DEVELOPING AND PILOT-TESTING COMMUNITY BASED STRATEGIES FOR INCREASING PHYSICAL ACTIVITY IN CHILDREN IN THE 3rd, 4TH, 5TH, AND 6TH GRADE ON AN AMERICAN INDIAN RESERVATION

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DEVELOPING AND PILOT-TESTING COMMUNITY BASED STRATEGIES FOR
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GRADE ON AN AMERICAN INDIAN RESERVATION

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ABSTRACT

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Individual Interdisciplinary

Developing and pilot-testing community based strategies for increasing physical activity in the children in the 3rd, 4th, 5th, and 6th grade on an American Indian Reservation

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This dissertation used a mixed-methods approach to conduct two inter-related studies focused on increasing physical activity (PA) in children in the 3rd, 4th, 5th, and 6th grades on an American Indian (AI) reservation in the northwestern US.

Study 1 assessed enhancers and barriers to increasing PA in elementary school children. Six focus groups were conducted with children and adults. Each focus group was comprised of 7 to 11 participants and lasted approximately one hour. The analysis revealed strategies to increase PA during the school day that included implementing structured activities during recess and painting lines on the playground for games such as hopscotch and four-square. The results of Study 1 were reported back to the focus group participants and the school for review. Further input was gathered as part of the planning for Study 2.

Study 2 assessed pre-to-posttest differences in self-reported PA and motivation to participate in PA, and body composition (height, weight, and waist circumference) in 4th, 5th, and 6th grade children (mean age = 11 ± 0.9; n = 61; AI = 28; White = 33). The recess intervention was pilot-tested during recess and included three zones: an area where lines were painted (Zone 1), an area where permanent playground equipment was located (control area; Zone 2), and an area where structured recess activities were facilitated bi-weekly (football, soccer, basketball, and ultimate frisbee; Zone 3). The 8-week intervention found significant pre-to-posttest differences in PA between all 3 zones. Females engaged in significantly more moderate-to-vigorous physical activity (MVPA) and vigorous physical activity (VPA) in Zone 1 and Zone 2 compared to males. Males engaged in significantly more MVPA and VPA in Zone 3 compared to females. There was no difference in PA levels between bi-weekly facilitator led activities in Zone 3.

These studies demonstrate how a CBPR, mixed-methods approach is inter-related and developed from the community’s perspective. The findings from this study offer insight into a field that has been relatively unexplored in Indian country and may help investigators determine effective and sustainable strategies to increase PA during recess in elementary school children on an AI reservation.
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CHAPTER 1: INTRODUCTION
1.0 Type 2 Diabetes Mellitus and American Indians

Obesity and the subsequent development type 2 diabetes mellitus (T2DM) have emerged as a major health problem among American Indians (AI) in the United States and Canada. According to the Centers for Disease Control (CDC), it is estimated that 23.6 million people (AI and non-AI’s combined) have diabetes.\(^1\) Among the reported cases, T2DM is the most prevalent form of diabetes\(^2\) and accounts for 90-95% of all diagnosed cases.\(^1\) Research shows that the prevalence of T2DM is on the rise\(^3\) and T2DM in children has been declared a public health problem.\(^2\) A meta-analysis by Dabelea et al.\(^2\) reported the mean age of diagnosis of T2DM is approximately 13.5 years in AI children. Other studies have reported the mean age of diagnosis in AI children at 12.1 years \(^4\) and 11.7 years.\(^5\) As the age of diagnosis continues to decrease, the need for effective obesity and diabetes prevention programs for AI children is urgent.

1.1 Rationale for Dissertation Studies

Prior research reports obesity prevalence in AI youth is 2.2 times higher compared to the general US population.\(^6\) Several studies in the following literature review describe the deleterious effects of obesity on health and its strong association with the development of type 2 diabetes mellitus. The long-term consequences of T2DM among AI children may be more devastating than type 1 diabetes mellitus as T2DM is associated with multiple co-morbidities such as cardiovascular disease, retinopathy, neuropathy, and nephropathy.\(^3\) Daily PA can reduce the risk of obesity and
associated chronic diseases, including T2DM. Increasing PA levels in AI children may hold the greatest promise for prevention of chronic diseases.

Obesity prevention programs are needed to avoid the long-term consequences of obesity in AI populations and may be the only long-term solution to the diabetes epidemic. Interventions designed to prevent disease before it occurs (i.e., prevention) are suggested to have a greater impact than weight-reduction programs (programs designed to reduce weight after it is already gained) and are urgently needed to develop effective exercise programs for AI children. School-based interventions designed to increase PA levels and decrease obesity in children such as Physical Activity Leaders (PALs) and CATCH are ideal models to follow when doing research in the school setting since they contain an intense emphasis on increasing physical activity. The HEALTHY study may also contain some strategies that are particularly effective for preventing overweight/obesity in high-risk children. The scope of these obesity/diabetes prevention studies align closely with this intervention that was designed and implemented to increase PA in AI children living on a rural, Montana reservation.

1.2 Justification for Using Community-based Participatory Research

Community-based participatory research (CBPR) is grounded in establishing co-equal partnerships between the researcher(s) and the community that promotes involvement from the inception to conclusion of the study, which in turn increases the likelihood of employing the best combination of community wisdom and scientific knowledge. This aspect is critical if the researcher hopes to gain entry into the community and establish the relationships necessary to develop a culturally appropriate intervention tailored to the community’s needs. Cultural adaptation of the intervention
components that are agreed upon and accepted by the community is arguably the most critical component (aside from community involvement), as traditional health care delivery systems have struggled to successfully reach AI communities.\textsuperscript{14} The most effective approach when implementing interventions is to involve community members in every aspect of the planning process and incorporate cultural values, beliefs and perspectives into the intervention. Establishing relationships and trust between the researcher(s) and community fosters capacity building for future translational studies.\textsuperscript{13} Thus, the elements of CBPR discussed above provide justification for utilizing this approach when designing and implementing interventions in AI communities.

1.3 Justification for Using a Mixed-Methods Approach

A mixed-methods approach is often embedded within CBPR studies.\textsuperscript{15-24} A mixed-methods, CBPR approach typically begins with a formative phase that aligns closely with the concepts of CBPR. In an exploratory, mixed-methods, CBPR study, the initial formative phase helps develop relationships between the researcher and with people living in the community, and provides opportunities to collect qualitative data describing the community’s perspective about ways to address the health problem of interest. The partnerships developed during this phase of the study build capacity for the research and serves as a foundation for the rest of the study, and beyond.

Some of the mixed methods used to develop and implement diabetes prevention programs in Indian Country are focus groups, interviews, direct observation, weekly meetings, and surveys.\textsuperscript{16,20,22,24,25} These data are used to identify common themes for diabetes prevention strategies that are then used to develop an intervention. Essentially, the community “tells” the researcher how the health problem in their
community can be addressed in addition to identifying culturally appropriate strategies that increase the likelihood of successful outcomes.

A mixed-methods CBPR approach is perhaps the most appropriate when working with AI communities. The process of establishing relationships, assessing community identified obesity and diabetes prevention strategies, and working with the community to implement these strategies supports using a mixed-method, CBPR approach in the studies described in this dissertation.
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CHAPTER 2: REVIEW OF LITERATURE
2.0 Prevalence of Obesity in American Indian children

Studies show a direct relationship between obesity and T2DM in AI youth.\(^9\) Nationwide data on obesity prevalence specific to AIs are limited,\(^{26}\) but the available research reports obesity prevalence among AI youth is increasing and is 2.2 times higher in native youth than non-native youth.\(^{27}\) Obesity in AI youth has been declared a serious public health concern.\(^{28}\)

Most of the studies determining obesity prevalence in AI children have been conducted in school settings. These cross-sectional studies typically use body mass index (BMI) to classify normal weight, overweight or obesity. The BMI is calculated by the equation weight(kg)/height(m)\(^2\). For children age 2 – 19 years old, overweight is defined by BMI as exceeding the 85\(^{th}\) percentile for age and sex and obesity is defined by BMI as exceeding the 95\(^{th}\) percentile for age and sex.\(^{29}\)

The following section describes obesity prevalence in various tribes living in the United States. Tribes represented in these studies include the Navajo in northeast Arizona, White Mountain Apache in eastern Arizona, Mescalero Apache in south central New Mexico, and Northern Plains Indians in Montana. The small number of studies included in this literature review clearly cannot represent the more than 550 sovereign tribes living in the U.S., which demonstrates how little we know about the true burden of obesity in AI children. Therefore, these studies may not accurately depict the true prevalence of obesity in AI children across the nation.

The Navajo Indian Reservation is located in northeast Arizona and spans a total of 360 square miles. It is the largest Indian reservation in the US. Sugarman and colleagues\(^{30}\) conducted a cross-section of body composition from Navajo Indian
children (ages 5-17) from 238 different schools that included every grade level (K-12; n = 1969). The results indicated that 11.2% of girls and 12.5% of boys were obese (≥ 95th percentile of weight for age compared to NHANES II).

The Fort Apache Indian Reservation is located in eastern Arizona. Nelson\textsuperscript{31} conducted a cross-sectional study of height and weight measurements collected from a 1992 cohort that included 2,024 White Mountain Apache students in pre-kindergarten through 12th grade. The author reported that 29% of the students were categorized as overweight and 12% were obese.

The Mescalero Apache Indian Reservation is located in south central New Mexico. In 1991, Gallaher and colleagues\textsuperscript{8} conducted a cross-sectional study of Mescalero Apache children aged one to five years old (n = 261) to determine genetic factors of obesity and prevalence of obesity among children in this age group. The data revealed obesity prevalence at 19.5 percent. According to the National Center for Health Statistics (NCHS) reference population, the expected rate of obesity in this age group was 5 percent. Thus, the prevalence of obesity in these children was significantly (\(p \leq 0.001\)) higher than the NCHS expected rate. Although the rates of obesity were high, the authors contest that using NCHS as a reference population to compare against AI populations may not be valid since the NCHS is made up of mostly white and black children.

The Pathways study was a large scale obesity prevention intervention study that included AI children in 41 elementary schools (grades 3rd – 5th) in seven southwestern AI communities in the United States. The tribes participating in this study included the White Mountain Apache, San Carlos Apache, Navajo, Sicangu Lakota, Oglala Lakota,
Tohono O’odham, and Gila River Indian Community (Pima-Maricopa).\textsuperscript{26} Caballero et al.\textsuperscript{26} reported that 48.9\% of the population was classified as overweight and 28.6\% were obese among 1,704 girls and boys assessed. According to these data, approximately 77.5\% of the entire sample was either overweight or obese.

Story et al.\textsuperscript{32} reported data on the 1997 Pathways data. The study was conducted among 2\textsuperscript{nd} – 3\textsuperscript{rd} graders in 41 schools in Arizona, New Mexico, and South Dakota. The investigators conducted a cross-sectional study of body composition (i.e., height, weight, and BMI) on 1441 students and determined that 17.9\% were overweight and 24.3\% were obese when compared to the NHANES I data. Overall, these data reported that 42\% of the children assessed in the sample were either overweight or obese.

The Aberdeen area encompasses four states that include North Dakota, South Dakota, Nebraska, and Iowa and contains 18 AI tribes. Zephier et al.\textsuperscript{33} measured school aged participants identified as AI in these communities. The data collected in this cross-sectional study is comprised of 12,559 K - 12\textsuperscript{th} grade students age five to 17 years old. The authors reported an overall prevalence of overweight among AI males at 39.1\% and females at 38\%. The authors reported overall prevalence of obesity among AI males at 22\% and females at 18\%. An additional analysis was calculated with the subset that contained children age 10 to 14 years old. The authors reported prevalence of overweight at 41.2\% for males and 37.9\% for females. The prevalence of obesity was reported at 23.6\% for males and 19.7\% for females. According to the data, the prevalence of AI children age 10 to 14 years old classified as overweight was greater in males compared to females. Additionally, combining the data of both girls and boys
(age 10 to 14 years old) revealed a higher prevalence of obesity compared to the entire sample of both girls and boys age 5 to 17 years old.

The Child Health Measures in Northern Plains Indian children and adolescents is a 5-year longitudinal study assessing risk factors associated with diabetes in children and adolescents attending schools on or near the eight AI reservations in Montana and Wyoming. The diabetes risk factors assessed in this study include BMI, blood pressure, family history of diabetes and heart disease, PA, and dietary intake. Cross-sectional data from five reservation communities participating in this study in 2008 showed that almost 57% of AI children age 5-19 years old were overweight/obese, 30% were pre-hypertensive or hypertensive, and 62% reported having a 1st or 2nd degree relative with diabetes.34 Other studies reporting Child Health Measures data show that 24.4% of subjects (n = 2,520) who had acanthosis nigricans (a marker for insulin resistance) were also obese35 and in 2010, 21.9% of the sample (n=1,792) were overweight and 34.7% were obese.36

These studies illustrate the critical importance of addressing obesity in AI youth. The studies described throughout the latter section of this review demonstrate a wide range of prevalence rates of overweight in AI and First Nations children and adolescents that vary between 17.9%37 to 66%,38 and obesity prevalence rates that vary between 9.2%39 to 71.4%.5 One study reported a prevalence of overweight and obesity combined in AI children and adolescents at 77.5%26 (Table 1). The prevalence of overweight and obesity reflect significant risk of chronic diseases for AI children— one of the most significant being high risk of developing T2DM40-42 as they mature into adulthood.3,43 These studies show that much of the research done with AI children is an
attempt to better understand and determine the burden of obesity existing in AI populations. These data provide rationale for the importance of developing and implementing effective behavioral interventions that decrease the prevalence of obesity in AI youth and ultimately, decrease their likelihood of developing T2DM in to adulthood.
Table 1. Prevalence of overweight and obesity in American Indian and First Nations children and adolescents studies.

<table>
<thead>
<tr>
<th>Tribe/Location</th>
<th>Population</th>
<th>Study Design</th>
<th>OW¹</th>
<th>OB²</th>
<th>Ref³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navajo</td>
<td>Children age 5-17 years, grades K-12; n = 1969</td>
<td>Cross-Sectional</td>
<td>DNR⁴</td>
<td>12%</td>
<td>30</td>
</tr>
<tr>
<td>White Mountain Apache</td>
<td>Children age 5-18 years, grades K-12; n = 2024</td>
<td>Cross-Sectional</td>
<td>29%</td>
<td>12%</td>
<td>31</td>
</tr>
<tr>
<td>Mescalero Apache</td>
<td>Children age 1-5 years; n = 261</td>
<td>Cross-Sectional</td>
<td>DNR⁴</td>
<td>20%</td>
<td>8</td>
</tr>
<tr>
<td>Seven southwestern tribes</td>
<td>Children grades 3-5; n = 1704</td>
<td>Cross-section of larger randomized control trial (Pathways)</td>
<td>49%</td>
<td>29%</td>
<td>26</td>
</tr>
<tr>
<td>Seven southwestern tribes</td>
<td>Children grades 3-5; n = 1441</td>
<td>Cross-section of larger randomized control trial (Pathways)</td>
<td>18%</td>
<td>24%</td>
<td>32</td>
</tr>
<tr>
<td>Aberdeen area</td>
<td>Children age 5-17 years; n = 12559</td>
<td>Cross-Sectional</td>
<td>39%</td>
<td>20%</td>
<td>33</td>
</tr>
<tr>
<td>Northern Plains Tribes</td>
<td>Children age 5-19 years; n = 1852</td>
<td>Cross-Sectional</td>
<td>22%</td>
<td>35%</td>
<td>36</td>
</tr>
</tbody>
</table>

¹Overweight prevalence; ²obesity prevalence; ³Reference; ⁴Data not reported
2.2 T2DM in American Indian Children

Incidence rates for T2DM in AI children are limited. A considerable amount of the literature elucidating T2DM incidence in AI populations has been done with the Pima Indians from the Gila River Indian Community in Arizona,\textsuperscript{9,38,40,44} but because all of these studies are with adults they are not presented in this review. Data from the Cree and Ojibway tribe in Canada are available—only one study focused on children that is presented in this literature review.\textsuperscript{5,45} Accordingly, this brief review describes studies reporting T2DM incidence among AI children representing the First Nations in Canada (Cree and Ojibway), and also includes an epidemiological review conducted by Fagot-Campagna.\textsuperscript{3}

2.2.1 Canada: First Nations of Northwest Ontario

In 1988, Dean and Moffatt\textsuperscript{45} examined medical records and found 15 cases of T2DM among children age 15 years and younger. The incidence rate was reported to be 5.6 cases per 1,000 person-years with a mean age of 12 years. Since the incidence of T2DM was determined from a medical record review, the investigators were certain that this incidence rate was an underestimate and the true incidence is much higher.

In 1996, Harris et al.\textsuperscript{5} conducted a study in northwestern Ontario (participants once again included the Cree and Ojibway tribes) and assessed the medical records for children age 16 years and younger. The study reported a diabetes incidence rate of 2.5 cases per 1,000 person-years, which amounted to a total of 18 diagnosed cases. The mean age of diagnosis was 11.7 years old and the majority of the patients were female (17 females and one male). Similar to the previous study, the authors speculate that the incidence rate reported from a medical record review is underestimated, coupled
with the fact that the trend of rising diabetes rates have been reported among AI children across the US and Canada. Forty percent of the Cree and Ojibway tribe are under the age of 16 years and at high risk of developing diabetes unless more diabetes (and obesity) prevention programs are implemented in AI and First Nations youth.

2.2.2 Meta-Analysis Studies

In 2000, Fagot-Campagna\(^3\) conducted a meta-analysis to elucidate incidence rates of childhood diabetes in North America. The study included children of different backgrounds that included Hispanic, African American, Caucasian, and American Indian. The study assessed time periods between 1988 and 1996 and included AI’s 15 to 19 years old. The authors reported an incidence rate of 4.5 cases per 1,000 compared to 4.1 cases per 1,000 for whites, African Americans, and Mexican Americans (data combined).

Collectively, the evidence from these studies suggest that the rate of T2DM in AI children residing in Canada and the US are comparable,\(^{45}\) but there is wide variability. The incidence of T2DM in AI children, however, may be higher than these studies report since many cases are asymptomatic and diagnosis are either misclassified, undiagnosed, or underreported.\(^3\) The literature reports T2DM incidence rates for non-Hispanic whites age 10 to 19 years at 3.8 cases per 1,000 person-years.\(^{46}\) The incidence rates of T2DM in non-Hispanic whites are much lower than those reported in the literature for AI children (incidence rates reported as high as 26.5 cases per 1,000 person-years\(^{47}\)) and considering the demographics of AI tribes that report a high population of children under that age of 16 years old,\(^5\) these data underscore the critical importance of developing diabetes (and obesity) prevention programs for AI children.
2.3 Diabetes’ Increasing Trends

Prior to the 1950’s, diabetes was rare and virtually non-existent among AI populations. American Indian tribes during the time (1950’s and 1960’s) were burdened with poor health conditions such as malnutrition and underweight, which in many cases proved to be fatal. Although commodity foods distributed to each tribe sought to address this problem, oftentimes the foods were high in fat and calories and low in fiber. Although commodity foods may have reversed the effects of malnutrition, the introduction of this Western diet, along with declines in hunting, fishing and gathering traditional practices, is thought to be one of the main factors contributing to the obesity epidemic and rampant development of T2DM in AI populations.

Some reasons that diabetes may have been relatively nonexistent during the 1950’s may be attributed to AI tribes’ inaccessibility to automobiles, fast food, and television. Throughout the years, AI tribes have evolved alongside mainstream society and adopted the technological and sedentary lifestyles like the rest of the modern world. Today, AI populations have access to modern technology such as television and video games, automobiles, fast food, and a host of other conveniences that are available throughout the United States. Despite the conveniences afforded through technology, these advancements have arguably contributed to a significant proportion of the population leading a sedentary lifestyle that is associated with the development of obesity and associated risk of T2DM.

The rise of T2DM in AI populations has prompted researchers to determine the risk factors responsible for the development of diabetes and test behavioral strategies that decrease risk factors associated with this deadly disease. Prior research...
has identified five major risk factors associated with risk for diabetes. These risk factors include 1) obesity, 2) sedentary lifestyle, 3) family history, and 4) hypertension. These five risk factors will be described in detail in the following section.

2.4 T2DM Risk Factors in AI Children
2.4.0 Obesity

Body mass index (BMI) is the standard measurement used to classify obesity, which is one of the greatest risk factors for T2DM. BMI is shown to be highly related to T2DM incidence among the Pima Indians. Pettitt et al. explored this relationship and reported that incidence rates of T2DM in Pima Indians with a BMI of 40 kg/m² is 70 cases per 1,000 person-years compared to a BMI of 20 kg/m², which is reported at 1 case per 1,000 person-years.

The prevalence of childhood and adolescent overweight in the US has tripled between 1980 and 2000, and African Americans, Hispanic-Latinos, and AI populations have the highest prevalence of obesity among North American children. The prevalence of overweight and obesity among AI youth is reported to be 2 – 4 times the national average.

Obesity has emerged as one of the greatest health issues in the world over the last few decades. Research suggests that obesity is the greatest risk factor for the development of T2DM. As obesity and sedentary lifestyles have increased, these risk factors that were once only seen in adults are now prevalent in youth. Despite age, the distribution of body fat located around the abdominal region has also been highly associated with risk for diabetes. Excess abdominal fat impairs insulin action on glucose metabolism, which augments insulin resistance. This effect remains
constant up to a body fat percentage equal to 28 percent. Individuals carrying excess body fat around the abdominal region have been reported to have blood glucose values in the diabetic range and significantly higher fat cell volumes compared to individuals that carry excess body fat in the lower body region. Hypertrophied fat cells have been shown to increase to a certain size and then hyperplasia occurs where the fat cells multiply. Weight loss only decreases the volume of the fat cells, but does not decrease the number of cells that have accumulated due to hyperplasia, which is why obesity is so devastating and difficult for individuals to lose the additional weight once it has accumulated.

The effects of weight loss on obesity have marked effects on insulin action and blood glucose mechanics. Obese subjects administered a liquid diet, which contributed to significant weight loss, reported significant improvements ($p \leq 0.05$) in mean total weight loss, mean BMI, mean fasting plasma glucose, mean total glycosylated hemoglobin, and mean adipocyte cell volume. After weight loss, a post assessment confirmed a 165% increase ($p \leq 0.001$) in the glucose disposal rate and these results support improvements in insulin action and glucose disposal at the site of target tissues such as adipocytes and skeletal muscle following significant weight loss. Incorporating aerobic exercise as a method to decrease body weight has been reported to significantly ($p \leq 0.05$) improve the performance of metabolic enzymes, which in turn enhance oxidative metabolism—these biomarkers collectively reflect an improvement in insulin sensitivity. These findings suggest sedentary activity (which contributes to the decline in oxidative metabolism) predisposes human skeletal muscle to the development of insulin resistance and these effects can be reversed with weight loss.
and physical activity. Accordingly, living a physically active lifestyle may decrease risk factors for T2DM and can directly address sedentary activity and overweight/obesity.  

2.4.1 Sedentary Lifestyle  

Regular PA decreases risk for obesity and diabetes. Limited data suggest that physical inactivity contributes to excessive weight gain in AI children, which in turn increases their risk for T2DM. Research shows that adopting and maintaining a physically active lifestyle plays a significant role in preventing T2DM. Resistance training has been shown to improve insulin sensitivity and glucose regulation in adults with impaired glucose or T2DM. This exercise modality may be important for decreasing risk factors associated with T2DM in AI children at high risk. For example, Shaibi et al. reported a 16 week twice-per-week progressive resistance training program in Hispanic adolescent males that led to significant increases \((p \leq 0.001)\) in insulin sensitivity in the training group compared to the control group. While current research suggests that physical activity improves disease risk profiles of overweight children, more studies are needed to determine the optimal frequency, intensity, duration, and mode of activity needed for obesity risk profile improvement.  

The effects of sedentary activity are deleterious and have been associated with weight gain, obesity, hypertension, insulin resistance, T2DM, and cardiovascular disease. Studies have shown that decreasing the amount of steps per day during short term intervals can be detrimental. Krogh-Madsen et al. conducted a study that required subjects to decrease the number of step per day by 1500 for 14 days. The authors reported a significant decline \((p \leq .001)\) in VO\(_{2\text{max}}\) \((\text{ml/min})\) of 7.2% and a
significant reduction \((p \leq .01)\) in the insulin-stimulated glucose disappearance rate.\(^{53}\)

Another study showed that a decrease of 7,000 steps per day for 14 days elicited a significant increase \((p \leq 0.05)\) in plasma insulin concentrations (suggesting insulin resistance) and fostered an increased storage of visceral fat.\(^{79}\)

Ekelund et al.\(^{80}\) studied the PA levels of individuals with a family history of diabetes and determined that two thirds (66.2\%) of the sample participated in less than 30 minutes (min) of PA per day according to four day accelerometry data. The time spent in sedentary activity had a significant \((p \leq 0.05)\), positive relationship with fasting insulin.\(^{80}\)

Television viewing (TV) is arguably one of the greatest contributors to sedentary activity. Subjects who spent > 40 hours per week watching TV had a mean BMI of 28 kg/m\(^2\), which is defined as overweight.\(^{81}\) The more time spent watching TV was associated with an increased consumption of fat, caloric intake, insulin resistance, fasting plasma glucose, obesity, and T2DM.\(^{81-84}\)

These studies are specific to adults, but can be translated to children due to the evidence of the deleterious effects sedentary activity has on the human body such that children may be just as susceptible to these negative consequences as adults. Thus, the need to develop PA interventions in populations with a high prevalence of obesity and diabetes prevalence such as AI youth is urgently needed.

2.4.2 Family History

Having a first-degree relative with diabetes and being AI are risk factors for type 2 diabetes mellitus.\(^2,85\) For example, 74-100\% of patients with T2DM report having at least one first- or second-degree relative with T2DM,\(^{86}\) or having multiple affected family members in one generation.\(^2\) On average, AI adults are 2.6 times more likely to have
T2DM than non-Hispanic whites of similar age, and data shows that minority children are more insulin resistant than non-minority children, regardless of degree of adiposity and other biological and behavioral factors. Cook and Hurley classify family history next to obesity as the second greatest risk factor for the development of diabetes and both of these variables (family history and obesity) are criteria for children to be tested for diabetes every two years.

Pettitt et al. assessed offspring of diabetic mothers, prediabetic mothers, and nondiabetic mothers. The offspring of mothers with diabetes were significantly more obese (p ≤ 0.001) compared to the offspring of prediabetic and nondiabetic mothers, with nearly half (47.7%) of the sample reportedly obese. The authors suggest that diabetic mothers may have had more diabetic and obese genes that were transferred to the offspring during pregnancy.

In 1991, Pettitt et al. evaluated the epidemiological data (reported every two years since 1965) collected on the Pima Indians and reported a 45% prevalence rate of diabetes among offspring age 20 to 24 who had a diabetic mother during pregnancy. The authors conferred evidence that mothers with diabetes and abnormal glucose tolerance during pregnancy impose a high risk on the offspring of developing obesity, insulin resistance, and abnormal glucose tolerance at young ages.

Barrett-Connor suggests that genetics may be so potent that individuals with a family history of diabetes will develop the disease regardless if they develop obesity or not. However, this may be unlikely as the diabetic gene may also contribute to obesity and thus the two conditions are likely to develop concomitantly.
Snehalatha and colleagues\textsuperscript{90} conducted a study comprised of adults with a mean age of 34.5 years. The participants were selected according to family history of diabetes (both parents affected; treatment group) or no family history (control group). The investigators conducted an oral glucose tolerance test (OGGT) and anthropometric measurements (age, height, weight, BMI, and waist and hip girth) to compare the groups. Among the group with a family history of diabetes, 21% of the sample was diagnosed with diabetes and 32% had impaired glucose tolerance. Every subject entered the study without diabetes and all diagnosis was detected during the study.

Savage et al.\textsuperscript{40} conducted a cross-sectional study by reviewing medical records of Pima Indians living in the Gila River Indian community. According to the medical record(s), individuals with two diabetic parents were found to have significantly higher two hour plasma glucose levels compared to those with only one diabetic parent. The subjects assessed in this study were 15 to 24 years of age, suggesting the genetic effect on blood glucose is more predominant during the teenage years in those with two diabetic parents compared to individuals with only one diabetic parent.

Dean and Moffatt\textsuperscript{45} conducted a cross-sectional study similar to that of Savage et al.,\textsuperscript{40} where the investigators assessed the medical records of AI children. The population in this study included First Nations children living in Manitoba, Canada aged 15 years and younger. The outcome of the study revealed 15 cases of T2DM among those included in the sample and all of the cases had at least one parent diagnosed with T2DM.

In 1991, Dean et al.\textsuperscript{4} followed up with a study that assessed the evaluation of First Nations children under 15 years of age who were referred to the diabetes clinic at
the Children’s hospital of Winnipeg between 1984 and 1990. During this span, 20 cases of T2DM among Indian children in Manitoba were reported. Among the 20 reported cases, 16 had a strong family history of diabetes, with all but one having a mother diagnosed with diabetes. The genetic component may even be higher as the parental information of the other four cases was not available to the investigators.

