Correlates of Physical Activity Frequency in Mohawk Elementary School Children
The Kahnawake Schools Diabetes Prevention Project (KSDPP)
1994 – 1997

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Abstract

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The epidemic of Type 2 diabetes in Aboriginal peoples can be curbed by promoting healthy physical activity habits early in life. **Purpose:** To identify childhood physical activity correlates. **Methods**: 383 4^{th}-6^{th} grade Mohawk children (193 boys, 190 girls) completed questionnaires and had anthropometric measures taken during 2 serial cross-sectional surveys as part of the Kahnawake Schools Diabetes Prevention Project (1994-1997). Physical activity was measured using the Weekly Activity Checklist. Demographics, community activities, parental variables, self-efficacy, sedentary activity, and overweight were correlates assessed using ordinal logistic regression. **Results**: 29.7, 33.4, and 36.8 percent were inactive, moderately active, and very active, respectively. Odds ratios and 95% confidence intervals [OR(95%CI)] of independent correlates for boys included year of measurement (1996 vs. 1994) [1.7(1.3,2.2)], older age [0.7(0.5,0.9)], and enrollment in school #1 [2.0(1.1,3.6)], lessons [2.8(1.3,5.9)] and summer sports [1.1(1.0,1.1)]. Independent correlates for girls were year of measurement [1.5(1.1,2.1)] and parental physical activity [2.0(1.2,3.3)]. **Conclusions**: Parental models are stronger influences for girls' activities while community factors influence boys' activities.

Résumé

L'épidémie du diabètes de type 2 (non insulinodépendant) qui sévit auprès des peuples autochtones peut être freiné par la promotion des changements des habitudes d'activité physique chez les jeunes. **Objectif**: Identifier les facteurs associatifs des habitudes de l'activité physique chez les jeunes enfants. **Méthodologie** : Lors de deux enquêtes transversales, un questionnaire sur les habitudes de l'activité physique et alimentaire a été complété, et des mesures anthropométriques ont été recueillies auprès de 383 enfants Mohawk inscrits en 4ème, 5ème et 6ème année de l'élémentaire (193 garçons, 190 filles). Ces enquêtes se sont tenues dans le cadre de la phase I du projet de prévention du diabète dans les écoles de Kahnawake (K.S.D.P.P. 1994-1997). L'activité physique est mesurée à l'aide d'une liste d'activités à rappel de 7 jours. Des analyses de régression logistique avec variables dépendante ordinales sont utilisées pour déterminer les facteurs associatifs entre l'activité physique et les données démographiques, support parental, efficacité personnelle, activités physiques structurées et organisées offertes dans la communauté, ainsi que des mesures d'inactivité. **Résultats** : Les proportions de jeunes enfants inactifs, modérément actifs, et très actifs sont respectivement de 29.7%, 33.4% et 36.8%. Les rapports de chances et l'intervalle de confiance à 95% [RP(IC95%)] pour les garçons sont les suivants : année de l'enquête [1.7(1.1,3.6)], âge [0.7(0.5,0.9)], école #1 [2.0(1.1,3.6)], leçons [2.8(1.3,5.9)], et activités sportives estivales [1.1(1.0,1.1)]. Les rapports de chances pour les filles sont : année de l'enquête [1.5(1.1,2.1)], et l'activité physique des parents [2.0(1.2,3.3)]. **Conclusions** : Le rôle des parents influence plus fortement le niveau d'activité physique des jeunes filles, alors que les activités offertes dans la communauté influencent plus fortement le niveau de l'activité physique des jeunes garçons.

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The Kahnawake Schools Diabetes Prevention Project (KSDPP)

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Background

1.1 Introduction

It has been observed that contemporary Canadian Indians "seem to occupy the unenviable position of having more of just about every category of disease than their co-nationals" (1). Since the Second World War, similar to the trends noted throughout North America, the advent of refrigeration (2), improved transportation, and the availability of health care (3) has helped shift the distribution of health events in native communities from infectious to chronic forms of disease (1). However, concomitant changes in their social, physical, and political environments have introduced new stresses, dramatically changed their traditional activities and dietary habits, and in combination with a genetic and phenotypic predisposition for metabolic disease, has resulted in the 'epidemic' (4,5) of Type 2 diabetes mellitus seen in native populations today (6,7).

Unheard of in native communities in the 1950's, the prevalence of Type 2 diabetes is presently two to five times the national rates (1,4,5,8,9,10,11), the incidence seems to be increasing (1,5,12), the average age of diagnosis is steadily decreasing (5,11,13), and even children are being diagnosed with the disease (14). Finally, poor glycemic control (5) and poor compliance with dietary and physical activity regimens (14) in Native diabetics has resulted in disproportionately high rates of complications like circulatory (1), endocrine (1), and renal diseases (15), amputation, and blindness (16).

These high prevalence, incidence, and complication rates along with a youthful population (17) forecast a high burden of future diabetic illness in Native communities. This burden has profound implications for health care delivery as more Native communities take on the responsibilities of administering their own health care through the Health Transfer Policy (1986)(18). Increasing budgetary constraints underline the need to prioritize the implementation of theory-based, culturally sensitive, and empirically tested community-based diabetes prevention programs (16).

Such programs need to be based on an improved understanding of Type 2 diabetes risk factors, their development, and how their distribution can be modified. Obesity, a major risk factor for Type 2 diabetes can be prevented through physical activity programs targeting children and youth. Presently, there is little understanding of the determinants and correlates of physical activity among children. The first part of this descriptive literature review aims to define and describe Type 2 diabetes and provide evidence linking this disease and obesity. The second part of this review discusses the evidence linking obesity and Type 2 diabetes with physical activity, and is followed by a review of the epidemiology of physical activity. The third part of this review lists determinants and correlates of physical activity and discusses them in terms of physical activity behavior theories. Finally, a summary of primary studies will demonstrate the common methods of ascertaining the prevalence and influences of physical activity in children.

1.2 Type 2 diabetes

1.2.1 Definition

The early stages of Type 2 diabetes are characterized by impaired glucose tolerance, skeletal muscle and hepatic insulin resistance, and impaired first and second phase insulin secretion. In the later stages further pancreatic beta cell dysfunction leads to unsuppressed hepatic glucose production and hyperglycemia (19,20,21). Type 2 diabetes has been formerly diagnosed when fasting venous blood glucose is greater than 7.8 mmol/L or when the 2-hour post-prandial blood glucose is greater than 11.1 mmol/L (12). As of 1998, Type 2 diabetes is diagnosed when the fasting venous blood glucose is 7 mmol/L or higher (13).

1.2.2 Prevalence of Type 2 diabetes

The Canada Health Survey of 1981 estimates that the national prevalence of Type 2 diabetes is 17/1000; for the population between the ages of 15 and 64, the prevalence is 15/1000, and for the population greater than 65, the prevalence is 67/1000. The ratio of female to male diabetics is 1.5:1 (1). Tan and Wornell (1991) estimate that the crude prevalence of Type 2 diabetes is 24/1000 based on a 1985 national survey (5). The Canadian Heart Health Survey Research Group estimates that the crude prevalence of self-reported Type 2 diabetes is 50/1000 based on a national cross-sectional survey of persons aged 18 to 74 conducted from 1986 to 1992 (23). Using data from the Second (1976-1980) and Third (1988-1994) National Health and Nutrition Examination Surveys (NHANES), Harris et al. (1998) report that the prevalence of Type 2 diabetes in adults over the age of 20 is 51/1000, the prevalence of undiagnosed Type 2 diabetes is 27/1000, and the prevalence of Type 2 diabetes in persons aged 40 to 74 has increased from

89/1000 to 123/1000 between the period of both surveys (24). Furthermore, the prevalence of Type 2 diabetes in Mexican Americans and non-Hispanic Blacks are 1.9 and 1.6 times the rates for non-Hispanic Whites, respectively (24).

Several studies have estimated the prevalence and incidence of Type 2 diabetes in Aboriginal populations. These prevalence estimates vary considerably and direct comparisons are difficult due to the inconsistent reporting of crude and age- and sex-adjusted estimates, the use of small samples, and different methods for ascertaining persons with Type 2 diabetes. Gillum et al. (1980) in their study of cardiovascular risk factors among urban American Indians in the southwestern United States report a crude prevalence of 34.0/1000 for the population aged 20 and over (25). Young et al. (1985) report a crude prevalence of 27.5/1000 in Natives living in northeastern Manitoba and northwestern Ontario; the prevalence estimates are 15/1000 and 67/1000 for those between the ages of 15 and 64, and over the age of 64, respectively. The ratio of female to male diabetics is 2.5:1 (8). Evers et al. (1987) report age adjusted rates of 139/1000 in men and 155/1000 in women of 2 southwestern Ontario Iroquois communities (26). Macaulay et al. (1985) report a crude prevalence of 120/1000 among persons aged 45 to 64 years in Mohawks living on the Kahnawake reserve in southwestern Quebec (19). Brassard et al. (1993) report a crude prevalence of 27/1000 in a population of James Bay Cree; age-standardized estimates for the population aged 20 years and over is 66/1000; crude rates are 52/1000 and 118/1000 for the population aged 20 years and over and between the ages of 40 to 69 years, respectively; more than half of the cases were diagnosed within the previous decade (27). Martinez and Strauss (1993) report an age-adjusted prevalence of 48.8/1000 on the Mohawk community of Akwesasne (St. Regis) (28). Fox et al. (1994) report an overall age-adjusted rate of 66.5/1000 in Indians of northwestern Ontario, and note that 45 percent of the cases were diagnosed in the previous 5 years indicating high incidence rates (5). Delisle et al. (1995) report age-adjusted rates of 486/1000 and 239/1000 among women and 239/1000 and 163/1000 among men of two Algonquin communities in southwestern Quebec; these authors report the possible inflating effects of self-selection bias in deriving the prevalence estimates (10). Pioro et al. (1996) report age-adjusted rates of 97/1000 and 61/1000 among Natives and non-Natives of Saskatchewan, respectively (11). Finally, the Aboriginal Peoples

Survey, conducted by Statistics Canada in 1991, using self-reports, found the age-standardized prevalence of diabetes to be 110/1000 among women and 80/1000 among men (29). This gender difference is not observed in the Canadian population as a whole, where diabetes rates among men and women are similar (29).

Other studies focusing on Type 2 diabetes in children have provided disturbing evidence suggesting that the prevalence of this disease is also increasing in children. In 1981, the prevalence estimate of Type 2 diabetes among Pima Indian children was 0.7/1000 (14). Both Young et al. (1985) (4) and Dean et al (1992) (15) reported Type 2 diabetes prevalence estimates of approximately 0.5/1000 in children up to age 15 in northwestern Ontario and northeastern Manitoba. In 1988, the prevalence estimate among Alaskan Aboriginal children was 0.1/1000 (15). In 1996, Harris et al. reported age-adjusted prevalence estimates of 2.5/1000 in children under the age of 16 in northwestern Ontario; and female to male cases was 6:1. Harris et al. emphasized the need to raise awareness among health care professionals that Type 2 diabetes can occur during childhood, particularly amongst First Nations people (14).

These estimates, outlined in Table 1, clearly demonstrate that the prevalence of Type 2 diabetes is higher in older age groups, higher in Aboriginal populations, and higher among Aboriginal women than men. The larger prevalence surveys predominantly use self-reported diabetes to ascertain cases, while the smaller studies of individual communities ascertain their cases by validating local lists of diabetic patients. The rate at which Native and Canadian populations are tested for diabetes and the motivation to self-report diabetes are examples of issues that must be considered when interpreting the precision of these prevalence estimates.

1.2.3 Type 2 diabetes risk factors

Over half the adult Pima Indian population over the age of 35 years in the southwestern United States have Type 2 diabetes. This population has been the subject of several epidemiologic and metabolic studies over the past three decades because of the prevalence of this disease and the relative genetic homogeneity of this population compared to the Caucasian population (30). Briefly, genetic factors that have been postulated to contribute to the high prevalence of diabetes among the Pima Indians include obesity-independent insulin resistance (30), an abnormal glycemic response to

Table 1: Prevalence of Type 2 diabetes in Canadian and Aboriginal populations, 1980-1998

Author/ Study	Population	Rate per 1000	Diabetes Ascertainment
Canada Health Survey, 1981	Canada, all	17	Self-report
	Canada, age > 65	67	
		female:male=1.5:1	
Tan and Wornell, 1991 (Fox et al., 1994)	Canada, all	24	Not indicated
Canadian Heart Health Survey Research Group (Reeder et al., 1992)	Canada, Men and Women 18-74	50	Self-report
	Men > 65	120	
	Women > 65	90	
Harris et al. 1998	United States		Self-report
	NHANES II* and III*, age > 20	51	
	NHANES II, ages 40-74	89	
	NHANES III, ages 40-74	123	
Gillum et al., 1980	Native Americans, southwestern US, age 20+	34	Interviewer administered questionnaire – self report
Young et al., 1985	Natives, NE Manitoba & NW Ontario, 15-64	46	Administrative records and patient record review
	ages 65 +	90	
		female:male=2.5:1	
Evers et al., 1987	SW Ontario Iroquois, Women, age adjusted	155	Computerized patient registry, patient record review, interview
	men, age adjusted	139	
Macaulay et al., 1985	Mohawks of Kahnawake (Quebec)	120	Comprehensive record review
Brassard et al., 1993	James Bay Cree, crude, all ages	27	Chronic disease registry and patient record review
	crude, ages 20 +	52	
	crude, ages 40-69	118	
	age adjusted, ages 20 +	66	

Author/ Study	Population	Rate per 1000	Diabetes Ascertainment
Martinez & Strauss, 1993	Mohawks of Akwesasne (Quebec), age adjusted	48.8	
Fox et al., 1994	Natives, NW Ontario.overall age adjusted	66.5	Nurse listing confirmed by chart review
Delisle et al., 1995	Algonquin communities SW Quebec,		Survey with invitation to test using Oral Glucose Tolerance Test
	women, community 1 & 2, age adjusted	486, 163	
	men, community 1 &2, age adjusted	239, 163	
Pioro et al., 1996	Natives, Saskatchewan	97	Self-report
	Native men, Saskatchewan	72	
	Native women, Saskatchewan	121	
	Non-natives, Saskatchewan	61	
	Non-native men, Saskatchewan	56	
	Non-native women, Saskatchewan	66	
Aboriginal Peoples Survey, 1991	Natives across Canada, age-adjusted, all	100	Self-report
	Women, age-adjusted	110	
	Men, age-adjusted	80	
Young et al., 1985	NW Ontario, NE Manitoba Native children < 16	0.5	Diabetes registry followed by chart review
Dean et al., 1992	NW Ontario, NE Manitoba Native children < 16	0.5	Diabetes registry review & physician confirmation
Reported in Dean et al., 1992	Alaskan Aboriginal children, 1988	0.1	Not stated
Harris et al., 1996	NW Ontario children, < 16, age-adjusted	2.5	Chart review
	girls less than 16, age-adjusted	4.24	
	boys less than 16, age-adjusted	0.72	
		female:male=6:1	

Note: SW, NW, NE, and NW denote combinations of north, south, east, and west
*Second and Third National Health and Nutrition Examination Survey

stress (31), and a low resting metabolic rate (30) which may be due in part to a mutation of the B-3-adrenergic-receptor gene expressed in visceral adipose tissues (32). Wendorf (1989) discusses the 'Thrifty Genotype' hypothesis to rationalize the development of the genetic factors contributing to diabetes (7). Familial factors such as parental obesity and Type 2 diabetes in first-degree family members, especially maternal obesity and diabetes in the mother are strong risk factors for Type 2 diabetes (30,33). Specifically, an in utero hyperinsulinemic environment due to maternal gestational diabetes (4,17,21), and poor maternal nutrition during pregnancy are risk factors for the development of Type 2 diabetes. Hales and Barker (1992) discuss these familial Type 2 diabetes risk factors in the context of the 'Thrifty Phenotype' hypothesis (34). Other risk factors for Type 2 diabetes include age, diets that are high in fat and low in fibre (22,35,36), hypertriglyceridemia (37), and mental stress (38).

