The Relationship Between Parental Nature Relatedness and Overweight/Obesity in Elementary School Children

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The Relationship Between Parental Nature Relatedness and Overweight/Obesity

in Elementary School Children

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A Thesis in the Field of Psychology

for the Degree of Master of Liberal Arts in Extension Studies

Harvard University

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Abstract

This survey based study involving 97 adult participants (86 mothers and 11 fathers) recruited at a small suburban pediatric clinic examined possible associations between parental nature relatedness and the body composition of primary school children (6-11 years). Research indicates that more nature related individuals tend to spend more active time in nature and they seem to have a more mindful approach to their food selection. These factors may contribute to a healthier lifestyle, which, if practiced in a family environment, might be negatively linked with the offspring’s body composition. It was hypothesized that parental nature relatedness, measured as a combination of three dimensions: NR-Self, NR-Perspective and NR-Experience, using the Nature Relatedness Scale, would negatively predict children’s BMI values. It was also hypothesized that the amount of time children spent playing in an outdoor natural environment, family socioeconomic status, parent’s age and the length of nursing would be inversely associated with children’s BMI values. Children’s TV/screen time and parental BMI were expected to be positively related to the dependent variable.

The results of regression analyses revealed that there was no relationship between parental nature relatedness (NR-Total) and children’s BMI values. However, when focusing on the three dimensions of the NR Scale separately, an unexpected significant positive connection between NR-Self and children’s BMI values was found. Also, NR-Experience mildly predicted children’s BMI in all parents sample in the model excluding the additional independent variables. The only additional significant variable that
predicted children’s BMI values in all regression models was the amount of time children spend actively in nature. No statistically significant cross-correlations among the additional independent variables were detected. Overall, the results indicate that it might be the practical aspect involving physical activity that is negatively linked with children’s body composition.

The study has numerous limitations, such as a relatively small sample size, small achieved Cronbach’s Alpha values, self-reported data, etc. Further research might address these factors.
Dedication

I would like to dedicate this thesis to my husband, Victor, and to my mother, Marcela.
Acknowledgments

I thank my Thesis Director, Dr. Shannon Hourigan, whose expertise and encouragement made my graduate experience very valuable and enriching. I appreciate her helpful advice, guidance, resourcefulness and friendliness throughout the whole research process. I also want to thank Dr. Dante Spetter, my Research Advisor, and to Sarah Powell and Chuck Houston for their support and insight.

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Chapter I

Introduction

According to the United Nations Population Division (2014), more than half of the world’s population lives in cities as opposed to rural areas, and the urbanization process is increasing. Individuals in urban settings engage in more indoor than outdoor activities, and Evans and McCoy (1998) estimate that people spend more than 90% of their lives within buildings. Compared to past generations, children in developed societies tend to spend less time playing outdoors in natural environments (Louv, 2005). Tree climbing, rolling down grassy hills, or other similar unstructured outdoor activities are becoming more foreign to urbanized children of the 21st century. These have been replaced with indoor activities like television viewing and video games. Modern technology that simulates the natural world, such as videos, live webcams of nature, animal robots, immersive virtual reality games, are becoming popular part of children’s lives and are replacing the real nature (Kahn, Severson & Ruckert, 2009). This trend, if combined with sedentary life style and unhealthy eating habits, may be one of the factors contributing to the problem of childhood overweight and obesity, one of the most critical global challenges of the 21st century (World Health Organization [WHO], 2016a).

The estimated number of overweight children under the age of five worldwide was 43 million in 2010 (WHO, 2016a). In the United States, approximately 17% (12.7 million) of children and adolescents are obese and this has immediate as well as long-term effects on their health and well-being (Centers for Disease Control and Prevention
Obese children and adolescents are more likely to become obese adults (Freedman et al., 2005) and childhood obesity is linked with a higher chance of premature death and possible disability in adulthood. Annually, 2.6 million people die worldwide as a result of being overweight or obese (WHO, 2016b). These facts point at the importance of focusing on the problem of overweight and obesity at early stages of life, and it is critical to identify risk factors for obesity.

Parents play an important role in children’s development; mothers’ and fathers’ preferences, attitudes, and behavior shape children’s lifestyle habits and those habits have an impact on children’s health and well-being. In most cases, parents make decisions about their children’s eating habits, they have an influence on their offspring’s activities, and the amount and the type of exercise their children get. Are parents who consider themselves more related to nature also more likely to have offspring who are normal weight, as opposed to overweight or obese?

Benefits of Nature

Thirty years ago, an American biologist, Edward Wilson, proposed the idea that people have a natural inclination and need to connect with other living creatures and things (Wilson, 1984), the biophilia hypothesis. He suggested evolutionary explanations behind the human desire to affiliate with nature, or with life and lifelike processes (Kellert & Wilson, 1993), hypothesizing that natural settings, not artificial urban spaces, were the original environment in which humans existed and evolved and therefore humans developed a special bond with nature. Support for the biophilia hypothesis includes pleasure associated with involvement in activities, such as outdoor/”green”
exercise, gardening, adventures in the wilderness, observing the natural beauty, interaction with animals and plants (Kellert & Wilson, 1993).

When people are asked to name their favorite places, forests, mountains, hills, parks, seas and lakes tend to be more frequently reported compared to more artificial, urban locations, such as streets or shopping centers (Korpela & Hartig, 1996; Korpela, Hartig, Kaiser, & Fuhrer, 2001). The researchers investigated the restorative experience in favorite places using a sample of 160 undergraduate students from University of California, Berkeley (Korpela et al., 2001). Participants described a place that they enjoy spending their time/they value it more than any other place/they view as particularly significant in their lives. Other participants were asked to describe the exact opposite type of place. The largest proportion of favorite locations, 48%, were places that could be categorized as nature settings. Natural places were also underrepresented among the unpleasant locations. Similarly, an earlier study by Korpela and Hartig (1996) with 78 student participants from Finland revealed that 25% individuals considered a place with natural features their favorite. On the contrary, unpleasant places were referred to as rather much/more urban by 85% of participants.

Nature influences humans in various useful ways. Calming, harmonizing and healing effects of nature inspired different types of popular alternative therapeutic approaches, such as gardening focused horticultural therapy, or animal oriented methods, such as canine therapy, hippotherapy, or dolphin therapy. In some cultures there is a tradition of human exposure to certain types of natural environments for therapeutic purposes. For example in Japan, “forest bathing” trips are commonly perceived and recommended as a way to relax, lower stress levels, and regain new energy (Ochiai et al.,
There is scientific evidence showing the benefit of exposure to natural environments on emotional, cognitive, as well as physical levels (Berman, Jonides & Kaplan, 2008; Ulrich, 1984; Wells, 2000; White, Pahl, Ashbully, & Herbert, 2013).

The results of the self-report based study that focused on favorite places, their qualities, and their impact showed that restorative experiences prevailed among all the considered favorite place experiences (Korpela et al, 2001). Restorative experience was viewed as an inherent potential in emotion and self-regulation that might involve a positive mood change, arousal reduction and relaxation, contemplation on one’s self and one’s priorities in life, or renewal of directed attention capacity. Restorative experiences in this research were associated specifically with natural places when compared with other than natural locations, excluding homes.

Similarly, a large scale British study with thousands of subjects investigated participants’ feelings of restoration recalled after visits to various natural settings within past week. The participants’ emotional state before the outdoor visit was unknown and participants were voluntarily choosing their outing locations. The construct of restoration was based on self-report of the extent to which the participants agreed that the visit made them feel calm and relaxed and refreshed and revitalized. Potential restorative effects of nature on cognitive processes were not explored. The study revealed that participants perceived significantly more intense restoration of depleted emotional resources after time spent in rural green natural settings compared to urban green places (White et al., 2013). Visits to coasts/beaches were linked with even more significant reports of restoration than visits to rural/countryside environments. Interestingly, results suggest that up to age 55, restoration feelings increase with age, meaning that older people
experienced greater feelings of calm and revitalization than younger people in similar situations. No significant differences were recorded as a function of socio-economic status or gender.