In 1996, Harris et al. reviewed medical records of Cree and Ojibway children under the age of 16 years. The investigators found 18 cases of diabetes—71.4% were obese and 92.9% had a family history of diabetes. More specifically, 69.2% had at least one parent with diabetes and the rest had a secondary relative with diabetes, such as an aunt, uncle, grandparent, etc.

In 1991, Gallaher and colleagues reviewed the medical records of Mescalero Apache children aged one to five years old to determine genetic factors for obesity and elucidate the true prevalence of obesity among children in this age group. The data were reported for 261 subjects, with a total obesity prevalence rate of 19.5% and a mean BMI of 19.5 kg/m². Obese children were 2.5 times more likely to have an obese mother than non-obese children and the prevalence of obesity increased with increasing birth weight. Thus, maternal obesity and high birth weight were strongest risk factors for childhood obesity suggesting a link not only for obesity, but also the development of diabetes.

2.4.3 Hypertension

Hypertension is highly associated with the development of T2DM. A study conducted by Fagot-Campagna et al. determined that 17-32% of youth diagnosed with T2DM also had hypertension. Physical inactivity has also been shown to contribute to
the development of hypertension. Saito et al.\textsuperscript{56} assessed physical activity levels in young obese subjects and found insulin resistance and decreased physical activity levels in those with hypertension (obese normotensive subjects did not show this relationship).

A meta-analysis compiled from various reports by Galloway et al.\textsuperscript{52} assessed blood pressure measurements and concluded that the rate of hypertension in AI’s is rising dramatically and increases concomitantly with increases in obesity and diabetes.

Sewell and colleagues\textsuperscript{91} assessed cardiovascular risk factors among White Mountain Apache tribal members applying for a physically strenuous job. The authors reported hypertension in 20\% of the 70 applicants, which was highly associated with obesity (51\%) and strongly related to the development of T2DM.

Gilbert and colleagues\textsuperscript{92} evaluated anthropometric and blood pressure (BP) measurements among 352 Navajo high school children age 13 to 19 years. The author’s reported hypertension in 36\% of the boys and 64\% of the girls coupled with obesity. In addition, systolic BP among boys increased with increasing BMI and systolic BP and diastolic BP increased with increasing BMI in girls. These data illustrate a positive relationship between increased BMI and BP in Navajo adolescents.

Smith and Rinderknecht\textsuperscript{93} reported significantly ($p \leq 0.05$) higher systolic (SBP) and diastolic blood pressure (DBP) in subjects determined to be overweight (BMI exceeding the 85\textsuperscript{th} percentile for age and weight) in a study assessing body composition of urban AI children age 5 to 18 years. The authors illustrated that waist circumference, age, and BMI were strong predictors of elevated SBP and diastolic blood pressure.
Waist circumference is perhaps the strongest predictor of SBP accounting for 52% of the variance, with only 30% of the variance accounted for by diastolic blood pressure.

Collectively, these studies demonstrate the overwhelming risk for AI children to develop diabetes in their lifetime. The studies provide evidence of the high risk facing offspring of overweight mothers and the detrimental effects of having a 1st or 2nd degree family member diagnosed with type 2 diabetes mellitus. Despite the strong association between diabetes risk and family history of diabetes, having this risk factor does not mean the offspring will automatically develop the disease. However, these results do suggest that interventions targeting sedentary activity and obesity are desperately needed not only for pregnant mothers, but also for children at risk of developing type 2 diabetes mellitus.

2.5 Obesity and Physical Activity Interventions

The majority of obesity and PA interventions have been conducted in non-AI children and adolescents. However, these interventions provide a good framework for investigators and communities to consider when designing interventions for AI youth. Many of these studies collaborated with schools to implement health curricula designed to increase knowledge in children about the risk of obesity and related behaviors (sedentary behavior, unhealthy eating, etc.). The following section describes the design, implementation, and evaluation of obesity and physical activity interventions in children and adolescents. Some of these studies address multiple behavioral factors, such as nutrition, diet and physical activity. Because the focus of this dissertation was to increase physical activity (and not improve dietary intake) during recess in children attending an elementary school on an AI reservation, this section of the literature review
will describe school-based childhood obesity prevention studies that contained components for increasing physical activity and/or reducing time spent in sedentary activities in children and adolescents.

The Switch what you Do, Chew, and View (VIEW) study employed an experimental design with 10 elementary schools that were randomly assigned to a treatment group (n=5 schools) or a control group (n=5 schools). Schools were matched by enrollment and percent free/reduced cost lunch prior to random assignment. The intervention included family, school, and community-based components that addressed risk factors for obesity. The specific objectives of the PA components were to increase PA to 60 min or more per day and reduce TV viewing/screen time to two hours or less per day, and increase fruit and vegetable consumption to at least five servings per day among 3rd – 5th grade students attending the schools. A total of 1,323 students participated in the study, who were mostly white (90 percent). The school based component integrated messages in to the curriculum (i.e., 60 min or more of PA, reduce TV time, etc.). Teachers were supplied with VIEW materials, but not required to participate. The community component was administered through media messages (i.e., billboards), and the family component was disseminated through monthly packets to parents and children that contained VIEW messages. Pre, post, and six month assessments consisted of the National Youth Risk Behavior Survey, anthropometric measurements (height, weight, and BMI), and objective measures of PA via pedometry. The post intervention assessment showed a significant decrease ($p \leq 0.05$) in screen time for parents in the intervention group. These differences were maintained at the six
month assessment. Children in the intervention group had a non-significant (Cohen’s $d = 1.83$, large effect) mean increase of 350 steps per day.

The HEALTHY study\textsuperscript{12} was a three year diabetes prevention intervention conducted in 42 schools at seven locations in the U.S. The schools were selected based upon a high minority population (i.e., African American and Hispanic) and at least 50% of the students receiving federally subsidized, free or reduced-price meals. The schools were randomly assigned to either receive the intervention (i.e., treatment; $n = 21$ schools) or serve as control ($n = 21$ schools). The school-based treatment curriculum targeted students in the 6th grade and consisted of four components that included 1) nutrition, 2) PA, 3) behavioral knowledge and skills (BNS), and 4) communications and social marketing (SM). The nutrition component targeted the content of school meals and food served within the school environment (i.e., vending machines). The PA component was implemented in to the PE curriculum with the objective to increase the time spent in moderate-to-vigorous PA (MVPA). The BNS component was administered within the classroom environment and disseminated through the Fun Learning Activities for Student Health (FLASH) cards. The communication and SM component were strategies the investigators employed to integrate each component of the project into the school environment/curriculum.

Baseline (fall of 6th grade) and post (spring of 8th grade) assessments consisted of biochemical (blood glucose level [BG; the authors did not describe if fasting or OGGT], insulin level, blood pressure [BP]), and anthropometric (weight, height, BMI, waist circumference) measurements in addition to on-going process evaluation that consisted of observation during the course of the intervention ($n = 4603$). There was no significant
difference in the combined prevalence of overweight and obesity between students in
the control and intervention schools, however students in the intervention schools who
were overweight or obese in the 6th grade had a 21% lower odds of being obese at the
end of 8th grade (odds ratio, 0.79; 95% CI = 0.63 to 0.098; p = 0.04). These findings
suggest that youth at higher risk for diabetes (i.e., overweight or obese) may be initially
more responsive to a behavioral intervention than youth at lower risk for disease.

The Child and Adolescent Trial for Cardiovascular Health (CATCH)95 was a
large-scale, multi-site study integrated in to the Physical Education (PE) curriculum in
grades 3rd – 5th and implemented in 96 elementary schools in four states (California,
Louisiana, Minnesota, and Texas). Students were recruited to participate in the study
beginning in the 3rd grade and completed the study at the end of their 5th grade year.
Schools were randomized to either measurement only (i.e., control) or intervention
condition. The intervention schools were further randomized in to a school-based
intervention or school-based plus family intervention. The intervention included
education on healthy eating, a PE program (CATCH PE Guidebook and the Activity
Box), cardiovascular health education, tobacco policy, school policy, and a home/family
component. The overall objective of the program was to modify and enhance the PE
curriculum. The CATCH curriculum was administered three days per week for a total of
90 minutes with the intent to promote children’s enjoyment of moderate-to-vigorous
physical activity (MVPA). The goal of the intervention was to engage students in MVPA
for at least 40% of the total PE time. Outcome measures collected at baseline and at
three year follow-up incorporated validated measures for observing fitness instruction
time (SOFIT; a direct observation instrument), physical activity record of classes
(PARC), a nine minute run, and a self-administered PA checklist (SAPAC; administered post assessment only). Additionally, the investigators collected process evaluation measures that included the Lesson Observation Checklist and the CATCH PE Debriefing Form.

Students in the CATCH intervention schools significantly increased their amount of MVPA during PE classes by 39% \( (p \leq 0.05) \) while the control schools increased MVPA by 23 percent. Compared to students in the control schools, students in the intervention schools reported a higher estimated energy expenditure (EE) kcal/kg \( (p \leq 0.05) \), higher EE rate kcal/kg/min \( (p \leq 0.05) \), increased vigorous PA minutes \( (p \leq 0.05) \), increased MET-weighted vigorous minutes \( (p \leq 0.05) \), and increased encouragement to be physically active \( (p \leq 0.0001) \). Data showed that half or more of the intervention group were engaged in MVPA for at least 40% of the class time \( (p \leq 0.0001) \), and class-time included warm-up \( (p \leq 0.0001) \) and cool down \( (p \leq 0.0001) \) compared to control schools. Gender differences were also observed in boys in the intervention group gaining more yards during the nine minute run \( (p \leq 0.0001) \) and engaged in more PA minutes \( (p \leq 0.0001) \), and vigorous PA minutes \( (p \leq 0.0001) \) compared to girls in the intervention group.

Planet Health\textsuperscript{96} was an obesity prevention study conducted among 10 schools that were randomly assigned to an intervention group \( (n=5) \) or a control group \( (n=5) \) in Boston, Massachusetts. Students in the 6\textsuperscript{th} and 7\textsuperscript{th} grade participated in this two year study \( (n = 1295) \). The intervention was designed to increase MVPA, improve diet (decrease consumption of high fat foods and increase consumption of fruits and vegetables), and decrease TV viewing time to less than two hours per day. The
intervention incorporated constructs of behavioral-choice and social cognitive theories of individual change to address these variables. More specifically, the intervention was curriculum based and included teacher training workshops, classroom lessons, PE materials, wellness sessions, and fitness funds. Pre and post measures included anthropometric measures (height, weight, skinfold thickness, BMI), a food and activity survey (measured TV viewing, PA, and dietary intake), a TV and video survey, a youth activity PA questionnaire, and a youth food frequency questionnaire. The authors report a significant decline in obesity prevalence ($p \leq 0.05$) in females in the intervention group (but not males), and females and males both decreased the amount of TV viewing ($p \leq 0.01$) in those receiving the treatment compared to control. The authors also reported that students in the schools implementing the treatment curriculum each hour of reduced TV viewing was associated with a reduction in obesity prevalence ($p \leq 0.05$) and increased remission of obesity ($p \leq 0.05$).

The Physical Activity Leaders (PALs)$^{10}$ was a two year intervention designed to encourage adolescent boys (14 years of age; $n = 100$) to become PALs in their homes and at school. The PALs intervention was administered in four disadvantaged (low SES) secondary schools in Australia and targeted high risk boys (i.e., disengaged in PE and/or not participating in sports). Four schools were randomly assigned to the intervention group (2 schools) or a wait-list control group (2 schools). Using $\alpha = 0.05$ and power of 80%, sample size estimation was calculated at 120 needed to detect a 1kg/m$^2$ (BMI) difference between groups. The PALs treatment consisted of school sport sessions, interactive seminars, lunch-time activities, PA and nutrition handbooks, leadership sessions, and pedometers for self-monitoring. The focus of treatment
materials were on resistance training and muscular fitness. Resistance training was performed with elastic tubing known as Gymsticks™ during gym and in the participants’ spare time. They were instructed to perform two sets of 8 to 12 repetitions that focused on all the major muscle groups. Perhaps the most unique aspect of this study was that participants were given benchmarks to complete and were presented leadership certificates once all criteria were met. Data were collected at baseline (pre-treatment), three months, and six months. After the six month study period was completed, the wait-list control school received the intervention, but data were not reported. Outcome measures included anthropometric (height, weight, BMI, waist circumference, body fat percentage), lower body strength (leg dynamometer), upper body muscular endurance (push-up test), abdominal muscular strength (seven stage abdominal strength test), daily step count (Yamax CW200 pedometers), and diet (NSW Schools Physical Activity and Nutrition Survey). The authors report a significant reduction in the number of participants classified as overweight or obese in the treatment group (p = 0.03) and participants in the treatment group showed a significant decrease in percent body fat (p ≤ 0.05) at six month assessment.

The majority of PA interventions described in this section were randomized controlled trials that included a large sample size with intensive behavioral educational components. Some of the studies report positive outcomes for increasing PA and decreasing risk factors for childhood obesity. It remains, however, to be seen what kind of effect combining different PA components have on increasing PA. For example, designing and implementing an intervention that combines resistance training strategies similar to those used in the PAL study and aerobic exercise components similar to those
used in the CATCH study may be effective at decreasing obesity and increasing PA levels in AI youth and non-AI youth. The effect of these combined PA strategies on AI youth is unknown. Thus, work more research in this area is needed.
Table 2. Childhood obesity prevention and physical activity interventions—school-based studies.

<table>
<thead>
<tr>
<th>Name of Study</th>
<th>Population</th>
<th>Study Design</th>
<th>Main Outcomes</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch what you Do, Chew, and View¹</td>
<td>Children age 9³ years; 3rd, 4th, and 5th grades; n = 1323</td>
<td>Experimental design with 10 elementary school randomly assigned to the treatment group (5 schools) or control group (5 schools). Schools were matched by enrollment and percent free/reduced cost lunch prior to random assignment.</td>
<td>Decreased amount of TV⁵ viewing**; increase in steps per day⁵ NS. <strong>Limitations of study:</strong> short-term length of intervention, documenting and tracking how the participants utilized the intervention strategies, documenting the impact of media messages on the outcome variables, small sample size, the influence of social desirability on the results, and reliance on pedometers to measure PA⁴.</td>
<td>94</td>
</tr>
<tr>
<td>The HEALTHY Study¹</td>
<td>Children age 11.3³ years; n = 4603</td>
<td>Experimental-cluster design with 42 schools randomly assigned to treatment group (21 schools) or control group (21 schools)</td>
<td>No significant difference in the combined prevalence of overweight and obesity between students in the control and intervention schools; students in the intervention schools who were overweight or obese in the 6th grade had a 21% lower odds of being obese at the end of 8th grade (p ≤ 0.05); <strong>Limitations of study:</strong> the sample is not generalizable since blacks and Hispanic students were intentionally oversampled and reliance on school staff to implement components of study.</td>
<td>12</td>
</tr>
<tr>
<td>Child and Adolescent Trial for Cardiovascular Health (CATCH)²</td>
<td>Children age 8³ years; n = 5106</td>
<td>Experimental design with 24 schools randomly assigned to a measurement only group (10 schools) or two treatment conditions: school-based intervention (7 schools) or school-based plus family intervention (7 schools)</td>
<td>Increase in MVPA⁶ by 39% (p ≤ 0.05); increased EE⁷ (p ≤ 0.05); increased EE⁷ rate (p ≤ 0.05); increased vigorous PA⁴ minutes (p ≤ 0.05); increased encouragement to be physically active (p ≤ 0.0001); boys increased distance in one mile run (p ≤ 0.0001) <strong>Limitations of study:</strong> The self-administered PA checklist was only administered once and change over time cannot be determined.</td>
<td>95</td>
</tr>
</tbody>
</table>

¹Obesity Prevention Program; ²Physical Activity Intervention; ³Reference(s); ⁴Physical Activity; ⁵Television; ⁶Moderate and Vigorous Physical Activity; ⁷Energy Expenditure; NS Not Significant

⁸Mean Value- age range was not provided

**Not Significant**
Table 2. Childhood obesity prevention and physical activity interventions—school-based studies cont.

<table>
<thead>
<tr>
<th>Name of Study</th>
<th>Population</th>
<th>Study Design</th>
<th>Main Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planet Health¹</td>
<td>Children age 9-11 years; n = 1295</td>
<td>Experimental design with 10 elementary school randomly assigned to the treatment group (5 schools) or control group (5 schools). Schools were matched by town or school size and ethnic composition.</td>
<td>Decrease in obesity prevalence ($p \leq 0.05$) in females, but not males; decreased amount of TV⁴ viewing ($p \leq 0.01$); Each hour of reduced TV⁴ viewing was associated with a reduction in obesity prevalence ($p \leq 0.05$)</td>
</tr>
<tr>
<td>Physical Activity Leaders¹</td>
<td>Children age 14ᵃ years; n = 100</td>
<td>Experimental design with 4 schools randomly assigned to the treatment group or wait-list control group (<em>the authors did not state how many schools were randomized to each condition</em>). Using $\alpha = 0.05$ and power of 80%, sample size estimation was calculated at 120 needed to detect a 1kg/m² (BMI) difference between groups</td>
<td>Significant reduction in the number of participants classified as overweight or obese in the treatment group ($p = 0.03$); Participants in the treatment group showed a significant decrease in PBF⁷ ($p \leq 0.05$)</td>
</tr>
</tbody>
</table>

Limitations of study: low participation rate during baseline measures (65%), randomization of participants was limited by schools, maturation of boys during the study, potential for measurement error in the assessment of obesity, limited validity of instruments used to measure diet and PA³ in this age group, and short-term length of intervention.

Limitations of study: The participants’ socio-economic status was not measured, participant recruitment/selection was conducted by teachers presenting the potential for selection bias, unreliable estimated of PA³ with the instruments employed, and the study only included male participants.

¹Physical Activity Intervention; ²Reference(s); ³Physical Activity; ⁴Television; ⁵Self Efficacy; ⁶Percent Body Fat
ᵃMean Value- age range was not provided
2.6 Diabetes Prevention Studies using a mixed-methods CBPR Approach in American Indian Children and Adolescents

The next section of the literature review describes the primary studies reported in the literature that are specific to diabetes prevention programs in AI youth and/or minorities at similar risk for diabetes. If behavioral programs are going to be effective on AI reservations, they should be designed in collaboration with community leaders and be culturally appropriate.\(^{91}\) Another aspect that must be considered in designing these programs is that most reservation communities are located in rural areas. Nelson et al.\(^ {31}\) reported limited opportunity for children to participate in sports activities on the Fort Apache Reservation – a tribe located in rural areas in Arizona. These limited sport opportunities coincide with a decrease in physical education (PE) and recess during the school day. Increased academic standards have been implemented into the school curriculum, which, in turn, have limited active and free play time for all students.

Childhood and adolescence are when physical activity behaviors are established\(^3\) and can provide a good foundation for facilitating positive behavior change. Dean et al.\(^4\) report how difficult compliance can be among their patients with diabetes to adhere to a diet and exercise program. Attrition is poor among adults participating in interventions that incorporate diet and exercise, which is why adopting healthy behaviors early in life, particularly in early childhood, may be practiced and carried in to adulthood. It is recommended that prevention programs targeting obesity and T2DM prevention should be implemented in school settings and specifically target children, 6-12 years old. \(^{91}\)
2.6.0 Zuni High School Diabetes Project

The Zuni High School (ZHS) Diabetes project\textsuperscript{19,23,24} targeted risk factors for diabetes among high school age students due to the increasing number being diagnosed with T2DM. The investigators conducted a formative assessment\textsuperscript{24} that included focus groups (consisting of high school students), interviews (consisting of school staff), and administered questionnaires to develop a culturally appropriate intervention. Participant input helped guide the development of the ZHS intervention and identified risk factors (obesity, hyperinsulinemia, sedentary activity, poor diet) to address. The intervention strategies included establishing supportive social networks, constructing a wellness facility, developing a diabetes curriculum, and modifying school meals to serve healthier content to students.\textsuperscript{24}

The development and implementation of the ZHS diabetes project was initiated following the formative phase of the study.\textsuperscript{23} Participants were informed/recruited to the intervention through school-wide announcements, in-class announcements, and flyers. The study employed a multiple cross-sectional design with a treatment group (ZHS students; n = 65; mean age = 17.5 years) and a control group (Anglo high school students; n = 37; mean age = 17.0 years). Assignment to each condition was selected without replacement to ensure blood and insulin data were not repeated in the sample. The intervention included a PA, diet, and a diabetes curriculum that was disseminated throughout various parts of the school. The PA component was conducted in a fitness room equipped with aerobic machines (treadmills, ergometers), weights, and a climbing wall. The PA component also included activities outside the fitness room that included aerobic classes, basketball tournaments, hiking and rock climbing, running camp and
races, mountain biking, and dances. The dietary component provided water and healthy snacks and sugar-free beverages in school vending machines. The diabetes curriculum consisted of reiterating the PA and dietary components, but also included information on diabetes prevention, carbohydrate metabolism, and nutrition. The investigators speculate that nearly every student was exposed to at least one component of the intervention.

Outcome measures for the treatment group and control group included plasma insulin, FBG, 30 minute plasma glucose after ingesting a 75 gram glucose load (modified OGTT), family history of diabetes, and anthropometric measures (height, weight, BMI). Data was collected at baseline, Year 1.5, and Year 3 of the intervention. The results of the study indicate that enrollment in the fitness facility increased from 8.5% (after year one) to approximately 28% (after year three) of the high school population. By year three, the students were consuming virtually zero sugared soft drinks during school and soft drinks had been replaced by 150 gallons of water per week. Baseline fasting insulin was significantly higher \((p \leq 0.05)\) in the treatment group compared to the control group. However, over the course of the intervention, significant declines were observed in fasting insulin \((p \leq 0.05)\) and 30 minute insulin levels \((p \leq 0.001)\). The results of this study suggest that integrating environmental changes in school settings may decrease the risk of developing T2DM in high risk children.

2.6.1 Pathways

The Pathways study\(^{18}\) was a culturally appropriate obesity prevention intervention conducted in six AI communities and included children in the 3\(^{rd}\), 4\(^{th}\), and 5\(^{th}\) grades \((n = 1704)\). Various components of the program were developed over three
years. The initial formative phase included interviews, focus groups, and direct observation to gain information and the communities’ perspective on the obesity prevention behaviors to be selected as priority during the intervention. These processes also fostered the relationship between the researchers and the community and also lead to developing a culturally appropriate school based curriculum that promoted healthful eating behaviors, PA, and family involvement.

The Pathways curriculum developed from the formative assessment consisted of two 45 minutes sessions per week for 12 weeks presenting different culturally tailored health topics. In addition, the constructs were integrated in to a fictional story featuring AI characters Amanda and Daryl White Horse. Additional components included indigenous learning modes, hands-on activities, and games. The PA component included the Sports, Play and Active Recreation for Kids (SPARK) PE curriculum (to increase the amount of minutes students spend in moderate and vigorous physical activity) and traditional AI games from each tribe of the Pathways study—these were not only used in PE, but also during recess. The SPARK curriculum was comprised of 14 health related fitness units and 10 sports related fitness units. The family component provided awareness about the Pathway’s program mission, objectives, and intervention strategies. The healthy eating component sought to lower the amount of fat in school meals while maintaining nutrient content. During phase one, the investigators learned keys to developing a culturally appropriate intervention that include, 1) develop and maintain long-term relationships with AI communities, 2) employ a variety of participation methods, 3) plan for extended time for IRB and tribal approvals when working with AI communities, 4) use formative research as a means to develop
participatory relationships, 5) provide information from all participating cultures as a way both to help standardize interventions and to be culturally appropriate, 6) reinforce key messages/skills at multiple environmental levels, 7) allow time for interventions to be understood and adopted, 8) involve the family more and find better ways to document their involvement, and 9) promote the wide variety of benefits of the project to the schools and tribes. At the conclusion of three years, these “lessons learned” helped modify certain aspects of the intervention components to enhance the effectiveness of phase two, which was a second three year phase of the Pathways intervention.

The second phase of the Pathways study employed an experimental design where the investigators randomly assigned 41 schools in seven AI communities to either the intervention group/school (n = 727 children) or control group/school (n = 682 children). The schools were selected based upon the proportion of children with AI ethnicity in the 3rd through 5th grade and stratified randomly according to upper and lower percent body fat. The intervention consisted of the same components (classroom curriculum, food service, PA, and family involvement), but were enhanced and/or modified for effectiveness based upon the results of phase one. Baseline (end of 2nd grade) and post (end of 5th grade) assessment included anthropometry (weight, height, BMI, subscapular skinfold thickness, bioelectrical impedance), PA (accelerometry and self-report questionnaire), dietary intake measured by direct observation, and surveys specific to diet and PA (knowledge, attitudes, and behavior [KAB] and 24 hour dietary recall). The results of the study determined that the Pathways intervention produced a significantly lower total daily energy intake (p ≤ 0.05), decreased percentage of energy
from total fat ($p \leq 0.001$), increased self-report PA ($p \leq 0.001$) and healthy food choice intentions ($p \leq 0.001$).

Pathways was a 3-year, randomized controlled trial that tested the effect of a school-based program on preventing obesity in AI children in the 3rd-5th grades. While the Pathways intervention had positive impacts on increasing PA and decreasing dietary fat in school lunch foods, the study found no significant reduction of the percentage of body fat or BMI in children in the intervention schools compared to children in the control schools.\textsuperscript{17}

2.6.2 Kahnawake Schools Diabetes Prevention Project

The Kahnawake Schools Diabetes Prevention Project (KSDPP)\textsuperscript{20} employed a community-based participatory research (CBPR) approach that was conducted with the Kahnawake and Akwesasne (Mohawk) reservations in Canada. The initial formative phase of the intervention described how the researchers gained entry into the community to discuss community members' perspectives on behaviors and health risks associated with diabetes (i.e., PA, health, disease, nutrition, etc.). The community discussion was used to design and implement programs and activities to prevent obesity and diabetes in children age five to 10 years old. A Community Advisory Board was also established during the formative phase.\textsuperscript{21} The investigators conducted a total of 12 interviews and seven focus groups (FGs; consisting of 3 to 17 participants). All sessions were audio taped and the recordings transcribed for theme identification. Focus group and interview data identified common themes related to community-based strategies and barriers to PA and healthy living. The barriers identified include a current lifestyle that is conducive to less farming, hunting and fishing and attribute these
changes to an increased consumption of fast food and decreased amount of PA since the community members no longer have to grow their own food. Technological advancements such as television and the availability of cars, trucks, and school buses promote a sedentary lifestyle. Participants claimed they were not aware of healthy behaviors and lacked the proper knowledge, confidence, and social support to participate in regular PA.

Phase two of the study developed the KSDPP intervention, with the long-term goal of decreasing the occurrence of T2DM in future generations. The short-term goal of the program was to decrease obesity, increase PA, and improve dietary intake in Kahnawake youth. The KSDPP employed a mixed longitudinal and cross-sectional community-wide intervention with a non-equivalent comparison group. The KSDPP intervention integrated behavior theory coupled with traditional learning styles of Al children and spanned a total of three years. Specifically, the intervention consisted of four components that included a health education curriculum, media campaign, improving the physical environment, and implementing healthy public policy for obesity prevention in youth. The health education program focused on nutrition, fitness, diabetes, introduction to anatomy and physiology, and healthy lifestyles that was administered for ten 45 minute lessons per year for each grade. Community mobilization was implemented with the objective to increase community awareness of improving attitudes toward healthy lifestyles. Media was used to increase community awareness for healthy lifestyles and the researchers disseminated healthy lifestyles messages through local newspapers, public service announcements, local radio, and posters in public locations. The physical environment was enhanced by developing
events such as a five kilometer (5km) treasure hunt, elementary school race, constructing a walking and bike path, and numerous other activities that support healthy lifestyles. Implementing public policy for healthy lifestyles was supported by the Kahnawake Education System that approved a school nutrition policy. The result of the policy mandated that the school can only serve healthy foods low in fat, simple sugar, high-fiber foods, no “junk” food, increase PE class time/sessions, and provide incentives for teachers and students that integrate extra PA into their daily routine.

The investigators conducted pre-to-posttest measures on the intervention group (Kahnawake school) and the control group (Mohawk school) to evaluate the effects of the program. Data collection consisted of a one mile run/walk test, anthropometric measures (weight, height, BMI, subcapular skinfold thickness, and waist and hip circumference), and questionnaires assessing diet, PA, and self-efficacy. The outcome of the study determined that children in the intervention group had significantly less ($p \leq 0.01$) increases in subcapular and triceps skinfold thickness, decreases in frequency of gym time ($p \leq 0.01$), and significantly ($p \leq 0.01$) worse performance on the one mile walk/run test compared to the control group at one year post-baseline. While the Kahnawake intervention had positive impacts on dietary intake (not reported) and body composition, the primary endpoints of BMI or body fat did not change in youth in the intervention or control schools at three year follow-up. Nonetheless, the KSDPP is a good model to replicate when employing a CBPR approach with the intent to design, implement, and evaluate a diabetes prevention program as evidenced by the strong community mobilization and cultural integration in the Kahnawake community.

