0.002	0.52	0.60	0.68	0.23	0.54	0.96	0.34	0.15
<b>MET</b>										
<b>Outdoor</b>	0.01	0.28	0.09	0.12	-0.03	0.01	-0.03	0.08	0.08	0.17
(N=146)	0.87	<0.001	0.30	0.13	0.71	0.92	0.76	0.32	0.32	0.04

**Table 7: Correlations between Parent-child Pair (n=12) MET scores:**

**Self-report MET scores compared to Parent Report MET scores of Physical Activity**

	<i>Correlation</i>	<i>P-value</i>
Overall MET scores	0.83	<0.001
MET Indoor	0.85	<0.001
MET Outdoor	0.67	0.02

**Table 8: Correlations between Self-report and Parent Report of Wellbeing**

Self-report Wellbeing		Parent Report Wellbeing
Q94a. My life is going more or less as I wished.	Correlation P value	Q115a. Life is as wished. 0.31 0.17
Q94b. My living conditions are excellent.	Correlation P value	Q115b. Excellent living conditions -0.09 0.69
Q94c. I'm satisfied with my life.	Correlation P value	Q115c. Satisfied with life 0.32 0.18
Q94d. Until now I have always gotten the most important things I wanted in life.	Correlation P value	Q115d. Gotten the most important things wanted in life 0.27 0.27
Q94f. On the whole I'm a happy person.	Correlation P value	Q115f. He/she a happy person 0.15 0.51
Q94g. Compared with most of my peers, I'm less happy than they are*.	Correlation P value	Q115g. Compared to peers, he/she less happy* 0.48 0.03
Q94h. On the whole, I'm very happy. I enjoy life, Come what may, I always make the best of things.	Correlation P value	Q115h. On whole, he/she very happy. Always make the best 0.26 0.26
Q94i. On the whole, I'm not very happy. Although I'm not depressed, I never seem to be as happy as I could be*.	Correlation P value	Q115i. On whole, he/she not happy* -0.07 0.76
Q94. MEAN Q94a-Q94i	Correlation P value	Q115. MEAN Q115a-Q115i 0.11 0.62
Q95. Where on the bar would you say your life generally stands? 0-10, 10 means the best life imagined, 0 means the worst life imagined	Correlation P value	Q116. On bar, life stands where? 0-10 0.26 0.25

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## Appendix A

### Vermont Child Health and Behavior Questionnaire: Self-report for 11-21 years old

#### Subsections: Exercise and Wellbeing

85. Do you participate in sports regularly? <sub>1</sub> No  
<sub>2</sub> Yes

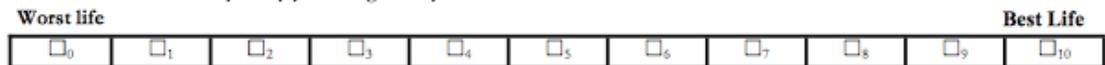
86. Please indicate below in which sport(s) you participate. For each sport, indicate how many years you have been practicing this sport, how many months per year, how often per week, and how much time you spend on the sport each time you take part in it.

type of sport		number of years	number of months per year	number of times a week	average time spent
I don't do any sports at the moment	<input type="checkbox"/> <sub>0</sub>				
ballet/dancing	<input type="checkbox"/> <sub>1</sub>	.....years	.....months	.....times	.....mins
baseball	<input type="checkbox"/> <sub>2</sub>	.....years	.....months	.....times	.....mins
basketball	<input type="checkbox"/> <sub>3</sub>	.....years	.....months	.....times	.....mins
working out/fitness	<input type="checkbox"/> <sub>4</sub>	.....years	.....months	.....times	.....mins
football	<input type="checkbox"/> <sub>5</sub>	.....years	.....months	.....times	.....mins
gymnastics	<input type="checkbox"/> <sub>6</sub>	.....years	.....months	.....times	.....mins
hiking	<input type="checkbox"/> <sub>7</sub>	.....years	.....months	.....times	.....mins
hockey	<input type="checkbox"/> <sub>8</sub>	.....years	.....months	.....times	.....mins
horseback riding	<input type="checkbox"/> <sub>9</sub>	.....years	.....months	.....times	.....mins
running/ jogging	<input type="checkbox"/> <sub>10</sub>	.....years	.....months	.....times	.....mins
lacrosse	<input type="checkbox"/> <sub>11</sub>	.....years	.....months	.....times	.....mins
martial arts	<input type="checkbox"/> <sub>12</sub>	.....years	.....months	.....times	.....mins
skiing	<input type="checkbox"/> <sub>13</sub>	.....years	.....months	.....times	.....mins
soccer	<input type="checkbox"/> <sub>14</sub>	.....years	.....months	.....times	.....mins
swimming	<input type="checkbox"/> <sub>15</sub>	.....years	.....months	.....times	.....mins
tennis	<input type="checkbox"/> <sub>16</sub>	.....years	.....months	.....times	.....mins
wrestling	<input type="checkbox"/> <sub>17</sub>	.....years	.....months	.....times	.....mins
volleyball	<input type="checkbox"/> <sub>18</sub>	.....years	.....months	.....times	.....mins
golf	<input type="checkbox"/> <sub>19</sub>	.....years	.....months	.....times	.....mins
other: _____	<input type="checkbox"/> <sub>20</sub>				

94. For each of the nine statements below, please indicate the extent to which you agree or disagree using the seven answer categories provided.

		Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
a.	My life is going more or less as I wished.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7
b.	My living conditions are excellent.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7
c.	I'm satisfied with life.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7
d.	Until now I have always gotten the most important things I wanted in life.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7
e.	If I had to live my life again, I would do more or less the same.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7
f.	On the whole I'm a happy person.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7
g.	Compared with most of my peers, I'm less happy than they are.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7
h.	On the whole, I'm very happy. I enjoy life. Come what may, I always make the best of things.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7
i.	On the whole, I'm not very happy. Although I'm not depressed, I never seem to be as happy as I could be.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7

95. The '10' on the right of the bar below means **the best life** you can imagine.  
The '0' on the left of the bar means **the worst life** you can imagine.  
Where on the bar would you say your life generally stands?



## Appendix B

### Vermont Child Health and Behavior Questionnaire: Parent Report

#### Subsections: Exercise and Wellbeing

106. Check the box for the sports your child participates in. Indicate how many years, how many months per year, how many times per week, and how long (in minutes) the child participates in each sport.

type of sport		number of years	number of months per year	number of times a week	average time spent
He/she doesn't do any sports at the moment	<input type="checkbox"/> <sub>0</sub>				
ballet/dancing	<input type="checkbox"/> <sub>1</sub>	.....years	.....months	.....times	.....mins
baseball	<input type="checkbox"/> <sub>2</sub>	.....years	.....months	.....times	.....mins
basketball	<input type="checkbox"/> <sub>3</sub>	.....years	.....months	.....times	.....mins
working out/fitness	<input type="checkbox"/> <sub>4</sub>	.....years	.....months	.....times	.....mins
football	<input type="checkbox"/> <sub>5</sub>	.....years	.....months	.....times	.....mins
gymnastics	<input type="checkbox"/> <sub>6</sub>	.....years	.....months	.....times	.....mins
hiking/climbing	<input type="checkbox"/> <sub>7</sub>	.....years	.....months	.....times	.....mins
hockey	<input type="checkbox"/> <sub>8</sub>	.....years	.....months	.....times	.....mins
horseback riding	<input type="checkbox"/> <sub>9</sub>	.....years	.....months	.....times	.....mins
running/ jogging	<input type="checkbox"/> <sub>10</sub>	.....years	.....months	.....times	.....mins
lacrosse	<input type="checkbox"/> <sub>11</sub>	.....years	.....months	.....times	.....mins
martial arts	<input type="checkbox"/> <sub>12</sub>	.....years	.....months	.....times	.....mins
skiing	<input type="checkbox"/> <sub>13</sub>	.....years	.....months	.....times	.....mins
soccer	<input type="checkbox"/> <sub>14</sub>	.....years	.....months	.....times	.....mins
swimming	<input type="checkbox"/> <sub>15</sub>	.....years	.....months	.....times	.....mins
tennis	<input type="checkbox"/> <sub>16</sub>	.....years	.....months	.....times	.....mins
wrestling	<input type="checkbox"/> <sub>17</sub>	.....years	.....months	.....times	.....mins
volleyball	<input type="checkbox"/> <sub>18</sub>	.....years	.....months	.....times	.....mins
golf	<input type="checkbox"/> <sub>19</sub>	.....years	.....months	.....times	.....mins
other: _____	<input type="checkbox"/> <sub>20</sub>	.....years	.....months	.....times	.....mins

115. Please indicate the extent to which you agree or disagree with the following statements about the child.

		Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
a.	His/her life is going more or less as he/she wishes.	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>	<input type="checkbox"/> <sub>6</sub>	<input type="checkbox"/> <sub>7</sub>
b.	His/her living conditions are excellent.	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>	<input type="checkbox"/> <sub>6</sub>	<input type="checkbox"/> <sub>7</sub>
c.	He/she is satisfied with life.	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>	<input type="checkbox"/> <sub>6</sub>	<input type="checkbox"/> <sub>7</sub>
d.	Until now he/she has always gotten the most important things he/she wanted in life.	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>	<input type="checkbox"/> <sub>6</sub>	<input type="checkbox"/> <sub>7</sub>
f.	On the whole he/she is a happy person.	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>	<input type="checkbox"/> <sub>6</sub>	<input type="checkbox"/> <sub>7</sub>
g.	Compared with most of his/her peers, he/she is less happy than they are.	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>	<input type="checkbox"/> <sub>6</sub>	<input type="checkbox"/> <sub>7</sub>
h.	On the whole, he/she is very happy. He/she enjoys life. Come what may, he/she always makes the best of things.	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>	<input type="checkbox"/> <sub>6</sub>	<input type="checkbox"/> <sub>7</sub>
i.	On the whole, he/she is not very happy. Although he/she is not depressed, he/she never seems to be as happy as he/she could be.	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>	<input type="checkbox"/> <sub>6</sub>	<input type="checkbox"/> <sub>7</sub>

116. The '10' on the right of the bar below means **the best life** you can imagine for your child.  
The '0' on the left of the bar means **the worst life** you can imagine for your child.

Where on the bar do you think your child's life generally stands?