The natural environment is also positively linked with human cognitive processes. Wells (2002) studied the “effects” of greenness on children’s cognitive functioning. In a sample of 17 children (ages 7-12) from low-income urban settings who were relocating to new homes, she used the Attention Deficit Disorder Evaluation Scale to compare children’s ability to focus/direct their attention before the move and several months after their move to their new houses. The housing quality in terms of greenness/naturalness before and after the move was also assessed: the pre-move versus post-move comparisons showed that the new houses had significantly more natural character (measured by the amount of nature in the window view from various rooms and by the yard type, e.g. grass, dirt, concrete, etc.), than the old ones. The new homes had significantly more natural character than the original housing. The final results of this study revealed a decrease of attention deficit disorder symptoms after moving into more natural homes and those children who used to reside in the least natural environments before the move had the highest directed attention capacity scores after the move (they experienced the highest increase of the naturalness of their homes).

Some of the strengths of this study were its longitudinal design and consistency (the use of the same researchers for pre and post move scoring and interviews, the same season timing). Although the author used a small sample of participants, and the participating families were not randomly assigned to their new homes, the results indicate a moderate correlation between natural environment and cognitive functioning in
children. The study focused primarily on the naturalness of home environment and attention focus; however, it would have been interesting to explore if the change of home environment was associated with some additional changes/improvements, such as physical health or emotional wellbeing.

Psychological benefits from nature exposure appear to be closely linked to physical wellbeing. According to Ulrich (1984), being able to view a natural setting from a hospital window may help with postoperative recovery. In this study based on records of patients hospitalized in Pennsylvania suburban hospital between 1972 and 1981, the author followed a sample of 23 matched patient pairs who underwent a gall bladder surgery. Rooms were assigned to patients as they became vacant. Nurses documented patients’ conditions during the first seven days after the day of surgery. Patients whose rooms were facing a small stand of deciduous trees had significantly fewer negative comments, such as “upset and crying” or “needs much encouragement” recorded by nurses during the one week post-surgery period compared to patients whose windows faced a view of a brick building wall. Additionally, patients with the natural view needed less pain medication after the surgery. The two groups also differed in the length of postoperative stay, with the tree view individuals experiencing shorter stays.

A national representative survey of more than eleven thousand adults in Denmark explored associations between access to green space and health (Stigsdotter et al., 2010). Participants were first interviewed and then completed a self-administered questionnaire inquiring about perceived stress levels, overall health, distance between their homes and the nearest green areas. People who had to walk/travel more than 0.6 miles to access the nearest green setting reported poorer health and health related quality of life than
individuals with easier access to the nearest green space (within 0.6 miles). 82% of participants reporting better access to a green area (closer than 0.2 miles) stated they had “really good” or “good” health compared to only 72% among people who reported larger distances to the closest green area (over 0.6 miles). The results clearly indicate an association between self-reported health and access to green environment. The US Centers for Disease Control and Prevention confirms that the easier access to parks people have, the more likely they are to use those places for exercise, to walk and bicycle (CDC, 2014). And, exercise affects human health in a positive way and helps to prevent health problems, such as obesity.

Coombes, Jones, and Hillsdon (2010) provided evidence that access to green spaces in urban areas is linked with higher use of those spaces, more physical activity and lower chances of being overweight or obese. In a large survey of nearly seven thousand adults from Bristol in the United Kingdom, the researchers used a zip code to determine access to the nearest green space. Results showed lower odds of achieving the recommended amount of physical activity (30 or more minutes at least five times per week) and an increase of being overweight/obese with increasing distance from “formal” types of green areas, such as parks. Individuals who lived more than 1.4 miles from a formal green place were approximately 36% less likely to visit it every week than those who lived less than 0.5 mile from such a place.

Nature Relatedness and Lifestyle

Despite the fact that humans benefit both psychologically and physically from their interactions with natural spaces, personal inclination towards nature varies across
individuals. Researchers, mostly in the field of environmental psychology, have recently focused on the analysis of the individual differences in attitudes toward the natural world.

As Nisbet, Zelenski, and Murphy (2009) describe, being nature related means recognizing and valuing the interconnectedness with other living things on this planet and viewing the relationship with nature as an important part of one’s being. According to this theory, nature connected individuals do not limit their understanding of nature simply to the green outdoor space behind the window; they feel they are a part of the complex system of the natural world. Nature relatedness does not mean just being attracted to the positive aspects, such as picturesque countryside sceneries, or cute animals. It involves the understanding of the inevitable natural negative aspects (dangerous animals, decay or death) in the context of the principles in the natural world. Nisbet and colleagues theorize that, consequently, a strong relationship with nature on cognitive and emotional levels tends to also reflect in people’s attitudes and actions.

Higher levels of nature relatedness are associated with particular behavior and lifestyle habits, such as more time spent outside and in green areas (Karlegger & Cervinka, 2009; Nisbet, Zelinski, & Murphy, 2011; Wolsko & Lindberg, 2013), or an engagement in outdoor sport activities (Haluza, Simic, Höltge, Cervinka, & Moshammer, 2014). It is also linked with a more selective approach to food selection (Nisbet et al., 2009) and it is inversely related to smoking (Haluza et al., 2014).

Certain personality features are significantly related to nature relatedness (Nisbet et al., 2009). For example, researchers have linked both agreeableness, that characterizes individuals who are considered kind, cooperative and sympathetic, and openness to experience with nature relatedness. This suggests that humans who are related to the
natural world might be more open to novelty, they are intellectually curious and perhaps adventurous. Nature relatedness was also weakly but significantly associated with the features of extraversion and conscientiousness.

Individuals who scored highly on the Nature Relatedness Scale developed by Nisbet et al. (2009) had a tendency to be responsible and think about the impact of their behavior. Consideration of future consequences was significantly related to nature relatedness. Statistically significant connections between nature relatedness and humanitarianism and love of animals were also observed (Nisbet et al., 2009).

Psychologically, individual differences in nature relatedness are connected with individual differences in well-being in humans (Nisbet et al., 2011). In their first investigation, the researchers asked 184 undergraduate student participants to complete the Nature Relatedness Scale and several measures of well-being: Psychological Well-being Inventory (covers the areas of autonomy, environmental mastery, positive relations with others, self-acceptance, purpose in life and personal growth), Positive and Negative Affect Schedule and Satisfaction with Life Scale. The second study was the same as the first one but the sample consisted of 145 executives from private as well as state sectors. In both tests, significant positive connections between nature relatedness and well-being measures were found.

Self-reports of nature relatedness are connected to self-reports of the amount of time spent outdoors; individuals who are more connected with nature spend more time outdoors (Karlegger & Cervinka, 2009; Nisbet, et al., 2009; Wolsko & Lindberg, 2013). Investigating the link between nature relatedness and time spent outside and in nature, Nisbet and colleagues sampled 145 adult Canadian executives and monitored their
outdoor and nature activities over 8 weeks. They found a positive correlation between nature relatedness and frequency of time spent outside and in nature. Similarly, in a sample of 184 randomly chosen Canadian undergraduate students, individuals with higher nature relatedness scores reported spending more time in nature-related activities (Nisbet et al., 2009).

Haluza and colleagues (2014) used a sample of 1500 participants to investigate nature connectedness and time spent doing outdoor sports and found that only 6% of those who scored low in nature relatedness reported engagement in outdoor sports compared to 66% in the group of highly nature connected subjects supporting the idea that nature related people spend more time in outdoor activities.

Karlegger and Cervinka (2009) took a different approach and focused on the influence of time spent in nature on nature connectedness in a sample of nearly two hundred Austrian high school students. The results of their regression analysis showed that the time spent in nature was a significant predictor of the adolescents’ nature connectedness level. There was also a strong social aspect: when their peers enjoyed spending time in the nature, the participants reported higher level of nature connectedness.