2.6.3 STOP! Diabetes Prevention Program
The STOP! Diabetes prevention program was conducted on the Winnebago Indian Reservation. The design, implementation, and leadership of the intervention was done in collaboration with boy’s who were 14 to 15 years old. The boys participated alongside the researchers in weekly meetings that lasted approximately three to four hours for a duration of eight weeks to develop the intervention. The weekly meetings followed the traditional approach of the Coyote Model: Learn by the coyote’s mistakes or success. Four adolescents named the Coyotes, led by example, indirectly leading other adolescents and reflected the cultural aspects of the STOP! Diabetes program. They helped to develop all curriculum materials and assisted in the organization of a community wide diabetes workshop designed to prevent and address risk factors for diabetes. Four adolescent volunteers led the workshop for children who were 13 to 18 years old.

The content presented in the workshop curriculum consisted of information about diabetes, nutrition and increasing PA as a means of prevention. Each component integrated culture and AI tradition in to the activity. The investigators collected data on volunteers that participated in bioelectrical impedance (BIA; to create fitness profiles), and self-report surveys specific to anthropometric measurements (height, weight), knowledge and evaluation (the latter two were collected pre and post workshop; n = 15).

The results of the study show that 64% of the participants completed a BIA assessment. Eight out of the nine participants that completed a survey increased knowledge and nine out of ten had a positive workshop experience. Although there were no changes in weight or BIA at the end of the study, the community involvement
approach used support the importance of using a peer-to-peer leadership approach to implement a community-based health education program.

2.6.4 Journey to Native Youth Health

Brown et al.\textsuperscript{16} used a CBPR approach to adapt the adult-based Diabetes Prevention Program (DPP) to be age- and culturally relevant for AI youth, age 10-14 living on two Montana Indian reservations. The formative phase included four focus groups and 14 individual interviews with members from both communities to explore barriers and enhancers to preventing risk factors associated with diabetes in AI youth living in these communities and ways to adapt the DPP curriculum for AI youth. Data showed that utilizing indoor facilities (fitness centers, weight rooms, and swimming pools), family involvement and encouragement, and incorporating cultural tradition (berry picking, arrow throwing, and planting sweet grass) were all strategies to increase physical activity. Barriers preventing youth from participating in PA included distance from available facilities, the physical environment (snakes, dogs, cars, etc.), and harsh winter months.

The formative data helped develop The Journey to Native Youth Health\textsuperscript{15} intervention that was implemented as an afterschool program that included 9 sessions with AI children age 10 – 14 years living on the two reservations. The study employed an experimental design with a treatment group (n = 32) and an active control group (n = 32). The treatment condition was the Journey to Native Youth DPP health curriculum and the active control condition was an alcohol and drug curriculum. Participants were randomly assigned to one of the two conditions by blocking school rosters by site and grade and randomly ordering within blocks for recruitment. The Journey to Native
Youth DPP sessions incorporated cultural components identified in the formative assessment that included traditional activities (e.g., berry picking), use of storytelling, language, and participation of elders. Children also participated in native games and kept nutrition diaries. Sessions were led by tribally enrolled community members. The data revealed a non-significant decrease in kcals and no change in PA or weight between the treatment and control groups. Although the results did not show statistically significant outcomes, the reach and successful implementation of the program coupled with the collaborative partnership with the tribally enrolled educators that led each session are important results of this study. Collectively, the mixed-methods approach and (non-significant) positive outcomes on target variables offer promise for future diabetes prevention programs in AI children.

The previous section outlines the available literature focusing on diabetes prevention in AI communities (Table 3). Collectively, these studies suggest that focusing obesity and diabetes prevention interventions on children may result in positive behavioral changes that decrease risk for obesity and diabetes as these children mature into adulthood.

This literature review helped to guide the mixed-methods, CBPR approach used in the dissertation studies. The formative phase incorporated qualitative methods that consisted of six focus group (FG) discussions. The analysis revealed that recess was an area of the school day in most need of an intervention. The participants identified specific strategies that could be implemented on the playground during recess in order to increase PA levels. These strategies in conjunction with the literature (on recess
interventions) helped to guide the development and design for both Study 1 and Study 2 of this dissertation.

Since none of the studies outlined in the preceding literature review implemented a recess intervention, a review of literature was completed to learn about research design and strategies to increase PA in this area of research. The following section details literature that reports on the implementation and evaluation of recess interventions, and how these studies helped to guide the design of the recess intervention in Study 2 of this dissertation.
Table 3. Diabetes Prevention Studies using mixed-methods CBPR approaches in American Indian Children and Adolescents.

<table>
<thead>
<tr>
<th>Name Of Study</th>
<th>Population</th>
<th>Research Design</th>
<th>Mixed-methods Approach and Intervention Components</th>
<th>Main Outcomes</th>
<th>Ref</th>
</tr>
</thead>
</table>
| Zuni High School Diabetes Project                  | Grades 9th, 10th, 11th, and 12th                | Multiple cross-sectional design with a treatment school (Zuni) and a control school (Anglo). | **Formative Phase:** Focus groups with High school students; Interviews with high school faculty, staff, and administrators; 24 hr dietary recall; Exploratory Questionnaire  
**Intervention (4 Components):** 1) Supportive Social Networks, 2) Teen Wellness Facility, 3) Diabetes Education (integrated into the existing school curriculum), and 4) Modification of food supply available to teens  
**Duration:** 4 years  
**Results:** Users of the wellness facility increased from 8.5% to 28% of the High School population; Baseline fasting insulin significantly higher ($p \leq 0.05$) in treatment group compared to control group; Year 3 fasting insulin no difference between treatment and control group  
**Limitations of study:** specific dietary data not available, inability to follow participants longitudinally in order to evaluate the impact of the exercise program, potential for medical records to be inaccurate, and self-selection of participants. | 19,23,24 |
| Pathways Purpose: to develop an obesity prevention intervention | Grades 3rd, 4th, and 5th                        | Experimental design where groups were randomly assigned to intervention and control groups by stratified randomization according to upper and lower percent body fat. | **Formative Phase:** 48 direct observations: recess, PE, and in class; 76 child-paired interviews; 10 in-depth interviews; with school officials; 14 focus groups; with care givers; 47 interviews; with care givers; 12 FG’s; with teachers and TA’s; 483 surveys (combined); Knowledge, Attitudes, and Behaviors (KAB) and Physical Activity Questionnaire (PAQ)  
**Intervention (4 Components):** 1) classroom curriculum to promote healthful eating and increased physical activity; 2) PE to increase PA, EE, and frequency of PE; 3) family education; 4) school food service.  
**Duration:** 3 years  
**Results:** Increase in PA² ($p \leq 0.001$; data specific to Self-Report; objective measures of PA² from accelerometry revealed no difference between intervention [Pathways] and control schools); increase in healthy food choice intentions§  
**Limitations of study:** self-report bias, inability for researchers to reduce caloric intake of participants categorized as obese, difficulty in implementing and evaluating intervention components among the different schools, and decreased compliance from school personnel to implement intervention strategies. | 17,25 |

Reference(s); ²Physical Activity; NS Not Significant
Table 3. Diabetes Prevention Studies using mixed-methods CBPR approaches in American Indian Children and Adolescents cont.

<table>
<thead>
<tr>
<th>Name Of Study</th>
<th>Population</th>
<th>Research Design</th>
<th>Mixed-methods Approach and Intervention Components</th>
<th>Main Outcomes</th>
<th>Ref</th>
</tr>
</thead>
</table>
| Kahnawake Schools Diabetes Project   | Kahnawake Community; children age 6 – 12 | Mixed longitudinal and cross-sectional community-wide intervention with multiple individual components with a non-equivalent comparison group | Formative Phase: 12 interviews, 7 focus groups (3 with children)  
Intervention (2 components): 1) School-based activities (health education curriculum) and 2) Community-based activities  
Duration: 3 years                                                                 | Results: Decrease in triceps and subscapular skinfold thickness ($p \leq 0.01$); Changes in PA$^2$, fitness, and television viewing$^{NS}$ (intervention period), but results not sustained (follow-up, post-intervention measures)  
Limitations of study: small sample sizes (under-powered) in intervention and comparison communities, lack of follow-up data in comparison community, utilizing unreliable instruments to measure variables.                                                                 | 20,21,98 |
| STOP! Diabetes                       | Children age 13-18 years; n = 15       | Pilot-project/Educational intervention                | Pilot Project: weekly meetings lasting 3 to 4 hours for 8 weeks to develop materials for a half day workshop  
Weekly Meetings:  
Coyote Model: Learn by the coyote’s mistakes or success: Four adolescents named the Coyotes, led by example, indirectly leading other adolescents and reflected the cultural aspects of the STOP! Diabetes program. They helped to develop all curriculum materials  
Health Education curriculum: Diabetes education, importance of physical activity and nutrition: manual and worksheet developed  
Half day workshop: included traditional games, preparation of nutritious foods  
Pre and post measures: knowledge questionnaires, bioelectrical impedance measures, height and weight,  
Duration: 3 years                                                                 | Results: 89% of the participants recorded an increase knowledge score on the questionnaire; 90% reported a positive workshop experience;  
Obesity rates in the community comparable to those reported in the literature.  
Limitations of study: curriculum development may not have been culturally appropriate, lack of rigorous statistical testing of pre and post measures, failure to match data to participants from the different measures, and small sample size. | 22  |
| Journey to Native Youth Health       | Children age 10-14 years               | Experimental design with treatment and active control group; Participants were randomly assigned by blocking school rosters by site and grade and randomly ordering within blocks for recruitment | Formative Phase: 4 focus groups; 5th, 8th grade students and adults; 14 interviews: Knowledgeable adults about youth health  
Intervention: 1) Journey to Native Youth Diabetes Prevention Program health curriculum (treatment group), and 2) Alcohol and drug curriculum (control group)  
Duration: 3 months                                                                 | Non-significant decrease in kcals; no change in PA$^2$ or weight  
Limitations of study: limited power to detect differences in measured outcomes; Findings are not directly translatable to other tribal communities without further adaptation. | 15,16 |

$^1$Reference(s); $^2$Physical Activity; $^{NS}$Not Significant
2.7 Recess Interventions

Current evidence verifies that children are more sedentary today than ever before. According to data from the 2003-2004 National Health and Nutritional Examination Survey, 42% of children, ages 6 – 11 are not achieving the recommended guidelines of 60 minutes of PA every day. This behavior depicts an inverse relationship with age (i.e., as age increases, PA declines) as only 28.7% of high school students and less than 5% of adults meet national guidelines for PA. PA has been shown to decrease the risk of developing diabetes and is most effective at controlling diabetes when medication is not warranted.

For many children, recess can provide nearly half of the minutes necessary to meet the daily PA goal without compromising academic performance. Over the course of a school day, children spend the most amount of activity time in recess, which has been shown to account for approximately 22 minutes or one third of the daily PA recommendations. That recess presents a prime opportunity to get children more physically active, researchers have focused on this area of the school to implement recess interventions to help children achieve the recommended 60 minutes of daily PA. The following section details the available literature on the design, implementation, and evaluation of recess interventions with the purpose of increasing PA in elementary school children during the school day.

Loucaides et al. conducted a study in Cyprus, Greece with 5th and 6th grade children (mean age = 11.1 ± 0.3 years; n = 247). This pre-to-posttest experimental recess intervention randomly assigned 3 inner city schools to receive a full or partial treatment or to serve as a control. Step counts of PA were measured with pedometers
four days prior to the implementation of the intervention and for four days four weeks after the intervention began. After the schools were randomly assigned, School 1 received the full treatment that consisted of three components, 1) space was allocated for team games on alternative days of the week where children of the same grade were divided in to teams to play a game of their choice, 2) playground markings were painted on the playground that included hopscotch, and 3) jump ropes were provided to the children for use during recess. School 2 received only partial treatment that consisted of one component that allocated space for team games on alternative days of the week where children of the same grade were divided in to teams to play a game of their choice. The findings revealed that mean step counts four weeks after the intervention in intervention schools were higher than the control group ($p \leq 0.001$). Despite this effect, offering multiple intervention components had no effect on PA levels since there was no difference in step counts between intervention groups (i.e., School 1 that received the full treatment and School 2 that received partial treatment). These outcomes suggest that allocating playground space may have positive effects on increasing children’s PA levels during recess.

A study done in Belgium by Verstraete and colleagues focused on 5th and 6th grade children (mean age = 10.9 ± 0.6 years, n = 235). This quasi-experimental pre-to-posttest recess intervention randomly assigned seven schools to receive a treatment (n = 4) or to serve as a control (n = 3). Physical activity was measured using accelerometry before (baseline) and three months after the treatment began (end-of-treatment, approximately 9 weeks post-baseline). Children in the treatment schools received a set of game equipment and activity cards describing games and activities
that can be performed with the recess/game equipment. Teachers encouraged the children to play with the game equipment. The set of game equipment for each class group included two jump ropes, two double dutch ropes, two scoop sets, two flying discs, two catchballs, one poco bal, one plastic ball, two plastic hoops, two super grips, three juggling scarves, six juggling rings, six juggling beanballs, one diabolo, one angel-stick, four spinning plates, two sets of badminton racquets and two sets of oversized beach paddles. The control group did not receive any game equipment. The authors reported significant treatment effects for the time spent in low \( (p \leq 0.05) \), MPA \( (p \leq 0.001) \), and MVPA \( (p \leq 0.01) \) during morning recess. Lunch recess demonstrated similar results with significant treatment effects found for low \( (p \leq 0.001) \), MPA \( (p \leq 0.001) \), MVPA \( (p \leq 0.001) \), and VPA \( (p \leq 0.001) \) during lunch recess. Children appeared to have been engaged in MVPA for about half of the time during both morning recess (56%) and lunch break (51%) at baseline—this finding suggests the need for recess interventions. The authors also suggest that longer lunch breaks may enable the children to organize and play complete games with the equipment resulting in higher proportions of active time.

Huberty et al.\(^{108}\) conducted a study with 2 schools (1 public school and 1 private/parochial school) that included 3\(^{\text{rd}}\), 4\(^{\text{th}}\), and 5\(^{\text{th}}\) grade children (mean age = 9.6, \( n = 93 \)) in the Midwestern United States. The pre-to-posttest quasi-experimental recess intervention implemented an 8 month intervention in both schools, but did not employ any randomization schemes or include a control group. Children from each school were invited to participate in the intervention. Body mass index was measured prior to the implementation of the intervention. Physical activity was measured with accelerometers
for one consecutive week pre- and post-intervention. The treatment consisted of modifying an environmental component of the Active and Healthy Schools program and tailored it to the Ready for Recess program. Activity zones were offered during recess every day. The objective of the intervention was to include activities that could be played with minimal equipment during a short recess period less than 20 minutes. Examples of some of the games played include soccer, kickball, and tag. The games offered in each zone were planned and modified each day and each week according to interest. Prior to recess, zones were marked by signs and markers to inform the children of the activity occurring in each particular zone. The investigators found that MPA during recess significantly increased from 18.1% pre-test to 31.2% posttest \( (p \leq 0.001) \), and VPA significantly increased from 7.2% pre-test to 16.8% post-test \( (p \leq 0.001) \). Pre-to posttest MPA during the school day increased from 4.9% to 9.1% \( (p \leq 0.001) \) and VPA from 1.6% to 2.6% \( (p \leq 0.001) \). The treatment was attributed to an increase of 2.5 \( (p \leq 0.001) \) and 2.2 \( (p \leq 0.001) \) minutes of MPA and VPA during recess. The treatment was also attributed to an increase of 18.7 \( (p \leq 0.001) \) and 4.7 \( (p \leq 0.001) \) minutes of MPA and VPA during the school day.

Ridgers et al.\textsuperscript{109-111} conducted a large scale study in North West of England with children in the K – 4\textsuperscript{th} grade (mean age = 8.1 years old, \( n = 470 \)). This pre-to-posttest quasi-experimental recess intervention included 15 intervention and 11 control schools (The authors simply stated the schools “took part” as an intervention or control school, but do not state how the conditions were assigned). Eleven children per elementary school were stratified by gender and randomly selected to participate in the collection of physical activity levels with accelerometry during morning, lunch, and afternoon recess.
periods. Body mass index was measured during the pre-intervention phase. Physical activity was measured at baseline, 6 weeks, 6 months, and 12 months following the painting/environmental changes of each playground. The treatment consisted of redesigning the playground with multicolored playground markings and dividing the playground into three colored zones: Red zone (sports area), Blue Zone (fitness and skills area), and Yellow Zone (chill out area). Control schools didn’t receive any redesign on the playground (i.e., similar to the treatment), however soccer balls and jump ropes were available to both playgrounds during the study.

The results of the treatment at the 6 week assessment reported no significant differences for PA between baseline and 6-weeks post-baseline in boys and girls. The 6 week assessment also revealed that during the intervention, boys engaged in 7.2% more PA compared to girls during recess. A significant interaction for MVPA was found between the treatment and recess length, suggesting the treatment was more effective when recess was longer. The results of the treatment at 6 months post-baseline reported an inverse interaction between the treatment and baseline measures for MVPA ($p \leq 0.05$) and VPA ($p \leq 0.10$), suggesting the treatment was stronger for those who were less active at baseline. Children in the treatment group engaged in 4.5% and 2.3% more MVPA and VPA during recess compared to children in the control group. The results of the treatment at 12 month assessment reported that children in the treatment group engaged in 1.4% more VPA than children in the control group. The treatment effects were strongest at the 6 month assessment and declined by the 12 month assessment.
Stellino et al.\textsuperscript{112} conducted a recess intervention using a quasi-experimental repeated measures design with a school in the Midwestern United States. Children in the 1\textsuperscript{st} – 4\textsuperscript{th} grades volunteered to participate in the study. Study measures included a demographic survey, BMI, and having child participants wear a pedometer during one 15 minute morning recess period for 5 consecutive weekdays for 4 weeks. The treatment included four recess activities of the week (RAW): RAW #1: no treatment; RAW #2: the first RAW was a circuit course resembling walking/fitness trails with jump ropes, large playground balls, bean bags and hula hoops; RAW #3: the second RAW was an obstacle course constructed on the outside of the playground area; RAW #4: the final RAW was frisbee’s (30 of all different colors) that were used primarily to throw at inanimate targets. The results of this study revealed that males were more physically active than females across all four weeks of the treatment. In addition, older children were more active than younger children. No treatment (RAW #1) accumulated more mean step counts (961.9) compared to all others. The second most was the circuit course (RAW #2) with 930.5 step counts. PA was higher in children with a healthy BMI (< 85%) compared to overweight or obese children (BMI > 85%).

Stratton and colleagues\textsuperscript{113} conducted a quasi-experimental, pre-to-posttest recess intervention in Northeast Wales with children (n=120) in early (age 4 – 7) and late (7 – 11) primary schools Although schools took part in the study as an intervention or control school, it is unclear how the school were assigned to these conditions. Five children from each age group were randomly selected to participate. PA data was collected with heart rate telemeters for 4 weeks prior to the treatment and 4 weeks after the treatment (i.e., playground lines painted). BMI was collected before and during the
treatment phase. Intervention schools received playground markings that were painted on the playground according to school preference that included designs like hopscotch and letter squares. Control schools did not receive any playground markings. MVPA in the treatment group increased playtime from 36.7% to 50.3% (increase of 13.6%) compared to a decrease in the control group from 39.9% to 33.4% (decrease of 6.5%; \( p \leq 0.01 \)). Boys increased MVPA from 40.6% to 44.8% (increase of 4.2%) and girls from 35.2% to 39.8% (increase of 4.6%) before and after the treatment. Playtime VPA in the treatment group increased from 7.9% to 12.4% (increase of 4.5%) compared to 8.0% to 8.0% (0%) in the control group (\( p \leq 0.01 \)). Boys increased VPA from 9.8% to 12.6% and girls from 5.9% to 7.9% before and after the treatment.

The studies described in this section helped guide the design and implementation of the recess intervention in this dissertation. The children and the PE teacher in the formative phase of our intervention talked about the need for four-square, nine-square, and hopscotch lines to be painted on the playground. Painting lines on the playground is similar to the study conducted by Loucaides et al.\(^ {106} \) that offered 3 activity zones on the playground with one being an area where hopscotch lines were painted. In addition, Stratton and Mullan\(^ {113} \) also painted lines on the playground for the treatment condition in their study.

The inclusion of competitive team sports came directly from the children that identified the specific games they wanted to play during recess in the FG discussions conducted in the first phase of our study. Some of the recess studies reported in the literature also include this aspect. Two of the studies\(^ {106,109} \) included a design similar to our recess intervention with the inclusion of three areas/zones on the playground that
had a different treatment implemented in each, one being sports. Our recess intervention was most similar to the design implemented by Ridgers et al.\textsuperscript{109} However, we also included components that were similar to the recess interventions implemented by Huberty et al.\textsuperscript{108} and Stellino et al.\textsuperscript{112} These were all factors to including team sports in one of the treatment conditions.

Our intervention components differ from other recess interventions reported in the literature in that we incorporated bi-weekly facilitator led activities and that children in the initial FG’s identified the kinds of activities they could feasibly take part in during the recess on an AI reservation.
Table 4. Recess studies done with elementary school children.

<table>
<thead>
<tr>
<th>Population and Location</th>
<th>Study Design</th>
<th>Recess Intervention Components</th>
<th>Main Outcomes</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades 5 &amp; 6; Mean age = 11.1 ± 0.3 years; n = 247 Cyprus</td>
<td>Pre-to-posttest experimental design where 3 schools were randomly selected to receive a full or partial treatment or to serve as a control. PA via step counts with pedometers was measured 4 days prior to the implementation of the intervention and for 4 days 4 weeks after the intervention began.</td>
<td>School 1 received the full treatment that consisted of 1) space was allocated for team games on alternative days of the week where children of the same grade were divided into teams to play a game of their choice, 2) playground markings were painted on the playground that included hopscotch, and 3) jump ropes were provided to the children. School 2 received only partial treatment that consisted of 1) space was allocated for team games on alternative days of the week where children of the same grade were divided into teams to play a game of their choice.</td>
<td>Mean step counts at 4 weeks post in both intervention groups were higher than the control group (p ≤ 0.001 &amp; p ≤ 0.01); Allocation of playground space may have positive effects on children's PA levels during recess; Offering multiple intervention components had no effect on PA levels, since there was no difference in PA between both treatment schools.</td>
<td>106</td>
</tr>
</tbody>
</table>

| Grades 5 & 6; Mean age = 10.9 ± 0.6 years n = 235 Belgium | Pre-to-posttest experimental design where 7 schools were randomly assigned to either receive the intervention (4 schools) to serve as a control (3 schools). PA was measured during the day via accelerometry before the implementation of the game equipment and three months after providing the game equipment. The authors did not specify the length of data collection (e.g., 1 full day for 5 consecutive days). | Children attending schools assigned to the treatment condition received a set of game equipment and activity cards describing examples of games and activities that can be performed with the equipment—teachers made sure kids shared the cards so they always had new ideas and didn't get bored with the same activities. Teachers were asked to stimulate the children to play with the game equipment. The set of game equipment for each class group included two jump ropes, two double dutch ropes, two scoop sets, two flying discs, two catchballs, one poco bal, one plastic ball, two plastic hoops, two super grips, three juggling scarves, six juggling rings, six juggling beanballs, one diabolo, one angel-stick, four spinning plates, two sets of badminton racquets and two sets of oversized beach paddles. | Significant intervention effects were found for the time spent in low (p ≤ 0.05), MPA (p ≤ 0.001), and MVPA (p ≤ 0.01) during morning recess. The time spent in MPA increased significantly in the intervention group, while it decreased in the control group; Significant intervention effects were found for low (p ≤ 0.001), MPA (p ≤ 0.001), VPA (p ≤ 0.001) and MVPA (p ≤ 0.001) intensity activities during lunch recess. The time spent in MPA, MVPA and VPA increased significantly in the intervention group, while it decreased in the control group; At pretest, children in the present study were engaged in MVPA for about half of the time during morning recess (56%) and lunch break (51%; suggests need for recess interventions); The longer duration of lunch breaks may enable the children to organize and to play complete games with the equipment resulting in higher proportions of active time. | 107 |
Table 4. Recess studies done with elementary school children, continued.

<table>
<thead>
<tr>
<th>Population and Location</th>
<th>Study Design</th>
<th>Recess Intervention Components</th>
<th>Main Outcomes</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades 3, 4, and 5; Mean age 9.6; n = 93; Midwest United States</td>
<td>Pre-to-posttest quasi-experimental design with 2 schools—1 public school and 1 private/parochial school. Both schools received an 8 month intervention (no randomization or control group). Children from each school were invited to participate. BMI was measured prior to the implementation of the intervention. PA was measured with accelerometers for 1 week from 7:30am to 4:00pm pre intervention and post intervention.</td>
<td>Investigators modified an environmental component of the Active and Healthy Schools program and tailored it to the Ready for Recess program. Activity zones were offered during recess every day. The objective was to include activities that could be played with minimal equipment during a short recess period less than 20 minutes. Examples of some of the games played include soccer, kickball, and tag. The games offered in each zone were planned and modified each day and each week according to interest. Prior to recess, zones were marked by signs and markers to inform the children of the activity occurring in each particular zone.</td>
<td>MPA during recess increased from 18.1% to 31.2% (13.1% difference; ( p \leq 0.001 )) and VPA from 7.2% to 16.8% (9.6 difference; ( p \leq 0.001 )). MPA during the school day increased from 4.9% to 9.1% (4.1 difference; ( p \leq 0.001 )) and VPA from 1.6% to 2.6% (1% difference; ( p \leq 0.001 )). The intervention was attributed to an increase of 2.5 (( p \leq 0.001 )) and 2.2 (( p \leq 0.001 )) minutes of MPA and VPA during recess; The intervention was also attributed to an increase of 18.7 (( p \leq 0.001 )) and 4.7 (( p \leq 0.001 )) minutes of MPA and VPA during the school day.</td>
<td>108</td>
</tr>
<tr>
<td>Grades K – 4; Age 2 – 10; n = 297; North West of England</td>
<td>Pre-to-posttest quasi-experimental design with 15 intervention and 11 control schools (The authors simply say the schools “took part” as an intervention or control school, but do not state how the conditions were assigned). Eleven children per elementary school were stratified by gender and randomly selected to participate in physical activity measured by accelerometry. BMI was measured during the pre-intervention phase. PA was collected during morning, lunch, and afternoon recess periods at baseline and 6 weeks following the painting/environmental changes of each playground.</td>
<td>Intervention schools received multicolor playground markings in addition to dividing the playground in to 3 colored zones: Red zone (sports area), Blue Zone (fitness and skills area), and Yellow Zone (chill out area). Control schools didn’t receive any redesign, however soccer balls and jump ropes were available to both playgrounds during the study.</td>
<td>No significant difference (( p &gt; 0.05 )) at baseline between boys and girls PA levels; Boys engaged in 7.2% more MVPA compared to girls during recess; Boys engaged in 3.1% more VPA compared to girls during recess; As BMI increased, recess PA decreased (non-significant); A significant interaction for MVPA was found between the treatment effect and recess length, suggesting the intervention was more effective when recess was longer.</td>
<td>109</td>
</tr>
</tbody>
</table>
Table 4. Recess studies done with elementary school children, continued.