The most salient and modifiable Type 2 diabetes risk factor is obesity. Obesity, a term which describes the degree of body fat, or adiposity, occurs when the total energy intake exceeds the total energy expenditure (39). The relationship between body fatness and diabetes was first demonstrated in 1936 by Joslin et al. who showed that 51 percent of diabetic males and 59.3 percent of diabetic females were at least 40 percent above average weight (40). The United States National Diabetes Commission noted in 1974 that the chance of developing diabetes more than doubles for every 20 percent excess in body weight (40). Data from NHANES I demonstrates that the relative risk of developing diabetes is 2.9 times greater for obese persons aged 20 to 75 years than for normal-weight individuals (Itallie, 1985) (41). Older age, magnitude of adiposity, maternal obesity, weight cycling, centrally-distributed fat, and low level of physical activity are independent risk factors for diabetes that are related to obesity (40).

The main effect of obesity in the development of Type 2 diabetes is increased skeletal muscle and hepatic insulin resistance. Insulin resistance is a reduction in the sensitivity of the muscles and the liver to respond to the biological effects of insulin (42). Several metabolic (42), neuroendocrine (43), and endocrine (31,44,45) mechanisms link obesity with insulin resistance. Although the literature describing the relationship between obesity and Type 2 diabetes is vast, complex, and often disjointed, obese individuals are at increased risk of developing this disease. Despite the saliency of obesity as a Type 2 diabetes risk factor, obesity cannot solely explain for the metabolic abnormalities associated with the diabetic and pre-diabetic phenotypes because these abnormalities also occur in individuals who are of a healthy weight (42).

1.2.3.1 Prevalence of obesity

The Canadian Heart Health Survey, conducted from 1986 to 1992 reported a prevalence of adult obesity, defined as a BMI between 27 and 34, of 32 percent in men and 22 percent in women. The prevalence of massive obesity, defined as a BMI exceeding 35 was 5 percent in women and 3 percent in men. The authors noted that secular changes in obesity were not seen when the data were compared with those of the Canada Health Survey (1978) and the Canada Fitness Survey (1981) (23). The Third National Health and Nutrition Examination Survey (1988-1994) reports the most recent estimates of overweight in the United States. In adults, overweight was defined as a BMI greater than the 85^{th} percentile BMI cutoff points derived from NHANES II, corresponding to a relative weight of 120 to 125 percent of desirable weight. In children, overweight was defined as a BMI exceeding the age- and sex-specific 95^{th} percentile BMI cutoff points derived from the second (1963-1965) and third (1966-1970) National Health Examination Surveys (NHES)(47). Although BMI is not a very good adiposity index for individuals because it 1) accounts for only half of the variability of more accurate adiposity measures, 2) does not distinguish fat and lean tissues or edema, and 3) may misclassify very athletic individuals as obese due to their greater proportion of muscle mass, it is a well-established index for overweight and obesity for population-based studies (48). NHANES III data estimates are that 14 percent of children and 12 percent of adolescents are overweight, and 33 percent of adult men and 36 percent of adult women are overweight. Flegal et al. (1998) report that the secular increase of obesity and overweight that occurred between the NHANES II and NHANES III surveys is almost entirely due to increases in the proportion of the population with BMIs exceeding 30.0 (49). Secular increases in overweight were also noted for children (47)

Increasingly high prevalence rates of obesity in Native populations of all age classifications have similarly been reported. According to the Nutrition Canada Indian Survey conducted during the 1970's, Indian men had lower mean weight-for-age than Canadians up to the age group of 40 to 49 years, above which Indian men had higher mean weight-for-age. Indian women were heavier than Canadian women at all age groups (1). Young et al. (1989) reported that for persons aged 20 to 24 years, the proportion of the Indian population with BMIs in the obese range compared with the proportion of obese Canadians was approximately 2 and 5 for males and females, respectively. This ratio decreased with increasing age, indicating a more overweight younger Indian population (6). Broussard et al. (1991) reported that the prevalence of overweight among a national sample of American Indian male and female adolescents was 24.5 and 25.0 percent, respectively (BMI exceeds 85^{th} percentile cutoff derived from NHANES II)(50). Bernard et al. (1995) reported that 24 percent of girls and 9 percent of boys in a sample of Cree school children exceeded the 95^{th} percentile cutoff derived from data from the 1987 National Center for Health Statistics in the US (51). Among Navajo children, Sugarman et al. (1990) reported that 11.2 percent of girls and 12.5 percent of boys exceed the weight-for-age 95^{th} percentile cutoff points derived from the National Center for Health Statistics reference for American children. Sugarman et al. also noted that when the data were compared with data collected from surveys on Navajo children in 1955, 1958, and 1981, secular increases in the prevalence of overweight and obesity were found (3).

1.2.3.2 Obesity risk factors

Risk factors for the development of adulthood obesity include genetic factors, antecedent childhood obesity, and the tracking of obesity-related behaviors such as diet and physical activity from childhood and adolescence through to adulthood. Genetic factors contributing to obesity have been extensively studied amongst Pima Indians. For example, Walston et al. (1995) identified a mutation in the B3-adrenergic-receptor genes among 642 Pima Indians which is associated with an earlier age onset of Type 2 diabetes (32). These receptors are expressed in visceral adipose tissue and are thought to be involved in the regulation of the resting metabolic rate through lipolysis and thermogenesis in brown fat. Disruptions of the gene for this receptor reduce lipolysis in animal models. Walston concluded that this mutation contributes to the genetic basis of the common forms of obesity, insulin resistance, and Type 2 diabetes (32).

Serdula et al. (1993) reviewed longitudinal studies of antecedent childhood obesity as a risk factor for adulthood obesity. These researchers noted a consistent positive correlation between measures of childhood and adulthood adiposity (skinfolds and BMI). The proportion of obese school-age children who become obese adults ranged from 42 to 63 percent; the risk of becoming an obese adult was 2.0 to 6.5 times higher in obese children than for non-obese children; and, the risk of becoming an obese adult increased with the magnitude of childhood obesity (52). The tendency of childhood obesity to retain its relative ranking within a population distribution over time, or tracking (53) emphasizes the need for the primary prevention of obesity in childhood.

Kumanyika (1993) reviewed obesity development in various ethnic groups of children. Maternal obesity, weight gain during pregnancy, prenatal exposure to hyperglycemia due to gestational diabetes (54), short duration of breastfeeding, earlier bottle feeding, early introduction of solid foods, cultural attitudes reflecting more positive values towards obesity, and permissive parental attitudes towards overeating, snacking on calorie-dense foods, and leisure-time sedentary activities are factors which were related to childhood obesity (55). Since the obesity is strongly influenced by parents, the primary prevention of childhood obesity requires parental support.

However, the majority of obese adults were not obese children (52), suggesting that prevention of childhood obesity *per se* may not be sufficient to curb adulthood obesity, but that other behavioral and cultural characteristics that track from childhood and are associated with obesity should also be the subject of prevention. Specifically, dietary and physical activity behaviors of childhood have been shown to track to adulthood (56,57,58,59). Since physical activity and nutritional behaviors track to adolescence and adulthood, since cognitive theories suggest that interventions may be more effective if introduced at an earlier time in life (60), and since children are accessible through the schools, improving children's eating habits and increasing physical activity have become appropriate goals of diabetes and cardiovascular disease prevention strategies. This study will focus on physical activity because this behavior has not been well studied in Native children.

1.3 Physical activity

1.3.1 Description

Physical activity is defined as, "any bodily movement produced by skeletal muscles that results in energy expenditure"(61). Physical activity is one of three inter-related processes that contribute to the total energy expenditure. The other two processes are the basal metabolic rate, which is the energy required to sustain the organ systems of the body, and the thermic effect of food, which is the energy required to digest foods (62).

Total = Energy Expenditure	**Basal + Metabolic Rate**	**Thermic Effect of Food**	**+**	**Physical Activity Level**

Weight loss occurs when the total energy expenditure exceeds the total energy input. Sixty to seventy-five percent of the total energy expenditure is as a result of the basal metabolic rate. The basal metabolic rate is, in part, genetically determined, but its' contribution to the total energy expenditure can be increased though increased physical activity. The thermic effect of food contributes approximately ten percent to the total energy expenditure. Finally, approximately twenty percent of the total energy expenditure is a result of physical activity. Increasing physical activity can augment its' contribution to the total energy expenditure up to sixty percent (62). From this, increasing the total energy expenditure will occur most with increases in physical activity (63), thus rationalizing the importance of physical activity in obesity prevention.

The association that increased physical activity decreases adiposity is well documented in observational studies. In a 4-year longitudinal study of the effects of changing common habits like exercise, television viewing, smoking, and eating habits on obesity in US male health professionals, Coakley et al. (1998) concluded that increasing vigorous activity as well as decreasing television viewing resulted in weight maintenance or modest weight loss (64). In a longitudinal study of the association between leisure time physical activity and 10-year change in adiposity in adults, Haapanen et al. (1997) found that inactive men and women had odds ratios and 95% confidence intervals [OR(95%CI)] of 2.59(1.69, 3.97) and 2.67(1.65-4.31) respectively, for clinically significant body mass gain when compared with the most active groups of people (65). In a one-year longitudinal study examining the effect of physical activity on the change in body fatness in 97 preschool children, Moore et al. (1995) found that preschool-aged children with low levels of physical activity, determined through 5-day wear of motion sensors, gained significantly more subcutaneous fat (subscapular and triceps skinfolds) than did active children (66). Though observational studies have demonstrated that increased physical activity contributes to lower adiposity measures for all age groups, clinical trials assessing the hypothesis that physical activity intervention reduces obesity have not been successful. Webber et al. (1996) report that after two and a half years of the interventions of the Child and Adolescent Trial for Cardiovascular Health, the children's increased physical activity did not manifest itself as decreased obesity (67).

Physical activity reduces the risk for developing Type 2 diabetes by increasing the total energy expenditure and increasing insulin sensitivity, both of which lower blood lipid levels (68). In a study assessing the effect of vigorous and non-vigorous (metabolic equivalent levels greater and less than 6, respectively) physical activity on insulin sensitivity in persons with glucose tolerance ranging from normal to mild Type 2 diabetes, Mayer-Davis et al. (1998) found that both physical activity intensities were associated with increased insulin sensitivity in all subgroups of sex, ethnicity, and diabetes (69). Similarly, in a longitudinal study of the association between physical activity and incident cases of Type 2 diabetes in Finnish men, Lynch et al. (1996) found that after adjusting for age, baseline glucose levels, and known risk factors, individuals who participated in moderate to vigorous physical activities (metabolic equivalents greater than 5.5) for at least 40 minutes per week were only 0.44 (0.22, 0.88) times as likely to develop Type 2 diabetes than individuals who were not as active. Men who were at high risk for the development of Type 2 diabetes were even more protected by the effects of moderate to vigorous physical activity (70).

The association between physical activity and Type 2 diabetes has been demonstrated in these and other observational studies (71), but not in randomized controlled trails. In their review of the relationship between physical activity and Type 2 diabetes, Kriska and Bennett (1992) cited that the 6-year feasibility study by Eriksson et al, 1991 was the only long-term clinical trial of diabetes prevention in which physical activity was included (72).

1.3.2 Epidemiology of physical activity

Results from the National Health Interview Survey and the Centers for Disease Control (CDC) Behavioral Risk Factor Surveillance System (BRFSS) (1987-1993) indicate that there has been a decrease in the total energy expenditure among adults in the US from the mid-1980's through to the mid-1990's. These data show that adults have kept a steady level of leisure-time physical activity and suggest that the decrease in total energy expenditure may be due to changes in other forms of physical activity. For instance, changes in transportation patterns and household work, and increases in sedentary activities like watching television, working at the computer, and playing video games are lifestyle changes that may have contributed to the decrease in total energy expenditure noted for this time period (47).

The effect of lifestyle patterns on the total energy expenditure has been recognized in recent public health recommendations which encourage individuals to incorporate more activity into their daily routine i.e. walking up the stairs instead of taking the elevator. Evidence that both vigorous and moderately intense activities lend protective effects against the development of disease (46) support these lifestyle- rather than physical fitness-oriented recommendations. Despite recommendations to include occupational, household, and recreational activities in the physical activity repertoire (69), physical activity estimates predominantly assess activities of the fitness-related forms of activity.

A common recommendation used to assess the prevalence of physical activity is to determine the proportion of individuals who '*exercise at least 3 times per week for 20 minutes or more where one is sweating and breathing hard*'. The Healthy People 2000 objective is to have at least 20 percent of adults engaging in recommended levels of vigorous physical activity (46). Using this recommendation, several prevalence estimates for vigorous physical activity have been reported:

- Sallis et al. (1989) reported that 45 percent of adults met recommended levels (73)
- National Health Interview Survey, 1991 (NHIS) reported that 18.1 percent of men and 14.9 percent of women met recommended levels (46)

- Behavioral Risk Factor Surveillance System, 1992 (BRFSS) reported that 15.8 percent of men and 12.9 percent of women met recommended levels (46)
- National Children and Youth Fitness Survey (NCYFS), 1984 reported that 61.7 percent of students in 10th through 12th grades met recommended levels (74)
- Heath et al.(1994) reported that 49.6 percent of male and 24.7 percent of female students from ninth through twelfth grade met recommended levels (74)
- NHIS-Youth Risk Behavior Survey, 1992 (NHIS -YRBS) reported that 60.2 percent of adolescent males and 47.2 percent of adolescent females met recommended levels; 12.1 and 15.3 percent of adolescent boys and girls reported no moderate or vigorous activity (46)
- YRBS 1995 reported that 74.4 percent of adolescent males and 52.1 percent of adolescent females met recommended levels; 7.3 and 13.8 percent of adolescent boys and girls reported no moderate or vigorous activity (46)

The Surgeon General's Report on Physical Activity and Health (1996) estimated that approximately 15 percent of adults and 50 percent of adolescents in the US participate in recommended levels of vigorous physical activity (46).

A second common recommendation used to assess the prevalence of physical activity is that described in the Surgeon General's Report (1996), which is that '*all persons over the age of 2 years should accumulate at least 30 minutes of endurance-type physical activity of at least moderate intensity, on most—preferably all—days of the week*'. The Healthy People 2000 objective is that by this year at least 30 percent of people aged 6 years and older will be participating in recommended levels of activity and no more than 15 percent will be inactive (46). Prevalence estimates using this recommendation are expressed in absolute minutes or proportions, and are often described as 'moderate to vigorous physical activity' (MVPA):

- NHIS, 1991 reported that 26.6 percent of male and 20.7 percent of female adults met recommended levels; a further 21.4 percent of adult men and 26.9 percent of adult women reported no participation in moderate physical activities (46)

- ➢ BFRSS, 1992 reported that 21.5 percent of male and 18.9 percent of female adults met recommended levels; a further 26.5 percent of male and 30.7 percent of adult females did not participate in moderate physical activities (46)
- ➢ Meyers et al. (1996) reported a survey of children from 5th to 8th grades in which boys and girls reported mean scores of 153 and 110 minutes of activity per day, in which 21 percent of the activity for boys and 8 percent for girls consisted of vigorous physical activity; and boys and girls reported an average of 165 minutes of daily sedentary activity (53 percent for boys, 60 percent for girls) (75)
- ➢ Simons-Morton et al. (1997) reported that in the Child and Adolescent Trial for Cardiovascular Health study, 3rd grade students reported an average of 89.9 minutes of daily moderate to vigorous physical activity; and, 12.8 percent reported 30 or fewer minutes of activity (76).

The Surgeon General's Report on Physical Activity and Health (1996) estimates that 22 percent of adults and 25 percent of adolescents in the US engage in recommended levels of moderate physical activity, and 25 percent of adults and 14 percent of adolescents in the US are inactive (46). Though this report does not cite prevalence estimates of physical activity for preadolescent children, evidence suggests that children are more active than adolescents. Goran et al. (1998) discusses findings of a 4-year longitudinal study in which the changes in girls' energy expenditure before adolescence was accounted for by a 50 percent reduction in physical activity between the ages of 6.5 to 9.5 (77).

Similar to the Surgeon General's recommendations, Simons-Morton et al. (1990), suggest that a reasonable minimum goal for children is '*one or more bouts of moderate to vigorous activity at least 10 minutes per day, and that ideally children should have 2 or more bouts of aerobic activity per day*' (78). In their study of 812 third and fourth grade children in Texas, US, using a 3-day activity checklist, these researchers found that 12.3 percent of boys and 13.3 percent of girls reported no bouts, 35.6 percent of girls and boys reported less than one bout, and 66.9 percent of boys and 64.8 percent of girls reported less than two bouts of moderate to vigorous activity greater than 10 minutes during the entire reporting period. Since only 35.2 and 33.1 percent of boys and girls are participating in recommended amounts of vigorous activity, these authors concluded that a large number of children might not be getting adequate amounts of physical activity (78).