The type of outdoor activity is also linked to the level of nature connectedness. As Wolsko and Lindberg (2013) discovered in their study of 410 US adults, more nature connected humans engaged more in appreciative types of outdoor activities (non-consumptive activities involving nature enjoyment through direct contact with the natural world) such as hiking, backpacking, cross-country skiing, snowshoeing. These activities provide them with greater opportunities to engage with the surrounding outdoor space
and experience it more intensely on the sensory level. On the contrary, when less nature related people do spend time outdoors, they are more likely to practice motorized recreational activities, such as motor boating or snowmobiling, or all-terrain vehicle driving.

Nature related people also are more likely to buy organic produce (Nisbet et al., 2009). The study with Canadian executives unveiled that nature relatedness was a significant predictor of organic food purchases. Highly nature related undergraduates were also significantly more likely to buy organic goods, and they were more likely to be vegetarians than those who were less related to nature. These results suggest that those who identify with high nature relatedness place a higher value on foods grown using organic farming practices and may indicate a more mindful approach to food selection and consumption.

Maternal smoking during pregnancy represents a prenatal risk factor for later overweight and obesity in children (Dubois & Girard, 2006; Gillman & Ludwig, 2013). Haluza et al. (2014) reported a link between nature connectedness and smoking. In their population-based survey of 1500 participants in Austria, smoking was inversely related to nature connectedness in females.

Because the concept of nature relatedness has gained research attention relatively recently, few studies have focused on how parent nature relatedness relates to family routines, however, one might reasonably hypothesize that parents/mothers would apply their views and principles about nature to their child rearing practices. A study investigating the link between the level of physical activity in parents and in their young children showed that when both parents were active the offspring was 5.8 times as likely
to be active as the offspring of an inactive couple (Moore et al., 1991). As a result, it is hypothesized that more outdoor time for children and family activities encouraging physical exercise could have a positive impact on children’s health, including their BMI.

Childhood overweight and obesity is multi-factorial and some of the risk factors are lack of physical activity and high levels of sedentary behavior (Rennie, Johnson, Jebb, 2005). Jago, Baranowski, Baranowski, Thompson, and Greaves (2005) explored whether sedentary behavior, physical activity, diet or TV viewing predicted BMI levels in preschoolers. The researchers followed a cohort of children, collecting data on preschoolers’ diet, TV watching and sedentary behavior based on annual direct observation. They reported that 3-6 year olds children’s BMI values were significantly predicted by television viewing time and level of physical activity. The results also indicated that passive TV viewing time might compete with physical activity.

Similarly, Kimbro, Brooks-Gunn, and McLanahan’s (2011) study involving nearly two thousand five year old children from multiple US urban settings (based on data from the US Fragile Families and Child Wellbeing Study) focused on the associations among neighborhood characteristics, weight, outdoor play and television watching of young children in urban areas of the United States. Hours of playing outside were negatively linked to children’s BMI and hours of television viewing were positively related to BMI values. For each hour of outdoor play, the children scored about half a percentile point lower on their BMI. At the same time, for every hour of TV watching, the children scored (on average) about half a percentile point higher on the BMI values.

A Norwegian study (Kristiansen, Juliusson, Eide, Roelants, & Bjerknes, 2013) sampling more than two thousand school children (ages 6-15) also showed that those who
spend more time watching TV/DVD or playing/working on a computer are at a higher risk of being overweight or obese than those children who spend less TV/screen time (OR overweight: 1.25, OR obese: 1.12). Nearly 50% of older children (age 12–15) in this study had a TV in their bedroom which was also associated with overweight and obesity. TV/screen time over 2 hours per day was considered high. This limit reflects the original recommendation of the American Academy of Pediatrics (2013) which suggested that parents should limit the time their children spend watching TV to 2 hours of good quality programming daily. However, no consistent relationship between TV/computer time and BMI or between outdoor play time and BMI was observed in 6-year old Dutch children after adjusting socio-demographic factors or family life-style factors in the study that examined nearly six thousand children and relied on reports of children’s behavior provided by parents (Wijtzes et al., 2014). The only factor that was significantly predicting children’s BMI in this research was sport participation: BMI percentile values were decreasing with increasing hours of sport activities.

Some researchers found a connection between BMI, outdoor activity and socioeconomic status. Kristiansen et al.’s (2013) study found that children of more educated parents in the city of Bergen, Norway, spent less TV/screen time, were involved in more sports (even walked to and from school more often) and had healthier diets (more fruits and vegetables, less sweets, fast food, sweet beverages) than children from families with less educated parents. In contrast, an unexpected, non-linear pattern between the socioeconomic status of families and children’s BMI was observed in Kimbro et al.’s (2011) study of urban children from the US: children from the wealthiest and the poorest backgrounds had the lowest BMI values, whereas those coming from the middle of the
socioeconomic status distributions had the highest BMI values. Additionally, hours of outdoor play were negatively related to BMI. Kimbro and colleagues posit that in poor communities of city environment parents may often restrict their offspring’s outdoor play due to safety problems. The authors discovered that specific social conditions in public housing projects may contribute to higher rates of physical activity of children from poor families. This type of housing provides relatively safe outdoor environment (often with accessible green space, courtyards/playgrounds) which helps parents feel comfortable about their neighborhoods. The results of this study showed that children living in public housing projects had an approximate outdoor play count 13% higher than other researched children.

Another factor that has been potentially linked to childhood obesity is breastfeeding. In their population based study, Armstrong and Reilly (2002) followed a sample of over thirty thousand children from Scotland, age of 39-42 months. The authors found that the children who were breastfed were significantly less likely to be obese than the infants who were not. Also, a meta-analysis of 10 prospective studies revealed that breastfeeding any time during the first year of infant’s life decreased the adjusted odds of overweight in childhood by 15% compared with not breastfeeding (Weng, Redssell, Swift, Yang, & Glazebrook, 2012). However, a prospective nationwide Chinese study (Jing et al., 2014) that focused on the effects of breastfeeding on childhood BMI and obesity did not support a relationship between breastfeeding, overweight and obesity in children. Overall, it seems that there are numerous other factors (social, economic, cultural, biological, etc.) that are involved in the connection between breastfeeding and children’s BMI (Savage, Orlet Fisher, & Birch, 2007). Maternal milk helps to introduce
babies to new flavors present in mother’s diet and it influences children’s later acceptance of solid foods, especially foods that might be healthy but not easily accepted, e.g. vegetables (Sullivan & Birch, 1994). Breastfeeding had not been studied in connection with nature relatedness. Therefore, it will be interesting to add it as an additional variable in the proposed study.

Overall, these research findings indicate that more nature related mothers and fathers might have healthier life styles including more outdoor physical activity, healthier food choices, and less smoking during pregnancy. Perhaps these life style choices reflect in a positive way on their offspring; parents who are more related to nature may naturally have a tendency to feed their children a healthier diet. They might incorporate more outdoor exposure including organized exercise as part of outdoor family activities; they might encourage more of their children’s outdoor free play. If possible, they may promote more walking opposed to use of motor vehicles. At the same time, the preference for outdoor entertainment and active interaction with nature might mean less time for an intense engagement with technological devices, such as TVs, computers, tablets that are often linked with sedentary leisure activities.

Study Hypothesis

Considering the reviewed research findings indicating connections between nature relatedness and lifestyle habits, it was hypothesized that parents of elementary school children who report being more related to nature would be more likely to have children with healthy weight body mass index values, as opposed to overweight or obese offspring. The purpose of this study was to test this hypothesis as well as examine some
other potentially related factors, such as the amount of active time children spend in the nature, the amount of time children dedicate to passive screen time activities (i.e., TV/video viewing, computer/small screen sedentary gadget play), family socioeconomic status, mothers’ age and BMI, breastfeeding history. It was hypothesized that socioeconomic status, parental age, breastfeeding history, and active time in the natural environment would be inversely related to children’s BMI values, whereas TV/screen time and parental BMI values would be positively associated with children’s BMI values.