<table>
<thead>
<tr>
<th>Population and Location</th>
<th>Study Design</th>
<th>Recess Intervention Components</th>
<th>Main Outcomes</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary school children; mean age = 8.1 years; n = 470; North West of England</td>
<td>Pre-to-posttest quasi-experimental design with 15 intervention and 11 control schools (The authors simply say the schools “took part” as an intervention or control school, but do not state how the conditions were assigned). Eleven children per elementary school were stratified by gender and randomly selected to participate in physical activity measured by accelerometry. BMI was measured during the pre-intervention phase. PA was collected during morning, lunch, and afternoon recess periods at baseline, 6 weeks, and 6 months following the painting/environmental changes of each playground.</td>
<td>Intervention schools received multicolor playground markings in addition to dividing the playground in to 3 colored zones: Red zone (sports area), Blue Zone (fitness and skills area), and Yellow Zone (chill out area). Control schools didn’t receive any redesign, however soccer balls and jump ropes were available to both playgrounds during the study.</td>
<td>No difference (p &gt; 0.05) in baseline MVPA and VPA levels between groups; The treatment effect was stronger with increasing recess duration in terms of increasing MVPA and VPA (p ≤ 0.05); Inverse interaction terms were found between the treatment and baseline measures for MVPA (p ≤ 0.05) and VPA (p ≤ 0.10), suggesting the treatment was stronger for those who were less active at baseline; Children in the treatment group engaged in 4.5% and 2.3% more MVPA and VPA during recess compared to children in the control group; Recess duration contributes to increases in PA levels.</td>
<td>110</td>
</tr>
</tbody>
</table>

| Elementary school children; mean age = 8.1 years; n = 470; North West of England | Pre-to-posttest quasi-experimental design with 15 intervention and 11 control schools (The authors simply say the schools “took part” as an intervention or control school, but do not state how the conditions were assigned). Eleven children per elementary school were stratified by gender and randomly selected to participate in physical activity measured by accelerometry. BMI was measured during the pre-intervention phase. PA was collected during morning, lunch, and afternoon recess periods at baseline, 6 months, and 12 months following the painting/environmental changes of each playground. | Intervention schools received multicolor playground markings in addition to dividing the playground in to 3 colored zones: Red zone (sports area), Blue Zone (fitness and skills area), and Yellow Zone (chill out area). Control schools didn’t receive any redesign, however soccer balls and jump ropes were available to both playgrounds during the study. | A significant positive treatment effect was found for VPA (accelerometry) during lunch recess, with the treatment children engaging in 1.4% more VPA than the control children; Boys engaged in significantly more MVPA and VPA than girls (p ≤ 0.05); As age increased, PA during morning and lunch recess decreased; BMI was a significant predictor for lunch recess MVPA, as overweight children were less active than normal weight children; The treatment effects were strongest at the 6 month assessment and declined by the 12 month assessment. | 111 |
Table 4. Recess studies done with elementary school children, continued.

<table>
<thead>
<tr>
<th>Population and Location</th>
<th>Study Design</th>
<th>Recess Intervention Components</th>
<th>Main Outcomes</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades 1 – 4; n = 61; Midwestern town in the United States</td>
<td>Quasi-experimental, repeated measures design with one school. PA was measured on a convenience sample of children for 5 weekdays for 4 consecutive weeks during one 15 minute recess period (through the duration of the treatment period). Prior to the intervention, children completed a demographic survey and BMI measurements.</td>
<td>The treatment consisted of four recess activities of the week (RAW): RAW #1—no treatment; RAW #2—the first RAW was a circuit course resembling walking/fitness trails with jump ropes, large playground balls, bean bags and hula hoops; RAW #3—the second RAW was an obstacle course constructed on the outside of the playground area; RAW #4—the final RAW was frisbee’s (30 of all different colors) that were used primarily to throw at inanimate targets.</td>
<td>Mean step count of 870.67 during the 15 minute morning recess; Males were more physically active than females across all 4 weeks; No treatment (RAW #1) accumulated more mean step counts (961.9) compared to all others. The second most step counts were the circuit course (RAW #2) with 930.5 step counts; Older children were more active than younger children; PA was higher in children with a healthy BMI (&lt;85%) compared to OW or OB children (BMI &gt;85%).</td>
<td>112</td>
</tr>
<tr>
<td>Elementary school children age 4 – 11; n = 120; Northeast Wales</td>
<td>Quasi-experimental, pre-to-posttest design with 4 intervention and 4 control schools (two early primary schools [4 – 7 years] and two late primary schools [7 – 11 years] each; The authors simply say the schools “took part” as an intervention or control school, but do not state how the conditions were assigned). Five children from each age group were randomly selected to participate. PA data was collected with heart rate telemeters for 4 weeks prior to the treatment and 4 weeks after the treatment (i.e., playground lines painted). BMI was collected before and during the treatment phase.</td>
<td>Intervention schools received playground markings that were painted on the playground according to school preference that included designs like hopscotch and letter squares.</td>
<td>MVPA in the treatment group increased playtime from 36.7% to 50.3% (increase of 13.6%) compared to a decrease in the control group from 39.9% to 33.4% (decrease of 6.5%; p ≤ 0.01); Boys increased MVPA from 40.6% to 44.8% (increase of 4.2%) and girls from 35.2% to 39.8% (increase of 4.6%) before and after the treatment; Playtime VPA in the treatment group increased from 7.9% to 12.4% (increase of 4.5%) compared to 8.0% to 8.0% (0%) in the control group (p ≤ 0.01); Boys increased VPA from 9.8% to 12.6% and girls from 5.9% to 7.9% before and after the treatment.</td>
<td>113</td>
</tr>
</tbody>
</table>
2.8 Summary of CBPR

Community-based participatory research (CBPR) is an approach that is designed to empower a community with the ultimate goal of eliminating unhealthy conditions that constitute political, economic and social subjugation that contribute to the development of disease. The key is establishing a co-equal partnership between the community and researcher(s) from the inception of the research question, implementation, data collection, and dissemination of results. A foundational element in this partnership is trust. The evidence that a trusting partnership has been established is demonstrated by the active participation by the community in the research process even after the study is completed.

Conducting studies incorporating a CBPR approach in AI communities is an ideal orientation to research since every aspect of the intervention is community-driven. Research suggests that interventions adapted to the cultural perspective of AI communities promote personal and collective efficacy when conducted with the active involvement of individuals in the intervention community. American Indian communities are grounded in deep spiritual, cultural, and traditional roots. Combining CBPR with these unique aspects of AI communities allows the pre-intervention planning phase to incorporate AI culture and perspectives into every aspect of the intervention. Another key of CBPR builds on the strengths and resources existing within the community by fostering a cyclical process in which problems are identified and solutions are developed that directly involve the community’s existing resources.

Research conducted on AI reservations to increase PA levels in AI children to decrease risk of obesity and diabetes is limited. Utilizing a CBPR approach to
implement an intervention designed to increase PA in AI children allows the investigator to conduct focus groups (FG), interviews, and associated qualitative methods to identify behavioral and environmental factors contributing to the health problem (i.e., sedentary activity). These methods provide community members the opportunity to discuss strategies to increase PA and guide the research design process in collaboration with the researcher(s). Many of the diabetes prevention programs implemented on AI reservations described in the latter section of the literature review utilized CBPR (or some form of it, e.g., working with the community to develop culturally appropriate activities despite implementing a full-scale intervention), and demonstrate how CBPR has been conducted on various AI reservations using a mixed-methods approach. Further, the studies also demonstrate how important it is for the researcher to foster a relationship with the community, incorporate community involvement (design, implementation, and proposed evaluation methods of the intervention), and use dialogue to identify barriers and enhancers to PA.

2.9 Overview of Dissertation Studies

This dissertation used a mixed-methods, CBPR approach to conduct two, inter-related studies focused on preventing risk factors (i.e., sedentary activity) associated with T2DM in children living on an American Indian reservation. The studies employed a mixed-methods approach (qualitative and quantitative) to develop and pilot-test community-based strategies to increase PA in children during the school day. Briefly, Study 1 assessed enhancers and barriers to increasing PA in children in the 4th, 5th, and 6th grade attending an elementary school on the Flathead Indian reservation. The community-identified strategies were used to design and pilot-test an intervention to
increase PA in this population. Study 1 used a CBPR approach to recruit community members (adults and children) to participate in six FG discussions with the purpose of identifying strategies that could increase PA during the school day in 4th, 5th, and 6th grade children. The results of this study were reported directly back to the study participants and the wider community/school for review, further input, and approval. After the community agreed that an intervention during recess was the area of the school day in most need and approved the specific strategies to be implemented on the playground, Study 2 was designed and implemented.

Study 2 was an 8 week recess intervention that was implemented during one recess period each day Monday through Thursday. Baseline (pre-intervention) and posttest (post-intervention) data collection included anthropometric measures (height, weight, BMI, and waist circumference) and two surveys (self-report PA and readiness to participate in recess activities) in elementary school children (mean age = 11 ± 0.9; AI = 28; White = 33; n = 61). The recess intervention included splitting the playground into three zones. Zone 1 was an area of the playground that contained concrete where four-square, nine-square, and hop-scotch lines were painted. Zone 2 was an area where permanent playground structures were located—no treatment was implemented in this zone. Zone 3 was an area where bi-weekly activities were facilitated. The specific activities were football, soccer, basketball, and ultimate frisbee. Daily counts of physical activity were measured by direct observation with the System for Observing Play and Leisure Activity in Youth (SOPLAY) instrument in children in the 3rd, 4th, 5th and 6th grades who were in the three zones during recess. All treatment conditions were identified during the FG discussions in Study 1.
Therefore, the overall purpose of this dissertation research was to identify, implement, and pilot-test community-identified strategies to increase PA in children in the 4th, 5th, and 6th grade residing in a tribal community in the Northwest Montana.
CHAPTER 3: STUDY 1. Assessing barriers and enhancers to increasing physical activity during the school day in children on an American Indian Reservation: A qualitative research study
3.1 Abstract

The purpose of this study was to determine community-identified factors that enhance or limit physical activity (PA) during the school day in 4th, 5th, and 6th grade children attending an elementary school on an AI reservation in Montana. Six community focus group (FG) discussions were led by trained researchers from the University of Montana in May and June 2012. Students in the 4th, 5th, and 6th grade and adult community residents took part in the FG discussions. There were 7 – 10 participants in each audio-recorded focus group that lasted approximately 60 minutes. The audio-recordings of the FG discussions were transcribed and analyzed utilizing Grounded Theory. Analysis of the FGs identified barriers to PA that fell into four main categories: school environment, community and school resources, electronic devices, and the role of parents and family. Emergent themes for strategies to increase PA in elementary school children fell into three main categories: structured/non-competitive activities, structured/competitive activities, and increasing school and community-wide capacity. The findings from this formative study will be used to design and pilot test a school-based PA intervention for 4th, 5th, and 6th grade children attending an elementary school on an AI reservation in Montana.

3.2 Introduction

Obesity has escalated to epidemic proportions in the United States (US) affecting one third of all US adults and nearly one fifth of children.\textsuperscript{116} This burden is of special concern for American Indian (AI) children as studies have reported obesity prevalence that ranges from 12\%\textsuperscript{30} to 51\%\textsuperscript{91} in this population. Obesity is the greatest risk factor
for developing type 2 diabetes mellitus (T2DM),\textsuperscript{41,42} which puts one fourth to half of all AI children at risk for this disease. Research shows that increasing physical activity (PA) may reduce the risk for childhood obesity\textsuperscript{9,10,12,17,18,21,94-96,117-122} and thus can be an effective childhood obesity prevention strategy. The alarming rates of AI childhood obesity accentuates the urgency to develop sustainable and effective behavioral interventions that increase PA in tribal communities.

There are seven Indian Reservations in Montana that are home to federally recognized tribes that include the Blackfeet (Am-ska-pi Pikuni), Crow (Apsaalooke), Salish (Selis), Kootenai (Ktunaxa Ksanka), Pend d’Oreilles (Qlispe), Assiniboine (Nakoda), Gros Ventre (A’aninin), Sioux (Lakota and Dakota), Northern Cheyenne (Tsetsehesestahase So’taahe), and Chippewa (Annishinabe Ojibwe). In addition, state recognized tribes include the Plains Cree (Ne-i-yah-wahk) and Little Shell Chippewa (Annishinabe and Metis). Consequently, Montana has one of the largest AI populations in the US, which accounts for 6.4\textsuperscript{123} of the states total population.

The prevalence of diabetes in Montana Indian adults is 16\% or two- to threefold higher than non-Indian populations in Montana. Montana Indian adults without diabetes have a high prevalence of T2DM associated risk factors.\textsuperscript{124,125} For example, in 2003, 70\% of Montana AI adults were found to be overweight (BMI $\geq$ 25, kg/m\(^2\)) and 77\% reported a family history of diabetes. A study conducted by Moore, et al.\textsuperscript{126} reported the prevalence of T2DM in Northern Plains Indian youth (<20 years old) living on Montana Indian reservations to be 0.23 percent. However, little is known about the prevalence of diabetes risk factors in Montana AI youth. These holes in the literature underscore the importance of living a healthy lifestyle—such as eating healthier foods and getting more
exercise—in order for Montana AI youth to sustain their low prevalence rates of diabetes as they become adults.

There is a paucity of literature describing the outcome of formative assessments used to design behavioral interventions to prevent obesity and diabetes in AI children.\textsuperscript{16,20,24,25} The few studies that are available followed a similar approach as the current study in terms of partnering with the community and conducting a series of focus groups (and/or interviews) to generate ideas and strategies around a specific health concern, and then develop an intervention based on the community-identified strategies.\textsuperscript{15,17,21,23} This kind of community-based participatory research (CBPR) approach fosters a collaborative partnership between the researcher and tribal community and is especially appropriate for use with AIs who historically have been vulnerable to researchers’ insensitivity and exploitation.\textsuperscript{127} CBPR actively engages the community in all aspects of the research process,\textsuperscript{128} builds upon existing community strengths,\textsuperscript{129} and holds significant promise for implementing effective and sustainable public health approaches.\textsuperscript{130}

Formative research done with AI communities have reported community-identified strategies to increase PA such as basketball and football,\textsuperscript{16,25,131} and integrating Native American culture and tradition\textsuperscript{16} in the design. These studies also cite television viewing,\textsuperscript{20,25} homework,\textsuperscript{25,131} and lack of time\textsuperscript{25,131} as barriers to eliciting lifestyle change. To our knowledge, formative studies exploring barriers and strategies to PA during the school day in 4\textsuperscript{th}, 5\textsuperscript{th}, and 6\textsuperscript{th} grade students in a tribal community in Northwestern Montana do not exist. This paper reports the outcomes of a formative assessment that was conducted with a Montana Indian reservation during the first-phase of a two-phase CBPR project. The purpose of this study was to listen to children and community
members’ perspectives for ways to increase PA during the school day in elementary school children. The main themes and strategies identified from community FGs were used to implement age-appropriate and culturally relevant activities for children in the 4th, 5th, and 6th grades.

3.3 Methods

The reservation community that participated in the study is small, rural, and provides limited opportunity for full-time employment. The population has less than 1,000 persons and is located in the northwestern US. Among those living on the reservation, almost one fourth of the children live in poverty or in single-parent families and a little over one third live in families where no parent has full-time, year-round employment. Almost two thirds of the K-12th grade students in schools on the reservation qualify for the free and reduced lunch program.

In the fall of 2011, we began the CBPR process by developing relationships and obtaining approvals for the study throughout the reservation with the Tribal Health Director, the Tribal Health Diabetes Team, Tribal Council, Indian Education Committee, the school superintendent, principal, teachers, and members of the community. These meetings, that took place over a seven month period, were necessary to secure support from Tribal Council, Tribal Health, Indian Education Committee, the school district, and the community. IRB approval for this study was obtained from The Rocky Mountain Tribal Institutional Review Board in Billings, Montana.

Once relationships were established and the necessary approvals for the study were obtained, the investigator collaborated with the Tribal Health Diabetes Coordinator to hold a community meeting. The purpose of the meeting was to discuss the goals and
objectives of the study and enlist community members’ support and involvement. Tribal Health staff recruited participants to the FG’s through flyers posted at local health clinics, elementary schools, reservation and community events, and by word of mouth. These recruitment strategies from local community members helped engage a heterogeneous sample from the community with respect to age, tribal affiliation, and position in the community (e.g., educator, parent, elder, and elementary school child). Approximately 20 families attended the community meeting. The investigator explained the details about the study, the purpose and intention of the FG’s, and how the data would be secured and disseminated. At the conclusion of the meeting, the investigators collected contact information from adults/parents who were interested in participating and parental consent from parents who gave permission for their child(ren) to participate in a FG. The entire sample was recruited according to this process.

The FG sessions were led by trained AI graduate students from the University of Montana in May and June 2012. Six FG’s were conducted with a total of 42 participants and each FG included 7 - 10 participants. Because the study was particularly interested in the views of children, three grade specific FG’s consisted of 4th - 6th grade students and three FG’s consisted of a combination of teachers, school staff, parents, elders, and community members.

Before the FG’s were conducted, team members received training in CBPR and qualitative methods that included conducting FG’s, Indigenous methodology, and data analysis techniques. The researchers and the Tribal Health Diabetes Coordinator developed a moderator’s guide that included open-ended questions. The questions were exploratory in nature, progressed from general to specific and contained questions
pertaining to barriers and strategies for increasing PA in 4th, 5th, and 6th grade children during the school day (Table 1).
Table 1. Focus group questions for increasing physical activity in 3rd, 4th, and 5th grade children during the school day.

<table>
<thead>
<tr>
<th>Adults</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you think children get enough exercise</td>
<td>What are some things that keep you from getting exercise each day?</td>
</tr>
<tr>
<td>during the school day to help prevent obesity and diabetes?</td>
<td></td>
</tr>
<tr>
<td>Think about how much exercise children</td>
<td>What are some things that help you get exercise each day?</td>
</tr>
<tr>
<td>receive during the school day—can you</td>
<td></td>
</tr>
<tr>
<td>describe some barriers they may face that</td>
<td></td>
</tr>
<tr>
<td>prevent them from getting enough exercise?</td>
<td></td>
</tr>
<tr>
<td>Do you think PE should be offered more days</td>
<td>Would you like it if you had PE more days during the week?</td>
</tr>
<tr>
<td>out of the week?</td>
<td></td>
</tr>
<tr>
<td>Can you describe some specific activities</td>
<td>What kinds of exercises do you and your friends like to do during PE that is fun and exciting?</td>
</tr>
<tr>
<td>that could be included during PE to get the</td>
<td></td>
</tr>
<tr>
<td>kids more physically active?</td>
<td></td>
</tr>
<tr>
<td>Do you think the school should allow for</td>
<td>What are the exercises at PE that are not very fun or exciting?</td>
</tr>
<tr>
<td>more recess breaks during the day?</td>
<td></td>
</tr>
<tr>
<td>Can you describe some activities that could</td>
<td>Would you like it if recess was offered more times each day? What kinds of exercises do you and your friends like to do during recess that is fun and exciting?</td>
</tr>
<tr>
<td>be offered during recess that would get the</td>
<td></td>
</tr>
<tr>
<td>kids more active and moving?</td>
<td></td>
</tr>
<tr>
<td>What are some ways we can get the youth</td>
<td>Can you tell me some of the things you would like to do during the school day when you’re not in PE or at recess to get more exercise?</td>
</tr>
<tr>
<td>more active and moving during the school day</td>
<td></td>
</tr>
<tr>
<td>without disrupting the current academic/testing schedule?*</td>
<td></td>
</tr>
</tbody>
</table>
The focus groups began with the facilitator providing an overview of the study. Participants then completed a brief demographic survey and a consent form (children provided assent). All sessions were audiotaped and were 45 to 90 minutes in length. A meal was provided and the adult participants received a $20 cash incentive. Each child participant received a basketball.

Audio-recordings were transcribed and formed the basis for analysis. Analysis followed the criteria for qualitative rigor outlined by Guba and Lincoln\textsuperscript{135} that applied the concepts of credibility, transferability, dependability, and confirmability. Themes and sub-themes were generated that consisted of strategies and barriers to physical activity. The investigators constructed a list of coded themes based on the inductive methods of grounded theory,\textsuperscript{136} and categorized the data using line by line analysis.

Once the final coding scheme was prepared, another trained study team member tested the finalized version of all possible codes on a subset of the entire sample that consisted of 69 units and constituted 10\% of the entire sample of verbatim transcripts.\textsuperscript{137} The coding scheme was successful with 59 out of 68 text units and revealed a score of 0.840 with Cohen’s kappa\textsuperscript{138} significantly higher than chance (kappa = .820). Discussing the discrepancies and determining if a code from the coding scheme described the indistinguishable unit more effectively resolved disagreements in the coding scheme. The coding scheme was then used for the remainder of the study and integrated into a qualitative analysis software program (NVivo 9, QSR International, Cambridge MA). The authors corrected minor grammatical inaccuracies in the quotes presented below to illustrate the themes.
3.4 Results

Description of the Sample

The child FG’s consisted of 14 males (64%) and 8 females (36%; n = 22) with a mean age of 10.6 ± 1.0 years. Nineteen (86%) of these children identified as Al, one as white (5%), and two as other (9%; French, German, and/or Irish). The adult FG’s consisted of 5 males (25%) and 15 females (75%; n = 20) with a mean age of 40.4 ± 8.5 years. Nineteen (95%) of the participants identified as Al and one (5%) identified as white.

Theme List

Analysis of the FG’s identified themes and sub-themes for barriers to PA that fell into four main categories: school environment, community and school resources, electronic devices, and the role of parents and family. Emergent themes and sub-themes for strategies to increase PA fell into three main categories: structured/non-competitive activities, increasing school and community-wide capacity, and structured/competitive activities. These results are discussed below.

Barriers to Physical Activity

School Environment

The elementary school teachers use a lecture style approach where the teacher stands in front of the class and the students sit in desks. Large portions of the adult FG discussions were spent talking about the relationship between the teaching styles of elementary school teachers and their child’s physical activity. A parent stated, “One of the things that you have to think about is that all of these classes are lecture methods. [Students] just sit and [listen] the whole time. It seems like the younger the individual,
the more physical exertion they need, and if they don’t get it, the less their attention
span is going to be. If [students] sit there and [teachers] drill them for hours and hours
and then tell them to take a five-minute run and then get back here and we’ll go for
another couple of hours, I don’t think [students] will get half of what [teachers] lectured
on.”

Exacerbating the amount of instruction time is the four-day school week that runs
from Monday through Thursday. The elimination of Friday has increased the length of
school days and resulted in a more intense focus on academics to compensate for one
less day of instruction. An adult stated, “By policy, they have to have a certain number
of minutes of instruction time and that is squished into four days. That’s fairly set unless
we want to add Friday’s back in, it’s a whole—I think that was part of when we voted
that they were shortening up recesses to get that Friday off. One parent talked about
the difficulty with the long school days, “. . . getting out at 4:00 pm, between homework
and dinner and showers, it’s hard to get all that [extra-curricular activities] in.” Adults
complained about how the school enforced lofty academic requirements in terms of the
volume of homework and performance on tests. A parent talked about how difficult it is
for the children to meet the academic expectations and the consequences for falling
short—she stated, “The one thing that I don’t like, too, is when kids don’t get homework
or anything done—they keep them in at recess. And this is the age where kids need to
be active.”

A consequence of decreasing the school week to four days in this community is
decreasing the number of recess periods from three to two per day. Also, the
playground is closely monitored which may hinder, rather than promote, PA during
recess. Adult FG participants mentioned how the playground lacked structured play and the rules enforced on the playground prevented children from playing certain games (e.g., tag) that would enhance activity during recess. An adult stated, “I don’t think they get enough [physical activity]—[the] school doesn’t have enough equipment for recess time and for outdoor activities like balls. My youngest one comes home and he says, ‘We can’t do this at recess because the teacher says we can’t.’ They are simple games like tag.” In addition, the short duration of recess makes it difficult to organize games and activities on the playground and seems to have become a sedentary break for many of the children.

A sub-theme of the School Environment the children identified was emphasis on competition and fitness and how that decreased their enthusiasm to participate in PA during the school day. They talked about the difficulty they had with the conditioning and body weight measurements during the presidential fitness test in PE. One participant said, “I don’t like the mile [time trial run] and I don’t really like when we do this stuff—the pull-ups and the curls because I can’t always do very many of them.” The children expressed how uncomfortable it made them feel to be weighed in front of their peers. One participant said, “When you get weighed [during the presidential fitness test], that’s what’s not fun for me.” The test itself was also identified as a barrier to PA as the children expressed disinterest and discouragement with the mile run, sit-ups, push-ups, pull-ups, curls, and sit and reach.

**Community and School Resources**

Participants identified a lack of equipment on the playground and during physical education (PE) classes, making it difficult for the children to play various games and
activities. The participants described how the playground resembled a field and many students were sedentary during the recess break. A parent said, “Yeah, it’s bad. If you look over there it is pretty much just a field. Fourth through sixth [grades] there are more than half the kids that just sit during recess time.” Coupled with having nothing to do, students have been faced with inappropriate playground conditions. One teacher commented, “There’s teachers that have to go in before school and pick up all the bottles and cigarette butts or whatever on that playground, too. It’s a big mess.” The budget does not have the funds to support a security position to have the premises patrolled after hours. There is also no funding to hire coaches, making it difficult for the community to find volunteer coaches for sports teams. Another teacher said, “There’s not enough coaches so they [children] were turned away [from participating in sports].”

**Electronic Devices**

Children identified electronic devices such as video games, computers, television and iPods as major barriers to exercise. Some children were aware these devices and activities hindered active time, but nonetheless, enjoyed using the devices. One child commented, “Playing video games—it’s good and bad because it doesn’t let you get as much exercise, and it’s good because it’s really fun.” Another child said, “There’s a lot of really fun games, once you start playing games you just can’t quit.” Adults identified cell phones as a barrier to their child’s exercise. One parent talked about the amount of texting their child does in comparison to the activity they receive during the school day, “I feel that they do have some programs going, but I feel that they don’t do enough physically even in the PE classes that they do. I see some things where they are doing something but it’s very minimal effort. Most of the time they don’t break a sweat or they
are looking bored. I feel that—I see in here about more people getting thumb exercises [texting on their cell phone] more than anything."

**Role of Parents and Family**

Adults recognized the influence that home life has on the development and choices children make when they are at home (i.e., outside of the school day). Some adults talked about how persuasive the parent’s influence was on the likelihood to elicit changes in children’s PA levels. A parent said, “I think a major factor is their home life—you’re competing with home life and home life sets a standard on the way things happen. If it’s not encouraged at home, there’s no way a stranger is going to be able to do it if their folks can’t keep them active.” Consequently, parents were identified as being unhealthy role models for their children. Much of this was attributed to the diet and habits that were being taught in the home. A parent said, “I did want to mention that another big component of the problem with diabetes is diet. I think that a lot of bad habits are being perpetuated with children. I know that this program is geared towards the PA aspect more, but I think even in the older generation, you see, if people have better eating habits then it would be less of an issue.”

**Strategies for Increasing Physical Activity**

**Structured/Non-competitive Activities**

Expanding playground space and painting lines on the concrete were seen as realistic solutions to counter the lack of equipment during recess. In response to a question about how to get the children more active during recess, an adult said, “Expand their space to use it for kickball and softball.” In terms of painting lines on the playground, a teacher said, “I have to paint the lines on the four-square. I need help
with that. I need to get those lines repainted. Those kids are using them. We need lines painted which is a matter of time and [the cost of] a case of paint.” In addition, children and adults alike wanted the frequency of recess breaks increased throughout the week.

The word “structure” continued to emerge when talking with the adults. One parent commented, “If they have something that was a little structured [during recess] where everybody had to do it, so you could get everybody involved….if you had something that was structured that everybody had to get involved then it might work out, too.” A teacher stated, “Maybe have somebody out there specifically to set up different games [during recess].” Children identified several games that were non-competitive—some required equipment and others required painted lines. Children said they would play games during recess including jump rope, hopscotch, shimmy, tag, four-square, nine-square, swinging, and playing on the monkey bars.

**Structured/Competitive Activities**

In addition to non-competitive activities, children also identified several competitive team sports they would likely play if they were offered during recess. One child commented, “Most of us really like dodgeball because we run a lot [and] you get exercise with your arms. You exercise with all of your body.” The PE teacher said, “Everybody gives me such a hard time about dodgeball, but they beg for that silly game. They want dodgeball.” Children identified several other competitive team sports they would participate in such as basketball, softball, football, varying kinds of soccer and volleyball, ultimate frisbee, baseball, t-ball, lacrosse, rugby, kickball, and Native American kickball.
Increasing School and Community-wide Capacity

Adults identified the need for building capacity and tapping into existing resources as strategies to increase PA in the community. Participants agreed that this would require involvement and collaboration from the administration, teachers, and parents. One parent said, “If you have a good administrator that says that we are going to do this, I expect this, and this is what is going to happen, then it happens. We need to get to that point. We are gaining ground.” One of the duties that inhibits some of the teachers from getting engaged in activities that increase PA was their preparation time. Recess was one of few breaks teachers have all day and it is vigorously protected. A parent said, “Teachers want the holy prep time. They don’t want that to be interrupted. If our goal is to get them active and moving, [then kids need to be physically active a] half hour every day at least.” According to adult FG participants, parental involvement was essential to the sustainability and success of a PA program focused on children. An adult said, “I would just say like you doing this [the investigator conducting the study to increase PA in the children], it picks up the slack for the kids that have parents that have no interaction with their kids at all. You’re doing them a great service because they wouldn’t get it at home no matter what.” Overall, adults agreed that community capacity, increasing teacher involvement in recess activities, and parental involvement are three critical components to creating and sustaining effective PA strategies for children during the school day.