Although there are almost no studies specifically estimating the physical activity levels of Aboriginal populations, anecdotal evidence supports the contention that Aboriginal people are a 'population in transition', and that their move from active, traditional lifestyles to more sedentary, non-traditional lifestyles is a large factor in the emergence of obesity and Type 2 diabetes observed today (17,27). The numerous Type 2 diabetes-related studies on Aboriginal people tend to concentrate on obtaining lipid and glucose measures as well as measures of obesity, but ascertaining levels of physical activity is insufficiently considered (3,6,8,10,15,25,27,50,79,80). For instance, Young et al. (1994) studied the medical records of 704 respondents of a previous survey to assess the incidence of Type 2 diabetes of northern Ontario and Manitoba Natives. Though 55 percent of the respondents were classified as active and 45 percent as inactive, the authors do not state how physical activity was ascertained (81). On the other hand, Fontveille et al. (1993) report the median, 25th, and 75th percentile values of reported hours per week of physical activity among Pima Indian adults and children [median (25th%, 75th%)]. These authors used the median hours per week of physical activity because of the extremely skewed distribution of physical activity. Male children participated in 2.0(1.0,4.0) hours, female children participated in 1.0(0.0, 2.0) hours, male adults participate in 3.0 (0.0, 3.0) hours, and female adults participated in 3.0(0.7, 3.0) hours of physical activity per week. Interestingly, the median values of Pima adults are higher than the Pima children's values for both genders. Corresponding estimates for Caucasian subjects analyzed in the same study are at least twice that of the Pima Indian estimates for all groups (82). Despite the paucity of information regarding the prevalence of activity in Natives, their high prevalence of obesity underlines the need for physical activity promotion in this population.

The assumption that underlines promoting physical activity in children for the primary prevention of adulthood obesity is that both obesity and physical activity track from childhood and adolescence through to adulthood. Raitakari et al. (1994) report a 6-year longitudinal study to assess the tracking correlation of physical activity and inactivity in children who were 12, 15, and 18 years of age at baseline participating in the Cardiovascular Risks in Young Finns study. These researchers found that physical inactivity shows better tracking than does physical activity (83). Using the same data set, Telama et al. (1996) report a study in which the physical activity levels of children aged 9 though 18 at baseline were assessed for over a 12-year interval; significant but low tracking correlation were found (84). Anderssen et al. (1996) report a 7-year longitudinal study of physical activity in adults aged 18 to 30 years in which physical activity declined sharply during early adulthood (85). These studies and others (86) provide evidence that the physical activity behaviors track into adulthood, and that the prevention of adulthood obesity and Type 2 diabetes entails the promotion of physical activity in youth.

1.3.3 Determinants and correlates of physical activity in children

In comparison to adults and adolescents there have been relatively few primary studies assessing the determinants and correlates of physical activity in preadolescents, an age group roughly defined as elementary school aged children. Several of the suggested physical activity influences in children are based on primary studies in older children and adults. From this, the literature describing the determinants and correlates of physical activity in children will occur in three formats. First, a brief list of influences will be stated and discussed. Then, some of the determinants and correlates will be described in greater detail in the context of theoretical models. Finally, the primary studies from which most of the previous information was extracted will be summarized to illustrate the common methods of physical activity research in children.

Suggested influences on children's physical activity, in no particular order, are as follows: previous activity (87,88,89), involvement in organized sports (79,90), knowledge (91,92), modeling influences of the mother, father, siblings, teachers, and coaches (56,88,93-97), parental encouragement for participation (58,76,97-99), parental support for participation (56,96), desire to conform to norms towards exercise (98), perceived attitudes of significant others (96,98), amount of television and videos watched and video games played (90,100,101), opportunity to participate in organized sports (98), the availability of equipment (96), self-efficacy (76,88,90,96,99), perceived behavioral control (102), perceptions of competency, beliefs, and values of achieving a task (103), and enjoyment of physical activity (96,102). Gender, family influences, and sedentary activity are three categories in which these determinants can be considered.

1) **Gender:** the list above reveals that the relative importance of each correlate depends on the gender of the child (56,87). For instance, boys and girls identify differential degrees of physical activity interest, influences (57), motives (39), support (89), encouragement (39), criteria for self-evaluation, and participation by their parents and siblings (56,104). The actual mechanism(s) involved in the socialization of boys and girls into physical activity is not well understood, but gender differences in physical activity levels have been found to emerge as young as first grade (105).

2) **Family:** Since the 1940's there has been increasing interest by medical and social scientists as to the role of the family in health and illness (106). The family is defined as "group of two or more individuals who reside in the same household and/or (who) identify a common emotional bond, and (who) are interrelated by performing some social tasks in common, for example, socialization of children or nourishment" (107). Cultural norms are first transmitted by the family, and are reinforced or modified by other socializing influences such as peers, coaches, teachers, schools, television, advertising, and the community. Though these other influences are powerful socializing agents, children remain in their families for many years and the family is considered to be the most stable and enduring influence, therefore the family is considered to be the prime socializing agent to the developing child (108,109). Accordingly, the demonstration of the family aggregation of psychosocial and physiological variables provides evidence that the family directly influences children's participation in sports and activity (39,104,107,110,111). Several mechanisms that have been proposed to describe the family aggregation of physical activity variables include parental modeling, the tendency for active parents to support their children in physical activity, the tendency of families to share activities, genetics (97), and common values and belief systems.

   The role of the family has been considered to be even more of a powerful socializing agent in minority groups. Results from the San Diego Family Health Project showed that the aggregation of physical activity habits in Mexican-American families tended to be higher than Anglo families. Sallis et al. (1988) have suggested that this finding may be due to the fact that the Mexican-American families sampled were not well integrated into the majority culture, and were therefore more reliant on family influences than Anglos, who tend to participate in a broader and more diverse social network (112).

3) **Sedentary activity**: In their study of leisure time activities in 2,200 elementary school children, Harrell et al. (1997) noted that boys reported participating in video games (33%), playing football (32%), bicycling (31%), watching television (28%), and playing basketball (26%), while girls reported doing homework (39%), bicycling (31%), watching television (30%), dancing (27%), and reading (23%). Harrell et al. concluded that children overall are fairly sedentary and girls report more sedentary activities than boys (113). Andersen et al. (1998) reported results of NHANES III study in which 26% of children in the US watched 4 or more hours of television each day, and concluded that the promotion of physical activity requires targeting of physical inactivity behavior (114). However, in a 2-year longitudinal study of television viewing habits and physical activity in adolescent girls in 6th and 7th grades, Robinson et al. (1993) reported that the amount of television viewing appeared to have only a weak association with subsequent physical activity (115). Though support for the hypothesis that sedentary activities correlate and predict future inactivity is equivocal, studies assessing physical activity determinants and correlates should investigate sedentary behavior.

Since the relative influence of each determinant on physical activity changes between developmental stages (91,116), a model linking these seemingly disparate determinants in children is needed (58). For instance, this model or theory should provide a mechanism linking family supportive behaviors with psychosocial constructs and physical activity, as well as describe the rationales for the observed gender differentials.

1.3.4 Theoretical Models used to Describe Behavior

Theoretical models are used to provide researchers with recommendations of the focus and methods of study, and offers mechanisms to link and describe phenomena

(117). Since obesity as an endpoint for obesity prevention and physical activity promotion is difficult to change significantly during a single program, more proximal endpoints for program evaluation have been identified. Proximal endpoints are the behaviors and characteristics hypothesized to mediate the relationship between the program and the expected outcome. These behaviors and characteristics are considered to be more modifiable in the short term and are identified using relevant psychosocial theories. Though these psychosocial constructs are difficult to measure because of the large degree of subjectivity involved in the development of their instruments, they are nevertheless invaluable measures used to evaluate contemporary physical activity promotion and obesity prevention programs.

Before delving into physical activity behavior models and theories, the related terms physical activity, exercise, and physical fitness should be considered. Where physical activity is 'any bodily movement produced by skeletal muscles that results in energy expenditure', exercise is a 'planned, structured, repetitive, and purposive form of activity in which the improvement or maintenance of one or more components of physical fitness is an objective' (61). These definitions illustrate that psychosocial theories describing exercise are likely different from those describing physical activity. For instance, the planned and purposive elements of exercise indicate that there are probably more cognitive processes antecedent to performing exercise than physical activity. Exercise, therefore, is often described as being 'habitual' and physical activity is described as being 'spontaneous'. Physical fitness is, "the ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and meet unforeseen emergencies" (61). Though physical fitness is hard to quantify because 'vigor', 'alertness', and 'enjoyment' are difficult to measure, its health-related components i.e. cardiorespiratory endurance, body composition, muscular endurance, strength, and flexibility can be measured by field and laboratory tests (61).

The distinction between physical activity and exercise is usually not explicitly made in research attempting to describe behavior. The extensive research on the cognitive processes involved in being physically active has concentrated on the exercise subdivision. The theoretical models most prevalent in the exercise literature are the Health Belief Model (118,119), Protection Motivation Theory, Social Cognitive Theory

(118,120,121), the Theory of Reasoned Action, the Theory of Interpersonal Behavior, and the Theory of Planned Behavior (119). These models and their constructs have been used to explain behavior mostly in adult populations. Of these, Social Cognitive Theory has received the most recognition in the health education literature because it incorporates many models for behavior change and suggests several avenues for program development (122,123).

1.3.4.1 Social Cognitive Theory

Social Cognitive Theory (1986), constructed by Bandura over several decades and originally coined Social Learning Theory, is not a unified, original theory but is an assemblage of several models (124). As one of several expectancy-value theories, it proposes that individuals' expectations for success and perceptions of their abilities on different tasks play a prominent role in their motivation to perform these tasks (125). Social Cognitive Theory is considered to be a 'large' theory, therefore studies can feasibly only measure a few of its constructs (126). The insightful review by Perry, Baranowski, and Parcel (1990) discusses in detail 11 major concepts of Social Cognitive Theory (123), which are listed as follows.

- Emotional coping responses
- **Environment** (opportunities, support)
- Expectancies, values, and incentives
- Knowledge and skills (capabilities)
- Locus of Control
- **Observational learning** (modeling)
- Outcome expectations
- Perception of environment
- Reciprocal determinism
- Reinforcements
- **Self-efficacy** (efficacy expectations)

Even though each of these 11 concepts are important to describe behavior, these authors present the caveat that during the development of these Social Cognitive Theory constructs often only one was explored while the others were excluded. First, the concept of locus of control presided in the behavior literature. Later, the concept of observational learning was common. In 1982, when Bandura postulated that self-efficacy is the common cognitive mechanism mediating the initiation of all behavior change, only self-efficacy items were included in several physical activity studies (123). Dzewaltowski

(1994) emphasizes the problems with measuring only a few constructs (127). This practice of excluding several Social Cognitive Theory constructs not only precludes the assessment of their relationships with one another, but has resulted in the disproportionate theoretical and empirical support for the environment, modeling, and self-efficacy constructs in the description of physical activity behavior, while other concepts like expectancies and values have been relatively ignored (125).

An orderly approach to discussing the determinants and correlates of physical activity is to present them in the context of their respective Social Cognitive Theory constructs. Specifically, most studies describe environment, modeling, and self-efficacy constructs.

1) **Environment:** the environment refers to all of the latent and salient behaviors and physical structures that enable a child to participate in physical activities. Most physical activity studies investigate the influence of social support, especially parental support. Garcia et al. (1995) describe social support for exercise as a "network of relationships that provide active assistance or encouragement of physical activity" (89). Verbal and non-verbal encouragement and supplying opportunities, equipment, and transportation are varied forms of the parental support investigated in the physical activity research. After observing pre-school children playing in the presence of their parents, Klesges et al. (1985) found that verbal forms of encouragement brought about a change in activity 82 percent of the time, and suggested that the direction of causality was from parent to child (128). However, using parental reports, Sallis et al. (1992) found that parental verbal encouragement was not associated with the activity of 4^{th} grade children, suggesting that more concrete means of supporting children's activity may be more effective in older children (129).

   Many researchers have postulated mechanisms linking parental support with physical activity: Klesges et al. (1984) proposes that parents who are active may also explicitly encourage physical activity in their children and may support their participation by buying equipment and providing transportation (112); Wigfield and Eccles (1992) propose that parents are "interpreters of reality" and help children assess previous sporting performances and competencies; if parents do not help stimulate positive self-evaluations then children will feel less efficacious at attempting future tasks (125); and, Biddle and Goudas (1996) found through exploratory path analysis that parental encouragement directly predicted vigorous activity and indirectly predicted activity through perceived competence (91). Controversial evidence exists regarding the association between gender and parental support. For instance, in a study of 4th grade children, Sallis et al. (1992) found that parental influence consistently influenced boys but not girls, and suggested that girls may not receive sufficient parental support to have an effect on their physical activity levels. On the other hand, Greendorfer (1976) found that family encouragement and actual participation by family members is a major factor in female sport participation (104). Similarly, Kesley et al., (1998) report from interviews with adolescent girls that 63% indicated that they wanted their parents to be involved in helping them make healthy food choices and provide opportunities to exercise (130).

2) **Modeling:** the principle of modeling maintains that for some tasks a child can best learn by observing someone else performing it (131). There are several statements regarding modeling and physical activity that can be gleaned from the literature: #1) *modeling is considered to be a dominant mechanism by which parents exert their influence on the physical activity behaviors of their children* (91,132,133). Either imitating the model (132) or cognitively assessing components of the model's performance are possible mechanisms by which models are influential. Bandura (1977) suggests that by merely observing parents participate and talk about physical activity, children learn to value and enjoy physical activity and become active themselves (112). Similarly, Brustad (1996) suggests that children who observe their parents participating and persevering in physical activity pursuits might perceive that their parents enjoy, value, and are efficacious at physical activities, and may develop similar attitudes and values which will help them be active as well (134); #2) *the number of family models also contributes to physical activity behavior*. For instance, Moore et al. (1991) found nearly a 6-fold increase in the likelihood of the child's being physically active if both parents were active relative to families in which neither parent was active (97); and Gottlieb and Chen (1985) found that when both parents

were exercising, the exercise frequency of students in 7th and 8th grade increased, and that this increase was more pronounced for girls indicating a potential parental-gender interaction effect (133); #3) *although active parents are likely to have an active child, low active parents are even more likely to have an inactive child*, indicating that physical inactivity may exert a more influential modeling behavior than physical activity. For instance, Freedson et al. (1991) suggests that in homes where only one parent exercises, the modeling effects of the inactive parent may be more influential than the effects of the active parent, and that it would be interesting to note if children's behavior is more or equally likely to be influenced when encouraged by an active rather than inactive parent (135). The modeling effects of inactive parents may be one reason for the equivocal results of the literature describing modeling correlates for physical activity in children (91). For instance, the study of 4th grade children by Sallis et al. (1992) (129), and the study of 3rd and 4th grade children by McMurray et al. (1993) (136), showed that parental physical activity was not related to children's physical activity; and, #4) *the gender of the physically active parent may alternatively influence physical activity behavior in children.* For instance, studies have shown that the father (39,97) or the mother (112) is most influential, while others have shown that the gender of the parent does not matter insofar as modeling behavior is concerned (93,95). Same-sex models have also been considered to be greater influences for children's physical activity behavior than opposite sex models (93,94). If this is true, then same gender parents may be particularly strong models for the transmission of stereotypic sex-role behavior (94). Since the socializing influence of the family may be greater in girls (94), and boys have more salient exercise models outside of the family, parental modeling may be especially important for girls.

3) **Self-efficacy**: in his pioneering book and paper entitled, "Toward a Unifying Theory of Behavior Change" (1977), Bandura presented a distinction between outcome and efficacy expectations. Outcome expectations, which are a major component of expectancy-value theories, play the largest role in influencing the initial motivation and decision to change health practices. When the health practice is believed to lead

to desired consequences but the change is difficult to make e.g. quitting smoking, self-efficacy becomes the most important influence for behavior change (137-139). Self-efficacy is the belief that one can successfully perform the desired behavior. Scales measuring self-efficacy for physical activity have been constructed and validated in adult populations. Several disjointed findings illustrate that self-efficacy is related to other psychosocial constructs, and that self-efficacy better describes difficult rather than simpler activities: Stretcher (1986) and Sallis (1986) report that self-efficacy may be an important predictor of the intention to do physical activity and subsequent levels of physical activity in adults (138,140); Duncan and McAuley (1993) suggest that self-efficacy is a potential link mediating social support and habitual physical activity (141); and, Hofstetter et al. (1990) found that self-efficacy is correlated with vigorous physical activity and not moderate physical activity (142). Finally, self-efficacy has been shown to have explanatory value in children for academic (143-145) and social settings (146,147), but not in the dietary and physical activity domains (147,148).