Definition of Terms

Nature relatedness

According to Nisbet et al. (2009), nature relatedness is a construct that defines individual differences in the way humans view their relationship with the natural world. It describes the extent to which people perceive themselves as connected, or internally identified with nature, which includes cognitive, affective, as well as physical aspects. Nature relatedness is also sometimes referred to as nature connectedness.

Body Mass Index (BMI)

BMI is the most frequently utilized measure of weight status (underweight, healthy weight, overweight, obese) reflecting an estimated percentage of relative body fat and muscle mass of an individual. The calculation is obtained by a person’s weight in kilograms (kg) divided by height in meters (m) squared: \( \text{BMI} = \frac{\text{kg}}{\text{m}^2} \), or by an individual’s weight in pounds divided by height in inches squared and multiplied by number 703 (CDC, 2016a).
Normal weight

For adult individuals, normal weight is defined as body mass index between 18.5 and 24.9 (CDC, 2016b). For children and adolescents (ages 2-19), normal weight is defined as body mass index between 5th and 85th percentile for children/adolescents of the same sex and age (CDC, 2016c).

Overweight

For an adult person, overweight is defined as body mass index between 25 and 29.9 (CDC, 2016b). For children and adolescents (ages 2-19), body mass index at or above 85th percentile, and lower than 95th percentile for individuals of the same age and sex (CDC, 2016c).

Obesity

Obesity is a condition characterized by an excessive amount of stored body fat. Operationally, for adults, body mass index 30 or above (CDC, 2016b); and at or above 95th percentile for children/adolescents (ages 2-19) (CDC, 2016c).
Chapter II

Method

This pen and paper survey based study used self-report measures and involved a sample of adult subjects, parents of elementary school children recruited in a medical facility.

Participants

The sample in this study consisted of 97 parents, adult primary care givers (86 females and 11 males; mean age: 37.5 years; range: 22-51 years) of elementary school children aged between 6-11 years (49 girls and 48 boys; mean age: 8.4 years; range: 6-11.8 years). 86 of these participants were biological mothers and 11 were fathers. Participants were recruited in the waiting room of Northboro Pediatrics, a small, privately owned suburban medical practice located in Northborough, Worcester County, Massachusetts. According to Dr. Correa from Northboro Pediatrics, more than one third of the patients, 36%, have Massachusetts Medicaid (MassHealth) insurance, which offers medical coverage for low and medium income people living in the state. (personal communication, October 28, 2016).

The participation was voluntary, and the subjects understood that by completing the survey they would become part of this research study that included no identifiable data. The participating individuals obtained an incentive, a $10 thank you gift card and a sticker with a picture of an animal.
The participation rate was high; a total number of 106 potential subjects were approached and invited to participate at the study. Five approached parents refused to participate, three participants were excluded because their surveys did not meet the requirements for the final analysis (partially completed forms) and one form completed by a grandmother (primary care taker) was eliminated.

Measures

To assess the level of nature relatedness in parents, a paper and pen Nature Relatedness Scale Test (Appendix B) was administered (Nisbet et al., 2009). The test consisted of 21 statements (e. g., “Even in the middle of the city, I notice nature around me”; “My connection to nature and the environment is a part of my spirituality”, etc.), and each of these statements was rated by the participating subjects using the Likert scale ranging from 1 (Disagree strongly) to 5 (Agree strongly). Eight of the total of 21 questions are designed for reverse scoring. The scale was created to measure the affective, cognitive and also experiential elements of individuals’ connection to the natural world on the trait level. The Nature Relatedness Scale was designed to capture three factors: NR-Self (internalized identification with the natural world representing individual emotions and thoughts about person’s personal connection with nature, for example “My relationship with nature is an important part of who I am”), NR-Perspective (views about an impact of individual actions on all living things, for example “The state of nonhuman species is an indicator of the future for humans”) and NR-Experience (refers to the actual practical contact with nature, for example “I enjoy being outdoors, even in unpleasant weather”) (Nisbet et al., 2009). Questions 5, 7, 8, 12, 14, 16, 17 and
21 examine the NR-Self factor, questions 2, 3, 11, 15, 18, 19 and 20 refer to the NR-Perspective factor and questions 1, 4, 6, 9, 10 and 13 investigate the NR-Experience factor.

The Nature Relatedness Scale is a valid self-report measure with a proven good internal consistency and temporal stability. Chronbach’s alpha for the full scale was .87, for NR Self it was .84, for NR Perspective it was .66 and for NR Experience it was .80. Test-retest stability explored over a period of 6 to 8 weeks for the full scale was .85, for NR Self it was .81, for NR Perspective it was .65 and for NR Experience it was .85 (Nisbet et al., 2009). The Nature Relatedness Scale is a unique instrument, the results demonstrate the temporal stability and since its introduction, it has been used in psychological research.

In order to investigate children’s body composition and all the additional variables, participants answered 17 written questions (Appendix C) that were printed on the back side of the Nature Relatedness Scale form. These questions were designed to elicit information about child’s age, gender, height and weight, the source of height and weight data (e.g., memory, data captured by the pediatrician that day), caregiver’s age, height, weight, gender, relationship to a child, length of breastfeeding, estimated time a child spends being active outside in nature, time a child spends watching TV/playing with screen type devices, caregivers highest achieved education, and the annual household income.

Body mass index values and percentile values of children were calculated from the birth month and year, height and weight information provided by participants using the Centers for Disease Control and Prevention’s BMI and Percentile Calculator for Child
and Teen, English Version (CDC, 2016d). Body mass index values of the participants were calculated from their self-reported weight and height information using the Centers for Disease Control and Prevention’s on-line BMI Calculator for Adults, English Version (CDC, 2016e).

Two separate questions about the average time a child spends engaged in active time outdoors in natural environment (free play, games, hiking, sports) allowed respondents to distinguish between the average number of outdoor hours during weekdays and weekends. Additionally, both of these two questions included separate summer time and winter time report scales given inherent variability in opportunity for outside play in New England. The answers were used to calculate the average active time a child spends in a natural environment per week. Similarly, parents reported the time a child spends engaged watching TV/playing sedentary games on the computer/tablet/phone/other screen type electronic devices for both weekdays and weekends. These four questions were modified from an assessment survey that was used in previous research focused on the associations among body fat, sedentary behaviors and physical activity (Wijtzes et al., 2014).

Procedure

After the Harvard Committee on the Use of Human Subjects approved the proposed research study observing the APA ethical guidelines, the investigator arranged a flexible data collection time schedule with Dr. Correa from Northboro Pediatrics who had previously provided a permission to recruit participants for this research study in his waiting room. The data collection process occurred during twelve consecutive weeks in
Summer and Fall 2016. The researcher approached potential participants after they checked in with the clinic administrative staff at the reception area, as they were waiting for their children’s pediatric appointments. Some participants were recruited after their children’s medical appointments finished and they were about to leave the medical office. Parents with visibly ill children requiring parental comfort and attention were not approached.

The researcher briefly introduced the purpose of the survey, verbally checked if the approached participants fulfilled the requirements for the participation (English language speaking primary care givers of a child between 6 and 11 years), and asked them if they were willing to participate. Each subject received an Information and Consent Sheet (Appendix A) that explained more details about the study, about the participation and an incentive information. It also provided subjects with contact details of the researcher and of the Harvard Committee on the Use of Human Subjects. Since no identifiable data was collected in this study, participants were not required to return a signed copy of the consent to the researcher. They kept the copy of the written consent and understood that by submitting a completed survey they would become part of the study. After they read the consent, they completed a research form consisting of two types of surveys, each printed on one side of the same sheet of paper: Nature Relatedness Scale (Appendix B), and the Demographic and Activity Survey (Appendix C). Form completion took 7-15 minutes. Participants were compensated for their participation at this research; each primary care giver who submitted a completed survey received an envelope with a $10 gift card and an animal sticker. In case the information about a child’s height and/or weight was missing, the researcher asked participants to obtain the
values from the administrative staff at the reception area who had access to their children’s medical records.