Healthy role modeling among parents and teachers was seen as a powerful resource within the community. One elder said, “I had some health issues but I got them taken care of. I am going to try to get her [granddaughter] to start walking with me
because before I couldn’t walk, but now I can, so I am going to get both of my
granddaughters to walk with me. I think they do need some exercise—I was
overweight. My doctor came right out and told me, you need to lose weight because it’s
not healthy. I don’t want to see my granddaughters grow up that way.” Several
participants described how sedentary behavior and unhealthy food choices by both
teachers and parents directly affected the children’s behaviors. A parent said, “I think
leading by example is big. I am outside a lot doing something and my kids have no
excuse. It’s not like I am sitting in front of the TV. If I can keep myself busy, they
should be able to.” This capacity building effort translated to instilling healthy behaviors
in the children through healthy role modeling and education from teachers and
community members.

3.5 Discussion

The purpose of this study was to explore strategies and barriers to PA during the
school day in 4th, 5th, and 6th grade children attending an elementary school on an AI
reservation. The findings from this formative assessment revealed several enhancers,
limitations, and strategies related to increasing PA in children during the school day.
Non-competitive playground activities and competitive team sports were seen as
strategies to increase physical activity. Altering the activity environment by painting
lines for games such as hop-scotch and four-square on the playground were also
identified. In order for sustainable and effective changes to occur, adults agreed that
this endeavor would take a coordinated and involved effort between school
administrators, teachers, and parents. The school week consists of four days that are
filled with lecture style teaching and primary emphasis on academics (homework and
test performance)—these were viewed as substantial barriers to PA during the school day. Lack of resources in terms of personnel and equipment, especially on the playground contributed to sedentary activity during the school day. Children reported that video games, television viewing, and cell phone use increased sedentary activity when they were at home.

Studies done in AI communities using a CBPR approach found strategies to increase PA were similar to those in our study. These included supportive social networks, serving healthier meals, and developing school based activities. Participants in our study identified the importance of social networks, more specifically family relationships. The participants identified and recognized that effective and sustainable change must be facilitated and supported by the family. Children identified several school-based activities that were specific strategies that could be implemented to increase PA during the school day such as basketball, football, soccer, and dodgeball.

The children discussed how there were no activities available for them to do during recess that were led by teachers, staff, or volunteers. The children expressed a desire for someone to be on the playground with them to play structured, competitive team sports during recess—these included basketball, softball, football, soccer, volleyball, ultimate frisbee, baseball, t-ball, lacrosse, dodgeball, rugby, kickball, Native American kickball, and volleyball and soccer with two balls. These findings are similar to those in other studies where AI children participated in FG’s and identified strategies for increasing physical activity. The sports they identified were basketball, football, volleyball, softball, and dodgeball. Basketball is the paramount sport
that Montana tribal communities play and this sport arguably attracts the greatest following. It is interesting to note that when the investigators sat down with the director of tribal health to discuss ways to integrate culture into the design of the intervention, he stated that basketball has evolved as culture on the reservation and one could argue that basketball is AI culture in the 21st century. The strong representation at state tournaments has inspired young Indian people to compete in basketball and may be one of the reasons that many studies report team sports as games that AI children identify as strategies to increase physical activity.

Prior research found that providing loose equipment such as playground balls, frisbees, and jump ropes are not only effective ways to increase PA, but are low cost and sustainable strategies to implement during recess.\textsuperscript{106,107,109,112} In addition, studies report painting lines on the concrete for games like hopscotch and foursquare resulted in significant increases in playtime during recess.\textsuperscript{106} The participants in our study discussed themes that agreed with those mentioned above—providing playground equipment such as monkey bars, swings, and slides for the children to utilize during recess would help increase their physical activity. The asphalt play areas at the elementary school lacked painted lines for games like hopscotch and four-square. Participants said that in the past, the school provided loose equipment like jump ropes, hula hoops, and playground balls. Over time, this equipment was lost, broken, wore out, vandalized, or came up missing when the children came in from recess. During this same period, the school stopped providing loose equipment as they lacked funding to replace these items. In a previous study, AI participants also identified jump ropes and
non-competitive activities as strategies to increase PA during recess\textsuperscript{25} and support the notion that increasing PA during recess can be simple and inexpensive.

Our findings support the need for trained staff to be on the playground during recess to lead team sports and teach fundamentals, rules, and sportsmanship instead of enforcing rules that may hinder activity on the playground. The adults and children both talked about rules that were being enforced and how this eliminated games like tag from being played on the playground. Tag is a game that requires an immense amount of running and when implemented during recess interventions, has been found to increase PA levels.\textsuperscript{108} Prior research has discovered that when children are directly supervised on the playground, their activity level is decreased, which may be attributed to teachers emphasizing safety that sometimes means PA is suppressed rather than promoted.\textsuperscript{104} Perhaps the school is placing too much priority on rules coupled with direct supervision that is hindering PA instead of encouraging it. This may also explain why so many children were found sitting during recess—there is nothing for them to do and the activities that they enjoy doing (e.g., tag) are not permitted on the playground.

This study revealed the importance of parental and family involvement. The relationship between the child and guardian was identified as a critical component to eliciting positive and sustainable change. Common themes showed that healthy lifestyle changes (e.g., increasing PA) must be reinforced at home and modeled by parents/guardians if they are going to have any lasting effect on children. Supportive social networks\textsuperscript{24} were one of the main themes identified by Zuni high school students in focus groups and interviews during the formative assessment of the Zuni High School Diabetes project.\textsuperscript{19,23,24} In another study in an AI community, Brown et al.\textsuperscript{16} found that
family was a particularly powerful motivator to exercise, especially when it actively involves other family members participating in the activity (e.g., round dances where singing, dancing, and socializing are taking place). Others report that children also identified peers and coaches as encouraging motivators for PA and sports participation. In contrast, a lack of social and family support, especially at home in terms of adults not being active with their children is a barrier to being physically active. Including family in the design of a PA intervention may be one of the most effective yet challenging strategies when working with AI communities. Our study describes the challenge that lies in receiving buy-in and active participation from the guardian(s). Perhaps targeting interventions towards activities that parents, children, and/or extended family members can do together (e.g., aunts, uncles, cousins) is one approach to increasing PA in children living in tribal communities.

An interesting finding from this study is that AI cultural activities were not mentioned as a key strategy to increase PA during the school day. These findings are similar to other studies that explored ways to increase PA during the school day from an AI perspective. Perhaps the emphasis on activities that are appropriate to implement during the school day drove the discussions toward Western style approaches such as playground games and team sports. If the study had cast a broader net in terms of focusing on the adult population and conducting a community-wide intervention, participants might have emphasized the importance of increasing PA through traditional AI games such as ring the stick, gathering stones, or sticks in the fist.
The children in this study talked about how much fun video games were and that they spent a large amount of time watching television. The adults talked about the amount of texting and time children spent on cell phones, watching television, and playing video games. Collectively, the use of electronic devices was identified as a hindrance to PA, especially at home. Hood et al.²⁰ conducted a qualitative study in a traditional Mohawk and Akwesasne community and the participants reported how the use of technology has disrupted their traditional lifestyle identifying television viewing as a substantial lifestyle change contributing to obesity and diabetes. The Pathways study also identified television viewing as a barrier to physical activity.²⁵ These findings support the need to limit the use of electronic devices (cell phones, television viewing, and video games) and provide alternative activities that children can do that get them active and moving. Future studies should focus on addressing these concerns outside of school while children are at home in the evening and on the weekend.

**Strengths and Limitations**

The interviewers were trained AI researchers from the UM. Although the interviewers were AI, no one had familial ties to the tribe or community. This may have made it uncomfortable for some of the participants to disclose sensitive information. In contrast, this fact may have influenced some of the participants to be more highly critical of the school system since the interviewers were not linked to the community. Teachers and school staff accounted for approximately half of the participants in each FG. Some of the questions explored areas of the school day that they instructed, which in turn may have prevented some participants to disclose information about issues pertaining to the current curriculum and style of instruction. In addition, the small sample may have also
contributed to bias by steering the exchange of information towards responses that are more socially acceptable (e.g., one child would identify an activity, then several children would identify the same one). However, we are confident that we reached data saturation since the same information was discussed in each FG. The participants identified needs to be addressed during the school day that were presented to the director of tribal health, the district superintendent and principal, and members of the community. This in turn created awareness and helped to initiate capacity building. There was excitement throughout the community and participants showed great support and interest in the project that was being conducted.

**Conclusion and Implications for Health and Diabetes Educators and Prevention Specialists**

The purpose of the study was to determine barriers and strategies to increase PA during the school day in 4th, 5th, and 6th grade children on an AI reservation. Adults and children identified recess as an area of the school day in need of attention. The children identified structured non-competitive playground activities, painting lines on the playground for games such as hopscotch, nine-square, and four-square, and structured competitive team sports as strategies to increasing physical activity. Barriers included the school environment that consisted of a four-day school week coupled with instruction centered teaching focused on academics (homework and test performance), lack of resources (personnel and equipment), and electronic devices. The data generated from this formative assessment will be used to develop a PA intervention during recess. This study adds data from a tribal community to a small group of studies that have explored community identified approaches that were used to develop a
school-based PA intervention. The results may help health and diabetes educators and prevention specialists better understand the needs that are prevalent within AI tribal communities and provides a framework when conducting a formative assessment with AI populations used to design and implement diabetes prevention programs.
CHAPTER 4: STUDY 2. Community-identified strategies to increase physical activity during elementary school recess on an American Indian reservation: A pilot study
4.1 Abstract

**Objectives.** The primary aim of this study is to determine the effect of a recess intervention on physical activity levels in children in the 3rd, 4th, 5th, and 6th grades attending an elementary school on an American Indian reservation.

**Methods.** Children from one elementary school in a tribal community in Northwestern Montana participated in this quasi-experimental repeated-measures 8-week pilot study. Fourth, 5th, and 6th grade children participated in pre – to posttest measures for body composition (height, weight, and waist circumference) PA surveys (the Modified Physical Activity Questionnaire for Adolescents and the Stages of Change and Motivation). A total of 61 children participated in pre and posttest body composition and survey measures (mean age = 11 ± 0.9; AI = 28; White = 33; n = 61). The 8-week recess intervention consisted of dividing the playground into 3 zones. Zone 1 was an area where lines were painted on the playground, Zone 2 was an area where permanent playground equipment was located, and Zone 3 was an area where facilitator led activities were provided. Physical activity was measured by direct observation with the System for Observing Play and Leisure Activity in Youth (SOPLAY) instrument.

**Results.** The SOPLAY measures were collected in children each day during pre-intervention (baseline), and throughout the 8 week intervention. Results showed significant differences during the intervention in moderate to vigorous physical activity (MVPA) and vigorous physical activity (VPA) between Zone 1 and Zone 2, Zone 2 and Zone 3, and Zone 1 and Zone 3 (p = 0.001). Females had significantly higher PA counts in Zone 1 (MVPA = p ≤ 0.05; VPA = p ≤ 0.01) and Zone 2 (MVPA = p ≤ 0.01; VPA = p ≤
0.01) compared to males, and males had significantly higher PA counts compared to females in Zone 3 (MVPA = \( p \leq 0.001 \); VPA = \( p \leq 0.001 \)). Males had significantly higher moderate physical activity (MPA), MVPA, and VPA compared to females during facilitator led and non-facilitator led activities (\( p \leq 0.001 \)). There was a significant pre-intervention to intervention decrease in sedentary activity in Zone 2 (\( p \leq 0.01 \)), and a significant pre-intervention to intervention increase in MPA and MVPA (\( p \leq 0.05 \), respectively) in Zone 1 for males and females. Females had a significant pre-intervention to intervention increase in PA counts in Zone 1 (MPA = \( p \leq 0.01 \); MVPA = \( p \leq 0.01 \); VPA = \( p \leq 0.01 \)) and Zone 3 (MPA = \( p \leq 0.01 \); MVPA = \( p \leq 0.01 \); VPA = \( p \leq 0.05 \)). A significant increase was found in weight in the children from pre- to post-intervention, 43.1± 13.5kg to 44.0 ± 14.2kg, respectively. The MPAQ-A questionnaire revealed a significant decrease (mean difference = 0.80; \( p = 0.008 \)) from pre- to posttest in the number of days children participated in vigorous PA for 20 minutes (i.e., from 4 days per week to 3 days per week). There was also a significant decrease (mean difference= 0.40; \( p = 0.05 \)) from pre- to posttest in the number of hours children spent in screen time (e.g., playing video games and/or computer use) during the school week. The SOCM data showed no pre- to posttest differences in children’s motivation to participate in recess activities. The results also show the feasibility of the recess intervention and that the various recess activities were able to be implemented successfully and the research team was able to engage the children on the playground. In addition, the ability to collect pre-to post-test measures is important when trying to determine behavior changes for the prevention of obesity and diabetes. To our knowledge, the SOPLAY instrument has not been used in a tribal community before.
Conclusion. Simple and low cost strategies are effective at increasing PA in females. The findings suggest that providing children games that are led by a facilitator is not necessary to increase PA as long as the proper equipment is provided. The decrease in screen time is directly related to sedentary activity, and has important implications in diabetes prevention for children.

4.2 Introduction

Diabetes in American Indian (AI) children is a major public health concern. From 1990 to 1998,\textsuperscript{142} diagnosed cases of diabetes had increased 71\% in AIs with the youngest age at diagnoses being 3.5 years of age.\textsuperscript{44} Obesity is one of the predominate risk factors for the development of diabetes,\textsuperscript{44,71,143} which continues to increase in female and male children, adolescents, and adults.\textsuperscript{144} Studies done with Northern Plains tribes in Montana, Wyoming, North Dakota, South Dakota, Iowa, and Nebraska report that 40\% of AI children (age 5 – 17 years) are overweight\textsuperscript{145} and 34\% obese,\textsuperscript{36} respectively. Research shows an association between sedentary activity and obesity in adults,\textsuperscript{50,51} and these factors are major contributors to the diabetes epidemic.\textsuperscript{50,71,146,147} These data demonstrate the importance of children developing physically active behaviors as they mature in to adulthood.

Despite the known health risks of living a sedentary lifestyle, current evidence verifies that children are more sedentary today than ever before.\textsuperscript{72} According to data from the 2003-2004 National Health and Nutritional Examination Survey,\textsuperscript{99} 42\% of children, ages 6 – 11 are not achieving the recommended guidelines of 60 minutes of PA every day.\textsuperscript{71,100} This behavior depicts an inverse relationship with age (i.e., as age increases, PA declines) as only 28.7\% of high school students\textsuperscript{101} and less than 5\% of
adults\textsuperscript{99} meet national guidelines for PA. Physical activity has been shown to decrease the risk of developing diabetes\textsuperscript{71,72} and is most effective at controlling diabetes when medication is not warranted.\textsuperscript{71}

For many children, recess can provide nearly half of the minutes necessary to meet the daily PA goal\textsuperscript{100,102} without compromising academic performance.\textsuperscript{103} Over the course of a school day, children spend the most amount of activity time in recess,\textsuperscript{102} which has been shown to account for approximately 22 minutes\textsuperscript{104} or one third\textsuperscript{105} of the daily PA recommendations. That recess presents a prime opportunity to get children more physically active, researchers have focused on this area of the school day to implement recess interventions to help children achieve the recommended 60 minutes of daily PA.\textsuperscript{100} Recess interventions have utilized a variety of simple and low-cost strategies to increase PA in children during the school day. Some of these include delegating zones for daily recess activities,\textsuperscript{106,108,109} painting lines for games such as hopscotch,\textsuperscript{106,113} providing activity cards that instruct children how to play games with the equipment provided,\textsuperscript{107} and administering a variety of activities that were introduced on a weekly basis.\textsuperscript{112}

Stratton and Mullan\textsuperscript{113} conducted a quasi-experimental, pre-to-posttest recess intervention in eight schools with children of the same age(s) and grade(s) in Northeast Wales (age 4 – 11; \( n = 120 \)). Four schools received the treatment and 4 schools served as a control. The treatment included painting the playground with markings according to school preference that included designs like hopscotch and letter squares. PA was measured with heart rate telemeters four weeks prior to the treatment and four weeks after the treatment was administered. Children in the treatment group increased MVPA
by 13.6% (36.7% to 50.3%) compared to the control group. Ridgers et al.\textsuperscript{110,111} conducted a pre-to-posttest quasi-experimental recess intervention with 15 intervention and 11 control schools in the Northwest of England (mean age = 8.1; n = 470). This study design featured 3 zones on the elementary school playground consisting of a sports area (Red Zone), a fitness and skills area (Blue Zone), and a chill out area (Yellow Zone). Physical activity was measured by accelerometry during morning, lunch, and afternoon recess at baseline, six weeks, six months, and 12 months. At the six month-from-baseline assessment,\textsuperscript{110} the results showed the treatment group engaged in 4.5% and 2.3% more MVPA and VPA compared to children in the control group. Physical activity was measured again at 12 months post baseline,\textsuperscript{111} These results showed the treatment group engaged in 1.4% more VPA than the control group. Huberty et al.\textsuperscript{108} conducted a study with 2 schools (1 public school and 1 private/parochial school) that included 3\textsuperscript{rd}, 4\textsuperscript{th}, and 5\textsuperscript{th} grade children (mean age = 9.6, n = 93) in the Midwestern United States. The quasi-experimental recess intervention implemented an 8-month treatment in both schools. Children from each school were invited to participate. Body mass index and physical activity (accelerometers for one consecutive week from 7:30am to 4:00pm) were pre-intervention and post-intervention. The treatment consisted of modifying an environmental component of the Active and Healthy Schools program and tailored it to the Ready for Recess program. Activity zones were offered during recess every day. The objective was to include activities that could be played with minimal equipment during a short recess period less than 20 minutes. Examples of some of the games played included soccer, kickball, and tag. The games offered in each zone were planned and modified each day and each week.
according to interest. Prior to recess, signs and markers were placed to inform the
children of the activity occurring in each particular zone marked zones. The
investigators found that MPA during recess significantly increased from 18.1% at
baseline to 31.2% at the end of the intervention (8-months post baseline) \((p \leq 0.001)\),
and VPA significantly increased from 7.2% at baseline to 16.8% at the end of the
intervention (8-months post baseline) \((p \leq 0.001)\).

The current study included three zones on the playground with one being a
sports area (facilitator/non-facilitator activities [Zone 3]). This is similar to the study
design used by Ridgers et al.\(^{109}\) The current study also featured a zone where the
playground was painted with lines, which was also similar to the intervention by Stratton
and Mullan.\(^ {113}\) However, painting lines on the playground was the only treatment
administered in the Stratton and Mullan\(^ {113}\) study and was described as playground
“designs,” whereas painting lines was one of two treatments built into the current study.
Perhaps most similar to the current study is that of Huberty and colleagues\(^ {108}\) who used
a quasi-experimental, one group pre-to-posttest design. The authors worked with 3\(^{rd}\),
4\(^{th}\), and 5\(^{th}\) grade children (mean age = 9.6, \(n = 93\)) and offered activity zones during
recess every day that included soccer, kickball, and tag.

The current study employed a quasi-experimental, one group repeated-measures
design. The intervention was conducted on a recess playground area that contained
painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator
activities (Zone 3). Thus, the components in the current study that are unlike other
recess interventions reported in the literature are, 1) the lines painted on the playground
were only one component (i.e., one Zone) of the treatment and contained hopscotch,
four-square, and nine-square, 2) the zone that included sports were led bi-weekly by a facilitator who participated in the games and enforced technique, rules, and sportsmanship, and 3) a CBPR approach was used to identify what activities should occur in Zone 1 and Zone 3, and 4) PA was measured with the System for Observing Play and Leisure Activity in Youth (SOPLAY), a valid direct observation instrument used to measure PA in children during recess. The SOPLAY method allowed the research team to distinguish PA levels between males and females in real time, which makes it an ideal tool to use when comparing gender differences and overall (males and females combined) changes in PA. Finally, to our knowledge, the literature does not contain a recess intervention conducted with children attending an elementary school on an AI reservation.

Therefore, the purpose of this pilot study was to, 1) determine the difference in PA in children between the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3) during the intervention period, 2) determine the difference in PA in children when a facilitator is present and when a facilitator is absent in the playground area with facilitator/non-facilitator activities, 3) determine the difference in PA counts in children from pre-intervention to intervention between the 3 playground zones, and 4) determine the pre-to-posttest differences in body composition (height, weight, and waist circumference) and the responses from the MPAQ-A and SOCM surveys in children in the 4th, 5th, and 6th grades.
4.3 Methods

Research Questions and Hypothesis for the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3), pre-to-posttest measures of body composition, and pre-to-posttest responses to the MPAQ-A and SOCM surveys.

Question 1

How will PA counts in child participants be affected between the zones during the intervention? Will there be a difference in PA counts by gender between the zones during the intervention?

Hypotheses 1

1a. There will be a difference in sedentary activity in children between the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

1b. There will be a difference in moderate physical activity (MPA) in children between the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

1c. There will be a difference in moderate to vigorous physical activity (MVPA) in children between the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

1d. There will be a difference in vigorous physical activity (VPA) in children between the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).
1.1a. There will be a difference between males and females for sedentary activity between the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

1.1b. There will be a difference between males and females for MPA between the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

1.1c. There will be a difference between males and females for MVPA between the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

1.1d. There will be a difference between males and females for VPA between the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

**Question 2**

How will PA counts in child participants be affected when activities are facilitated versus non-facilitated? Will there be a difference in PA counts by gender in facilitated versus non-facilitated led activities?

**Hypotheses 2**

2a. There will be a difference in sedentary activity in children when a facilitator is present compared to when a facilitator is absent (Zone 3).

2b. There will be a difference in MPA in children when a facilitator is present compared to when a facilitator is absent (Zone 3).

2c. There will be a difference in MVPA in children when a facilitator is present compared to when a facilitator is absent (Zone 3).
2d. There will be a difference in VPA in children when a facilitator is present compared to when a facilitator is absent (Zone 3).

   2.1a. There will be a difference in sedentary activity for males and for females when a facilitator is present compared to when a facilitator is absent (Zone 3) during the recess activities.

   2.1b. There will be a difference in MPA for males and for females when a facilitator is present compared to when a facilitator is absent (Zone 3) during the recess activities.

   2.1c. There will be a difference in MVPA for males and for females when a facilitator is present compared to when a facilitator is absent in Zone 3 during the recess activities.

   2.1d. There will be a difference in VPA for males and for females when a facilitator is present compared to when a facilitator is absent in Zone 3 during the recess activities.

**Question 3**

Will PA in children increase from baseline to intervention? Will there be a difference in baseline to intervention PA counts by gender?

**Hypotheses 3**

3a. There will be a decrease in sedentary activity in children from baseline to intervention in the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).
3b. There will be an increase in MPA in children from baseline to intervention in the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

3c. There will be an increase in MVPA in children from baseline to intervention in the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

3d. There will be an increase in VPA in children from baseline to intervention in the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

3.1a. There will be a decrease in sedentary activity in children from baseline to intervention for both males and females in the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

3.1b. There will be an increase in MPA in children from baseline to intervention for both males and females in the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

3.1c. There will be an increase in MVPA in children from baseline to intervention for both males and females in the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

3.1d. There will be an increase in VPA from baseline to intervention for both males and females in the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

**Question 4**
Will there be a difference in body composition (height, weight, and waist circumference) and MPAQ-A and SOCM survey measures in children between baseline (pretest) and end-of treatment (8 weeks post-baseline/posttest)?

**Hypothesis 4**

There will be differences in height, weight, and waist circumference and responses to the 7-item MPAQ-A and 8-item SOCM surveys from pre- to posttest.

An additional exploratory analysis was computed with the following **question**:

What is the difference in children’s PA between the specific activities (football, soccer, basketball, and ultimate frisbee) when a facilitator is present versus when a facilitator is absent? Will there be a difference in PA by gender during the bi-weekly facilitated activities?

**Exploratory Hypothesis**

EHa. There will be a difference in sedentary activity in children between the different activities (football, soccer, basketball, and ultimate frisbee) when a facilitator is present compared to when a facilitator is absent (Zone 3).

EHb. There will be a difference in MPA in children between the different activities (football, soccer, basketball, and ultimate frisbee) when a facilitator is present compared to when a facilitator is absent (Zone 3).

EHc. There will be a difference in MVPA in children between the different activities (football, soccer, basketball, and ultimate frisbee) when a facilitator is present compared to when a facilitator is absent (Zone 3).
EHd. There will be a difference in VPA in children between different activities (football, soccer, basketball, and ultimate frisbee) when a facilitator is present compared to when a facilitator is absent (Zone 3).

EH.1a. There will be a difference in sedentary activity between male and female children for the different activities (football, soccer, basketball, and ultimate frisbee) when a facilitator is present compared to when a facilitator is absent (Zone 3).

EH.1b. There will be a difference in MPA between male and female children for the different activities (football, soccer, basketball, and ultimate frisbee) when a facilitator is present compared to when a facilitator is absent (Zone 3).

EH.1c. There will be a difference in MVPA between male and female children for the different activities (football, soccer, basketball, and ultimate frisbee) when a facilitator is present compared to when a facilitator is absent (Zone 3).

EH.1d. There will be a difference in VPA between males and females for the different activities (football, soccer, basketball, and ultimate frisbee) when a facilitator is present compared to when a facilitator is absent (Zone 3).

Community-based Participatory Research Approach

This study was conducted with an AI tribal community in Northwestern Montana. The approach followed the process of Community-based Participatory Research (CBPR)\textsuperscript{128} where the community was actively engaged in all aspects of the study. The reservation community is small, with a population less than 1,000 persons.\textsuperscript{132} The elementary school houses children in 3\textsuperscript{rd} – 6\textsuperscript{th} grade and offer one recess period per
day in the afternoon for 10 minutes (lunch offers the children a limited break for recess, but is dependent on how quickly they eat their lunch). In the fall of 2012, the investigator partnered with the community to develop and implement a PA intervention. The process began with a formative assessment in June 2012 that consisted of six focus group discussions with children (4th, 5th, and 6th graders) and adult community members. The purpose of this assessment was to determine community identified barriers and strategies to get children more physically active during the school day. Qualitative analysis of these data revealed that during the focus group discussions in the formative phase of this project, participants mentioned several times the needs that were prevalent on the playground during recess. For example, some participants discussed how children sat during recess, others described how there was nothing for the children to do during recess, and others talked about how rules on the playground during recess prevented children from playing certain games that require a high amount of PA. Adults also discussed how the school only offered two, brief 20 minute recess periods per day throughout a 9 hour school day (this was decreased to 1 recess period per day by the time the intervention was administered during fall 2013). When asked if they would like more recess periods per day, nearly every child unanimously voted yes. Children also identified several activities they would like to do during recess, but could not due to unavailability, lack of equipment, and rules that prevented them from playing. The investigator reported these findings back to the community with a comprehensive and detailed list of themes identified by children and adults that was comprised of the strategies and barriers to PA during the school day. The elementary school principal and teachers, tribal health director, and several community members agreed with these
findings and also endorsed the list of themes for both barriers and strategies that were identified.

Participant Recruitment

The formative assessment targeted 4th, 5th, and 6th grade children. In 2012, when the focus groups were conducted, these grades all shared the playground during recess. Accordingly, the recess intervention targeted this recess period and targeted this age group. One detail that was not revealed until the fall 2013 when participant recruitment began was 3rd grade was added to the 4th, 5th, and 6th grade recess. IRB approval was only granted to conduct the study with 4th – 6th grade, but it was not possible to exclude 3rd grade from the activities offered on the playground during recess. Thus, 3rd grade children participated with the 4th – 6th grade children during the recess intervention on the playground, but only 4th – 6th grade children participated in pre- to posttest measures (height, weight, and waist circumference and the MPAQ-A and SOCM surveys).

The investigator visited every 3rd, 4th, 5th and 6th grade classroom during the fall 2013 and met the teachers and the students. A presentation was given to each class that described all components of the recess intervention, however, only 4th – 6th grade students were invited to participate in the MPAQ-A and SOCM survey and body composition (height, weight, and waist circumference) measures before (baseline/pretest) and after (end-of-treatment/posttest) the 8 week recess intervention. A letter containing the information about the study was sent home with each child to notify parents about the intervention. The letter also included a parent consent form. Since no child was excluded from participating in the recess activities, consent was only
needed for those children interested in participating in body composition measures and
the MPAQ-A and SOCM survey assessments. The information about the study was
also published in the school/community newsletter that is disseminated electronically
and hard copy throughout the community. Child assent was obtained from students that
returned a parent consent form. All 3rd, 4th, 5th, and 6th grade elementary school children
in this tribal community were eligible to participate in the recess activities.
Approximately 150 children were on the playground during any given recess period.

IRB approval for this study was obtained from The Rocky Mountain Tribal
Institutional Review Board in Billings, Montana. Additional approvals were obtained from
the School Board, principal, and superintendent.