The evidence linking environmental, modeling, and self-efficacy influences on physical activity in children is inter-related, emphasizing that Social Cognitive Theory constructs are not mutually exclusive. Koepsell et al. (1992) describes Social Cognitive Theory as a 'large theory' that is useful for the formulation and implementation of interventions, but is too abstract and general to describe in detail how a program will produce its postulated effects. 'Small theories', or theoretical models are therefore needed to complement the comprehensiveness of large theories (126). Bandura's Self-Efficacy theory and Eccles theory of Achievement-Values are theories that are smaller in scope and provide more details describing the relationship between several Social Cognitive Theory constructs.

Eccles' theory posits that parents' expectations of the success of their children in a particular achievement area, in combination with their views about the value of success in that domain will result in socialization practices that will provide greater or lesser support to their children's involvement in free-choice activities. Over time, children also adopt expectancies and values similar to those of their parents (103). To illustrate, the belief that a parent has about the competency of their child to swim laps, in combination with the value they attach to being able to swim well, will result in socializing practices like encouragement and providing opportunities for their child to participate in swimming lessons. Higher levels of encouragement and more opportunities will result in the child having successful experiences, feelings of competence in the water, and continued expectancies for success in swimming. From this, children has been socialized to believe they are both competent in and value an activity such as swimming and will ultimately have similar beliefs and values of their parents. Eccles' formulation links the constructs related to the environment, the perception of the environment, skills, expectancies and values, and self-efficacy (efficacy expectations) outlined in Social Cognitive Theory.

Bandura states that individuals learn about how efficacious they are at accomplishing specific tasks through four main sources of information: performance accomplishments, vicarious influences, social persuasion, and physiological states. Of these performance accomplishments are the strongest and most influential sources of self-efficacy information because they derive from previous personal experience. Vicarious influences, or modeling, are those in which the individual observes a person attempting a task, and based on these observations draws inferences about their own capabilities to do this same task. Social persuasion includes both direct and indirect suggestions and encouragement to attempt particular tasks. Finally, stressful and difficult situations might elicit physiologic arousal like sweating, 'wobbly knees', and 'stomach butterflies', which may have informative value concerning the competency of an individual to perform a specific task (137). Self-efficacy enhancing interventions are aimed at modifying these four influences. From this, self-efficacy for exercise can be positively influenced by experiencing exercise, observing others exercising, being encouraged to exercise, and exercising at a comfortable intensity (73).

1.3.5 Relevance of Cognitive Theories

The use of cognitive theories to explain physical activity behaviors in children is problematic. First, a main criticism for these cognitive models is their poor ability to explain behavior—these models in adults (119) can account for only 35 percent of the variance in exercise behavior. However, these models have been constructed to explain the predisposition of individuals to undertake an action, not their actual actions.

A second criticism is that these models have not been adequately demonstrated to explain physical activity behaviors in children. It has been suggested that the cognitive processes of these theories may be somewhat irrelevant for children and their physical activity levels because their typical activity patterns are diffused, unorganized, and spontaneous in nature (149), each of which preclude the undergoing of an elaborate decision-making process.

A third criticism of any psychological theory is the assumption that in the cognitive process the Self predominates over the Collective (150). Eder (1990) contends that children possess full conceptions of the Self at around 7 and 8 years of age (151). Most studies measuring psychosocial constructs have been conducted in predominantly White middle-class populations, a population that emphasizes conceptions of the Self more so than the Collective (150). Therefore, the use of cognitive theories are appropriate in children of this population who are in middle to late elementary grades. The use of cognitive theories in cultures where the Collective has relatively more influence, such as in some Aboriginal populations, may be more problematic (150). To counter, Bandura notes that self-efficacy has been wrongly equated with Western individualism, and that a strong sense of efficacy is needed for successful functioning regardless of whether it is achieved individually or by a collective (152).

1.4 Primary Studies Assessing Physical Activity Determinants/ Correlates in Children

The aim of this section is to summarize the methods of primary research investigating the determinants and correlates of physical activity in children. The results of these findings have been cited previously. Primary studies were located in a Medline search using the words, 'physical activity', 'exercise', and 'children'. The search was restricted to studies published in the English language, and studies were not restricted by date of publication. Studies that did not include elementary school aged subjects were excluded. The psychosocial theory involved in the choice of determinants and correlates examined in each study was noted. Studies that assessed the activity patterns of family members but did not assess psychosocial variables were retained because of the evidence suggesting that family members differentially influence children's involvement in physical activities, which in themselves are correlates and determinants. Table 2 summarizes the primary studies extracted from this Medline search.

Sixteen primary studies assessing the prevalence and/or determinants and correlates of physical activity in pre-adolescent children were found. All of these studies, except the study by Greendorfer and Lewko (1978) (104), took place within the last decade. The studies ranged in size from 3 small studies with less than 100 children, 9 medium sized studies with approximately 100 to 300 children, and 3 large studies with more than 1000 children. Thirteen of the studies were cross-sectional, two were longitudinal, and one was a randomized controlled trial. Finally, six studies cited the cognitive model used to derive the determinants and correlates investigated. Social Cognitive Theory, the Health Belief Model, the Health Promotion Model, the Theory of Planned Behavior, and the Family Influences Model (Social Cognitive Theory and Eccles' theory of achievement-values) were cited theories used to derive determinants and correlates. The varied objectives and choice of determinants and correlates investigated by these 16 studies demonstrates that cognitive theories are too large in scope for a single study to simultaneously assess more than a few constructs.

The scant information about physical activity behaviors in children is reflected in the few studies obtained for this review. Accordingly, the Physical Activity and Health Report of the Surgeon General (1996) reports recommendations and prevalence estimates for physical activity for all age and sex categories except pre-adolescents (46). A primary reason for this apparent lack of information is the difficulties inherent in measuring physical activity in children.

Physical activity is difficult to measure because of problems of reliability, validity, practicality, and obtrusiveness of the measurement tool. These problems are augmented when the study subjects are children. Ideally, a physical activity assessment should be reliable, valid, and sensitive to change in individual activity patterns, applicable in diverse groups, administratively feasible, and not alter physical activity behavior (153). The tools that have been used in children's population-based studies are accelerometers, heart rate monitors, direct observation, daily logs, and interviewer- and self-administered self- and proxy- reports (61). All of these tools, with the exception of heart rate monitors, were used in the 16 studies included in this review. By far, interviewer- and self-administered self-reports were used the most to assess physical activity.

Reliability: Reliability refers to how well a measurement is consistent and free from random error. The difference between the true value and the observed value is measurement error, of which there are systematic and random errors. Random errors are due to chance and are a concern of reliability. The reliability of physical activity measurement tools are typically low because physical activity is a behavior that varies considerably from one day to the next (154). Therefore, reliability of the tool can be improved if a more representative sample of days per subject are used to derive the physical activity score (135,155) or by measuring more subjects for group observations (154).

Of the 16 studies, Pate et al. (1990)(156) and Fontveille et al. (1993)(82) assessed global ratings of children's activity, Craig et al. (1996)(102) and Deheeger et al. (1997)(157) assessed past year physical activity, Sallis et al. (1992)(58) assessed physical activity over the past day, and the rest of the studies assessed activity over several or all days within the past week. While increasing the number of days of assessment helps to ensure that the sampled days are representative, this increased time period can affect the feasibility, obtrusiveness, and validity of the estimate depending on the type of measurement tool used. Since most of the 16 studies assessed physical activity using interviewer- and self-reports, a brief consideration of the validity of this form of assessment is warranted.

Validity: Validity refers to the accuracy with which a measurement tool assesses what it is intended to assess. Criterion validity, which is a form of validity which measures the performance of an instrument against the performance of an established instrument, is assessed in physical activity studies by comparing physical activity estimates derived from questionnaires and logs with those derived using physiologic measurement tools like heart rate monitors and accelerometers. Heart rate monitors are attractive criterion measures of physical activity because they measure the heart rate, which is directly influenced by physical activity. However, these monitors are problematic because the heart rate is also affected by variables like body temperature and emotions.

Accelerometers are also attractive criterion measures of physical activity because they measure gravity-induced movements, which are a direct consequence of physical activity. However, accelerometers are problematic because they must be kept dry and will underestimate activity if the child has to take the tool off in order to participate in swimming activities or does activities like biking which has predominantly horizontal movements (153,158).

Of the studies assessed, only Freedson et al. (1991)(135) and Sallis et al. (1992)(129) used accelerometers to validate their physical activity assessments. No studies used a heart rate monitor. Studies may not use physiological measures because they are more expensive tools and budgetary constraints may make them not feasible.

In lieu of these considerations, several studies use fitness tests to crudely assess the criterion validity of a physical activity assessment. Health related physical fitness, which includes body composition and cardiorespiratory endurance, can be measured by several laboratory and field tests (159), but their correlation coefficients with physical activity are typically low (156,160). Only Pate et al. (1990) assessed physical fitness. These researchers found the correlation between parent's global ratings of their children's physical activity and results of a 1.6 kilometer run/walk fitness test to be 0.17, and the correlation between physical activity and the sum of skinfold thickness to be 0.29 (156).

Practicality and feasibility: Due to the ease of administration, most population-based studies have used interviewer- or self-administered self- or proxy- reports to assess physical activity (161). The validity of these recall questionnaires depends on the ability of the subject to accurately remember his or her activities for the entire recall period and the selectivity of these memories. It has been demonstrated that children less than 10 years of age should not be expected to accurately recall their activities greater than one week previously (162), and that individuals remember sequences of events rather than individual activities (163). Specifically, spontaneous activities, like playing outside, are not as easily recalled as habitual ones, like going to swimming lessons two times per week (158). The physical activity reports will therefore underestimate spontaneous activity, a form of activity that likely contributes significantly to the total activity in children.

When the questionnaires are interviewer-administered, more valid self-reports are obtained because the interviewers use contextual and temporal prompts to facilitate memories (161,164). Extensive research has taken place in an attempt to design self-administered questionnaires that have the memory-enhancing components of the interview session. Baranowski et al. (1984,1985)(163,165) suggest that the use of contextual prompts, a segmented recall period, a recall period not exceeding one week, clear instructions, items appropriate to the child's developmental stage e.g. not asking for an exact estimation of time in children less than 10 years old, incentives for form completion, and the consideration of factors such as the presence of parents during the form's administration are factors which improve the validity of physical activity reports (163,165).

Of the 11 studies assessing physical activity through self-reports, most conformed to these recommendations. For instance, the studies by Sallis et al. (1988)(112), Stucky-Ropp et al. (1993)(96), Kimiecik et al. (1996)(103), and Simons-Morton et al. (1997)(76) which assessed the intensity, duration, and frequency of activities were interviewer–administered to help with memory cues; the studies by Fontveille et al. (1993)(82) and Deheeger et al. (1997)(157) which assessed physical activities over the past year were interviewer-administered with a parent present, both of whom could aid in the recollection of activities over the longer duration; and, the studies by Sallis et al. (1992)(58), Craig et al. (1996)(102), and Trost et al. (1996)(90) made use of daily or past-week checklist-type questionnaires. These questionnaires asked the children to check off activities that were participated in for a specified time period and of specific intensity. On the other hand, the study by Bernard et al. (1995)(51) did not use memory-enhancing cues like a checklist or a segmented day to help children remember the 'number of activities in school and out of school within the past week of at least 30 minutes in duration where they were breathing hard and perspiring'.

McMurray et al. (1993)(166) used a similar checklist format that included intense as well as sedentary activities to derive the physical activity score. Several researchers similarly assessed measures of sedentary activity, particularly television viewing habits. Fontveille et al. (1993)(82) found that the level of physical activity negatively correlated with the time spent watching television. Trost et al. (1996)(90) found that the television viewing habits were significant correlates of moderate to vigorous physical activity. On the other hand, Stuck-Ropp et al. (1993)(96) found that television viewing did not explain a significant amount of the variance in the children's participation in vigorous physical activity. These findings provide equivocal evidence regarding the relationship between physical activity and television viewing habits.

In summary, most studies assessing the determinants and correlates of physical activity in elementary school children are medium-sized cross-sectional surveys conducted in the past decade, and approximately half have used a theory to choose the psychosocial constructs investigated. The significant determinants and correlates of each study are found in Table 2 and are cited at various points in the Background of this dissertation. The physical activity assessments are not easily compared because of the varied use of measurement tools. Since the choice of measurement tool depends considerably on the feasibility of the project, most studies used interviewer- and self-administered self- proxy-report questionnaires. Of these, most studies used a checklist format of questionnaire to assess past day to past week physical activity.

1.5 Summary of Background

The epidemic of diabetes and related disorders in Native populations is expected to increase, emphasizing the need for theory-based, culturally sensitive, and empirically tested community-based diabetes prevention programs. Promoting physical activity to children through the schools is a logical and appropriate prevention approach. Physical activity promotion has had little success because childhood physical activity determinants are not well understood, there are many problems associated with physical activity measurement, and there is not much empirical support for the relevance of theoretical models to describe physical activity behaviors in children. Of the models used in physical activity research, the constructs of Social Cognitive Theory are most prevalent. Notably, self-efficacy, parental support, and modeling are considered to be important constructs explaining physical activity behaviors in children. The few studies assessing physical activity in children are not easily compared because of the use of several measurement tools and units of assessment. Furthermore, no study has explored these relationships in Native children. Ascertaining the determinants or correlates of physical activity in Aboriginal children using a popular theoretical model and a commonly used physical activity instrument is an invaluable source of information for the planning, implementation, and evaluation of physical activity promotion programs in this population.

1.6 Objective

The aim of this study is to use a theory-based approach to ascertain the prevalence and correlates of physical activity in Mohawk elementary school children. Potential correlates include physiological and psychosocial variables. The psychosocial variables pertain to the environment, observational learning, and self-efficacy constructs of Social Cognitive Theory. To prioritize the variables for analysis, they were arranged such that physiological, demographic, and psychosocial variables like self-efficacy constituted an 'inner core', family support variables and the family environment eg. telvision viewing habits, constituted a 'middle core', and variables pertaining to the community environment constituted the 'outer core'.

It is expected that children who are physically active know about diabetes and the benefits of physical activity, have high self-efficacy to be physically active, have parents who support physical activity, have parents who are physically active, engage in moderate amounts of sedentary activities, and participate in community activities.