To avoid clustering of collected data, only one child from each family was included. Incomplete forms (from care givers who originally agreed to participate but did not finish their forms due to time constraints) were excluded from the study.

Design

The main purpose of this study was to investigate whether there was any relationship between the level of parental nature relatedness and the offspring’s body composition, and to examine if any of the other considered variables (time spent outdoor, screen time, parental age, parental BMI, SES and length of nursing) are associated with children’s body composition. In order to answer these questions using the collected data, the plan was to utilize regression analysis methods.

The predictor, or independent variable, was the numeric score calculated from the Nature Relatedness Scale (Likert Scale ranging from 1 to 5). The main dependent variable was children’s body composition represented by children’s BMI percentile values (ranging from 1 to 100). Five of the additional predictor variables were numerical: parent’s age, the number of hours a child spends watching TV/playing sedentary games on screen type electronic gadgets per day, the number of hours a child spends being active in a natural outdoor environment per day, the number of months a child was breastfed and parental BMI. Two additional predictor variables were categorical: parent’s education and annual family income. Prior to regression analyses, these two categorical
variables were transformed into continuous numerical variables and used in linear
regression models.

After reverse scoring the appropriate items of the NR Scale, the information
collected in the paper and pen survey form was transferred to an Excel spreadsheet
data base. Adult BMI values and child BMI percentile values were obtained using the
BMI and Percentile Calculator for Child and Teen, English Version (CDC, 2016d) and
the Centers for Disease Control and Prevention’s BMI Adult Calculator (CDC, 2016e).

Selected data from the Excel database were transferred to the Statistical Package
for the Social Sciences (SPSS) program (version 23) that was used for the statistical
analysis. The data was examined to identify potential outliers. Descriptive statistics tests
were run first to understand the background information about the sample (demographics,
body composition types of parents and children). Additionally, nature relatedness test
scores (NR-Total, NR-Self, NR-Perspective and NR-Experience) were analyzed. Prior to
running the regression analyses, the Johnson family transformations were applied to the
dependent variable measure to achieve an approximately normal distribution (Johnson,
1949). Because the tool assessing nature relatedness, the main independent variable,
consists of three subscales, a multicollinearity tests was conducted to investigate potential
correlations between NR-Total and the three subscales. To determine if there were any
relationships between the main examined variables, linear regression analysis tests were
run. Alpha level of .05 was determined as a significance criterion for the planned tests. In
the first model, the relationship between the NR-Total and children’s BMI percentile
values was explored. The second model focused on analyzing the relationship between
the three dimensions (NR-Self, NR-Perspective and NR-Experience) and children’s BMI
percentile values. Both models were run separately for the full sample including mothers and fathers and for mothers only.

In order to understand if any of the additional independent variables might be related to children’s BMI percentile values, multiple regression analysis tests were run. The first model included the NR-Total and the additional independent variables (parent’s age, length of breastfeeding, parent’s BMI, child’s hours of screen time per day, child’s hours of active outdoor time, annual household income and parent’s highest achieved education). The second model included the three NR dimensions and the additional independent variables. Both models were run separately for the full sample including mothers and fathers and for mothers only. Additionally, a Backward Stepwise Linear Regression was used to remove the weakest independent variables from the models and to keep only those that explain the distribution best.

A series of Pearson’s correlations were conducted with child BMI to determine the strength of possible relationships with all independent variables. A backward stepwise linear regression analyses were run to compare the results with the results of the previously used multiple linear regression tests. Finally, Pearson’s correlation analyses were used to examine possible correlations among all independent variables.
Chapter III

Results

Descriptive statistics tests analyzing the demographics and body mass index data of the sample ($N = 97$) used in the current study provided useful information about the studied population. The analysis of the socioeconomic background showed that 59% of the children were from families where the annual household income was lower than $60,000; 30% of the children were from families with the annual household income between $60,000 and $110,000 and 11% of the children were from families with the annual household income higher than $110,000. Reports of study participants’ highest achieved education levels revealed that 43% of the participating parents were high school graduates or below, 27% of the parents had either some college, technical school or an associate degree, 21% were college graduates or did some graduate work after they earned their college degrees and 9% of the parents had a master’s degree or higher.

Overall, parents in the sample ($N = 97$) had diverse BMI values ($M = 26.86, SD = 4.68$). The adult BMI analysis revealed that 35% of the participating parents had normal body composition, 44% were overweight, 21% were in the obese category and none of the participants were underweight. The results analyzing the offspring’s BMI percentiles ($M = 65.39, SD = 30.71$) showed that 57% of children in the study were in the healthy weight category, 17% were overweight, 22% were obese and there were also 4% of underweight children.
The descriptive statistics of total parental nature relatedness scores and the scores of the three nature relatedness dimensions (NR-Self, NR-Perspective and NR-Experience) for the entire sample population \((N = 97)\) were calculated, and Cronbach’s alpha values for NR-Total and all three dimensions were computed (Table 1). The same calculation process was repeated for the sample of mothers only \((n = 86)\) with similar results.

### Table 1

*Means of Parental Nature Relatedness Scores and Cronbach’s Alphas, Full Sample*

<table>
<thead>
<tr>
<th>Variable</th>
<th>(N)</th>
<th>(M)</th>
<th>SD</th>
<th>Range</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR-Total</td>
<td>97</td>
<td>3.87</td>
<td>.447</td>
<td>2.5 - 4.9</td>
<td>.675</td>
</tr>
<tr>
<td>NR-Self</td>
<td>97</td>
<td>4.11</td>
<td>.556</td>
<td>2.6 - 5.0</td>
<td>.614</td>
</tr>
<tr>
<td>NR-Perspective</td>
<td>97</td>
<td>3.84</td>
<td>.646</td>
<td>2.4 - 5.0</td>
<td>.478</td>
</tr>
<tr>
<td>NR-Experience</td>
<td>97</td>
<td>3.58</td>
<td>.754</td>
<td>1.7 - 4.8</td>
<td>.602</td>
</tr>
</tbody>
</table>

An average child in the sample was breastfed for over six months \((M = 6.68, SD = 6.47)\). Screen time results indicated that as a whole, parents reported that their children spent over two hours per day average watching TV/playing sedentary games on electronic devices \((M = 2.33, SD = 1.50)\) and they spent more time being active in nature daily \((M = 3.24, SD = 1.68)\).
In order to detect a potential presence of multicollinearity, a series of Pearson’s correlation tests were run between the NR-Total and the three subscales/dimensions. The results reported strong correlations between NR-Total and NR-Self, \( r(95) = .737, p < .001 \), between NR-Total and NR-Perspective, \( r(95) = .650, p < .001 \), and between NR-Total and NR-Experience, \( r(95) = .691, p < .001 \). To address the multicollinearity issue, the regression tests analyzing the data in the current study were run separately for NR-Total and separately for the three subscales.

In the next phase, series of regression analyses were conducted and each test was performed for both samples; the full sample \( (N = 97) \) and for the sample consisting of mothers only \( (n = 86) \). The results were then compared. In most tests, no significant differences between the two samples were observed. Therefore, nearly all the reported results are based on the full sample model \( (N = 97) \). In case a difference between the two samples was detected, results for both samples are reported.

A simple linear regression was conducted to test if the main independent variable, nature relatedness (NR-Total), predicted children’s BMI percentiles for the entire sample population \( (N = 97) \). The results of the tested model showed an insignificant association between the two variables, \( r(95) = .069, R^2 = .005, F(1, 95) = .45, p = .503 \).