Pilot Study Design

This repeated-measures, quasi-experimental design included a convenience
sample of one group of 4th, 5th, and 6th grade children where pre-to-posttest measures
were collected. The measures collected on this group included body composition,
MPAQ-A, and the SOCM. Although these measures were collected from this group,
this group was not specifically monitored during the recess intervention portion of the
study and thus, these measures were not linked to the SOPLAY PA data. The
intervention implemented on the playground consisted of dividing the playground in to 3
zones and implementing a treatment in Zone 1 (painting lines) and Zone 3
(facilitator/non-facilitator activities). Zone 1 was an area where children engaged in
free play and was the only area on the playground that contained concrete. Lines were
painted in Zone 1 for games such as four-square, nine-square, and hopscotch. Zone 2
was an area that contained slides, swings, ladders, monkey bars, and various climbing
structures. No treatment was implemented in this zone. Zone 3 was an area where competitive activities were led bi-weekly for 8 weeks by a facilitator. This zone was located in a field bordering the playground that was rarely utilized. The activities offered in this zone were football, soccer, basketball, and ultimate frisbee. The sample size estimate was calculated from the MPAQ-A that determined the study needed 60 children in the pre-to-posttest measures in order to power the study at a $p = 0.05$ level with 80% confidence to see a 3.0 unit change in the physical activity score.

Birds-eye view of the playground that depicts Zone 1, Zone 2, and Zone 3.
Recruitment phase for body composition measures and survey assessments
Eligible children (all 4th, 5th, and 6th grade children)

Pre-Intervention Assessments (parental consent)
Body Composition (n=67)
Surveys (n=67)

Baseline collection of PA during recess in each defined zone area: No intervention (1 week)

Lines painted on the playground
Intervention period 8 weeks

Zone 1: Lines painted on the concrete: four-square, nine-square, and hop-scotch
Zone 2: Structured playground equipment (control)
Zone 3: Structured playground activities facilitated bi-weekly (football, soccer, basketball, and ultimate Frisbee)

Post-Intervention Assessments
Body Composition (n=61)
Surveys (n=61)

Figure 1. Study Procedure
Procedure

Figure 1 depicts the outline of the study procedure. Baseline (pre-test) measures of body composition (height, weight, and waist circumference) and the collection of two PA surveys (MPAQ-A and SOCM) were done prior to the start of the treatment period (8 weeks) and were repeated at the end of treatment (i.e., 9 weeks post-baseline measures) in 4th, 5th, and 6th grade children whose guardian provided consent. The following week, baseline (pre-test) measures of PA were collected during recess in all 3rd, 4th, 5th, and 6th grade children on the playground during recess. A camera was stationed at each zone and videotaped the 10 minute recess period in the afternoon for four days (Monday through Thursday—the reservation does not have school on Friday). Video cameras recorded approximately 2 minutes prior and approximately 1 minute after the recess bell that summoned the beginning and end of recess. The cameras recorded all three zones using this same procedure for the duration of the recess intervention. The children were free to move between the zones and were not restricted to one zone. The Friday following the collection of baseline measures and prior to the start of the 8 week recess intervention, four-square, nine-square, and hop-scotch lines were painted on the concrete in Zone 1. The research team also painted boundaries on the basketball court.

The recess intervention began in Week 3. Data was collected in all 3rd, 4th, 5th, and 6th grade children that participated in the playground areas with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3). No treatment other than painting lines on the concrete in Zone 1 was implemented. Zone 3 was the designated area of the playground where structured recess activities were
facilitated bi-weekly. A facilitator led the first week of recess activities (football) and the next week the facilitator was absent. During the week(s) when the facilitator was absent, a boundary for the prior week’s activity was defined with cones and the equipment necessary to play the game was also provided. This weekly configuration continued throughout (i.e., one week of facilitator led activities followed by one week of non-facilitator led activities) the eight week intervention with the four activities that were offered (football, soccer, basketball, and ultimate frisbee).

Prior to the start of recess, the research team set up cones on the playground to define boundaries for the playing field and set up goals (i.e., touchdown markers). As children entered the playground, anyone that wanted to join the game was included. No child was excluded from participation. The facilitator’s role was to teach and enforce rules, proper technique, alleviate disputes, and ensure sportsmanship (i.e., no cheating, points being allotted correctly, etc.). The facilitator was engaged in each game and closely monitored for safety. The following week the facilitator was absent. The field was set up with cones and the necessary equipment was provided (i.e., a football).

Observation Instrument

The System for Observing Play and Leisure Activity in Youth (SOPLAY) was used to calculate PA levels in children during the recess intervention. This direct observation instrument is based on momentary time sampling and has been previously validated\textsuperscript{148} to obtain data on leisure and play time PA in children. Counts of children were calculated for sedentary, walking, and very active categories by gender using left to right scans and tallying with a mechanical counter. A moderate to vigorous physical activity (MVPA) category was created by summing the walking and active categories.\textsuperscript{149}
Four trained assessors analyzed video recordings of each zone during every recess period for 9 weeks. The procedure was consistent with the protocol designed by McKenzie. Females engaging in sedentary activity were scanned first. The assessors conducted a left to right scan using a mechanical counter to calculate the amount of females observed in sedentary activity. Scans lasted approximately 10 seconds for each dependent variable. A child was eligible to be counted once during the scan. The assessors recorded how many counts were observed and then scanned for females in the walking and active categories and then the procedure was repeated for males. Ten second scans were done at 4 minutes and 8 minutes for a total of two observations per recess period.

Because of the high density of children in each zone, partial counts were computed to increase accuracy. Before scanning, the total amount of children in the screen were counted and then the screen size was reduced to approximately half, but depicted an area that was representative of the activity being performed in that zone. The zone was then scanned according to the SOPLAY procedure outlined above. The formula used for computation required summing the number of children counted (by gender) for each dependent variable during one scan and dividing by the total number of children counted before the scan (i.e., children in the zone before the screen was reduced to half). This number was divided by the counts of each dependent variable to determine sedentary activity, moderate physical activity (MPA), moderate to vigorous physical activity (MVPA), and vigorous physical activity (VPA) for both girls and boys.

Assessors reviewed the SOPLAY protocol and were instructed on how to properly calculate PA counts with this method. All four assessors trained on the videos
that contained the first two months of recess footage for approximately three hours per week. Reliability tests included assigning all four assessors to the same 72 observations to scan according to the procedure above for the calculation of female and male PA counts in each category (sedentary activity, MPA, and VPA). Video footage for the entire 9 weeks was not analyzed until the assessors achieved an 80% inter-observer agreement score.104

Physical Activity and Stages of Change Surveys and Body Composition Measures

Sixty-one children in the 4th, 5th and 6th grade participated in self-reported physical activity and stages of change surveys and body composition measures. Self-report PA was collected with the 7-item Modified Physical Activity Questionnaire for Adolescents (MPAQ-A).140 Test-retest estimates have not been tested specifically in American Indian children,15 but the one month reproducibility coefficient for hours/week is reported at 0.79140 and the validity for hours/week reported at 0.63-0.76140 for both genders. Readiness and motivation to participate in recess activities was collected with a modified 8-item version of the Transtheoretical Model- Stages of Change and Motivation (SOCM).141 For body composition measures, height was measured to the nearest 0.1 cm using a calibrated stadiometer (Seca Ltd, Birmingham, UK). The participant was asked to stand with no shoes or hat squarely on the ground under the stadiometer. Heels were positioned close together, legs straight, arms at sides, and shoulders relaxed. The participant was asked to stand fully erect without altering the position of the feet and heels—the heels were checked to make sure that they did not rise off the ground. The headpiece was lowered perpendicular and snug to the crown of
the head with sufficient pressure to compress the hair. The measure was recorded to the nearest 0.1 cm and documented on the participants’ measurement sheet.

Body weight was recorded to the nearest 0.1 kg using a digital scale (Seca Ltd, Birmingham, UK). Participants were asked to remove all excess clothing (e.g., jackets, sweatshirts, etc.) and stand on the center of the scale platform. Weight was recorded and transferred to the participants’ measurement sheet. BMI was calculated with the formula weight(kg)/height(m)$^2$ and converted to age- and sex-specific BMI percentiles with the Centers for Disease Control and Prevention equations\textsuperscript{151} for classification.

Waist circumference was measured to the nearest 0.1 cm using a standard tape measure. The examiner stood on the right side of the participant while they were in standing position and palpated the right hip area for the right iliac crest. The tape measure was stretched across the trunk in a horizontal plane walking around the participant moving from anterior to posterior position making sure that the tape was parallel to the floor and snug. Waist circumference was then recorded on the participant’s Measurement Sheet.

Data Analysis

Descriptive statistics were used to report mean and standard deviations for demographic and PA variables. Two-tailed independent $t$-tests were used to compare the difference in sedentary activity, MPA, MVPA, and VPA (separately) between baseline and intervention, between facilitator led and non-facilitator led activities, and between genders. Two-tailed paired $t$-tests were used to detect changes in pre- and post-measures of body composition and survey response. This analysis was performed in R 3.0.3. Analysis of Variance (ANOVA) was used to detect differences in
PA between each zone during the intervention and to detect differences in PA between facilitator led and non-facilitator led activities in Zone 3. Where warranted, Bonferroni Post hoc tests were used to determine differences between zones in sedentary activity, MPA, MVPA, and VPA separately. The analysis was performed in SPSS 22.0 (SPSS, Inc, Chicago, IL). Statistical significance was set at the $\alpha = 0.05$ level.

Logic of the Analysis

As mentioned above, the design of this study was a repeated-measures, quasi-experimental design. The objective of the analysis was to compare the mean PA counts between each Zone (i.e., Zone 1, Zone 2, and Zone 3). Comparing the mean PA counts between each Zone was an important outcome of this analysis so that we could determine which treatment component (e.g., the lines that were painted in Zone 1, the facilitator-led activities in Zone 3, etc.) was eliciting the greatest effect on physical activity. Even though there was technically one group on the playground during recess, treating each Zone as a group allowed the investigator to use ANOVA in this component of the analysis. Accordingly, this afforded the investigator the ability to compare the mean PA counts between each zone with ANOVA.

The assumptions of ANOVA are, 1) the samples are independent, 2) the data is normally distributed, and 3) the variances are equal (Homogeneity of variance). Normality was tested with the Shapiro Wilk’s test, and Homogeneity of variance was tested with the Levene’s test. The results showed that the data did not violate the ANOVA assumptions, thus the data were analyzed according to ANOVA procedure.
4.4 Results

Table 1. Descriptive measures for children that participated in body composition, MPAQ-A, and SOCM measures.

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
<th>Mean (SD*)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Composition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>61</td>
<td>43.5 (13.9)</td>
</tr>
<tr>
<td>Height (m)</td>
<td>61</td>
<td>1.4 (0.1)</td>
</tr>
<tr>
<td>WC** (cm)</td>
<td>61</td>
<td>72.9 (11.9)</td>
</tr>
<tr>
<td>BMI#</td>
<td>61</td>
<td>66.5 (30.3)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>61</td>
<td>11 (0.9)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>28</td>
<td>(46)</td>
</tr>
<tr>
<td>Girls</td>
<td>33</td>
<td>(54)</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Indian</td>
<td>28</td>
<td>(46)</td>
</tr>
<tr>
<td>White</td>
<td>33</td>
<td>(54)</td>
</tr>
</tbody>
</table>

*Standard Deviation
**Waist Circumference
#BMI for-age and sex specific percentiles
**Descriptive Measures**

Descriptive measures are reported in Table 1. Sixty-eight children in the 4th, 5th, and 6th grade provided parental consent and child assent and were enrolled in the study. Of these, 61 children completed pre- and post-test measures of body composition, MPAQ-A and SOCM surveys. Children in the 3rd, 4th, 5th, and 6th grade were observed during recess using the SOPLAY validated measure. Approximately 150 children per day were observed using this method. The dependent variables for PA included sedentary activity, MPA, MVPA and VPA.
Table 2. Mean (SD) of physical activity counts in Zones 1, 2, and 3 during baseline and the 8-week recess intervention.

<table>
<thead>
<tr>
<th></th>
<th>Baseline PA# Counts</th>
<th>Intervention PA# Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zone 1</td>
<td>Zone 2</td>
</tr>
<tr>
<td>Girls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary</td>
<td>2.4 (1.4)</td>
<td>12.2 (3.6)</td>
</tr>
<tr>
<td>Moderate</td>
<td>2.1 (1.5)</td>
<td>4.8 (1.9)</td>
</tr>
<tr>
<td>MVPA*</td>
<td>4.8 (2.9)</td>
<td>12.8 (3.1)</td>
</tr>
<tr>
<td>Vigorous</td>
<td>2.7 (1.5)</td>
<td>8.0 (2.1)</td>
</tr>
<tr>
<td>Boys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary</td>
<td>2.4 (1.5)</td>
<td>4.7 (2.2)</td>
</tr>
<tr>
<td>Moderate</td>
<td>4.0 (1.6)</td>
<td>5.1 (2.2)</td>
</tr>
<tr>
<td>MVPA*</td>
<td>7.8 (2.8)</td>
<td>9.8 (4.2)</td>
</tr>
<tr>
<td>Vigorous</td>
<td>3.8 (2.1)</td>
<td>4.7 (2.8)</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary</td>
<td>2.4 (1.4)</td>
<td>8.5 (4.8)</td>
</tr>
<tr>
<td>Moderate</td>
<td>3.0 (1.8)</td>
<td>4.9 (2.0)</td>
</tr>
<tr>
<td>MVPA*</td>
<td>6.3 (3.2)</td>
<td>11.3 (3.8)</td>
</tr>
<tr>
<td>Vigorous</td>
<td>3.2 (1.9)</td>
<td>6.4 (2.9)</td>
</tr>
</tbody>
</table>

# PA= physical activity
* MVPA= moderate to vigorous physical activity
€ Significantly different from baseline at p ≤ 0.01
† Significantly different from baseline at p ≤ 0.05
†† Significantly higher counts than males during intervention at p ≤ 0.05
* Significantly higher counts than males during intervention at p ≤ 0.01
** Significantly higher counts than females during intervention at p ≤ 0.001
Hypothesis 1. Comparison of PA counts between Zones during the intervention

SOPLAY measures for PA between each zone during the intervention are reported in Table 2. The data in Figure 2 provides the evidence to test the hypothesis that there will be a difference between the area with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3) for sedentary activity, MPA, MVPA, and VPA.

Results revealed a significant difference between the zones for sedentary activity ($F(2,310) = 91.20, p = 0.001$). Bonferroni Post hoc tests indicate that mean sedentary counts were highest for playground equipment (Zone 2; 4.9 ± 4.1), followed by painted lines (Zone 1; 2.1 ± 2.5), and then facilitator/non-facilitator activities (Zone 3; 0.8 ± 1.1) (Figure 2A). These data provide full support of the hypothesis that there is a difference in sedentary activity between the zones.

The data show a significant difference between the zones for MPA ($F(2,310) = 5.99, p = 0.003$). Bonferroni Post hoc tests indicate the mean MPA counts for painted lines (Zone 1; 4.2 ± 2.3) and playground equipment (Zone 2; 4.2 ± 2.1) were higher than facilitator/non-facilitator activities (Zone 3; 3.3 ± 2.5) (Figure 2B). These data provide partial support of the hypothesis that that there is a difference in MPA between the zones.

The findings indicate a significant difference between the zones for MVPA ($F(2,308) = 25.77, p = 0.001$). Bonferroni Post hoc tests indicate that mean MVPA counts were highest for playground equipment (Zone 2; 9.7 ± 4.6), followed by painted lines (Zone 1; 8.1 ± 3.2), and then facilitator/non-facilitator activities (Zone 3; 6.3 ± 4.3)
These data provide full support of the hypothesis that there is a difference in MVPA between the zones.

Based on the evidence, a significant difference was found between the zones for VPA ($F(2,310) = 25.44, p = 0.001$). Bonferonni Post hoc tests indicate that mean VPA counts were highest for playground equipment (Zone 2; $5.4 \pm 3.6$), followed by painted lines (Zone 1; $4.0 \pm 2.3$), and then facilitator/non-facilitator activities (Zone 3; $3.0 \pm 2.8$) (Figure 2D). These data provide full support of the hypothesis that there is a difference in VPA between the zones.

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**Figure 2.** Physical activity counts for males and females combined between Zones 1, 2, and 3 during the 8 week intervention. A) Sedentary Activity, * = Zone 1 vs Zone 2, $p \leq 0.0001$; # = Zone 2 vs Zone 3, $p \leq 0.0001$; † Zone 3 vs Zone 1, $p \leq 0.0001$; B) Moderate PA, * = Zone 1 vs Zone 3, $p < 0.01$; # = Zone 2 vs Zone 3, $p \leq 0.0001$; C) Moderate to Vigorous PA, * = Zone 1 vs Zone 2, $p = 0.003$; # = Zone 2 vs Zone 3, $p \leq 0.001$; † Zone 3 vs Zone 1, $p \leq 0.001$; D) Vigorous PA, * = Zone 1 vs Zone 2, $p \leq 0.001$; # = Zone 2 vs Zone 3, $p \leq 0.001$; † Zone 3 vs Zone 1, $p = 0.017$. 

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The findings indicate a significant zone by gender interaction effect between males and females for sedentary activity ($F(2,310) = 61.40, p = 0.001$), MPA ($F(2,310) = 16.29, p = 0.001$), MVPA ($F(2,308) = 64.20, p = 0.001$), and VPA ($F(2,310) = 57.10, p = 0.001$; Figure 3A – D).

Figure 3. Interaction effect between males and females in Zones 1, 2, and 3 during the 8 week intervention.
The data in Figure 4 provides the evidence to test the hypothesis that there will be differences between males and females for sedentary activity, MPA, MVPA, and VPA for that area that contains painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3). These data show that females engaged in significantly more sedentary activity in Zone 2 ($p \leq 0.01$) compared to males (Figure 4A). These data only provide partial support for the hypothesis there was no difference in sedentary activity in the area that contained painted lines (Zone 1) and the area that contained facilitator/non-facilitator activities (Zone 3).

Based on the evidence, males engaged in significantly more MPA in facilitator/non-facilitator activities (Zone 3; $p \leq 0.001$) compared to females (Figure 4B). These data only provide partial support for the hypothesis since the data show that there was no difference in MPA between males and females in the area with painted lines (Zone 1) and the area that contained playground equipment (Zone 2).

The findings indicate that females engaged in significantly more MVPA for painted lines (Zone 1; $p \leq 0.05$) and playground equipment (Zone 2; $p \leq 0.01$) compared to males (Figure 4C). Additionally, the data show that males engaged in significantly more MVPA in facilitator/non-facilitator activities (Zone 3; $p \leq 0.001$) compared to females (Figure 4C). These data reject the null hypothesis that there will be no difference in MVPA between males and females for the area that contained painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

These data show that females engaged in significantly more VPA for painted lines (Zone 1; $p \leq 0.01$) and playground equipment (Zone 2; $p \leq 0.01$) compared to
males (Figure 4D). Additionally, the data show that males engaged in significantly more VPA in facilitator/non-facilitator activities (Zone 3; \( p \leq 0.01 \)) compared to females (Figure 4D). These data reject the null hypothesis that there will be no difference in VPA between males and females for the area that contained painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

Figure 4. Physical activity counts for males and females in Zones 1, Zone 2, and Zone 3 during the 8 week intervention. * = females significantly higher physical activity counts than males, \( p \leq 0.05 \); # = females significantly higher physical activity counts than males, \( p \leq 0.01 \); † = males significantly higher physical activity counts than females, \( p \leq 0.01 \); ^ = males significantly higher physical activity counts than females, \( p \leq 0.001 \).
Hypothesis 2. Comparison of PA counts in children during facilitator led and non-facilitator led activities during the 8 week intervention in Zone 3.

SOPLAY objective measures for PA in children during facilitator led and non-facilitator led activities during the 8 week intervention are reported in Table 3. The data in Figure 5 tests the hypothesis that there will be a difference in sedentary activity, MPA, MVPA, and VPA in children between facilitator led versus non-facilitator led activities.

Table 3. Mean (SD) of physical activity counts for facilitator led and non-facilitator led activities in Zone 3 during the 8 week recess intervention.

<table>
<thead>
<tr>
<th></th>
<th>Facilitator</th>
<th>No Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary</td>
<td>0.5 (0.6)</td>
<td>0.8 (0.7)</td>
</tr>
<tr>
<td>Moderate</td>
<td>2.1 (1.5)</td>
<td>1.9 (1.4)</td>
</tr>
<tr>
<td>MVPA</td>
<td>3.5 (1.9)</td>
<td>3.3 (2.8)</td>
</tr>
<tr>
<td>Vigorous</td>
<td>1.3 (1.0)</td>
<td>1.4 (1.6)</td>
</tr>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary</td>
<td>1.1 (1.6)</td>
<td>0.8 (1.3)</td>
</tr>
<tr>
<td>Moderate</td>
<td>4.7 (2.1)*</td>
<td>4.5 (3.1)*</td>
</tr>
<tr>
<td>MVPA</td>
<td>9.3 (2.6)*</td>
<td>9.0 (4.8)*</td>
</tr>
<tr>
<td>Vigorous</td>
<td>4.6 (2.0)*</td>
<td>4.6 (3.8)*</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary</td>
<td>0.8 (1.2)</td>
<td>0.7 (1.0)</td>
</tr>
<tr>
<td>Moderate</td>
<td>3.4 (2.2)</td>
<td>3.2 (2.7)</td>
</tr>
<tr>
<td>MVPA</td>
<td>6.4 (3.7)</td>
<td>6.2 (4.7)</td>
</tr>
<tr>
<td>Vigorous</td>
<td>3.0 (2.3)</td>
<td>3.0 (3.3)</td>
</tr>
</tbody>
</table>

*= males significantly different from females, \( p \leq 0.001 \)

Based on the evidence, there is no difference in sedentary activity, MPA, MVPA, and VPA between males and females when activities were facilitated and non-facilitated. In contrast to the hypothesis, the data do not support a difference in PA between males and females when a facilitator was present or absent.
Figure 6 provides evidence to test the hypothesis that there will be a difference in sedentary activity, MPA, MVPA, and VPA by gender when a facilitator is present and when a facilitator is absent. Based on the evidence, there is no difference in PA for males when a facilitator is present or absent and for females when a facilitator is present or absent. These data fail to reject the null hypothesis.
The data in figure 7 compares the PA levels between males and females when a facilitator is present and when a facilitator is absent. The data show that males engaged in significantly more MPA, MVPA, and VPA ($p \leq 0.001$) when a facilitator was present and when a facilitator was absent (Figure 7B, 7C, 7D) compared to females.
Hypothesis 3. Comparison of PA counts between baseline and intervention

Descriptive measures for PA from pre-intervention to intervention are reported in Table 2. The data in Figure 8 provides the evidence to test the hypothesis that there will be a decrease in sedentary activity and an increase from pre-intervention to intervention in MPA, MVPA, and VPA in the area that contained painted lines (Zone 1) and facilitator/non-facilitator activities (Zone 3), and no pre-intervention to intervention differences in PA in Zone 2 (zone with playground equipment).

Based on the evidence, a significant decrease in sedentary activity was found in the area that contained playground equipment (Zone 2; p ≤ 0.01) from pre-intervention
to intervention (Figure 8A). These data provide partial support for the hypothesis since there was no difference in sedentary activity from pre-intervention to intervention in the areas that contained painted lines (Zone 1) and facilitator/non-facilitator activities (Zone 3).

The findings indicate a significant increase in MPA for the area that contained painted lines (Zone 1; \( p \leq 0.05 \)) from pre-intervention to intervention (Figure 8B). These data provide partial support for the hypothesis since there was no difference in MPA from pre-intervention to intervention in the area that contained playground equipment (Zone 2) and facilitator/non-facilitator activities (Zone 3).

The results revealed a significant increase in MVPA for painted lines (Zone 1; \( p \leq 0.05 \)) from pre-intervention to intervention (Figure 8C). These data provide partial support for the hypothesis since there was no difference in MPA from pre-intervention to intervention in the area that contained playground equipment (Zone 2) and facilitator/non-facilitator activities (Zone 3).

The data show no change in VPA from pre-intervention to intervention (Figure 8D). In contrast to the hypothesis, there was no change in VPA from pre-intervention to intervention in all three zones on the playground.
The data in figure 9 and figure 10 provides the evidence to test the claim that there will be a decrease for both males and females in sedentary activity from pre-intervention to intervention in the area with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3). In addition, there will be an increase for both males and females in MPA, MVPA, and VPA from pre-intervention to intervention in the area with painted lines (Zone 1), playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3).

Based on the evidence, a significant decrease in sedentary activity for both males ($p \leq 0.01$; Figure 9A) and females ($p \leq 0.01$; Figure 10A) was found in the area.
that contained playground equipment (Zone 2) and a significant decrease in sedentary activity for facilitator/non-facilitator activities (Zone 3) for females (p ≤ 0.01; Figure 10A). In contrast to the hypothesis, the data do not support any difference in sedentary activity from pre-intervention to intervention for males and females in the area with painted lines (Zone 1) and for males in the area facilitator/non-facilitator activities (Zone 3).

The findings indicate a significant increase in MPA in the area with painted lines (Zone 1; p ≤ 0.01) and facilitator/non-facilitator activities (Zone 3; p ≤ 0.01) for females (Figure 10B) and no change for males. These data provide partial support for the hypothesis since there was no difference in MPA from pre-intervention to intervention for females in the area that contained playground equipment (Zone 2) and there was no change in MPA from pre-intervention to intervention in males in all three zones.

The results revealed a significant increase in MVPA in the area that contained painted lines (Zone 1; p ≤ 0.01) and facilitator/non-facilitator activities (Zone 3; p ≤ 0.01) for females (Figure 10C) and no change for males. These data provide partial support for the hypothesis since there was no difference in MVPA from pre-intervention to intervention for females in the area that contained playground equipment (Zone 2) and there was no change in MPA from pre-intervention to intervention in males in all three zones.

The data show a significant increase in VPA for the area that contained painted lines (Zone 1; p ≤ 0.01) and facilitator/non-facilitator activities (Zone 3; p ≤ 0.05) for females (Figure 10D) and no change in VPA for males. These data follow the same pattern as the previous two intensities such that there was no difference in VPA from pre-intervention to intervention for females in the area that contained playground
equipment (Zone 2) and there was no change in MPA from pre-intervention to intervention in males in all three zones.

Figure 9. Physical activity counts for males from baseline to intervention. * = significantly different from baseline, $p \leq 0.05$; # = significantly different from baseline $p \leq 0.01$. 

Descriptive measures of body composition are reported in Table 1. A significant increase was found in weight from pre to post intervention (43.1 ± 13.5kg to 44.0 ± 14.2kg, p < 0.001). No other significant differences were found for any of the body composition measures from pre- to posttest. Two of the children (3%) were categorized as overweight and 13 (21%) were categorized as obese at post-test.

The MPAQ-A questionnaire revealed a significant decrease (mean difference = 0.80; p = 0.008) from pre-to-posttest in the number of days children participated in...
vigorous PA for 20 minutes from 4 days per week to 3 days per week. There was also a significant decrease (mean difference= 0.40; $p = 0.05$) from pre-to-posttest in the number of hours of screen time (video games and computer use) during the school week. There was no pre- to posttest change in children’s motivation to participate in recess activities.

Exploratory Hypothesis. Comparison of PA counts between facilitator-led versus non-facilitator led activities (e.g., football, soccer, basketball, and ultimate frisbee) during the 8-week intervention.

Descriptive measures for PA between each activity during the four activities in Zone 3 are reported in Table 4. The data in Figure 11 provides the evidence to test the claim that there will be a difference between facilitated and non-facilitated activities in Zone 3 for sedentary activity, MPA, MVPA, and VPA.
Table 3. Mean (SD) of physical activity counts for one week during the four treatment activities in Zone 3 when a facilitator led the activity and when the facilitator was absent during the 8 week intervention.