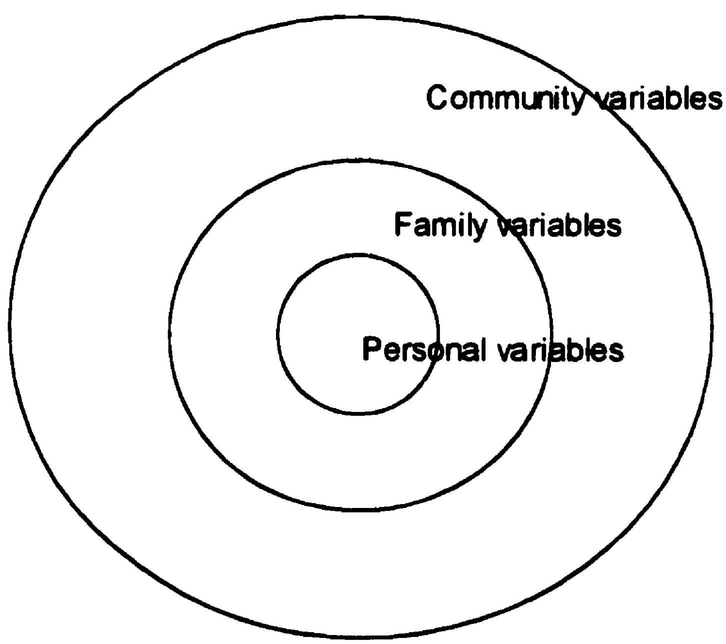


Table 2:
Summary of primary studies investigating determinants and correlates of aerobic physical activity in children

Authors Population	Relevant Question, Study Design, Study Theory, Correlates/ determinants studied	Assessment of Physical Activity	Results
#1 Greendorfer & Lewko, 1978 95 children between 8 and 12 years of age enrolled in summer fitness program	To assess the influence of significant others on active sport involvement of children and determine in which dimensions differences in influence occur between the sexes Cross sectional No theory cited ➢ Family ➢ Individual family members ➢ Peer social system ➢ Teacher social system	Active sport involvement, an index score, was derived from 9 items relating to the number of sports played, skill in sports, ease of learning sport skills, and importance of sport participation	➢ For boys, only peers were significant socializing agents; for girls, neither family, peers, nor teachers constituted social systems that predicted sport involvement ➢ When influences of individual family members were assessed, for boys and girls, parents were significant socializing agents but siblings were not; and, among parents, for both boys and girls, the father was the only significant family socializing agent ➢ In sum, fathers, peers, and teachers are significant predictors for boys' sport involvement, and fathers and peers influence girls' sport involvement
#2 Sallis et al., 1988 206 grade 5 children and their families (San Diego Family Health Project)	To investigate the aggregation of physical activity in Anglo and Mexican-American families using standardized and validated physical activity assessments Cross-sectional Social Cognitive Theory Health Belief Model ➢ Body mass ➢ Family member pairs	7-day Physical Activity Recall: interviewer-administered, distinguishes moderate-, high-, and very high-intensity activities; final units of measurement are a total summary score (KKD) and time spent in very high-intense activity (HARD)	➢ In Anglos, the KKD was significantly correlated only for siblings and mother-older child pairs; and the HARD score was correlated for both mother-children pairs ➢ For Mexican-Americans, intrafamilial correlations were higher: the KKD was significantly correlated for father-older child, mother-children, and sibling pairs; and the HARD score was correlated for spouses, mother-children, and sibling pairs

#3 Pate et al., 1990 2352 third and fourth grade students (1150 male and 1202 female) (NCYFS II)	To examine the associations between measures of participation in physical activity and health-related physical fitness in children Cross-sectional No study theory relevant ➢ Physical education ➢ Community-based activities ➢ Global activity level ➢ Television watching ➢ Parental activity habits ➢ Physical fitness (body composition and cardiorespiratory endurance)	Global rating of the child's activity level from parents Note: the dependent variable for these analyses were measures of physical fitness, in which physical activity was a set of independent variables (derived from factor analysis)	➢ Physical activity and physical fitness are significantly associated in 8- to 9-year old children ➢ 18% to21% of the variance in fitness status could be accounted for by the physical activity factors that were formed via factor analysis of the physical activity variables ➢ At most, 50% to 60% of the variance in fitness test performance remains to be accounted for by all environmental and behavioral factors i.e. dietary habits (body composition) and test familiarity, motivation, and habitual physical activity (1.6 km walk/run).
#4 Freedson & Evenson, 1991 30 five to nine year olds (13 boys and 17 girls) and their biological parents	To determine whether children of higher and lower activity parents had activity patterns similar to their parents Cross sectional No theory cited ➢ Physical activity of all family members (family models)	Caltrac accelerometer worn for 3 consecutive 12-hour days by each family member; with completion of Caltrac Activity Record: info on frequency, intensity, duration and type of activities; In METs: Inactive/ light < 3.5, moderate= 3.6-5.5, hard =5.6-9.0, very hard > 9.1.	➢ The data suggest the presence of a gradient across categories where the largest proportion of inactive children are in families where neither parent is active. Moreover, if both parents are active, nearly all children are active (93-97%) ➢ Even though parents are likely to have an active child, low active parents are more likely to have a low active child. Thus, physical inactivity may exert a more influential modeling behavior than physical activity.
#5 Sallis et al., 1992 297 fourth	To examine the associations between multiple indicators of family influences and multiple indicators of children's physical activity	➢ 1-day recall using checklist with 20 out of school activities 15 or more minutes; summed for index; Medium	➢ For girls, parental education, body mass index, and ethnicity explained 19% f the variance in physical activity assessed via the Caltrac accelerometer (entire model not significant) ➢ For boys, body mass index, single parent status, parent

grade students (148 girls and 149 boys) and their parents San Diego, California	Cross-sectional No theory cited ➢ Cardio-respiratory endurance (1 mile walk/ run) ➢ Anthropometery ➢ Parental support (encouraged, did activities with child, transported child)	intensity (5 METs) e.g. basketball, frisbee, and kickball; Hard intensity (9 METs) e.g.running/ jogging and bicycling. ➢ Caltrac accelerometer: 1 day, taken off at school ➢ Parental survey-checklist	transported child, and ethnicity explained 6.5 % of the variance in physical activity assessed via Caltrac accelerometer. ➢ Surprisingly, more significant findings for boys, verbal encouragement by parents not associated with physical activity, and parental activity not related to physical activity; Suggest parental self-report contribute to these non-associations
#6 Fontveille et al., 1993 85 children ages 8 to 10 (42 Caucasian and 43 Pima Indian) and their parents	To assess the physical activity of children Cross-sectional No study theory given ➢ obesity (anthropometry, whole body resistance) ➢ physical activity past week and past year ➢ amount of time spend sleeping, napping, playing, watching television, playing video and computer games	Interviewer- administered sport-leisure activity questionnaire to child and one parent ➢ Children: past week and past year (account for seasonal variation) frequency and duration; Activities excluded walking ➢ Parent: rate activity level of child: inactive, moderate, heavy, vigorous	➢ In past week, Caucasian boys are active 4.0 hours per week, girls are active 2.5 hours per week; Pima boys are active 2.0 hours per week, and girls are active 1.0 hours per week ➢ Pima children have higher percentage of body fat ($p<0.00001$). ➢ Different indices of obesity correlate negatively with physical activity in Pima children compared to Caucasian children. ➢ Children with a more centralized fat distribution more likely to spend a greater amount of time watching tv ➢ Level of physical activity negatively correlated with the time spent watching tv ➢ Relationship between obesity and tv viewing found in Caucasian children but not in Pima children
#7 McMurray et al., 1993 1,253 third and fourth grade students	To understand the relationship between parental exercise patterns and attitudes toward exercise and their children's aerobic fitness and activity patterns. Cross-sectional No theory cited	Self-Report Activity questionnaire (26 common activities including sedentary and intense activities; children reported the three activities most often participated in and number of	➢ Boys' activity score was 71.2 +/- 31.1; girls' activity score was 58.4 +/- 27.7 ➢ Fathers were more active than the mothers: 30.1% of fathers and 19.3% of mothers exercised 3 or more times per week ➢ Habits of the mother weakly correlated with daughter's aerobic power whereas no significant findings were

and their parents	➢ Anthropometry ➢ Aerobic power ➢ Heart rate ➢ Parental attitudes for exercise: benefits, barriers ➢ Parental physical activity	times per week; Intensity for each activity multiplied by frequency to give index)	found comparing the mother with the son or the father with a child of either gender ➢ No association between parental exercise habits and those of children ➢ No association between parental attitudes and physical activity of children
#8 Stucky-Ropp et al., 1993 242 fifth and sixth grade students (121 boys and 121 girls)	To explore factors in children and their parents that may influence the level of physical activity in children Cross-sectional Social Learning Theory ➢ self-efficacy ➢ direct parental modeling ➢ modeling and support ➢ enjoyment ➢ home equipment ➢ exercise knowledge ➢ tv watching & video games	Physical Activity Interview: 3-day recall; frequency, duration, and intensity estimates; Activities assigned MET values; Children probed to assess whether any f the actual minutes spent at moderate to vigorous activity i.e. sweat and breathe hard	➢ Descriptive statistics of the physical activity assessment were not cited ➢ For boys, their enjoyment of physical activity, friend and family modeling and support, mother's barriers to exercise, and mother's family support explained 13 percent of the variance in boy's participation in vigorous physical activities. ➢ For girls, their enjoyment of physical activity, home equipment, mother's family support, mother's barriers to exercise, and parental modeling explained 12 percent of the variance in girl's participation in vigorous physical activities
#9 Bernard et al., 1995 144 fourth and fifth grade students	To assess the relationship of weight to physical activity and television viewing Cross-sectional No theory given ➢ Anthropometry (overweight defined as greater than 90th percentile) ➢ 24-hour diet recall ➢ television viewing	Physical activity (in-school and out-of-school exercise of at least 30 minutes duration and of sufficient intensity for the subject to be out of breath and perspire	➢ Frequency of physical activity varied between 0 and 7 times per week, with a mean of 2.7 times. ➢ Overweight children participated in less physical activity (2.1 vs 3.1 times per week; $p<0.001$) ➢ Overweight children spent on average more time watching television than non-overweight children (14.2 vs 11.6 hours; $p<0.01$)

#10 Garcia et al., 1995 Two cohorts of children, total of 286 children, one cohort in fifth and sixth grades and the second cohort in eighth grade	To identify differences in the exercise-related beliefs and exercise behaviors of male and female preadolescents Longitudinal (8-10 weeks) Health Promotion Model ➢ Self-esteem ➢ Developmental stage ➢ Perceived health status ➢ Exercise self-efficacy ➢ Self-schema ➢ Benefits & barriers ➢ Previous exercise ➢ Exercise models ➢ Exercise norms ➢ Social support for exercise ➢ Access to facilities	Child/ Adolescent Exercise Log: the frequency and duration of 16 activity items are multiplied by their corresponding MET values, an index of total effort is derived by summing across all 16 activities, and an average daily exercise score is calculated (7-day log)	➢ Descriptive statistics of the physical activity assessment were not cited ➢ No statistically significant gender differences were reported in exercise self-efficacy, social support for exercise, exercise models, exercise norms, the benefits/barriers differential, sedentary time, or access to facilities or programs ➢ The model variables explain 19.3% of the variance in exercise behavior for the total sample, with only gender, the benefits/barriers differential, and access to exercise facilities entering the equation at significant levels.
#11 Craig et al., 1996 310 fifth and eighth grade children	To study the extent to which perceived behavioral predicted children's intent to engage in vigorous activity three times a week outside of gym class Cross-sectional Theory of Planned Behavior ➢ Intent to participate in vigorous activity ➢ Attitudes towards engaging in vigorous activity ➢ Subjective norm ➢ Perceived behavioral control	Checklist with list of activities with METS > = 6 to assess the frequency of vigorous physical activity (baseball, basketball, football, ice/field hockey, soccer, tennis, fast biking, cross-country skiing, jogging, fast-lap swimming, roller skating, dancing, martial arts, ice skating, and jumping rope); Frequency of responses: 'every day' to 'less than once a year'.	➢ Girls in grade 5 reported an average of 7.2 hours of vigorous activity per week; boys in grade 5 reported an average of 9.5 hours of vigorous activity per week ➢ Multivariate analysis of factors that predicted intent to participate in vigorous activity are attitude, subjective norm, perceived behavioral control, weekly level of vigorous activity (categorical variables), and body mass index (R2 = 0.37).

#12 Kimiecik, et al., 1996 81 children between ages of 11 and 15 (26 girls and 55 boys)	To determine if children's beliefs about MVPA is related to their own MVPA participation; and if children's perceptions of their parents beliefs related to their MVPA behavior Cross-sectional Family Influences Model (Social Cognitive Theory and Eccles' expectancy –value model of achievement motivation) ➢ Children's beliefs ➢ Fitness value ➢ Perceived competence ➢ Goal orientation ➢ Children's perception of parental beliefs	Interviewer-administered 2-day recall, includes 1 weekend and 1 weekday: 12 potentially aerobic activities at segmented periods of the day (running/ jogging, walking fast, bicycling, rollerblading, skate boarding, exercise stations activity, rope jumping, dancing, skating, weight training, vigorous games, and sports); for each, choice of none/ less than 10 minutes/ greater than 10 minutes; summary scores for each duration category	➢ During the week, children reported an average of 2.72 +/- 2.33 bouts, and 1.00 +/- 1.37 bouts of MVPA greater than and less than 10 minutes, respectively ➢ During the weekends, children reported an average of 2.62 +/-1.88 bouts, and 0.57 +/-1.23 bouts of MVPA greater than and less than 10 minutes, respectively ➢ On average, the children reported participation in approximately 5 fitness-oriented activities over a two-day period ➢ The degree to which children participate in MVPA is most strongly related to their perceptions concerning their fitness competence and a task orientation ➢ The value children place on fitness participation when compared to other activities was not related to level of MVPA (value very difficult to measure)
#13 Trost et al., 1996 365 fifth grade students, rural, predominantly African – American	To determine if gender differences in physical activity in fifth grade children could be accounted for by differences in selected physiologic, psychosocial, and environmental determinants of physical activity behavior Cross-sectional Social Cognitive Theory ➢ Cardiorespiratory fitness ➢ Body composition ➢ Upper body strength ➢ Intentions to be active	Previous Day Physical Activity Recall completed 3 consecutive times: self-report questionnaire with 17, 30-minute blocks beginning at 3 p.m. and continuing through 11:30 p.m.; 35 common activities are listed and student enters main activity in each block and rates intensity of each activity. Hard activities were described as those requiring hard breathing and moving	➢ Boys reported significantly greater participation in vigorous physical activities with the number of 30-minute blocks being 2.3 +/- 0.1 and 1.3 +/- 0.1 for the boys and girls, respectively ➢ Boys scored higher on the barriers self-efficacy sub-scale, reported greater amounts of television watching in the after school period, participated in more community teams, and were more involved in community physical activity organizations. ➢ No significant differences were observed for participation in school sport and access to sporting equipment ➢ Of the determinant variables that differed significantly across genders, television watching self-efficacy to

	➢ Self-efficacy—barriers ➢ Self-efficacy- seek support ➢ Self-efficacy-other activity ➢ School sports ➢ Community organizations ➢ Equipment at home ➢ Television viewing habits	quickly (>=6METs)	overcome barriers, and participation in community sports were significant covariates of vigorous physical activity
#14 Deheeger et al., 1997 86 healthy 10 year old French children (56 boys and 32 girls)	To investigate the relationships between physical activity, dietary intake, and body composition in children Longitudinal (since 1985) No theory given ➢ Dietary intake ➢ Anthropometric measures ➢ Age of adiposity rebound ➢ Television/video games	Interview with child and parent to assess physical activity over the past year, week, and occasional sports; children were classified as highly active if they were in the third tertile (greater than 14 hours per week in girls and 17.5 hours per week in boys)	➢ Highly active boys report activity levels of 20.3 +/- 2.8 hours per week (n=18), and highly active girls report activity levels of 17.5 +/- 1.6 hours per week (n=11) ➢ Time spent watching television was positively correlated ($p<0.05$) with the BMI, triceps skinfolds, and subscapular skinfolds (r=0.27,0.24, and 0.26, respectively) ➢ The BMI development differs between active and less active children. Before age 6, BMI is lower in less active children, there is an earlier adiposity rebound, and after age 6 the BMI is higher in less active.
#15 Simons-Morton et al., 1997 2410 third grade students from 96 schools (CATCH)	To assess the amount of daily physical activity in a multi-ethnic sample of US third grade students Randomized Controlled Trial Social Cognitive Theory ➢ Cholesterol/blood pressure ➢ Anthropometry ➢ 9-minute distance run ➢ self-efficacy ➢ perceived support ➢ reinforcements	Children's Physical Activity Interview: segmented by time of day, estimation of duration and frequency of activities; Activities categorized according to METs values to give 'minutes of moderate to vigorous activity', 'vigorous minutes', and 'sedentary minutes'.	➢ Boys reported an average of 37.2 +/- 36.2 minutes of vigorous activity per day, while girls reported an average of 32.1 +/-32.0 minutes of vigorous activity per day ➢ Factors associated with vigorous activity are gender, site (4 sites in this study), physical activity support, physical activity self-efficacy, and cholesterol. These factors are also significantly associated with moderate to vigorous physical activity

#16 Trost et al., 1997 202 fifth grade rural children, predominantly African American	To examine predictors of vigorous physical activity and moderate to vigorous physical activity in a cohort of rural, predominantly African-American children Longitudinal Social Cognitive Theory ➢ (please see Trost et al., 1996)	Previous day physical activity recall (please see Trost et al., 1996)	➢ For girls, stepwise regression analysis found participation in community sports teams, self-efficacy in overcoming barriers, enjoyment of physical education, race/ethnicity, and perception of mother's physical activity level accounted for 26% of the variance in vigorous physical activity. ➢ For boys, self-efficacy in overcoming barriers was the only significant predictors of vigorous physical activity, accounting for just over 5% of the variance.