In order to investigate possible associations between the three dimensions of the Nature Relatedness Scale (NR-Self, NR-Perspective and NR-Experience) and children’s BMI percentile values, a multiple regression analysis was run and one minor difference between the two samples was detected. The full sample \( (N = 97) \) and the sample consisting of mothers only \( (n = 86) \) were both statistically significant, \( r(95) = .316, R^2 = .100, F(3, 93) = 3.43, p = .020 \) and \( r(84) = .297, R^2 = .088, F(3, 82) = 2.65, p = .054 \),
respectively. In the full sample model \((N = 97)\), NR-Self significantly predicted children’s BMI percentile values, \(\beta = .31, t (93) = 2.97, p = .004\) and the Pearson’s correlation test showed a significant weak positive relationship between the two variables, \(r (95) = .243, p = .008\). The same was observed in the model consisting of mothers only \((n = 86)\), \(\beta = .29, t (82) = 2.61, p = .011\) and \(r (84) = .233, p = .015\). NR-Perspective was not significantly predicting children’s BMI values in either of these two models. Unlike in the mothers only model, NR-Experience in the full sample model \((N = 97)\) predicted children’s BMI percentiles significantly, \(\beta = -.21, t (93) = -2.00, p = .048\). At the same time, the Pearson’s correlation test showed that the NR-Experience was not significantly correlated with children’s BMI percentiles, \(r (95) = -.114, p = .133\).

In the next step, the additional independent variables were added into the tested models. Multiple linear regression was used to investigate any potential relationships between each one of the independent variables with children’s BMI percentiles. The first test included the following independent variables: NR-Total, parent’s age, breastfeeding length, parent’s BMI, child’s screen time per day, child’s active time outside in nature per day, annual family income and the highest achieved parent’s education. The results of this test showed that the model \((N = 97)\) was not statistically significant, \(r (95) = .323, R^2 = .105, F (8, 88) = 1.28, p = .262\). The only independent variable that significantly predicted children’s BMI percentile values was the time children spent outside in natural environment per day, \(\beta = -.280, t (88) = -2.71, p = .008\). The Pearson’s correlation test showed a statistically significant negative and weak correlation, \(r = -.279, p = .003\) between these two variables. None of the other independent variables contributed to the model significantly (Table 2).
Table 2

Regression Analysis Summary for Variables Predicting Children’s BMI Values (NR-Total, Full Sample)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR Total</td>
<td>0.17</td>
<td>0.22</td>
<td>.08</td>
<td>0.75</td>
<td>.458</td>
</tr>
<tr>
<td>Parent Age</td>
<td>-0.01</td>
<td>0.01</td>
<td>-.10</td>
<td>-0.96</td>
<td>.341</td>
</tr>
<tr>
<td>Breastfeeding</td>
<td>-0.01</td>
<td>0.02</td>
<td>-.07</td>
<td>-0.63</td>
<td>.528</td>
</tr>
<tr>
<td>Parent BMI</td>
<td>0.00</td>
<td>0.02</td>
<td>.01</td>
<td>0.06</td>
<td>.955</td>
</tr>
<tr>
<td>Screen Time/Day</td>
<td>-0.01</td>
<td>0.06</td>
<td>-.02</td>
<td>-0.15</td>
<td>.880</td>
</tr>
<tr>
<td>Out. Time/Day</td>
<td>-0.15</td>
<td>0.06</td>
<td>-.28</td>
<td>-2.71</td>
<td>.008</td>
</tr>
<tr>
<td>Annual Income</td>
<td>-0.04</td>
<td>0.06</td>
<td>-.08</td>
<td>-0.74</td>
<td>.462</td>
</tr>
<tr>
<td>Education</td>
<td>-0.02</td>
<td>0.05</td>
<td>-.04</td>
<td>-0.34</td>
<td>.737</td>
</tr>
</tbody>
</table>

*Note. $R^2 = .105 (N = 97, p < .05).*

Next, the same multiple regression model with all additional independent variables was run, but NR-Total was replaced with the three nature relatedness dimensions (NR-Self, NR-Perspective and NR-Experience). This model ($N = 97$) was statistically significant, $r (95) = .439$, $R^2 = .193$, $F (10, 86) = 2.05$, $p = .037$ and the results also revealed two significantly contributing independent variables within the model. NR-Self significantly predicted children’s BMI percentiles, $\beta = .313$, $t (86) = 2.95$, $p = .004$ and the correlation between NR-Self and children’s BMI percentiles was significant, positive and weak, $r = .243$, $p = .008$. Active outdoor time in nature was the second significant predictor of children’s BMI percentiles, $\beta = -.239$, $t (86) = -2.39$, $p = .019$, weakly negatively correlated with the dependent variable, $r = -.279$, $p = .003$. None of the other independent variables contributed to the model significantly (Table 3).
Table 3

Regression Analysis Summary for Variables Predicting Children’s BMI Values (Three NR Dimensions, Full Sample)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR Self</td>
<td>0.53</td>
<td>0.18</td>
<td>.31</td>
<td>2.95</td>
<td>.004</td>
</tr>
<tr>
<td>NR Perspective</td>
<td>-0.02</td>
<td>0.15</td>
<td>-.02</td>
<td>-0.16</td>
<td>.872</td>
</tr>
<tr>
<td>NR Experience</td>
<td>-0.26</td>
<td>0.13</td>
<td>-.21</td>
<td>-1.94</td>
<td>.055</td>
</tr>
<tr>
<td>Parent Age</td>
<td>-0.02</td>
<td>0.01</td>
<td>-.15</td>
<td>-1.47</td>
<td>.145</td>
</tr>
<tr>
<td>Breastfeeding</td>
<td>-0.01</td>
<td>0.01</td>
<td>-.07</td>
<td>-0.65</td>
<td>.518</td>
</tr>
<tr>
<td>Parent BMI</td>
<td>0.01</td>
<td>0.02</td>
<td>.04</td>
<td>0.41</td>
<td>.679</td>
</tr>
<tr>
<td>Screen Time/Day</td>
<td>-0.29</td>
<td>0.06</td>
<td>-.05</td>
<td>-0.47</td>
<td>.643</td>
</tr>
<tr>
<td>Out. Time/Day</td>
<td>-0.13</td>
<td>0.05</td>
<td>-.24</td>
<td>-2.39</td>
<td>.019</td>
</tr>
<tr>
<td>Annual Income</td>
<td>-0.05</td>
<td>0.06</td>
<td>-.08</td>
<td>-0.83</td>
<td>.407</td>
</tr>
<tr>
<td>Education</td>
<td>-0.01</td>
<td>0.05</td>
<td>-.03</td>
<td>-0.26</td>
<td>.797</td>
</tr>
</tbody>
</table>

Note. $R^2 = .193$ (N = 97, p < .05).

In order to double-check and determine which of the independent variables contributed to children’s body composition significantly, a Backward Stepwise Linear Regression was conducted and the results were compared with the findings from the previously run multiple linear analyses. Gradually, all independent variables that did not explain the distribution well were removed and only the significant variables with the strongest correlations were left. The results mirrored those found previously; the amount of outdoor active time children spend in nature was selected as statistically significant in predicting children’s BMI percentiles in both samples and all models. Additionally, NR-Self predicted significantly children’s BMI percentiles in the full sample model.