<table>
<thead>
<tr>
<th></th>
<th>Football*</th>
<th>Football**</th>
<th>Soccer*</th>
<th>Soccer**</th>
<th>Basketball*</th>
<th>Basketball**</th>
<th>Ultimate Frisbee*</th>
<th>Ultimate Frisbee**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary</td>
<td>0.7 (0.5)</td>
<td>1.2 (0.3)</td>
<td>0.8 (0.8)</td>
<td>0.7 (0.8)</td>
<td>0.2 (0.5)</td>
<td>0.6 (0.9)</td>
<td>0.4 (0.5)</td>
<td>0.4 (0.7)</td>
</tr>
<tr>
<td>Moderate</td>
<td>1.3 (0.7)</td>
<td>1.0 (0.4)</td>
<td>1.5 (0.7)</td>
<td>2.4 (2.1)</td>
<td>3.5 (1.8)</td>
<td>2.3 (1.0)</td>
<td>1.6 (0.8)</td>
<td>2.3 (1.4)</td>
</tr>
<tr>
<td>MVPA‡</td>
<td>2.1 (0.8)</td>
<td>2.1 (1.3)</td>
<td>3.5 (2.0)</td>
<td>4.2 (4.5)</td>
<td>5.2 (1.6)</td>
<td>3.7 (2.0)</td>
<td>2.5 (0.8)</td>
<td>3.6 (3.1)</td>
</tr>
<tr>
<td>Vigorous</td>
<td>0.8 (0.4)</td>
<td>1.1 (0.9)</td>
<td>1.9 (1.5)</td>
<td>1.8 (2.5)</td>
<td>1.6 (0.8)</td>
<td>1.4 (1.5)</td>
<td>0.9 (0.5)</td>
<td>1.4 (1.9)</td>
</tr>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary</td>
<td>3.0 (2.0)</td>
<td>1.6 (1.9)</td>
<td>1.3 (1.3)</td>
<td>0.8 (1.0)</td>
<td>0.2 (0.4)</td>
<td>0.3 (0.6)</td>
<td>0.0 (0.0)</td>
<td>0.0 (0.0)</td>
</tr>
<tr>
<td>Moderate</td>
<td>6.0 (1.6)</td>
<td>4.0 (3.3)</td>
<td>3.8 (2.0)</td>
<td>5.3 (4.5)</td>
<td>4.0 (1.8)</td>
<td>3.7 (1.6)</td>
<td>5.3 (2.9)</td>
<td>5.2 (3.1)</td>
</tr>
<tr>
<td>MVPA‡</td>
<td>11.7 (1.9)</td>
<td>10.8 (5.6)</td>
<td>8.9 (2.5)</td>
<td>9.7 (6.6)</td>
<td>8.0 (1.7)</td>
<td>6.8 (2.2)</td>
<td>8.9 (3.2)</td>
<td>8.6 (4.0)</td>
</tr>
<tr>
<td>Vigorous</td>
<td>5.7 (2.7)</td>
<td>6.8 (4.5)</td>
<td>5.1 (2.1)</td>
<td>4.4 (5.5)</td>
<td>4.0 (1.6)</td>
<td>3.1 (0.9)</td>
<td>3.6 (1.1)</td>
<td>3.5 (2.1)</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary</td>
<td>1.8 (1.9)</td>
<td>1.4 (1.3)</td>
<td>1.1 (1.0)</td>
<td>0.8 (0.9)</td>
<td>0.2 (0.4)</td>
<td>0.5 (0.7)</td>
<td>0.2 (0.4)</td>
<td>0.2 (0.5)</td>
</tr>
<tr>
<td>Moderate</td>
<td>3.6 (2.7)</td>
<td>2.5 (2.8)</td>
<td>2.7 (1.8)</td>
<td>3.8 (3.7)</td>
<td>3.8 (1.8)</td>
<td>3.0 (1.5)</td>
<td>3.5 (2.8)</td>
<td>3.7 (2.7)</td>
</tr>
<tr>
<td>MVPA‡</td>
<td>6.9 (5.2)</td>
<td>6.4 (5.9)</td>
<td>6.2 (3.5)</td>
<td>6.9 (6.1)</td>
<td>6.6 (2.2)</td>
<td>5.2 (2.6)</td>
<td>5.7 (4.1)</td>
<td>6.1 (4.3)</td>
</tr>
<tr>
<td>Vigorous</td>
<td>3.2 (3.2)</td>
<td>4.0 (4.3)</td>
<td>3.5 (2.4)</td>
<td>3.1 (4.3)</td>
<td>2.8 (1.7)</td>
<td>2.3 (1.5)</td>
<td>2.2 (1.7)</td>
<td>2.4 (2.2)</td>
</tr>
</tbody>
</table>

*Facilitator Present  
**Facilitator Absent  
‡ Moderate to Vigorous Physical Activity  
€ Significantly higher counts than females at p ≤ 0.05  
§ Significantly higher counts than females at p ≤ 0.01
Based on the evidence, a significant difference was found between facilitator led and non-facilitator led activities for sedentary activity \( (F(7,88) = 5.43, p \leq 0.01) \).

Bonferonni Post hoc tests indicate that facilitator led football had significantly higher sedentary counts than facilitator led basketball, non-facilitator led basketball, facilitator led ultimate Frisbee, and non-facilitator led ultimate Frisbee. In addition, non-facilitator led football had significantly higher sedentary counts than facilitator led basketball and non-facilitator led ultimate Frisbee (Figure 11A). These data provide partial support of the hypothesis since there was a difference in sedentary activity between the recess activities in Zone 3 when a facilitator is present and absent.

The findings indicate no difference between the activities in MPA (Figure 11B). A follow-up test was not warranted. These data fail to reject the null.

Results did not reveal any differences between the activities in MVPA (Figure 11C). A follow-up test was not warranted. These data fail to reject the null.

The data show no difference between the activities in VPA (Figure 11D). A follow-up test was not warranted. These data fail to reject the null.
Figure 11. Physical activity counts between facilitator and non-facilitator led activities in Zone 3 during the 8 week recess intervention. Bonferroni Post hoc tests ($\alpha = 0.05$); $F =$ facilitator; NF = No facilitator; * = Football (F) vs Basketball (F), $p = 0.001$; # = Football (F) vs Basketball (NF), $p = 0.01$; † = Football (F) vs Ultimate Frisbee (F), $p = 0.004$; ‡ = Football (F) vs Ultimate Frisbee (NF), $p = 0.002$; ^ = Football (NF) vs Basketball (F), $p = 0.01$; ¥ = Football (NF) vs Ultimate Frisbee (NF), $p = 0.047$.

The data in Figure 12 compares the PA levels between males and females for recess activities when a facilitator is present or absent. The data show no difference between males and females in sedentary activity (Figure 12A) for all recess activities, whether or not a facilitator was present.
Based on the evidence, males had significantly higher MPA compared to females during facilitator led football, non-facilitator led football, facilitator led soccer, and facilitator led ultimate Frisbee (Figure 12B).

The findings indicate that males had significantly higher MVPA compared to females for all the activities except non-facilitator led soccer (Figure 12C).

Finally, the data show that males had significantly higher VPA compared to females during facilitator led football, non-facilitator led football, facilitator led soccer, facilitator led basketball, non-facilitator led basketball, and facilitator led ultimate Frisbee (Figure 12D).

Figure 12: Physical activity counts of males and females in Zone 3 for activities that were facilitated and non-facilitated during the 8 week intervention. # = significantly different from females, p ≤ 0.05; * = significantly different from females, p ≤ 0.01
4.5 Discussion

The purpose of this study was to examine the effect of a recess intervention on PA in elementary school children (mean age = 11 years). To our knowledge, this is the first study done in an AI tribal community that implemented a recess intervention that included painting lines on the playground and providing facilitator and non-facilitator led activities. This novel approach not only provided the children three different choices of activities during recess, it also afforded children the opportunity to play games with a knowledgeable adult and learn proper techniques, rules, and sportsmanship. Further, the findings from this study offer insight into a field that has been relatively unexplored in Indian country and may help investigators determine effective and sustainable strategies to increase PA during recess in children attending schools on AI reservations.

Significant differences in children’s PA were found between the playground area with painted lines (Zone 1), the area with playground equipment (Zone 2), and facilitator/non-facilitator activities (Zone 3) for sedentary, MVPA, and VPA. Significant differences in children’s MPA only occurred between the playground area with painted lines (Zone 1) and the area with playground equipment (Zone 2), and between the area with playground equipment (Zone 2) and facilitator/non-facilitator activities (Zone 3). Further, these differences followed a pattern where the playground equipment (Zone 2) had the highest amount of activity, followed by painted lines (Zone 1), followed by facilitator/non-facilitator activities in Zone 3. Playground equipment (Zone 2) was an area of the playground where permanent playground structures were located. When the team viewed the SOPLAY measures videos to conduct the scans of each zone, it was clear that playground equipment (Zone 2) housed the greatest proportion of children on
the playground before and after the intervention began. Research shows that the odds of children engaging in MVPA are greater in areas with playground equipment compared to other areas of the playground, which was demonstrated by the children in this study.

Gender played a role in physical activity patterns. Females engaged in significantly more MVPA and VPA for painted lines (Zone 1) and playground equipment (Zone 2) compared to males, and males engaged in significantly more MVPA and VPA in facilitator and non-facilitator led activities (Zone 3) compared to females. Boyle et al. conducted a study that observed playground behavior between females and males during recess. The author reported that females are much more social and territorial on the playground than males. Perhaps this same dynamic is taking place with females in the area with painted lines (Zone 1) and playground equipment (Zone 2). The emphasis on the activities in these two zones is less on competition, and more on having fun and socializing during recess. In addition, many females identified these games during the formative phase of this study (unpublished data), which may indicate why females engaged in more PA compared to males. It could be assumed that boys lost interest in the area with painted lines (Zone 1) since four-square, nine-square, and hopscotch are games that focus less on competition and more on having fun.

The comparison of PA levels between facilitator and non-facilitator led activities in Zone 3 revealed no difference in children. Prior studies using direct observation of children during recess has shown they are more physically active in areas that are not directly supervised. Our findings are in contrast to this since the children were physically active despite a facilitator being present or absent. The absence of a
significant pre- to posttest difference in PA in children between facilitator versus non-facilitator led activities has direct implications for schools. Specifically, these finding suggest that children can be taught how to play games, and if provided with the proper equipment, they will play the games whether the facilitator was present or absent.

Football, soccer, basketball, and ultimate Frisbee were the sports offered in Zone 3. Even though the data did not find an overall difference between facilitator and non-facilitator led activities, a gender difference was found with males having significantly higher MPA, MVPA, and VPA compared to females whether the facilitator was present or absent. Males have been found to have significantly higher \((p=0.02)\) participation rates in sports compared to females.\(^{153}\) Correlates of PA show that males are more physically active than females 81% of the time\(^{154}\) and objective measures of PA with accelerometry confirm these trends.\(^{99}\) A study done with First Nations children in Canada found that males were more likely to meet PA standards than females.\(^{155}\) Other studies support these trends with males consistently found to participate in more PA during recess interventions \(^{106,109,111,112}\) and direct observation studies \(^{104,105,156,157}\) compared to females. This may explain this trend in Zone 3 where the activities focused on competing for the duration of the recess period. The emphasis on competition remained whether or not the facilitator was present.

The findings from pre-intervention to intervention show that sedentary activity significantly decreased in the area with playground equipment (Zone 2) and MPA and MVPA increased in the area with painted lines (Zone 1). In addition, females showed a significant decrease in sedentary activity in the area with playground equipment (Zone 2) and facilitator/non-facilitator activities (Zone 3), males showed a significant decrease
in sedentary activity in the area with playground equipment (Zone 2), and females showed a significant increase in MPA, MVPA, and VPA in the area with painted lines (Zone 1) and facilitator/non-facilitator activities (Zone 3) from pre-intervention to intervention. The treatment in the area with painted lines (Zone 1) included lines that were painted on the concrete for four-square, nine-square, and hop-scotch. A similar study was done by Stratton and Mullan\textsuperscript{113} where the researchers painted lines on the playground and found a significant increase ($p \leq 0.01$) from pre to post intervention in MVPA for both genders.\textsuperscript{113} Huberty et al. conducted a similar study where they implemented a pre and post design that included activities zones.\textsuperscript{108} The authors found a significant increase in MPA and VPA for both genders from pre-intervention to post-intervention.\textsuperscript{108} Verstraete et al.\textsuperscript{107} offered children structured games complete with equipment and instruction found a significant improvement in MVPA for all children from pre-intervention to intervention.\textsuperscript{107} In the latter study, teachers were asked to “stimulate” the children to participate. Our study took a similar approach by inviting children to participate in bi-weekly facilitator led activities. Our findings showing females had a significant increase in PA levels after the lines were painted partially agree with the findings from Stratton and Mullan.\textsuperscript{113} The studies described above support a significant improvement in PA for both males and females when introduced to new play environments, but males in our study did not show any improvements. The effect could be attributed to reduced competition for playground equipment because there were new, additional opportunities available to females.

It is interesting to note the PA pattern between genders that emerged in the zone with facilitator-led and non-facilitator led sports (Zone 3). Females showed a significant
increase in MPA, MVPA, and VPA from pre-intervention to intervention, but males did not show any change in PA counts. However, when PA between males and females were compared, males had significantly higher MPA, MVPA, and VPA compared to females. Essentially, both genders improved their PA levels in Zone 3 after activities were implemented that contained sports equipment and a bi-weekly facilitator. These findings are supported by the literature that shows providing sports equipment has been shown to stimulate PA in 4th and 5th grade children.\textsuperscript{157} Children with no equipment on the playground engage in 8.2% more sedentary activity and 6.9% less MPA than children who are provided equipment during recess.\textsuperscript{156} Additionally, the intervention provided more play space that was sparsely utilized prior to the implementation of Zone 3, which has been shown to be a negative predictor of sedentary activity and a positive predictor of VPA.\textsuperscript{156} Allocation of playground space also has positive effects on children’s PA levels during recess\textsuperscript{106} by enabling the playground to offer more activities.\textsuperscript{108} Thus, offering more playground space and providing equipment for games may prove sustainable and effective for long-term improvements in PA levels during recess.

A significant increase in body weight in children was observed from pre-to-post intervention. Body weight increased from 43.1± 13.5kg to 44.0 ± 14.2kg, approximately 0.5 pounds. Prior research has shown that children age 6 to 12 years old gain an average of 5 to 7 pounds per year and grow about 2.5 inches per year.\textsuperscript{158} According to these data, this is on average about 0.5 pounds per month. The duration of this study was 8 weeks, or 2 months. Thus, the gain in weight may be attributed the rapid and natural growth process that children this age experience.
The MPAQ-A revealed a significant decrease in the number of hours of screen
time (video games and computer use) during the school week. This is an important
finding considering evidence of the relationship between screen time and obesity,
although, we do not know how many of the children who completed this pre- to posttest
measure participated in the recess activities and Zones, and the number of days they
were on the playground. Prior research has reported children age 9-12 spend 130.6
minutes per day watching television, 12.5 minutes per day on the computer, and 42.2
minutes per day playing video games. Additionally, children categorized as
overweight (according to age- and sex-specific BMI percentiles) spent 161.5 minutes
per day watching television, 21.7 minutes per day on the computer, and 40.8 minutes
per day playing video games. Viewing more than two hours of television per day has
been found to be significantly associated with overweight and obesity with a 13.4
percent probability of developing obesity. According to these data, decreasing
screen time is a critical component of preventing obesity and diabetes.

The other significant difference that was detected in the MPAQ-A was the
number of days children participated in VPA for 20 minutes from 4 days per week to 3
days per week. The posttest measures were conducted at the beginning of December
when area temperatures significantly decrease. A study done by Farley et al. conducted direct observation of children’s PA levels on the playground during recess
throughout three different seasons. The authors report that when temperatures are
colder (below 60°F), 76% of the children engaged in MPA and VPA versus 66% of the
children during hot temperatures. In addition, a study done by Ridgers et al. measured the association between PA and variables associated with PA during recess
during the summer months of June and July when temperatures ranged from 53.6°F – 80.6°F. The study found that temperature was a significant negative predictor of VPA. Accordingly, the results from our study are hard to compare to others as only one study exists that shows an increase in PA during colder temperatures and a decrease in PA during hotter temperatures. Perhaps the best interpretation for our findings are that the children didn’t engage in as much PA during the post-test measures when the temperature was cold versus the pre-test measures when temperatures were warmer.

The only significant differences found in the exploratory analysis between the specific sports activities offered in Zone 3 was in sedentary activity, with the highest counts in facilitator led football and non-facilitator led football. This is not surprising since a function of the game is fast paced action followed by periods of little to no activity. The facilitator attempted to quickly call plays and keep the children moving as much as possible. It is possible that SOPLAY measurement scans were conducted in between plays where sedentary counts accumulated much higher than counts with the other activities, which were more fast paced (e.g., soccer). No other differences were found between any of the activities for the other dependent variables. Prior studies have shown that offering multiple intervention components on the playground has no effect on children’s PA levels,\textsuperscript{106} which is supported by our findings.

**Strengths and Limitations**

Limitations of this study include the lack of a comparison group, one-group design, small sample size and no formal link between recess activity levels and participants who completed the pre- and posttest body composition, MPAQ-A and SOCM measures. The small sample size in one community makes the findings difficult
to generalize to other tribal communities. Additionally, the intervention was limited to one, 10 minute, recess period per day. The strengths of this study are attributed to the strategies, which were identified directly from the children during the formative phase of this project. The playground lines are permanent and will stay on the playground for the children to utilize. The lines also represent a sustainable piece of this study. The SOPLAY PA instrument allowed the assessors to distinguish between males and females, and thus, examine gender differences in PA levels in the different zones. The investigator was able to work with the school to implement the recess intervention components in addition to engage the children on the playground during recess. The investigator received feedback throughout the study from the children and teachers in regards to how much the children enjoyed the activities on the playground. The research team was also able to obtain parent consent and child assent to recruit over 60 children in the pre- and posttest measures. In addition, the ability to collect pre-to post-test measures provided an indication of behavior changes that are important for the prevention of obesity and diabetes. The school, community, and reservation were in total support of this project and collaborated with the investigator from start to finish. Finally, the investigator was able to engage university students to help with data collection of all phases of the intervention, and they were trained to accurately assess the SOPLAY PA data.

Implications and Future Research

The observation that there was no difference in outcomes between facilitator led and non-facilitator led activities has direct utility for schools. For example, schools can ask competent school personnel to show children how to play specific games and
provide the necessary equipment. Our study shows that if these two things happen, children will play regardless is someone is facilitating the activity or not or not. To achieve improved PA among children, schools may not have to hire more personnel. Rather, schools should devote resources to provide guidance (where needed) and adequate playground equipment. In addition, community-identified approaches such as painting lines on the playground were effective at increasing PA in females, and are inexpensive and sustainable methods to adopt. More research is needed in tribal communities to establish strategies and evidence based approaches to help children achieve daily PA guidelines. That this study was perhaps the first recess intervention done on an AI reservation, the lack of literature made our findings difficult to compare to other studies conducted with tribal communities. Tribal communities are unique and different from populations where other recess interventions have been done due to their rural location, high unemployment rates, low socioeconomic status, high rates of chronic disease, and lack of opportunity to be physically active. Recess presents a prime opportunity during the school day to get children physically active and accounts for one third of the daily PA recommendations. Our findings suggest that efforts to help children in this area of the school day begin at the policy level. Research shows that schools are more focused on academics than children’s physical activity levels and are making substantial cuts, often as high as 28%, to time spent in recess. Policy changing efforts should be specific to increasing not only frequency, but also, the duration of recess. Research shows that longer recess breaks enable children to organize and play games with the equipment resulting in higher proportions of active time. Adding more daily recess time and increasing playground space are
proven strategies that have been shown to have positive effects on PA levels. Researchers should conduct a formative assessment that ascertains community identified strategies that are low cost and sustainable.

**Acknowledgements**

The authors are grateful for the help and support from the students, teachers, principal, superintendent, school board, and the community. This study could not have been done without you! We also like to thank the undergraduate research team at the University of Montana: Caleb Kemp, Ashely Shreiner, Devin Kavanagh, and Brian Yonts. Finally, we thank Dr. Steve Gaskill for his technical support and guidance with the SOPLAY analysis.
DEVELOPING AND PILOT-TESTING COMMUNITY BASED STRATEGIES FOR INCREASING PHYSICAL ACTIVITY IN CHILDREN IN THE 3rd, 4th, 5th, AND 6th GRADE ON AN AMERICAN INDIAN RESERVATION

CHAPTER 5: Conclusion
This dissertation employed a CBPR mixed-method approach, with the purpose of developing and pilot-testing community-identified strategies to get 3rd, 4th, 5th, and 6th grade children living in a tribal community more physically active during the school day. The formative phase of this project was spent developing relationships with key leaders on the reservation that included the Tribal Health Department Head, Tribal Health Diabetes Team, Tribal Council, the school’s principal and superintendent, and the Indian Education Committee. These aspects of the CBPR process took a considerable amount of time, dedication, and effort to establish and to make the appropriate connections on the reservation to ensure the success of the project. It took nearly two years before data could be collected for the first study of this dissertation. The time frame included the process of getting to know various people and securing approvals from key entities on the reservation.

After all approvals were in place, the formative assessment was conducted with the purpose of finding out how to get children more physically active during the school day. Six focus groups were organized and centered on the question, “how can we get children more active and moving during the school day?” The analysis revealed a need for a recess intervention—the children and adult participants also identified specific strategies that could get children more physically active on the playground during recess.

The themes identified in the focus groups were reported back to the community for feedback and clarification. The principal, teachers, Tribal Health Department Head, and community members all supported the themes that were identified from the analysis.
Accordingly, these specific strategies were used to design the 8 week recess intervention.

To our knowledge, this is the first recess intervention done in a tribal community that included painting lines (e.g., four-square) on the playground and providing facilitator led activities. This design provided the children with three different Zones on the playground that offered a different type of activity during recess; more specifically, Zone 1 offered lines painted on the playground for four-square, nine-square, and hopscotch, Zone 2 was an area with permanent playground structures, and Zone 3 offered facilitator led activities. In Zone 3, the children had the opportunity to play games with an adult and learn proper technique, rules, and sportsmanship for each of the activities offered (football, soccer, basketball, and ultimate frisbee).

One of the greatest strengths of the dissertation studies was demonstrating the feasibility to conduct a mixed-methods, CBPR study with children, at an elementary school and with community members on an American Indian reservation. Throughout the study the investigator was able to work directly with the principal and teachers to implement the recess intervention components and obtain parent consent and child assent and successfully recruit over 60 children to complete the pre- and posttest measures. Feasibility was also demonstrated on the playground with the research team’s ability to engage the children in the different zones during recess. This built capacity by simply adding to what the children like to do during recess (identified during the formative phase) by leading organized games that were structured with rules, technique, and sportsmanship. The four-square, nine-square, and hopscotch lines
were painted on the playground with oil based paint and remain to this day—these lines represent a sustainable piece of this study.

This process took approximately three years to complete which is not uncommon with CBPR projects conducted in Indian Country.\textsuperscript{15,17,19,21,23,98} Much of the time was spent establishing relationships, building capacity, and working with the community during every phase of the research process.

The implications of the findings suggest that if children are provided with playground equipment and taught how to play games, they will play despite an adult facilitating the game or not. Another important finding was that recess in this school was reduced to one ten minute break in the afternoon per day.

Future research studies should include a larger sample size, a wait-list control group, and randomization. It was difficult to determine the true effects that the recess intervention had on the pre and posttest measures of body composition, MPAQ-A, and the SOCM because the SOPLAY PA instrument was not paired to any particular child. Physical activity was calculated from direct observation. Thus, body composition and any other measures should be paired with PA, perhaps by objective measures such as heart rate telemeters or accelerometers.
REFERENCES


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APPENDIX A: STUDY 1 MATERIALS

Moderators Guide for Focus Groups

The following discussion guide is designed to help you, the moderator, get conversation going, keep it on topic, and help draw out pertinent information. The questions in each section are not necessarily intended to be asked sequentially, rather use your discretion in moving through them. Move through them in a way that makes sense with the flow of conversation amongst the group. Use the questions as a starting place for discussion. If you don’t hit all the questions, that is okay. It is more important to hear a variety of questions than to talk for one hour about only one question. Also, feel free to ask follow-up questions as you see fit. The more natural this discussion feels the better!

Moderator’s Guide – Suggested format and script

Hello and welcome to the focus group. I want to thank you for taking the time to participate in this discussion. Please let me tell you a little bit about this project and what we hope to learn from this focus group. I am a doctoral student at the University of Montana under the supervision of Dr. Blakely Brown, Department of Health and Human Performance and Dr. Gyda Swaney, Department of Psychology. We are all interested in finding ways to prevent risk factors for diabetes in children on the Flathead Reservation. Studies show that one of the best ways to prevent risk factors for diabetes in children is to increase their daily physical activity. The goal of my doctoral studies is to design, implement, and evaluate a program that increases the amount of physical activity that elementary school children in Arlee receive during the school day, with a special focus on physical education. By talking with community members and 4th, 5th, and 6th grade students in Arlee I will learn how to make this happen. The plan is to take what is learned in the focus groups and use the information to design a physical activity program for children in the 4th, 5th, and 6th grades and try this out in the Arlee Elementary School sometime next year. The outcome of the physical activity program will be of interest to other Montana reservation communities and maybe even nationwide in communities looking at ways to improve their children’s health.

Before we begin, please be aware that this discussion should run about 60 minutes. You are welcome to take a break and use the restroom any time during the focus group. Before we get started, please read the Informed Consent form and let me know if you have any questions. Please sign and date the bottom once you have read and understand it. Once this is complete, can you please fill out the demographic checklist?

***** ALLOW 10 MINUTES TO READ AND SIGN FORMS *****

As you’ve probably noticed, I have a recorder on the table. I’d like to record our discussion so that we don’t miss any of your comments. To make sure your responses are confidential, I will only call you by your first name but neither your first or last will appear in our final reports. The information you share today will be used to help improve our project. The tapes I am using will be destroyed after they have been transcribed and checked for accuracy.
Please remember that there are no wrong answers to a focus group question. I expect everyone present will have different points of view. I want to make sure that you feel comfortable expressing your own opinion. You have been asked to take part in the focus group because of what you do on the reservation and because you expressed interest in the project at the community meeting. Your participation is invaluable since you are interested in the health of our school aged children and knowledgeable about the barriers and enhancers these children face in receiving adequate daily physical activity. Please answer all questions from the viewpoint of the community you live in. Do you have any questions so far?

**Major areas of questions for adult focus groups:**
How many days per week do 4th, 5th, and 6th graders participate in physical education?
If the response is less than five days: How do you feel about possibly altering the curriculum or school day to increase the amount of PE to five days per week or to just get the kid’s active and moving in general during class time?
How do you think this could be accomplished?
Do you think this is feasible to do and do you think we could get the support from parents, teachers, and administrators to alter the structure of the school day to accommodate the PE strategies? Why or why not?
What are some ways we can get the youth more active and moving during the school day without disrupting the current schedule?
What do you think about having a school-wide 10 minute walk at the beginning of the day? Do you think people would support this idea? Do you think they would participate in the walk? Why or why not?
How can we structure PE to incorporate more intense aerobic activities?
What are barriers that keep kids from participating in physical activity?
What are enhancers that get kids physically active?
Do you have any ideas about how to incorporate culture into the curriculum that gets kids active and moving (example: dancing)?
Would you be supportive of a six to eight week program during PE that tries to get kids active and moving, which will be culturally tailored? Why or why not?
Is there anything else you want to add to this discussion?

Thank you again for your insights. All of the things you shared today will help us understand the barriers and enhancers for children in your community to increase the amount of physical activity they participate in each day. I appreciate your honesty and openness in talking about these issues. Here is a $20 gift for your time. Thank you again for your time. Have a safe trip home.

**Major areas of questions for the 4th, 5th, and 6th grade children’s focus groups**
How many days per week do you guys have PE in school?
If the response is less than five days: How would you feel if that changed and you had PE five days each week?
How many times each day do you get to go to recess?
What do you do after school?
What if there were intramurals after school, what kind of sports would you like to do and if they were available would you join?
Can you tell me some fun exercises you would like to do during PE? How about at recess? What about during the day when you are in class with your teacher? How about after school? If the school offered a special exercise program, when do you think would be the best time for it—during PE, recess, or after school? Remember we talked about intramurals after school? Do you lose concentration during class because you have so much energy and need a break to get up and move around? What if your teacher took an exercise break during the day when you are learning? What would you think about doing a 10 minute walk at the beginning of the day before you have to sit down and start learning? Do you think your friends and other students that are not here would like to do something like this in the morning? Can you tell me why they would or wouldn’t? Can you name some things that keep you from doing exercise during school? How about after school and on the weekend when you are with your parents? Is there anything else you think is important for me to know about kids and exercise in this school?