Methods

2.1 Background

Kahnawake, or "On the Rapids"(168), is the third most populous Native community in Canada (169) and is situated on the south shore of the St. Lawrence River about 19 kilometers south of Montreal, Quebec. The residents of Kahnawake are Kanien'keha:ka people (Mohawk), who are one of the Six Nations of the Iroquois Confederacy. Iroquois people have resided in the St.Lawrence Valley region since the pre-contact period, which is marked by the Jacques Cartier expedition of 1534 (170).

Kahnawake has relatively recently experienced a large degree of change due to the emergence of six municipalities within the periphery of reserve lands, and the construction of the St. Lawrence Seaway, the Mercier Bridge, highways 132, 138, and 127 through the small community during the 1950's. These mega-projects 'necessitated' the quick expropriation of farmlands, effectively cut the people's access to the water for the popular activities of fishing and swimming, and encouraged the quick urbanization of the community due to its 'proximity' to Montreal (168).

During the 1980's, community physicians conducted a series of studies indicating that high prevalence rates of obesity, diabetes, and diabetic complications existed in Kahnawake (171). This increased awareness led to the development of the Kahnawake Schools Diabetes Prevention Project (KSDPP), which was started in 1994. The main objective of this community- and school-based project is to provide children with the basic knowledge, skills, and family, school, and community support required to engage in lifestyle changes including an improved diet and increased physical activity for the prevention of the development of diabetes (172).

2.1.1 KSDPP study design: The design of KSDPP is a non-randomized intervention trial in which the elementary school children from the experimental community, Kahnawake were exposed to an intervention from 1994 to 1997, and the elementary students from a comparison community, Tyendinaga, did not receive the intervention. Tyendinaga, another Mohawk community, is situated near Deseronto, Ontario.

At the beginning of the 1994 and 1996 school years multiple measurements of all intermediate and outcome variables were taken of students from grades 1 through 6, for whom parental consent was obtained. In 1995, only students in grades 2 and 3 were measured. This design includes a cohort of children whom had measurements taken three years in a row. Thus, cohort and serial cross-sectional analysis of the KSDPP data are possible (173).

2.1.2 KSDPP Subjects: In 1994, there were 445 students aged 6 to 12 attending two local elementary schools in Kahnawake, representing approximately 95% of community children of that age. The comparison sample population consists of the 150 students attending Quinte Elementary School, the sole school on the Tyendinaga reserve. Students who attend two small traditionally based elementary schools in Kahnawake and comprise about 5% of the elementary school students were excluded (173).

2.1.3 KSDPP outcome measures: A self-administered questionnaire, anthropometric measures, and a 1.6-kilometer run/walk fitness test were the outcome measures for the evaluation of KSDPP.

1) **Questionnaire:** The KSDPP in-Class Student Questionnaire consists of 160 items assessing variables such as family size and birth order, television viewing and video games, 7-day recall physical activity and dietary checklists, participation in school and summer sports teams, diabetes knowledge, physical activity and nutrition knowledge, perceived family support for exercise and eating habits, and dietary and physical activity self-efficacy. The physical activity assessment was an adaptation of the Weekly Activity Checklist (Sallis et al., 1993). Some of the items assessing knowledge were derived from the San Diego Family Health Project, and were found to have good reliability and validity (92), while others were constructed for the KSDPP study. The rest of the items were extracted from two studies: 1) items assessing demographics, self-efficacy, television viewing and video game playing habits, and involvement in community physical activities were derived from the instruments of the Coeur en santé program in St. Louis du Parc (174), an inner-city neighbourhood in Montreal, Canada, which in turn were derived from the instruments of the Child and Adolescent Trial for Cardiovascular Health (CATCH) (Dr. Paradis, personal communication). The psychometric properties of the CATCH instruments have been studied extensively, the results of which have been published by Edmundson et al. (1996)(179); 2) family-related items were derived from the San

Diego Family Health Project. Items referring to traditional foods like cornbread and traditional sports like lacrosse were added to the questionnaire to better reflect the 'Mohawk reality'. The questionnaire underwent a pretest with students in 4th through to 6th grades in Kanehsatake (n=25), a Mohawk community not participating in the project, and it was then modified so that it could be administered under 45 minutes. The items of the questionnaire used dichotomous yes/no, three-, four-, and five-point Likert format, and multiple-choice answers. Cronbach's alphas ranged from 0.55 to 0.73 for the parental support and self-efficacy items, and were low for the knowledge items (180).

2) **Anthropometric measures:** Anthropometric measures of height (centimeters), weight (kilograms), whole body bioelectrical resistance (ohms), subscapular and triceps skinfold thickness (millimeters), and waist and hip circumference (centimeters) were taken from each child in the October of each intervention year using standardized procedures developed for other studies and trained staff (172). Each anthropometric measure was taken three times and the average measure was used for analyses. Several indices for adiposity such as the Quetelet body mass index (BMI), subscapular to triceps skinfold ratio, waist to hip circumference ratio, and percentage body fat from published regression equations were derived (172).

3) **Physical fitness:** The 1.6-kilometer walk/run test used in the KSDPP is a popular physical fitness field test for children (96). This fitness test was administered two days in a row and the better of two times was considered the best measure of physical fitness. Measures of physical fitness are often used to approximate physical activity levels, but these approximations are only moderate at best (156,176). Shephard (1984) posits that factors like the willingness to go all out, experience with running technique and pace, track conditions, and inter-subject variance in maximum oxygen uptake contribute to the low validity of this test and a moderate correlation with physical activity (177). Despite this, physical fitness is enhanced by vigorous physical activity and therefore is a better approximation of the intensity of usual

physical activity. From this, the correlation of physical fitness and high levels of physical activity make this variable worthy of investigation (172).

2.1.4 KSDPP data collection procedures: Data were collected during October of 1994, 1995, and 1996. Anthropometric measures were taken the same day of the 1.6-kilometer run/walk fitness test. The children in 1st through 3rd grades completed the questionnaire at home with the help of a parent, and the children in 4th through 6th grades completed the questionnaire at school. During the administration of the questionnaire at school, students were instructed not to talk or share answers, were informed that it was very important for them to answer honestly, and reassured that no one at home or at school would see their answers. Considering that students of one of the elementary schools learn to read and write Mohawk before English, each administration of the questionnaire for all schools entailed that one adult sit with three students to help children understand all of the items (172,173).

2.1.5 KSDPP ethical considerations: Gregory et al.(1992) well states, "Indians are reaching or have reached the point of satiation in regard to research, especially research without beneficial consequences"(19). To facilitate the implementation of KSDPP into the community, a Code of Research Ethics was drawn up at the onset of the study. This Code establishes a set of principles and procedures in which partners of the KSDPP study may work and communicate in their related but separate agendas. Three partnerships are described in this Code, and are 1) the people of the Kanien'keha:ka (Mohawk) community of Kahnawake, 2) community based researchers of the Kateri Memorial Hospital Center and the Kahnawake Education system, and 3) academic researchers from McGill University and the Université de Montreal. The policy statement of the Code insists that the research should "empower the community to support community goals of health and wellness, to promote healthy lifestyles, improve self-esteem, and fulfill its traditional responsibility for caring for the Seventh Generation"(178). The dissemination of the results should not, for example, directly compare participating schools or communities.

Parental consent was obtained for all children participating in the KSDPP in-Class Student Questionnaire, the 1.6-kilometer walk/run fitness test, and the anthropometric measurements. The students were informed that they could withdraw from the collection of outcome variables at any time they wished. The ethics committee of the Groupe de recherche interdisciplinaire en santé at Université de Montréal approved the protocol (173).

2.2 *Dissertation Study*

The study reported here draws its data from the first three years of KSDPP (1994-1996). Thus, the study design, subjects, intervention, variables, instruments, and data collection procedures remain those of the KSDPP study. A description of the design, subjects, variables, and analyses plan for the study reported here is the topic of the following section.

2.2.1 Dissertation study design: the determinants of physical activity were determined using the data in its cross-sectional form. Use of the longitudinal data for these analyses i.e. children who were in grades 1 or 2 at baseline and had measures taken three times (1994, 1995, and 1996), and students who were in grade 3 and 4 at baseline and had measures taken twice (1994 and 1996) was not used for two reasons. First, the sample size of the longitudinal data set was determined to be 179 students after being cleaned for missing baseline and follow-up data for physical activity. It was deemed that the individual cohorts of 90 boys and 90 girls were not large enough to assess more than 5 variables in a multivariate regression analysis (179). Second, the children who were in the lower three grades filled out their questionnaires at home with the help of their parents and children in the higher three grades filled them out at school. The measurement bias resulting from this procedure cannot be distinguished from age- or grade- related effects on physical activity.

2.2.2 Dissertation study subjects: The impact evaluation results of KSDPP showed that there were no differences in the mean physical activity levels or levels of overweight between the intervention and comparison schools (180). To augment the sample size, the data from the intervention and comparison schools were collapsed. To further increase the sample size, the data from 1994 and 1996 were collapsed into one data set. The children who were measured twice i.e. were in grade 4 in 1994 and in grade 6 in 1996, were randomized into the 1994 or 1996 data set, and only the measures from the corresponding year were used. Observational units that were missing anthropometric measures and all of the parental support and self-efficacy items-- the main empirically supported constructs of Social Cognitive Theory, were deleted. The final data set consisted of 383 children in grades 4 through 6 from both communities (see Figure 1).

2.2.3 Description of dissertation study variables:

2.2.3.1 Dependent variable (physical activity): KSDPP assessed physical activity levels using a derivative of the Weekly Activity Checklist developed for 4th grade children by Sallis et al. (1993), to which additional activities were added to reflect prevailing community activities. The psychometric properties of the Weekly Activity Checklist are described by Sallis et al. (1993) who report a 3-day test-retest reliability coefficient of 0.74, and criterion validity coefficients of 0.34 and 0.26 with the Caltrac accelerometer on the first and third day of assessment, respectively. These authors state that the low reliability coefficients reflect the daily variability of physical activity, and that the low validity coefficients reflect the generally poor performance of the Caltrac accelerometer as a criterion (181).

The 7-day physical activity recall used by KSDPP consists of a checklist of 26 extra-curricular activities that could be checked for each day of the previous week. The sum of the check marks gives a frequency of physical activity score for the past week in which higher scores reflect more activity (Appendix 1). When a cell of the checklist remained blank, the assumption was that the child did not do the activity on the day in question.

Table 3 lists the activities of the checklist used by KSDPP, the percentage of children who responded that they had participated in the given activity at least once in the previous week, and a range of metabolic equivalent values (METs). METs correspond to an estimate of total energy expenditure for a given activity and are defined as multiples of the resting metabolic rate (182). One MET is defined as the energy expenditure for sitting quietly, which corresponds to 3.5 ml of oxygen per kilogram of body weight per minute or 1 kilocalorie per kilogram of body weight per hour in adults (182). The energy expenditure during exercise has been given a value of 5 METs, which corresponds to five times that of the resting metabolic rate (183). MET values for common activities have been published in a compendium by Ainsworth et al. (1993) (182). Though a listing of children's activities and their corresponding MET values are included in this compendium, the list is not complete and several activities are estimated from similar activities for which values are given. MET values indicate which activities are of the moderate-to-vigorous (MET values between 3 and 5) and vigorous (MET greater than 6) intensities.

Table 3 shows that the ten most frequent activities reported, in descending order, were walking, biking, playing tag, playing outside, playing ball games, jogging, rollerblading, skating/ hockey, soccer, and basketball. There were no significant differences between the genders in the reporting frequencies of these activities except that girls played more tag than boys. Table 3 also lists the activities in ascending order of relative intensity (MET values). From this arrangement, it is clear that boys' participation is greater in activities that are more intense. But this likely reflects the fact that there are more organized activities available for boys in this community. If the activities were weighted by their corresponding MET scores, then the *intensity of physical activity* would be the dependent variable, and boys would be classified as being more active because they were involved in more organized sports. If the activities were not weighted, then the *frequency of physical activity* would be the dependent variable, and the differences in scores between the genders could not be attributed to the forms of organized sports available in the community.

Table 3:

KSDPP 7-day physical activity recall: response, gender differentials, and MET value range, KSDPP, 1994-1997

Activity	Percentage respond participation at least once All children	Confidence Interval (Gender frequencies of participation)	Range of MET values
Tag	61.4	0.4, 0.9 (girls)	5.0 (dodge ball)
Bowling	17.5		3.0
Walking	90.1		2.0 – 5.0
Gymnastics	11.0		4.0
Social dance	26.9	0.4, 0.9 (girls)	3.0 – 5.5
Golf	10.4	1.2, 5.1 (boys)	4.5 – 5.5
Skateboarding	17.0	1.6, 5.0 (boys)	5.0
Softball	21.9		5.0
Ball games	50.7		5.0
Play outside	56.9		5.0 (children's games)
Hopskotch	16.4	0.1, 0.3 (girls)	5.0
Aerobic dance	6.5		6.0 – 7.0

Activity	Percentage respond participation at least once All children	Confidence Interval (Gender frequencies of participation)	Range of MET values
Jazz	3.4	0.1, 1.0 (girls)	6.0 – 7.0
Basketball	36.3		4.5 – 8.0
Jogging	46.7		7.0
Biking	66.8		4.0 – 8.0
Rollerblading	45.6		5.5 – 7.0 (skating)
Skating	41.8		5.5 – 7.0
Swimming	11.2		4.0 – 6.0 (not lap swimming)
Skipping rope	19.6	0.2, 0.3 (girls)	5.0 (children's games)
Lacrosse	16.7	2.1, 7.4 (boys)	8.0
Football	26.9	2.2, 6.0 (boys)	8.0
Hockey	41.3	5.4, 14.0 (boys)	8.0
Soccer	40.7		7.0
Boxing	15.7	1.7, 5.9 (boys)	6.0 – 9.0
Judo	9.4		10.0

The dependent variable in this study was an ordinal measure of physical activity corresponding to the recommendations by Simons-Morton et al. (1990) that children should participate in 2 or more bouts of physical activity at least 10 minutes per day (78). Students were characterized as '*inactive*' if their frequency scores were less than 14 (two bouts x seven days), '*active*' if their scores were equal to or greater than 14 and less than 28 (four bouts x seven days), and '*very active*' if their scores were greater than 28 (more than 4 bouts x seven days). Using these cut-off points, 29.8 percent were inactive, 33.4 percent active, and 36.8 percent of the children were very active. Physical activity was a categorical random variable.

2.2.3.2 Potential Correlates

There are 12 groups of potential correlates assessed for these analyses. They were organized into 'inner', 'middle', and 'outer' core variables.

Inner core variables

1) **Sociodemographic characteristics**: information on the sociodemographic characteristics collected in the KSDPP questionnaire included the student's age, gender, number of children in the family, birth order of the respondent, and school attended. All of these variables were categorical.

2) **Physical fitness**: physical fitness was defined as the best of two times in repeat performances of the 1.6-kilometer walk/run test. Though some analyses normalize the best time by dividing it by the weight of the child (177), this was not done because the physical activity score was not normalized. Rather, the physical fitness

time was age and sex standardized using criterion-referenced standards of the FITNESSGRAM (Institute for Aerobics Research, 1987). Though these standards have not been validated (184), Looney and Plowman (1990) have used the FITNESSGRAM standards in their analysis of the First and Second National Child and Youth Fitness Survey (NCYFS) with which our results can be compared (185). Thus, the physical fitness test was a dichotomous variable in which the children's times for the run/walk test did or did not reach the age- and sex-specific criterion (Appendix II).

3) **Overweight:** Measures of body composition are used to approximate obesity and overweight. Body composition can be measured in laboratory conditions by dual energy X-ray absorptiometry, hydrodensitometry, total body water, potassium, and electrical conductivity, or by an array of field measures such as anthropometry and bioelectrical resistance (186). Obesity, which is often determined by assessing whether an individual exceeds the age- and sex-specific 95th percentile for a specific anthropometric measure (187), was not used for this study because of the expected small sample size. Using the NHANES II data set to derive age- and sex-specific cut-off points, four measures of overweight were investigated to classify subjects as overweight and not overweight:

   - BMI measure exceeds their respective 85th percentiles
   - Both BMI and subscapular skinfold measures exceed their respective 85th percentiles
   - Both BMI and triceps skinfold measures exceed their respective 85th percentiles
   - Both BMI and sum of skinfolds measures exceed their respective 85th percentiles

   The NHANES II cutoffs for BMI, triceps and subscapular skinfold thickness, and sum of skinfolds thickness are found in Appendix III. Using a more restrictive definition of overweight helps reduce misclassification. For instance, children who have a high proportion of lean muscle tissue might be misclassified as overweight if only their BMI is compared with the reference data. Another measure of adiposity used in these analyses was percentage body fat, which was determined using two separate regression equations: the first derived using Caucasian children by Newman

(1989), and the second derived using Mohawk and Caucasian children by Goran et al., (1996)(186).