A series of additional Pearson’s correlations investigating possible correlations among all independent variables were conducted. The original value used to determine
statistical significance was $p < .05$. The analyses of the full models ($N = 97$) resulted in some additional statistically significant findings: NR-Total was weakly negatively correlated with screen time, $r (95) = -.205, p = .044$; NR-Experience was very weakly negatively correlated with screen time, $r (95) = -.198, p = .026$ and the length of breastfeeding was very weakly positively correlated with parent’s age: $r (95) = .174, p = .044$. The test detected significant correlations in the models run with mothers only ($n = 86$): NR-Total was weakly positively correlated with the length of breastfeeding, $r (84) = .219, p = .021$; NR-Self was weakly positively correlated with the length of breastfeeding, $r (84) = .180, p = .049$; NR-Experience was weakly positively correlated with parent’s BMI, $r (84) = .200, p = .032$; NR-Perspective was weakly positively correlated with parent’s age, $r (84) = .216, p = .023$ and parent’s age was weakly correlated with breastfeeding, $r (84) = .269, p = .006$. However, due to the amount of variables compared, there was a high risk of experiencing a family-wise error. Therefore, in order to control the Type I error rate, a modified Bonferroni test called the Holm procedure was applied (Holm, 1979). The p-values were compared with the newly calculated adjusted, stricter alphas and all of the p-values exceeded the appropriate adjusted alpha values. As a result, none of the originally detected significant correlations were considered statistically significant.
Chapter IV
Discussion

This study aimed to investigate if there is any association between parental nature relatedness and children’s body composition. Based on the existing research indicating connections between nature relatedness and life style, it was hypothesized that parents who are more connected to the natural environment on affective, cognitive and experiential level combined would be more likely to have an offspring of healthy weight opposed to overweight or obese. The initial simple linear regression analysis that used the reported total score values of the nature relatedness measure (NR-Total), and that was conducted with the full sample \((N = 97)\) and the mothers only one \((n = 86)\), did not show statistically significant relationships between parental nature relatedness and children’s BMI percentile values. Therefore, it can be concluded that parental connectedness with nature, when considered as a combination of emotional, cognitive and experiential aspects (measured as NR-Total), did not predict children’s body composition in this study.

However, the fact that the Nature Relatedness Scale was designed to measure three different dimensions of this construct (NR-Self, NR-Perspective and NR-Experience), allowed for further analyses that lead to some interesting findings. When the three dimensions of nature relatedness were considered separately as independent variables in a linear regression analysis, the strength of parents’ internal identification with nature (NR-Self) predicted children’s BMI percentiles in both, the full sample model
(N = 97) and in the mothers only model (n = 86). Backward Stepwise Linear Regression mirrored these findings in the full sample model. Surprisingly, these significant associations were positive, indicating that children’s BMI percentiles were increasing with the increasing strength of their parents’ internal identification with the natural world. Mothers and fathers who viewed themselves as strongly related to nature on cognitive and emotional level (e.g., they felt very connected to all living things on the earth; their connection to nature and the environment was a part of their spirituality; they noticed nature around them, even in the middle of the city; their relationship with nature was an important part of who they were) did not tend to have an offspring with healthier BMI values. When the mean scores of all three dimensions were compared, the NR-Self values for both groups were the highest of the three dimensions and the NR-Experience had the lowest means. This indicates that although parents in this study might have felt strongly related to nature on cognitive and emotional level, on average, they were not equally practically involved with nature and all its aspects (e.g., spent time outside in natural settings often, enjoyed hiking in an unpleasant weather, did not mind getting their hands dirty while digging in the earth, chose a remote, wilderness types of areas as their ideal vacation spots).

One of the possible explanations of the surprising positive connection between NR-Self and children’s BMI could be that children of parents who strongly identified with nature in the study (scored highly on NR-Self) might not be very physically active in general or their lifestyles involve other factors that contribute to higher BMI values (e.g., high calorie diet, unhealthy eating habits, etc.). Parents who strongly identify with nature on personal level might be well aware of the benefits of outdoor nature activities but
perhaps there are certain circumstances that prevent them and their children from spending active time in nature often. It could be their busy schedules combined with an uneasy access to the nearest green areas. Study by Kimbro et al. (2011) highlighted the importance of parental perception of the neighborhood quality/neighborhood collective efficacy, which seems to be positively linked with the amount of time children spend playing outside. Information on the type of housing and proximity of outdoor green areas was not collected in this study. However, active time children spent outside in nature reported by parents in this research was a statistically significant predictor of children’s BMI values in all explored models. Additionally, the Backward Stepwise Linear Regression singled out the amount of time children played in outdoor natural areas as the main predictor of their body composition. This finding is consistent with research demonstrating the impact of physical activity on children’s BMI values and it mirrors the American Academy of Pediatrics’ recommendations about physical activity as an obesity prevention measure (American Academy of Pediatrics, 2013).

Parental NR-Experience significantly predicted children’s body composition in one model only (when the three NR dimensions were used as only independent variables with a sample consisting of mothers and fathers). It showed that the BMI of children was decreasing with an increasing strength of mothers and fathers’ self-reported practical experience with nature. This could suggest that parents who are more active in their contact with nature (their relationship is not just on the cognitive and affective level but they actually spend time in nature frequently) are those who might have children with healthier BMI values. It would be useful to conduct these analyses with a substantially larger sample to see if the same pattern could be observed.
In this study, unlike in some other existing research, no statistically significant connections between the annual household income and children’s body composition or between parental education and children’s BMI values were found. Nursing history was not associated with children’s BMI values, the screen time did not seem to predict children body composition and BMI values of parents did not predict their offspring’s BMI values.

Limitations and Future Directions

This research study has several limitations. The tool chosen to assess parents’ nature relatedness, the Nature Relatedness Scale, has been proven to have good reliability and validity and it has been widely used in current research. However, Cronbach’s Alpha levels achieved in this study were not satisfactory, which limits the overall interpretation of the results. Although the used scale is more complex, compared to other nature relatedness/connectedness tools commonly used in research, such as Connection to Nature Scale (Mayer & Frantz, 2004) that focuses on affective aspects only, it is an explicit, self-report instrument. Self-reporting techniques are vulnerable to the effects of response bias, especially social desirability and memory bias. Perhaps future research studies focusing on similar topics might try to include a computer based Implicit Association Test (Bruni & Schultz, 2010) exploring implicit beliefs about self and about nature. A useful approach would be to use a combination of at least two different nature relatedness measuring tools.

Also, all the additional data, such as the height and weight information, the amount of TV/screen time and time actively spent outdoors in the natural environment
was based on answers provided by parents. Self-report methods are always susceptible to social desirability bias and to limits of memory, which might have been an issue in this study, e.g. over-reporting the amount of time children spent outside in the nature/under-reporting children’s screen time, etc. The fact that the data collection took place in a medical facility setting could have contributed to the social desirability bias affecting the collected information. The care givers were aware that active outdoor time was beneficial to their children’s health, and the pediatric setting with various displays of healthy lifestyle recommendations in the waiting room area (poster promoting outdoor time, audiovisual program explaining the benefits of exercise, etc.) could have made the care givers over-report on the amount of time their children are active outdoors. It might have also affected the reports of parental identification with nature. This might have also influenced participants when they reported their children’s/ their own weight information – they might have reported lower values to fit the desired healthier ideal. In order to achieve a more objective and precise picture, a more elaborate, observational technique could be employed, involving the use of electronic time report tools that should help eliminate the bias. The best method to obtain the most exact height and weight data would be the use a stadiometer and a calibrated personal scale.

The fact that the researcher could not control circumstances/setting during the time participants were completing their surveys could be considered a limiting factor as well. Some participants had more time to fill out their forms (waiting time for their child’s medical appointment was longer), some subjects finished completing the surveys inside the doctor’s office while their children were examined by the doctor/nurse, and some participating individuals filled the surveys after their child’s appointment (some
might have been in a hurry, some were relaxed). These factors combined with the presence of children, who sometimes interrupted the survey completion process, might have affected the level of concentration and the choice of answers.

The current study used single time measures of nature relatedness and BMI and it concentrated on elementary school aged children (6-11 years), which also offers a limited view. A longitudinal perspective might show different patterns. It could be also interesting to capture the changes throughout the developmental years starting from birth until adolescence.

Another limitation is the number of factors considered. There are numerous other important aspects that could be investigated and that would provide additional insight, such as the type of family diet, feeding habits, children’s sleep routines, school exercise programs, etc. Parent’s genetic background or health conditions that might have had an impact on their offspring’s BMI were beyond the scope of this investigation. Further research should incorporate these. Also, the focus on one care giver and one child per family offers only a limited view; future research exploring parental nature relatedness and children’s BMI might benefit from the inclusion of both primary caregivers (if available), and all their offspring.