Thank you again for all your help. All of the things you shared today will help me understand what kind of exercises the kids in this school like to do and what keeps kids from getting exercise. You will receive either a sled, skipping rope, or ball for participating in this discussion. Thank you again for your time and have a good rest of the day.
Demographics Survey - Adult

Participant ID#________________

1. Age______________

2. Sex:
   □ Female
   □ Male

3. Ethnicity:
   □ Native American (please specify your Tribal Affiliation:_______________________)
   □ Hispanic/Latino
   □ Native Hawaiian/Pacific Islander
   □ Asian
   □ White, non-Hispanic
   □ African American
   □ Other:____________________________________________________________

4. How many people do you support with your yearly income?______________________

5. How many of these people who you support with your income live with you?________

6. What is the range of your yearly income that supports you and the number of people you listed in Question 4?
   □ $  0 – $20,000
   □ $21,000 – $40,000
   □ $41,000 – $60,000
   □ $61,000 – above

7. Years of school completed:
   □ Less than high school
   □ High school diploma/GED
   □ Some college/Associate degree
   □ College degree
   □ Graduate degree
Demographics Survey - Child

Participant ID#_________________

1. Age ______

2. Grade
   □ 4th grade
   □ 5th grade
   □ 6th grade

2. Sex:
   □ Girl
   □ Boy

3. Ethnicity:
   □ Native American (Tribe:_____________________________________________)
   □ Hispanic/Latino
   □ Native Hawaiian/Pacific Islander
   □ Asian
   □ White, non Hispanic
   □ African American
   □ Other:______________
Focus Group Master Theme List

**BARRIERS: School Environment**
*Instruction Centered Teaching*
*Academic Requirements: Tests, Homework*
*Four day school week and long school days*
*PE: Lack of PA, Structure, Transition, Lack of Frequency, Lack of Duration, Structure Hinders PA Time, Lack of Support and Collaboration from Teachers*
*Recess: Structure, Rules, Short Duration, Elimination*
*Being Weighed in Front of Peers*
*Emphasis on Competition and Fitness: Fitness Testing, Running the Mile, Running (in general), Sit-ups, Push-ups, Pull-ups, Curls, Sit and Reach; Follying; Dodgeball, Soccer, and Tag*

**BARRIERS: Community and School Resources**
*Lack of Equipment*
*Lack of Playground Equipment*
*Inappropriate Playground Conditions*
*Lack of Funding*
*Lack of Coaches*
*After School: Lack of Programs*
*Lack of Extra-curricular Activities*
*Lack of Personnel*
*Lack of Sidewalks*
*Vandalism (Attributed to lack of security?)*

**BARRIERS: Electronic Devices**
*Cell phones*
*Video Games: Wii*
*Watching TV*
*IPod*
*Computers: Facebook*

**BARRIERS: Transportation**
*Traveling/Living Outside the Community*

**BARRIERS: Role of Parents and Family**
*Lack of Parental Involvement*
*Lack of Skill to Ride a Bicycle*
*Lack of Parental Consent to Ride Bicycles*
*Lack of Motivation/Self Discipline*
*Lack of Interest*
*Unhealthy Role Models: Parents*
*Babysitting Siblings*
*Taking Care of Animals*
*Unhealthy Diet (Social Norm?)*
*Sleeping*

**STRATEGIES: Structured/Non-competitive Activities**
*Exercise Breaks During Classroom Instruction: 10 Minute Walk, Calisthenics, Desk Aerobics, Maintenance/Clean-up, Refocus Moments, Native Games, “Bucket” List, Dance, Morning Stretching, Chair Aerobics, Training with Resistance Bands, Early Morning Activities*
*Active Learning*
*Structured Playground Activities: Jump Rope, Hopscotch, Shimmy, Ping Pong, Tag, Four Square, NineSquare (similar to foursquare but with more people) Swinging, Tossing a Ball, Pretend Games, Running, Playing on the Monkey Bars*
*Individual Sports: Rock Climbing*
*Individual Exercise: Riding Bike, Dancing, Walking, Riding Scooters, Jump Rope, Stretching, Hiking, Yoga*
*Increasing Structure during PE: Proper Warm-up and Cool-down, Calisthenics, Team Building Activities, Active Video Games Flagship*
STRATEGIES: Increasing School and Community-wide Capacity
Community Clean-up Day
Elementary Playground: Expand Playground Space, PaintingBoundaries on the Playground
Recruiting Community Volunteers
Facilitating Teacher Buy-in/Collaboration
Administrative Involvement: Changing Policies
Parental Involvement
Healthy Role Modeling Among Parents and Teachers
Announce Activities during the School Day/Utilizing Effective Communication Strategies
Instilling Healthy Behaviors
Award Incentives for Participating in an Activity
Encourage Goal Setting
Utilizing the Arlee Fitness Center
Utilizing the Community Basketball Courts and Gyms
PE: Increase Frequency
Recess: Increase Frequency
Incorporating Transportation

STRATEGIES: Providing a Healthy Diet and Nutrition Education
Nutrition Education
Nutrition/Healthy Diet
Healthy Snacks

STRATEGIES: Structured/Competitive Activities
International Sports Day
Individual Exercise: Shuttle Run, Weight Training, Sit-ups, Chin-ups, Running
Team Sports: Basketball, Softball, Football, Soccer, Volleyball, Ultimate Frisbee, Baseball, T-Ball, Lacrosse, Dodgeball, Rugby, Flammy Ball (Variation of volleyball where the ball can legally bounce before hitting it), Kickball, Native American Kickball, Volleyball (with 2 balls at once), Soccer (with 2 balls at once)
Individual Sports: Swimming, Foot Races, Wrestling, Archery
Combat Sports: Tae Kwan Do
Presidential Fitness Test Preparation
APPENDIX B: STUDY 2 SURVEYS AND ANALYSIS

Measurement Sheet

<table>
<thead>
<tr>
<th>Participant ID</th>
<th>Date of Birth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gender: Male Female

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Waist Circumference (cm)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MPAQ – A Questionnaire

Participant ID____________________ Date____________________

Directions: Circle or draw an X through the choice that best answers the question for you.

1. Think about the past week, how many days did you do at least 20 minutes of exercise that made you breathe hard and your heart beat fast (this can be sports, jogging, running, or fast biking)? If you are not sure if an exercise was hard, please ask.

<table>
<thead>
<tr>
<th></th>
<th>0 days</th>
<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
<th>4 days</th>
<th>5 days</th>
<th>6 days</th>
<th>7 days</th>
</tr>
</thead>
</table>

2. Think about the past week, how many days did you exercise for at least 60 minutes per day? Add up all of the time you spend in any kind of exercise that makes your heart beat fast and makes you breathe hard some of the time (this can be walking fast, playing, running, biking, swimming, or other sports). If you are not sure if an exercise counts, please ask.

<table>
<thead>
<tr>
<th></th>
<th>0 days</th>
<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
<th>4 days</th>
<th>5 days</th>
<th>6 days</th>
<th>7 days</th>
</tr>
</thead>
</table>

3. On a school day, how many hours do you watch TV?

<table>
<thead>
<tr>
<th>I do not watch TV</th>
<th>Less than 1 hour per day</th>
<th>1 hour per day</th>
<th>2 hours per day</th>
<th>3 hours per day</th>
<th>4 hours per day</th>
<th>5 or more hours per day</th>
</tr>
</thead>
</table>

4. When you have school, how much time do you play video games or use a computer for stuff that’s not school work (things like Game Boy, Xbox, and the Internet count)?

<table>
<thead>
<tr>
<th>I do not play these games</th>
<th>Less than 1 hour per day</th>
<th>1 hour per day</th>
<th>2 hours per day</th>
<th>3 hours per day</th>
<th>4 hours per day</th>
<th>5 hours per day</th>
<th>6 or more hours per day</th>
</tr>
</thead>
</table>
5. When you don’t have school, how much time do you watch TV, play video games or use a computer for stuff that’s not school work (things like Game Boy, Xbox, and the Internet count)?

<table>
<thead>
<tr>
<th>I do not play these games</th>
<th>Less than 1 hour per day</th>
<th>1 hour per day</th>
<th>2 hours per day</th>
<th>3 hours per day</th>
<th>4 hours per day</th>
<th>5 hours per day</th>
<th>6 or more hours per day</th>
</tr>
</thead>
</table>

6. Each week when you are in school, on how many days do you go to PE class?

<table>
<thead>
<tr>
<th>0 days</th>
<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
<th>4 days</th>
<th>5 days</th>
<th>6 days</th>
<th>7 days</th>
</tr>
</thead>
</table>

7. Think about the past year, on how many sports teams did you play (teams run by your school or town count)?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
SOCM Questionnaire

Participant ID____________________ Date___________________

The next three questions talk about how much you want to try different things at recess. Check (✓) the box that is more like YOU for each question.

1. How much do you want to play on a sports team at recess?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I do not want to play</td>
<td>I hardly want to play</td>
<td>I sometimes want to play</td>
<td>I want to play most of the time</td>
<td>I want to play all of the time</td>
</tr>
</tbody>
</table>

2. How much do you want to use lines on the playground for games like hopscotch, four-square, and those kinds of games at recess?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I do not want to use the lines for games</td>
<td>I hardly want to use the lines for games</td>
<td>I sometimes want to use the lines for games</td>
<td>I want to use the lines for games most of the time</td>
<td>I always want to use the lines for games</td>
</tr>
</tbody>
</table>

3. How much do you want to join in some other kind of game at recess?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I do not want to join in</td>
<td>I hardly want to join in</td>
<td>I sometimes want to join in</td>
<td>I want to join in most of the time</td>
<td>I always want to join in</td>
</tr>
</tbody>
</table>
The next five questions talk about things you do at recess. Check (√) the box that is more like YOU for each question.

4. I do not join games at recess and right now I have no plans to start.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AGREE</td>
<td>DISAGREE</td>
<td>UNSURE</td>
</tr>
</tbody>
</table>

5. I do not join games at recess but am thinking about starting.

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<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AGREE</td>
<td>DISAGREE</td>
<td>UNSURE</td>
</tr>
</tbody>
</table>

6. I do not join games at recess but I want to start in the next month.

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<thead>
<tr>
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<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AGREE</td>
<td>DISAGREE</td>
<td>UNSURE</td>
</tr>
</tbody>
</table>

7. I have been joining games at recess but it’s been less than six months.

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<thead>
<tr>
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<th>1</th>
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<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AGREE</td>
<td>DISAGREE</td>
<td>UNSURE</td>
</tr>
</tbody>
</table>

8. I have been joining games at recess for at least six months now.

<table>
<thead>
<tr>
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<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AGREE</td>
<td>DISAGREE</td>
<td>UNSURE</td>
</tr>
</tbody>
</table>
SPARK Questionnaire

Participant ID___________________ Date___________________

HOW DO YOU FEEL ABOUT . . .

Put a check (✓ or an X) on the ONE face that shows how you feel about that question. Be sure to check only ONE face for each question.

A. How do you feel about taking a walk for exercise?

B. How do you feel about PE class?

C. How do you feel about doing exercise with a lot of running?

D. How do you feel about exercise that makes you tired or sweat?
Check (✓) one of the two things that you would do if you had to choose.

**E. After school I would chose to**

<table>
<thead>
<tr>
<th></th>
<th>play inside</th>
<th>OR</th>
<th>play outside</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>play a running game with friends</th>
<th>OR</th>
<th>take a walk with friends</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>take a walk with friends</th>
<th>OR</th>
<th>watch TV</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>watch TV</th>
<th>OR</th>
<th>play a running game with friends</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**F. PE class is**

<table>
<thead>
<tr>
<th></th>
<th>nice</th>
<th>OR</th>
<th>awful</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>unhealthy</th>
<th>OR</th>
<th>healthy</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>sad</th>
<th>OR</th>
<th>happy</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>important</th>
<th>OR</th>
<th>unimportant</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>fun</th>
<th>OR</th>
<th>boring</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Check (v) one word from each pair.

G. Watching TV is

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>OR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>nice</td>
<td></td>
<td>awful</td>
</tr>
<tr>
<td>2.</td>
<td>unhealthy</td>
<td></td>
<td>healthy</td>
</tr>
<tr>
<td>3.</td>
<td>sad</td>
<td></td>
<td>happy</td>
</tr>
<tr>
<td>4.</td>
<td>important</td>
<td></td>
<td>unimportant</td>
</tr>
<tr>
<td>5.</td>
<td>fun</td>
<td></td>
<td>boring</td>
</tr>
</tbody>
</table>

H. Exercise that makes me tired and sweat is

<table>
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<th></th>
<th></th>
<th>OR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>nice</td>
<td></td>
<td>awful</td>
</tr>
<tr>
<td>2.</td>
<td>unhealthy</td>
<td></td>
<td>healthy</td>
</tr>
<tr>
<td>3.</td>
<td>sad</td>
<td></td>
<td>happy</td>
</tr>
<tr>
<td>4.</td>
<td>important</td>
<td></td>
<td>unimportant</td>
</tr>
<tr>
<td>5.</td>
<td>fun</td>
<td></td>
<td>boring</td>
</tr>
</tbody>
</table>

I. Doing exercise after school is

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>OR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>nice</td>
<td></td>
<td>awful</td>
</tr>
<tr>
<td>2.</td>
<td>unhealthy</td>
<td></td>
<td>healthy</td>
</tr>
<tr>
<td>3.</td>
<td>sad</td>
<td></td>
<td>happy</td>
</tr>
<tr>
<td>4.</td>
<td>important</td>
<td></td>
<td>unimportant</td>
</tr>
<tr>
<td>5.</td>
<td>fun</td>
<td></td>
<td>boring</td>
</tr>
</tbody>
</table>
**WHAT I AM LIKE**

J. Check (✓) the box that is more like YOU for each question.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>OR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I do very well at all kinds of games and sports</td>
<td></td>
<td>I don’t feel I am very good when it comes to games and sports.</td>
</tr>
<tr>
<td>2</td>
<td>I wish I could be a lot better at games and sports.</td>
<td></td>
<td>I feel I am good enough at games and sports.</td>
</tr>
<tr>
<td>3</td>
<td>I think I could do well at games and sports I have not tried</td>
<td></td>
<td>I am afraid I might not do well at games and sports I have not</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>tried.</td>
</tr>
<tr>
<td>4</td>
<td>I feel I am better than others my age at games and sports.</td>
<td></td>
<td>I don’t feel I can play games and sports as well as others my</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>age.</td>
</tr>
<tr>
<td>5</td>
<td>Most of the time I watch games and sports.</td>
<td></td>
<td>Most of the time I play games and sports.</td>
</tr>
<tr>
<td>6</td>
<td>I don’t do well at new outside games and sports.</td>
<td></td>
<td>I am good at new outside games and sports.</td>
</tr>
<tr>
<td>7</td>
<td>I am happy with my height and weight.</td>
<td></td>
<td>I wish my height or weight could change.</td>
</tr>
<tr>
<td>8</td>
<td>I am not fat.</td>
<td></td>
<td>I wish I was thinner.</td>
</tr>
<tr>
<td>9</td>
<td>Most of the time I am not happy with who I am.</td>
<td></td>
<td>I am happy with who I am.</td>
</tr>
<tr>
<td>10</td>
<td>I like who I am.</td>
<td></td>
<td>I wish I was someone else.</td>
</tr>
<tr>
<td>11</td>
<td>I am happy the way I am.</td>
<td></td>
<td>I wish I could change.</td>
</tr>
</tbody>
</table>
THINK ABOUT THIS SCHOOL YEAR

N. This school year, how much time did you spend on a weekend day watching TV and videos, or playing computer/video games?

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>None</td>
<td>Less than 1 hour</td>
<td>1-2 hours</td>
<td>3-4 hours</td>
<td>5 hours or more</td>
</tr>
</tbody>
</table>

O. This school year, how much time did you spend on a weekend day working or doing chores that made you get tired, breathe hard, or sweat?

<p>| | | | | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>None</td>
<td>Less than 1 hour</td>
<td>1-2 hours</td>
<td>3-4 hours</td>
<td>5 hours or more</td>
</tr>
</tbody>
</table>

P. This school year, how much time did you spend on a weekend day doing exercise that made you get tired, breathe hard, or sweat?

<p>| | | | | |</p>
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<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>None</td>
<td>Less than 1 hour</td>
<td>1-2 hours</td>
<td>3-4 hours</td>
<td>5 hours or more</td>
</tr>
</tbody>
</table>

Q. This school year, which of these did you take? (You may check more than one.)

1. ballet
2. other dance
3. tennis
4. swimming
5. judo/karate
6. horseback riding
7. soccer
8. football
9. baseball/softball
10. basketball
11. gymnastics
12. volleyball
13. I did NOT take any of these this school year.
14. Other________________

R. This school year, which sports teams were you on? (You may check more than one.)

1. baseball/softball
2. basketball
3. football
4. gymnastics
5. soccer
6. swimming
7. tennis
8. track and field
9. I was NOT on any sports team this year
10. Other________________
THINK ABOUT THE PAST WEEK

S. How many DAYS in the past week did one of your parents encourage you to do exercise?

<table>
<thead>
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<th>4</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>days</td>
<td>day</td>
<td>2 or 3 days</td>
<td>Almost</td>
<td>Every day</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>1</td>
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<td></td>
<td></td>
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<td>5</td>
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</table>

T. How many DAYS in the past week did one of your parents do exercise with you?

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<td>Almost</td>
<td>Every day</td>
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<td>5</td>
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</tbody>
</table>

U. How many DAYS in the past week did one of your parents take you to a place to do exercise?

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<th>1</th>
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<th>3</th>
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<td>days</td>
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<td>5</td>
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</tbody>
</table>

V. How many DAYS in the past week did you walk, bike, or skateboard to school?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>days</td>
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</tbody>
</table>
THINK ABOUT THE FUTURE

W. Do you think you will do exercise all the time next summer?

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I will NOT</td>
<td>I bet I will NOT</td>
<td>About a 50/50 chance</td>
<td>I bet I WILL</td>
<td>I WILL</td>
</tr>
</tbody>
</table>

X. Do you think you will do exercise all the time, when not in school, one year from now?

<p>| | | | | |</p>
<table>
<thead>
<tr>
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<td>I bet I will NOT</td>
<td>About a 50/50 chance</td>
<td>I bet I WILL</td>
<td>I WILL</td>
</tr>
</tbody>
</table>

Y. Do you think you will do exercise all the time when you are an adult?

<p>| | | | | |</p>
<table>
<thead>
<tr>
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<tr>
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<td>I bet I will NOT</td>
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<td>I bet I WILL</td>
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</tr>
</tbody>
</table>

Z. Do you think you will smoke cigarettes when you are an adult?

<p>| | | | | |</p>
<table>
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<tr>
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<td>I bet I WILL</td>
<td>I WILL</td>
</tr>
</tbody>
</table>

THANK YOU VERY MUCH!!!
ANOVA Tables

ANOVA between Zones 1, 2, and 3 during 8 week intervention
Dependent Variable: Sedentary Physical Activity

Table 1. Factorial Analysis of Variance for counts in Sedentary PA between Zones 1, 2, and 3.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Residual Sum of Squares</th>
<th>d.f.</th>
<th>Mean Square</th>
<th>F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone</td>
<td>921.53</td>
<td>2</td>
<td>460.77</td>
<td>91.20</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Gender</td>
<td>361.07</td>
<td>1</td>
<td>361.07</td>
<td>71.47</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Zone * Gender</td>
<td>620.45</td>
<td>2</td>
<td>310.23</td>
<td>61.40</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Residual Error</td>
<td>1566.20</td>
<td>310</td>
<td>5.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R Squared = .548 (Adjusted R Squared = .540)

Table 2. Bonferroni Post Hoc test for counts in Sedentary PA between Zones 1, 2, and 3

<table>
<thead>
<tr>
<th>Zone</th>
<th>Zone</th>
<th>Mean Difference</th>
<th>Standard Error</th>
<th>p-value</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>-2.78</td>
<td>0.31</td>
<td>&lt; .0001</td>
<td>-3.54 -2.06</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>1.32*</td>
<td>0.31</td>
<td>&lt; .0001</td>
<td>0.58 2.07</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4.12*</td>
<td>0.31</td>
<td>&lt; .0001</td>
<td>3.37 4.87</td>
</tr>
</tbody>
</table>

*The mean difference is significant at the 0.05 level

ANOVA between Zones 1, 2, and 3 during 8 week intervention
Dependent Variable: Moderate Physical Activity

Table 3. Factorial Analysis of Variance for counts in Moderate PA between Zones 1, 2, and 3.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Residual Sum of Squares</th>
<th>d.f.</th>
<th>Mean Square</th>
<th>F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone</td>
<td>56.51</td>
<td>2</td>
<td>28.26</td>
<td>5.99</td>
<td>0.003</td>
</tr>
<tr>
<td>Gender</td>
<td>29.56</td>
<td>1</td>
<td>29.56</td>
<td>6.27</td>
<td>0.013</td>
</tr>
<tr>
<td>Zone * Gender</td>
<td>153.52</td>
<td>2</td>
<td>76.76</td>
<td>16.29</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Residual Error</td>
<td>1461.19</td>
<td>310</td>
<td>4.71</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R Squared = .140 (Adjusted R Squared = .127)

Table 4. Bonferroni Post Hoc test for counts in Moderate PA between Zones 1, 2, and 3

<table>
<thead>
<tr>
<th>Zone</th>
<th>Zone</th>
<th>Mean Difference</th>
<th>Standard Error</th>
<th>p-value</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>0.83*</td>
<td>0.30</td>
<td>0.01</td>
<td>.11</td>
<td>1.55</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>0.96*</td>
<td>0.30</td>
<td>0.01</td>
<td>.24</td>
<td>1.68</td>
</tr>
</tbody>
</table>

*The mean difference is significant at the .05 level
ANOVA between Zones 1, 2, and 3 during 8 week intervention
Dependent Variable: Vigorous Physical Activity

Table 5. Factorial Analysis of Variance for counts in Vigorous PA between Zones 1, 2, and 3.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Residual Sum of Squares</th>
<th>d.f.</th>
<th>Mean Square</th>
<th>F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone</td>
<td>319.25</td>
<td>2</td>
<td>159.63</td>
<td>25.44</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Gender</td>
<td>46.66</td>
<td>1</td>
<td>46.66</td>
<td>7.44</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Zone * Gender</td>
<td>716.46</td>
<td>2</td>
<td>358.23</td>
<td>57.10</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Residual Error</td>
<td>1945.43</td>
<td>310</td>
<td>6.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R Squared = .358 (Adjusted R Squared = .347)

Table 6. Bonferroni Post Hoc test for counts in Vigorous PA between Zones 1, 2, and 3

<table>
<thead>
<tr>
<th>Zone</th>
<th>Zone</th>
<th>Mean Difference</th>
<th>Standard Error</th>
<th>p-value</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>-1.5'</td>
<td>0.34</td>
<td>&lt; 0.001</td>
<td>-2.32 -0.67</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1.0'</td>
<td>0.34</td>
<td>0.017</td>
<td>0.13 1.78</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2.5'</td>
<td>0.34</td>
<td>&lt; 0.001</td>
<td>1.62 3.29</td>
</tr>
</tbody>
</table>

*The mean difference is significant at the .05 level

ANOVA between Zones 1, 2, and 3 during 8 week intervention
Dependent Variable: Moderate to Vigorous Physical Activity (MVPA)

Table 7. Factorial Analysis of Variance for counts in MVPA between Zones 1, 2, and 3.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Residual Sum of Squares</th>
<th>d.f.</th>
<th>Mean Square</th>
<th>F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone</td>
<td>609.30</td>
<td>2</td>
<td>304.65</td>
<td>25.77</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Gender</td>
<td>2.19</td>
<td>1</td>
<td>2.19</td>
<td>0.19</td>
<td>0.66</td>
</tr>
<tr>
<td>Zone * Gender</td>
<td>1517.39</td>
<td>2</td>
<td>758.70</td>
<td>64.20</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Residual Error</td>
<td>3641.31</td>
<td>308</td>
<td>11.82</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R Squared = .369 (Adjusted R Squared = .359)

Table 8. Bonferroni Post Hoc test for counts in MVPA between Zones 1, 2, and 3

<table>
<thead>
<tr>
<th>Zone</th>
<th>Zone</th>
<th>Mean Difference</th>
<th>Standard Error</th>
<th>p-value</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>-1.5'</td>
<td>0.47</td>
<td>0.003</td>
<td>-2.70 -0.42</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>1.8'</td>
<td>0.47</td>
<td>&lt; 0.001</td>
<td>.719 3.04</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3.4'</td>
<td>0.47</td>
<td>&lt; 0.001</td>
<td>2.27 4.57</td>
</tr>
</tbody>
</table>

*The mean difference is significant at the .05 level
ANOVA between facilitator led and non-facilitator led activities (labeled as sport) in Zone 3 during 8 week intervention
Dependent Variable: Sedentary Physical Activity

Table 7. Factorial Analysis of Variance for counts in Sedentary PA between facilitator led and non-facilitator led activities (labeled as sport) in Zone 3 during 8 week intervention.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Residual Sum of Squares</th>
<th>d.f.</th>
<th>Mean Square</th>
<th>F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sport</td>
<td>34.03</td>
<td>7</td>
<td>4.86</td>
<td>5.43</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Gender</td>
<td>2.17</td>
<td>1</td>
<td>2.17</td>
<td>2.43</td>
<td>.12</td>
</tr>
<tr>
<td>Sport * Gender</td>
<td>17.02</td>
<td>7</td>
<td>2.43</td>
<td>2.72</td>
<td>.01</td>
</tr>
<tr>
<td>Residual Error</td>
<td>78.72</td>
<td>88</td>
<td>0.90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R Squared = .403 (Adjusted R Squared = .302)

Table 8. Bonferroni Post Hoc test for counts in Sedentary PA between facilitator led and non-facilitator led activities (labeled as sport) in Zone 3 during 8 week intervention.

<table>
<thead>
<tr>
<th>Sport</th>
<th>Sport</th>
<th>Mean Difference</th>
<th>Standard Error</th>
<th>p-value</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Football (F)</td>
<td>Basketball (F)</td>
<td>1.63*</td>
<td>0.36</td>
<td>0.001</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>Basketball (NF)</td>
<td>1.34*</td>
<td>0.37</td>
<td>0.01</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>Ultimate Frisbee (F)</td>
<td>1.62*</td>
<td>0.41</td>
<td>0.004</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>Ultimate Frisbee (NF)</td>
<td>1.60*</td>
<td>0.39</td>
<td>0.002</td>
<td>0.35</td>
</tr>
<tr>
<td>Football (NF)</td>
<td>Basketball (F)</td>
<td>1.21*</td>
<td>0.33</td>
<td>0.01</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>Ultimate Frisbee (NF)</td>
<td>1.17*</td>
<td>0.36</td>
<td>0.047</td>
<td>0.01</td>
</tr>
</tbody>
</table>

*The mean difference is significant at the .05 level
F = Facilitator led sport
NF = Non-facilitator led sport

ANOVA between facilitator led and non-facilitator led activities (labeled as sport) in Zone 3 during 8 week intervention
Dependent Variable: Moderate Physical Activity

Table 9. Factorial Analysis of Variance for counts in Moderate PA between facilitator led and non-facilitator led activities (labeled as sport) in Zone 3 during 8 week intervention.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Residual Sum of Squares</th>
<th>d.f.</th>
<th>Mean Square</th>
<th>F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sport</td>
<td>27.57</td>
<td>7</td>
<td>3.94</td>
<td>0.86</td>
<td>0.54‡</td>
</tr>
<tr>
<td>Gender</td>
<td>180.64</td>
<td>1</td>
<td>180.64</td>
<td>39.62</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Sport * Gender</td>
<td>40.60</td>
<td>7</td>
<td>5.80</td>
<td>1.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Residual Error</td>
<td>401.18</td>
<td>88</td>
<td>4.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R Squared = .372 (Adjusted R Squared = .265)
‡ Post Hoc test not warranted
ANOVA between facilitator led and non-facilitator led activities (labeled as sport) in Zone 3 during 8 week intervention
Dependent Variable: Moderate to Vigorous Physical Activity (MVPA)

Table 10. Factorial Analysis of Variance for counts in MVPA between facilitator led and non-facilitator led activities (labeled as sport) in Zone 3 during 8 week intervention

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Residual Sum of Squares</th>
<th>d.f.</th>
<th>Mean Square</th>
<th>F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sport</td>
<td>29.67</td>
<td>7</td>
<td>4.24</td>
<td>0.42</td>
<td>0.89‡</td>
</tr>
<tr>
<td>Gender</td>
<td>859.70</td>
<td>1</td>
<td>859.70</td>
<td>85.32</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Gender * Sport</td>
<td>140.86</td>
<td>7</td>
<td>20.12</td>
<td>1.99</td>
<td>0.06</td>
</tr>
<tr>
<td>Residual Error</td>
<td>886.66</td>
<td>88</td>
<td>10.08</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R Squared = .537 (Adjusted R Squared = .458)
‡ Post Hoc test not warranted

ANOVA between facilitator led and non-facilitator led activities (labeled as sport) in Zone 3 during 8 week intervention
Dependent Variable: Vigorous Physical Activity

Table 11. Factorial Analysis of Variance for counts in Vigorous PA between facilitator led and non-facilitator led activities (labeled as sport) in Zone 3 during 8 week intervention

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Residual Sum of Squares</th>
<th>d.f.</th>
<th>Mean Square</th>
<th>F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sport</td>
<td>35.81</td>
<td>7</td>
<td>5.11</td>
<td>0.93</td>
<td>0.48‡</td>
</tr>
<tr>
<td>Gender</td>
<td>253.14</td>
<td>1</td>
<td>253.14</td>
<td>46.01</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Sport * Gender</td>
<td>48.34</td>
<td>7</td>
<td>6.91</td>
<td>1.26</td>
<td>0.28</td>
</tr>
<tr>
<td>Residual Error</td>
<td>484.14</td>
<td>88</td>
<td>5.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .420 (Adjusted R Squared = .321)
‡ Post Hoc test not warranted