Percentage body fat (Newman, S.L., 1989)
= [weight (kg) – fat free mass (kg)] / weight (kg)
= [weight (kg) – {0.302 + 0.868* height* height (cm2)/ resistance (ohms)}]/weight (kg)

Percentage body fat (Goran, M.I., 1996)
= fat mass / weight
= {-2.3 + 0.15 subscapular skin fold (mm) + 0.36 weight (kg) + 0.12 triceps skinfold (mm) – 0.20 height (cm) x height (cm) / whole body resistance (ohms)} / weight (kg)

Both equations incorporate measures of whole body electrical resistance. Body electrical resistance is a measurement based on the principle that the body's electrical resistance is the function of the distribution of water and electrolytes among the various compartments of the body, which enable different tissues to act as conductors, semiconductors, and insulators (188). In a validation study by Goran et al. (1996) using 50 preadolescent children aged 4 to 9 years old, estimates of fat mass using biolectrical resistance moderately correlated with fat mass derived from dual x-ray absorptiometry ($r2=0.78$) (186).

In total, 6 measures of overweight were used to classify individuals in this study. The first 4 involved comparisons of anthropometric measures against the NHANES II reference, were dichotomous, and overweight was coded as 0 and not overweight was coded as 1. The remaining overweight variables were derived from approximations of percentage body fat and were continuous random variables.

4) **Distribution of body fat**: a central distribution of body fat is an independent risk factor for diabetes in adults (40). The KSDPP evaluation revealed that children in grades one through six tend to have their fat centrally distributed (180). To assess whether the distribution of fat is a correlate of physical activity, the waist to hip circumference ratio and the subscapular to triceps skinfold thickness ratio were two indicators of body fat distribution investigated. The subscapular to triceps skinfold thickness ratio was dichotomized whereby a value of 0 indicated that the ratio was equal to or exceeded the 85^{th} percentile and a value of 1 indicated that the ratio was

less than the 85th percentile of the NHANES II reference. The waist to hip ratio was a continuous random variable.

5) **Physical activity self-efficacy:** four items in the KSDPP questionnaire assessed physical activity self-efficacy. Students responded, 'I know I cannot / Maybe I can / I know I can' to the questions, "How sure are you that you could really try to do each of the following activities regularly, beginning tomorrow, for at least the next six months: 1) Walking or biking instead of getting a ride in a car, 2) Play outside after school, 3) Play outside on weekends, and 4) Play outside instead of watching TV or playing video games". The second and third self-efficacy items were excluded from the analysis because it was felt that 'playing outside' was not a sufficiently difficult behavior to require self-efficacy. Rather, the first and fourth items, which required a decision to be made and therefore might be more difficult to accomplish, were retained for further investigation. These items were dichotomous random variables in which higher self-efficacy received higher scores and lower self-efficacy received a score of zero.

Middle variables

6) **Parental modeling***:* the modeling effect of parents was assessed by the following KSDPP item: "Does one of your parents or guardian do physical activity or play sports?" This item received a score of 0, 1, or 2 if the 'never/rarely', 'sometimes', or 'often' responses were indicated, respectively. It is unfortunate that the gender of the physically active parent was not assessed in the KSDPP study because of the possibility of suppressing significant effects from individual members when all family members are treated as a single influence (104). This item was a categorical random variable.

7) **Parental enacted support***:* parental support for physical activity, an enacted form of parental support, was assessed by the following KSDPP question, "During the past six months my family (or members of my household) has offered to exercise with me". The item received a score of 0, 1, 2, or 3 if the 'never', 'rarely', 'a few times', or 'often' responses were indicated, respectively. This item was a categorical random variable.

8) **Parental verbal support:** parental encouragement for being physically active, a form of verbal support, was assessed by the following KSDPP question, "Does one of your parents or guardians encourage you to be physically active or play sports?" The item received a score of 0, 1, 2, or 3 if the 'never', 'rarely', 'a few times', or 'often' responses were indicated, respectively. Parental verbal support was also assessed by the question, "Does one of your parents or guardians tell you to be physically active or to play sports?" The item received a score of 0, 1, or 2 if the 'never or rarely', 'sometimes', or 'often' responses were indicated, respectively. This second variable which considers the influence of 'reminding' a child to be active, was not incorporated into an index with the parental encouragement variable because such a score would mask the conceptual differences between encouraging and telling a child be active. These items were categorical random variables.

9) **Amount of time spent watching television:** three items assessed the television viewing habits of children during different times of the week. Students responded that during the week they 'did not watch television', 'watched 1 program a day', '2 to 3 programs a day', '4 to 5 programs a day', or 'more than 6 programs a day'. Television viewing habits during the week received a high score of 3 if the child reported that they 'did not watch television' or watched '1 or 2 programs a day'; students received a low score of 0 if they reported watching 'more than 6 programs a day'. The second and third items assessed children's viewing habits on Saturday morning and Saturday afternoon, respectively. The responses 'did not watch television', or 'watched television for part of the morning/ afternoon', 'most of the morning/ afternoon', or 'all of the morning/ afternoon' were coded in as 3,2,1, and 0 respectively. Finally, and index of television viewing was created by summing the scores of the 3 individual items. The scores for the summary index ranged from 0 to 9, where 0 meant that the child watched a maximum amount of television and would likely be less active than children who watch less amounts, and 9 meant that the child watched no television. The individual items were categorical random variables and the television index was a continuous random variable.

10) **Video game playing habits**: the video game playing habits of students were assessed by the KSDPP item asking how often the child played video games. Students

responded that they 'never play video games', 'rarely play video games', 'play video games several times per week', and 'play video games every day'. Children who never played video games received a score of 3, while those who played video games every day received a score of zero. Rather than incorporating the video game playing item into the television summary score, it was retained as an individual variable because boys play more video games but do not watch more or less television than girls (113). The video game playing variable was a categorical random variable.

Outer core variables

11) **Organized physical activity:** KSDPP assessed whether children participated in summer sports, school sports teams, and extra-curricular lessons. Since these activities take place at different times of the year (school vs. summer) and the determinants for participating in these activities likely differs (non-competitive vs. competitive), these activities were analyzed separately. Participation in summer sports, originally coded from 0 to 5 for involvement in zero to 5 summer sports, respectively, was recoded as 0, 1, and 2 for involvement in none, one, and more than one summer activity. Being involved in school teams or being enrolled in lessons were both dichotomous variables (yes/no).

12) **Year of measurement**: since subjects in the intervention community and comparison community both experienced increases in physical activity between 1994 and 1996, and since the physical activity levels were not significantly different between the communities for either year (180), the data from both communities were combined for these analyses. To control for secular differences in activity, a variable for the year when the observations were measured was included in these analyses. That is, 1994 and 1996 were the two values, and the resultant indicator was dichotomous.

Though knowledge of diabetes, physical activity, and healthy eating were assessed in the KSDPP questionnaire, knowledge was not used in the analyses because the postively skewed distribution of the responses resulted in a ceiling effect in which there was little variance. Table 4 describes the frequencies and means of the unmodified variables of the KSDPP data set.

Table 4:

Descriptive statistics of unmodified potential correlates of physical activity in Mohawk elementary school children, KSDPP, 1994-1997

Categorical Variables		Frequency	Percentage
Year of measurement	1994	201	52.5
	1996	182	47.5
Gender	Girls	190	49.6
	Boys	193	50.4
Age	8	15	3.9
	9	109	28.5
	10	133	34.7
	11	121	31.6
	12	5	1.3
School	1	123	32.1
	2	155	40.5
	3	105	27.4
Number of siblings	0	10	2.6
	1	101	26.4
	2	124	32.4
	3	78	20.4
	4	35	9.1
	5	19	5.0
	6	7	1.8
	7	4	1.0
	8	1	0.3
	Missing	4	1.0
Birth order	1	130	33.9
	2	135	35.2
	3	71	18.5
	4	21	5.5
	5	9	2.3
	6	5	1.3
	7	4	1.0
	Missing	8	2.1
Parents are physically active	Rarely	70	18.3
	Sometimes	187	48.8
	Often	122	31.9
	Missing	4	1.0
Parents encourage children to be active	Never	35	9.1
	Rarely	40	10.4
	Sometimes	90	23.5
	Often	216	56.4
	Missing	2	0.5

Categorical Variables		Frequency	Percentage
Parents tell their children to be active	Rarely	60	15.7
	Sometimes	144	37.6
	Often	178	46.5
	Missing	1	0.3
Parents offer to exercise with their children	Never	83	21.7
	Rarely	63	16.4
	Sometimes	138	36.0
	Often	94	24.5
	Missing	5	1.3
Self-efficacy to walk/bike instead of ride in a car			
	I cannot	25	6.5
	Maybe I can	79	20.6
	I know I can	269	70.2
	Missing	10	2.6
Self-efficacy to play outside instead of watching T.V.			
	I cannot	35	9.1
	Maybe I can	91	23.8
	I know I can	247	64.5
	Missing	10	2.6
Belong to a sports team at school	No	162	42.3
	Yes	221	57.7
Take lessons	No	279	72.8
	Yes	104	27.2
Number of summer sports activities	0	92	24.0
	1	180	47.0
	2	66	17.2
	3	33	8.6
	4	10	2.7
	5	2	0.5
Watch television on weekdays	More than 6 programs/ day	105	27.4
	4-5 programs / day	98	25.6
	2-3 programs / day	125	32.6
	One program / day	39	10.2
	Don't watch television	16	4.2
	Missing	0	0.0
Watch television Saturday morning			
	All of the morning	93	24.3
	Most of the morning	77	20.1
	Part of the morning	172	44.9
	Don't watch television	39	10.2
	Missing	2	0.5

Categorical Variables		Frequency	Percentage
Watch television Saturday afternoon	All afternoon	34	8.9
	Most of the afternoon	53	13.8
	Part of the afternoon	174	45.4
	Don't watch television	119	31.1
	Missing	3	0.8
Television score			
(6 or more programs/ day and all day on weekends)	0	14	3.7
	1	15	3.9
	2	37	9.7
	3	41	10.7
	4	52	13.6
	5	68	17.8
	6	68	17.8
	7	57	14.9
	8	22	5.7
(don't watch television)	9	9	2.3
Play video games	Every day	65	17.0
	Several times a week	72	18.8
	Rarely play video games	189	46.7
	Never play video games	66	17.2
	Missing	1	0.3

Continuous Variables	Mean +/- Standard deviation (Range)
Height	142.7 +/- 8.4 cm (121.8 – 169.0)
Weight	41.3 +/- 13.1 kg (22.0 – 110.5)
Bioelectrical Resistance	657.0 +/- 85.8 ohms (446 – 1007)
Subscapular Skinfold	12.1 +/- 8.1 mm (3.1 – 62.0)
Triceps skinfold	15.8 +/- 6.9 mm (3.7 – 41.0)
Waist circumference	67.8 +/- 12.1 cm (37.7 – 124.5)
Hip circumference	78.6 +/- 10.9 cm (57.5 – 122.9)
Body mass index	20.0 +/- 4/8 kg/cm2 (13.0 – 43.2)

Continuous Variables	Mean +/- Standard deviation (Range)
Waist to hip ratio	0.9 +/- 0.1 (0.0 – 1.6)
Subscapular to Triceps skinfold ratio	0.7 +/- 0.3 (0.3 – 2.3)
Skinfold sum	27.9 +/- 14.5 mm (7.7 – 103.0)
Percentage body fat (Newman equation)	0.3 +/- 0.1 (0.0 – 0.7)
Percentage body fat (Goran equation)	0.2 +/- 0.1 (0.1 – 0.4)
Best time 1.6 kilometer walk/run test	684.5 +/- 191.7 seconds (299 – 1211) *

* 6 missing values

2.2.4 Dissertation data analysis

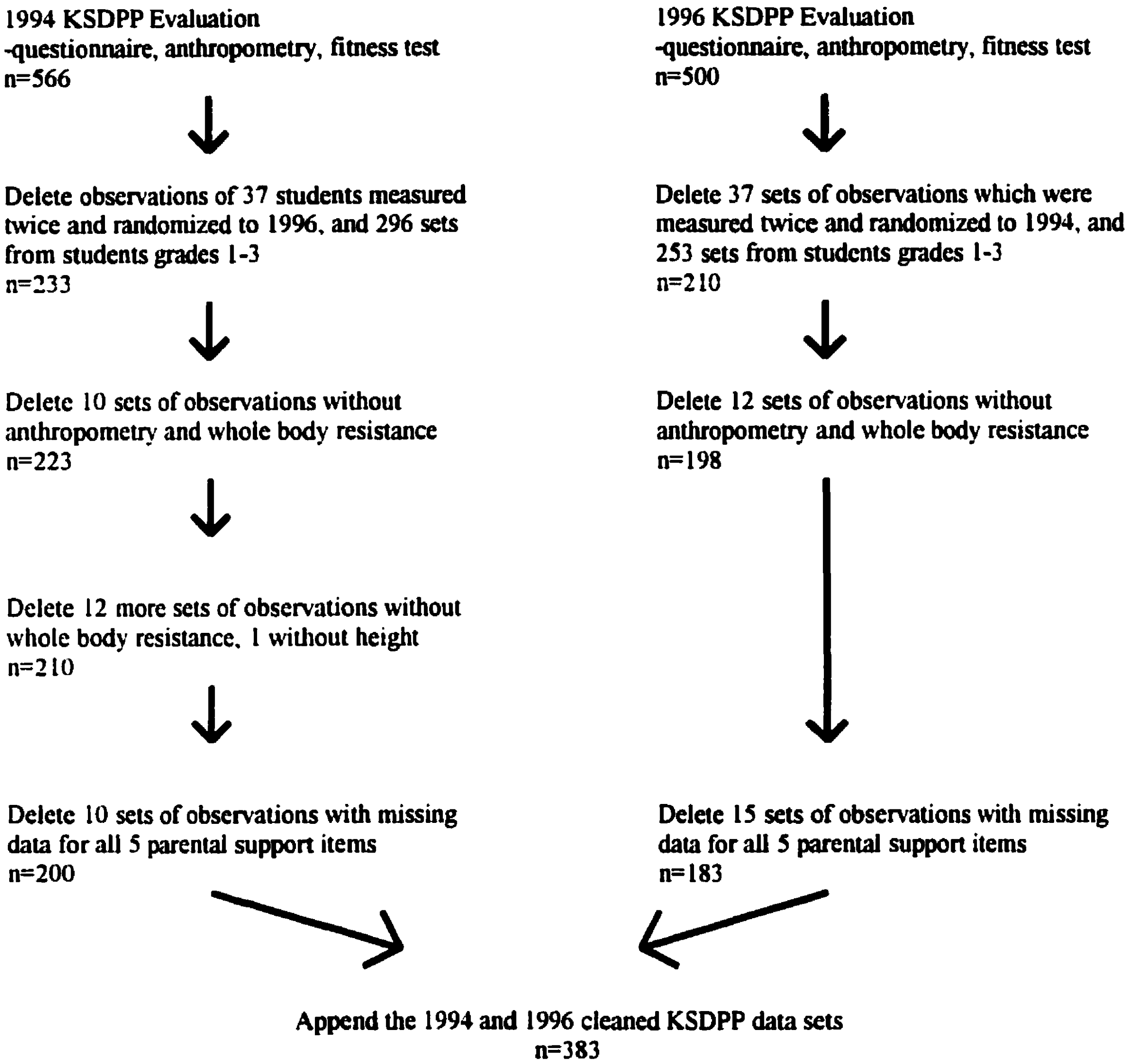
Polychotomous logistic regression was used for these analyses because the dependent variable, physical activity, was an ordinal categorical random variable. The ordinal responses were categorized as inactive, active, and very active, and were coded as 0, 1, and 2, respectively. Ordinal logistic regression rather than nominal logistic regression were used for these analyses because of the implicit order between the physical activity levels. Ordinal regression models the cumulative logit function (ln (p/(1-p)) using the proportional odds model (McCullagh, 1980). The cumulative logit function is based on the log odds of more favorable to less favorable responses. For these analyses, the cumulative logit function was the log odds of a child being 'very active' to being 'active', and the log odds of being 'very active' or 'active' to being 'inactive' (189).