A substantially larger sample size would have been beneficial for this study. The minimum sample size for the planned correlation analysis model was calculated using online statistics calculator for multiple regression with the following chosen parameters: the probability level $\alpha = .05$; statistical power 0.8; anticipated effect size ($f^2$) 0.15, i.e. medium. The required minimum number of participants for this study design was 97 (Soper, 2006-2015). However, the normality condition test revealed a problem with
normal distribution due to a small sample size. The chosen sampling method could be viewed as a limitation as well. Ideally, an entirely random sample should be selected for a research study of this kind involving a regression analysis. In the current study, a technique of voluntary response sampling was chosen as the best possible available option.

Recruiting participants from more than just one geographic area could also offer an interesting picture. Even though the sample in this research study was relatively diverse (socio-economic status, BMI values of participants and their children), the information about ethnicity/race was not recorded. Comparing differences among various races/ethnic groups or even cities versus suburbs or states/countries/cultures might reveal some interesting variability.

Conclusion

Overall, it can be concluded that in this study, parental nature relatedness measured as a combination of NR-Self, NR-Perspective and NR-Experience, did not significantly predict body composition in elementary school children. Unexpected positive connection between parental NR-Self and children’s BMI values suggests that parents who strongly identify with nature on a personal level might not necessarily engage their offspring in activities that contribute to their healthy weight. It seems to be the practical aspect of parental contact with nature that might be negatively associated with their offspring’s body composition. The results also indicate that the amount of time children spend actively outdoor in natural settings is negatively linked with their BMI values. This finding could be used to support various efforts to engage elementary school
children in practical recreational and educational outdoor nature activities (organized hiking, exploratory nature trips, free play in natural settings, outdoor exercise programs, etc.).
Dear Parent,

My name is Eva Rivas, I am a researcher from Harvard University Extension School and I am investigating if there is any relationship between maternal (parental) nature connectedness and children’s (age 6-10) body composition. If you are 18+ and you are a primary care giver of your child, I would be most grateful if you could help me by filling out the enclosed survey.

Children in developed societies spend less time playing in nature than previous generations. However, parents’ views and decisions can influence their children’s life style habits. The purpose of my research is to find out if the level of your connection with nature is linked to your child’s body mass index. This study will also reveal how parental age, socio-economic status, length of nursing, the amount of time a child spends being active in a natural environment or the amount of screen time (TV/computer/portable device) might affect the possible relationship.

The research is anonymous and no identifiable information is collected. Therefore, there are no identity/confidentiality risks involved. To participate, please fill out the enclosed survey sheet (both sides, marked Part #1 and Part #2). By doing this, you are providing your consent to participate in this anonymous study. The whole process should not take more than 10 minutes. As an appreciation for participating in this study, you will receive a $10 gift card and an animal sticker. The participation is voluntary, and there are no consequences if you opt not to participate. If you wish not to participate, simply do not fill out the survey.

If you have questions or concerns, or if you would like to talk to the research team, please contact Eva Rivas at 857-277-3801 or e-mail erivas@fas.harvard.edu.

This research has been reviewed by the Committee on the Use of Human Subjects in Research at Harvard University. They can be reached at 617-496-2847, 1414 Massachusetts Avenue, 2nd Floor, Cambridge, MA 02138, or cuhs@fas.harvard.edu. They can be reached if your questions, concerns, or complaints are not answered by the research team/if you cannot reach the research team/if you want to talk to someone besides the research team/if you have questions about your rights as a research participant.

THANK YOU!
Appendix B

Nature Relatedness Scale

Instructions: For each of the following, please rate the extent to which you agree with each statement, using scale from 1 to 5 as shown below. Please respond as you really feel, rather than how you think “most people” feel.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disagree strongly</strong></td>
<td><strong>Disagree a little</strong></td>
<td><strong>Neither agree or disagree</strong></td>
<td><strong>Agree a little</strong></td>
<td><strong>Agree strongly</strong></td>
</tr>
</tbody>
</table>

1. I enjoy being outdoors, even in unpleasant weather. _____
2. Some species are just meant to die out or become extinct. _____
3. Humans have the right to use natural resources any way we want. _____
4. My ideal vacation spot would be a remote, wilderness area. _____
5. I always think about how my actions affect the environment. _____
6. I enjoy digging in the earth and getting dirt on my hands. _____
7. My connection to nature and the environment is a part of my spirituality. _____
8. I am very aware of environmental issues. _____
9. I take notice of wildlife wherever I am. _____
10. I don’t often go out in nature. _____
11. Nothing I do will change problems in other places on the planet. _____
12. I am not separate from nature, but a part of nature. _____
13. The thought of being deep in the woods, away from civilization, is frightening. _____
14. My feelings about nature do not affect how I live my life. _____
15. Animals, birds and plants should have fewer rights than humans. _____
16. Even in the middle of the city, I notice nature around me. _____
17. My relationship to nature is an important part of who I am. _____
18. Conservation is unnecessary because nature is strong enough to recover from any human impact. _____
19. The state of non-human species is an indicator of the future for humans. _____
20. I think a lot about the suffering of animals. _____
21. I feel very connected to all living things and the earth. _____
**Scoring Information**

Reverse scored items: 2, 3, 10, 11, 13, 14, 15, 18; NR-Self items: 5, 7, 8, 12, 14, 16, 17, 21; NR-Perspective items: 2, 3, 11, 15, 18, 19, 20; NR-Experience items: 1, 4, 6, 9, 10, 13.

Overall NR score is calculated by averaging all 21 items (after reverse scoring appropriate items). Scores on the 3 NR dimensions are also calculated by averaging appropriate items after reverse scoring.
Appendix C

Demographic and Activity Survey

SURVEY, Part #2

Please provide the following info:

Your child’s age: ……..years ………months
Your child’s gender: M / F

Your child’s height: ………’………” Your child’s weight: ……….lbs

Your child’s height & weight info source: pediatrician’s record / school nurse record / Other:……………………………

Your age: ………years Your height: …….’…….” Your weight ………….lbs
Your gender: M/F  If you are female, are you a biological mother of the child?  YES/NO

1. How many months was your child breastfed during his/her first 2 years?..............

2. How many total hours of active time (free play, games, sports, hiking) on average per day during a WEEKDAY does your child spend outdoors in natural areas (yard/garden/park/forest/ beach, etc.)?

   In summer:  0  1  2  3  4  5  6  7  8  > 9
   In winter:   0  1  2  3  4  5  6  7  8  > 9

3. How many total hours of active time (free play, games, sports, hiking) on average per day during a WEEKEND does your child spend outdoors in natural areas (green yard/garden/park/forest/beach, etc.)?

   In summer:  0  1  2  3  4  5  6  7  8  > 9
   In winter:   0  1  2  3  4  5  6  7  8  > 9

4. How many total hours (on average) per day during a WEEKDAY does your child spend watching TV/playing sedentary games on the computer/tablet/phone/other screen type electronic devices?

   0  1  2  3  4  5  6  7  8  > 9

5. How many total hours (on average) per day during a WEEKEND does your child spend watching TV/playing sedentary games on the computer/tablet/phone/other screen type electronic devices?

   0  1  2  3  4  5  6  7  8  > 9
6. Your highest achieved education (please check the appropriate option):

☐ Grade school  ☐ College graduate
☐ Some high school ☐ Some graduate work
☐ High school graduate ☐ Master’s degree
☐ Associate degree ☐ Advanced professional degree (e.g. MD, PhD)
☐ Some college/technical school

7. Annual household income (please circle the appropriate):

Less than $35K  $35K-$60K  $60K-$85K  $85K-$110K  More than $110K

THANK YOU VERY MUCH!
References


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