2.2.4.1 Preparation of the data set: Before categorical and continuous random variables were entered into multivariate regression analysis, 1) the frequency within each level of a given categorical variable was assessed, and levels were collapsed if they had relatively small frequencies; and, 2) the quartiles of the continuous random variables were plotted two separate times against the logit of p_i (i = 1,2) and assessed for linearity, where p_1 was the probability of being 'very active' for the first plot, and p_2 was the probability of being 'active' or 'very active' for the second plot. When the continuous random variables did not satisfy the linearity assumption, they were modified to categorical random variables.

All of the dichotomous variables were recoded as 0 or 1, in which a value of 0 indicated the category in which children were likely to be least active, and a value of 1 indicated the category in which children were likely to be more active. Categorical variables were similarly coded, where higher values indicated categories where the children were most likely to be more active. One dummy variable was created to account for each of the schools participating in KSDPP.

2.2.4.2 Missing data: since parental support, self-efficacy, and modeling are the three main psychosocial constructs analyzed as potential correlates in this and other studies, observational units that were missing data for all of these constructs were deleted from the data set (n=25). Data from 22 students were deleted because of missing anthropometric and whole body resistance measurements. The data of one more student was deleted because the height and weight measurements were missing. The data of 12 more students were deleted because of a missing whole body resistance measure. For the rest of the ordinal categorical variables, observations with missing data were assigned to the category least likely to be active, which would reduce the effect of that variable on physical activity rather than attenuate it. To test this assumption, after deleting all of the observational units that had at least one missing observation (n=29), the multivariate analysis was done a second time. The number of observational units available for these analyses was 383.

Figure 1: Response



2.2.4.3 Statistical Analysis: Spearman rank correlation coefficients were computed to assess simple relationships between variables and identify potential sources of confounding. It was expected that physical activity would correlate positively with physical fitness, and correlate negatively with age, television, and increased adiposity. The proportion of children that were inactive, active, and very active for all potential correlates was then examined. To identify significant univariate and bivariate associations (stratified by gender), the crude odds ratios with 95% confidence intervals were calculated for all categories of each potential correlate. Correlates were individually entered into the logistic regression model in which demographics and physiological variables were entered before psychosocial ones. A second model was derived using stepwise ordinal regression. Of the final models, only variables whose confidence interval did not include 1.0 were retained in the model. Subsequently, all correlates not included in the model were individually entered in the model to identify possible confounding variables. Three statistics were computed for each of the final models: 1) the –2 Log L statistic assessed the null hypothesis that the model had significantly more explanatory power than the mean of the dependent variable, physical activity; 2) the test for the proportional odds assumption assessed the null hypothesis that there existed a common parameter estimate for each variable (there was a common parameter estimate between the log odds of being 'very active' or 'active' versus 'inactive' and 'very active' versus 'active' or 'inactive'); and 3) the Breslow and Day goodness of fit residual chi-square statistic assessed whether the predicted proportions of children in each correlation category were close enough to observed proportions. This goodness of fit statistic was considered to be appropriate for this analysis because of the large number of covariate patterns (189). All analyses used version 6.12 for Windows (TS020) version of SAS.

Table 5:

Frequencies of modified potential correlates of physical activity in a sample of Mohawk elementary school children, KSDPP, 1994-1997 @.

Variable		*All Frequency*	*%*	*Boys Frequency*	*%*	*Girls Frequency*	*%*
Year of measurement							
	1994	201	52.5	95	49.2	106	55.8
	1996	182	47.5	98	50.8	84	44.2
Gender							
	Girls	190	49.6	--	--	--	--
	Boys	193	50.4	--	--	--	--
Age							
	9	124	32.4	59	30.6	65	34.2
	10	133	34.7	67	34.7	66	34.7
	11	126	32.9	67	34.7	59	31.1
School							
	1	123	32.1	59	30.6	64	33.7
	2	155	40.5	80	41.5	75	39.5
	3	105	27.4	84	28.0	51	26.8

Variable	*All Frequency*	*%*	*Boys Frequency*	*%*	*Girls Frequency*	*%*
Family size						
1 or 2 children	115	30.0	64	33.2	51	26.8
3 or 4 children	202	52.7	107	55.4	95	50.0
5 or more children	66	17.2	22	11.4	44	23.2
Birth order						
Later born	253	66.1	121	62.7	132	69.5
First born	130	33.9	72	37.3	58	30.5
Parents are physically active						
Rarely	74	19.3	40	20.7	34	17.9
Sometimes	187	48.8	89	46.1	98	51.6
Often	122	31.9	64	33.2	58	30.5
Parents encourage children to be active						
Never/Rarely	77	20.1	47	24.4	30	15.8
Sometimes	90	23.5	40	20.7	50	26.3
Often	216	56.4	106	54.9	110	57.9
Parents tell their children to be active						
Never/ Rarely	61	15.9	29	15.0	32	16.8
Sometimes	144	37.6	66	34.2	78	41.1
Often	178	46.5	98	50.8	80	42.1
Parents offer to exercise with their children						
Never	88	23.0	47	24.4	41	21.6
Rarely	63	16.4	38	19.7	25	13.2
Sometimes	138	36.0	63	32.6	75	39.5
Often	94	24.5	45	23.3	49	25.8
Self-efficacy to walk/bike instead of ride in a car						
I cannot/ Maybe I can	114	29.8	65	33.7	49	25.8
I know I can	269	70.2	28	66.3	141	74.2
Self-efficacy to play outside instead of watching T.V.						
I cannot/ Maybe I can	136	35.5	84	43.5	52	27.4
I know I can	247	64.5	109	56.5	138	72.6
Belong to a sports team at school						
No	162	42.3	69	35.8	93	48.9
Yes	221	57.7	124	64.2	97	51.1
Take lessons						
No	279	72.8	155	80.3	124	65.3
Yes	104	27.2	38	19.7	66	34.7

Variable	*All Frequency*	*%*	*Boys Frequency*	*%*	*Girls Frequency*	*%*
Number of summer sports activities						
No activities	92	24.0	29	15.0	63	33.2
One activity	180	47.0	88	45.6	92	48.4
Two or more activities	111	29.0	76	39.4	35	18.4
Watch television on weekdays						
More than 6 programs per day	105	27.4	56	29.0	49	25.8
4-5 programs a day	98	25.6	44	22.8	54	28.4
2-3 programs a day	125	32.6	60	31.1	65	34.2
One program a day/ Don't watch	55	14.4	33	17.1	22	11.6
Watch television Saturday morning						
All of the morning	95	24.8	57	29.5	38	20.0
Most of the morning	77	20.1	31	16.1	46	24.2
Part of the morning	172	44.9	87	45.1	85	44.7
Don't watch television	39	10.2	18	9.3	21	11.1
Watch television Saturday afternoon						
All afternoon	37	9.7	23	11.9	14	7.4
Most of the afternoon	53	13.8	26	13.5	27	14.2
Part of the afternoon	174	45.4	85	44.0	89	46.8
Don't watch television	119	31.1	59	30.6	60	31.6
Television Score						
0 – 3 (excess T.V.)	110	28.7	56	29.0	54	28.4
4 – 7 (moderate amount of T.V.)	245	63.2	125	64.8	117	61.6
8 – 9 (little or no television)	31	8.1	12	6.2	19	10.0
Play video games						
Every day	66	17.2	50	25.9	16	8.4
Several times a week	72	18.8	44	22.8	28	14.7
Rarely play	179	46.7	83	43.0	96	50.5
Never play	66	17.2	16	8.3	50	26.3
BMI >/ 85th percentile *						
Yes	126	32.9	59	30.6	67	35.3
No	257	67.1	134	69.4	123	64.7
BMI & Subscapular >/85th percentile*						
Yes	102	26.6	51	26.4	51	26.8
No	281	73.4	142	73.6	139	73.2
BMI and Triceps >/ 85th percentile *						
Yes	88	23.0	41	21.2	47	24.7
No	295	77.0	152	78.8	143	75.3
Sum of skinfolds >/ 85th percentile *						
Yes	109	28.5	55	28.5	54	28.4
No	274	71.5	138	71.5	136	71.6

Variable	*All Frequency*	*%*	*Boys Frequency*	*%*	*Girls Frequency*	*%*
Waist to hip ratio						
4th quartile (larger ratio)	95	24.8	50	25.9	45	23.7
1st to 3rd quartiles (smaller ratio)	288	75.2	143	74.1	145	76.3
Subscapular to Triceps skinfolds ratio						
4th quartile (larger ratio)	96	25.1	39	20.2	57	30.0
1st to 3rd quartiles (smaller ratio)	287	74.9	154	79.8	133	70.0
Percentage body fat (Goran et al. 1996)						
4th quartile (heavier)	95	24.8	38	19.7	57	30.0
1st to 3rd quartiles (lighter)	288	75.2	155	80.3	133	70.0
Best time 1.6 kilometer walk/run test**						
Don't meet standard	144	37.6	64	33.2	80	42.1
Meet standard	239	62.4	129	66.8	110	57.9

@ percentages sum to 100 within the gender; percentages may not add to 100.0 due to rounding
*NHANES II reference data set
** FITNESSGRAM (Institute for Aerobic Research, 1987)

Table 5 provides further information as to the characteristics of the sampled population for these analyses. Briefly 1) a larger proportion of the data come from measurements taken in 1994 rather than 1996; 2) though it would be expected that the ratio of boys to girls in each year would be roughly even, there is a smaller proportion of girls measured in 1996 than in 1994; 3) there seems to be more girls coming from larger families, but this might be an indication of small sample size rather than of a true trend in this population; 4) and roughly half of the children have parents who are 'sometimes' physically active and encourage their children to be active. It is disturbing to note that a substantial percentage (20 percent) of children perceive that their parents are not encouraging them to be active; 5) a larger proportion of boys belong to team sports and participate in more summer sports than girls, and girls are enrolled in more lessons than boys; 6) boys and girls do not seem to differ in their television viewing habits, but a larger percentage of boys play more video games; 7) insofar as overweight is concerned, when the more exclusive definitions were used, roughly 25 percent of the children were classified as overweight and 75 percent were not. Since the cutoff values were derived from the 85th percentiles of the NHANES II data set, these percentages suggest that 10 percent more children are overweight than the national U.S. population. However, 40 percent of the BMIs of children aged 5 through 18 assessed in the American Indian

School Children Height and Weight Survey (1990) exceeded the 85th percentile of the NHANES II sample (190). This comparison suggests that the children of this study may not be as overweight as other Native children. Furthermore, a comparison using NHANES III (1988-1993) derived cutoffs might be more appropriate because the measurements were taken at roughly the same time as those of KSDPP; 8) finally, 67 percent of the boys and 58 percent of the girls exceeded the criterion-referenced physical fitness standards of the FITNESSGRAM. In comparison, 77 percent of boys and 60 percent of girls of the First and Second National Children and Youth Fitness Survey (NCYFS) exceeded these standards (185). These results suggest that while the girls seem to be as fit as girls in the national survey, boys seem to be a little less fit, according to the 1.6 kilometer run/walk fitness indicator.

Results

The results of these analyses are presented primarily with tables. The Spearman rank correlation matrix, and univariate, bivariate, and multivariate tables are accompanied by relevant highlights.

3.1 Spearman rank correlation coefficients

As mentioned in the Methods, it was expected that physical activity would correlate positively with physical fitness, and correlate negatively with age, television, and increased adiposity. Table 6 presents the Spearman rank correlation coefficient matrix of all variables included in these analyses. As expected, the negative correlation of physical activity and age [$r = -0.12$, $p<0.05$] indicates that older children in grade 6 tend to be less physically active then children in grade 4. Similarly, boys tend to be more active than girls [$r = 0.13$, $p< 0.001$], and children who watch less television throughout the week tend to be more active than children who watch more television [$r=0.08$, $p< 0.10$]. Interestingly, when the more restrictive definitions of overweight were used, such as having a BMI and either skinfolds thickness measure exceeding the 85^{th} percentile of the NHANES II reference, children who were classified as overweight tended to be more physically active than those who were not overweight [$r\sim0.09$, $p < 0.10$]. There did not exist a significant simple correlation between the physical fitness indicator and physical activity. Involvement in summertime activities had the highest simple correlation than all the other variables [$r=0.29$, $p<0.0001$]. As stated before, the average physical activity levels of the children from both communities increased from 1994 to 1996. The corresponding simple correlation was the second highest [$r=0.27$, $p< 0.0001$]. The parental support variables all correlated significantly [$r\sim0.11$–0.15, $p<0.05$] with physical activity in the expected direction. Girls were more likely to be self-efficacious than boys. Since gender did not correlate significantly with any of the parental variables, it was not expected that gender would confound their relationship with physical activity. In support of the literature, boys were more likely to play video games [$r=-0.33$, $p<0.0001$] and be involved in organized physical activities [summer sports $r=0.27$, $p<0.0001$, school teams $r=0.13$, $p<0.001$].

Table 6: Spearman Rank Correlation Matrix: KSDPP, 1994-1997

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Physical activity frequency	1.00												
2	Age	-.12 #	1.00											
3	Gender	.13 $	-	1.00										
4	School	-.09 *	-	-	1.00									
5	Family size	-	-	-.13 #	-	1.00								
6	Birth order	-	-	-	-	-.27 !	1.00							
7	Parents are physically active	.15 $	-	-	-	-	.10 *	1.00						
8	Parents encourage their children to be active	.15 $	-	-	-.13 #	-	.09 *	-	1.00					
9	Parents tell their children to be active	.11 #	-	-	-.10 *	-	.09 *	.19 !	.30 !	1.00				
10	Parents offer to exercise with their children	.11 #	-	-	-	-	-	.13 $	.25 !	.17 $	1.00			
11	Self-efficacy walk/bike instead of getting a ride	.15 $	-.10 #	-.08 *	-.19 !	-	-	.09 *	.11 #	-	.18 !	1.00		
12	Self-efficacy play outside instead of watch t.v.	-	-	-.17 !	-.15 $	.11 #	-	-	.10 *	-	-	.26 !	1.00	
13	Participation in school teams	.11 #	.11 #	.13 $	.10 #	-	.12 #	-	-	-	-	-	-	1.00
14	Enrolled in lessons	-	-.15 $	-.17 !	.09 *	-	-	-	.09 *	-	.09 *	-	-	-
15	Involvement in summer sports	.29 !	-	.27 !	-	-	.09 *	.10 *	-	.13 #	-	-	-	.34 !
16	Television habits during the week	.08 *	-.11 #	-	-	-	-	-	.13 #	-	.09 *	.12 #	.20 !	-
17	Television viewing on Saturday morning	-	-	-	-	-	-	-	-	.10 *	.11 #	.11 #	.13 #	-
18	Television viewing on Saturday afternoon	-	-	-	-.15 $	-	0.11#	.09 *	-	.10 #	-	-	-	-
19	Television score (0- a lot, 9- none)	0.11#	-	-	-	-	-	.09 *	.11 #	-	.09 *	-	.17 !	-
20	Video game playing habits	-	-	-.33 !	-.09 *	-	-	-	-	-	-	-	.27 !	-
21	BMI >/ 85th percentile *	-	-.08 *	-	-	-	-	-.10 *	-.11 #	-.13 #	-	-	-	-
22	BMI & subscapular skinfolds >/ 85th percentile*	-.09 *	-	-	-	-	-	-.10 #	-	-.10 #	-	-	-	-
23	BMI & triceps skinfolds >/ 85th percentile *	-.10 *	-	-	-	-	-	-.12 #	-	-.11 #	-	-	-	-
24	Sum of skinfolds >/ 85th percentile *	-.09 *	-	-	-	-	-	-	.09 *	-.15 $	-	-	-	-
25	Waist to hip ratio	-	-	-	.18 !	-	-	-.12 #	-.09 *	-.15 $	-	-	-	-
26	Subscapular to triceps skinfolds ratio	-	-	.11 #	-	-	-	-	-	-	-	-	-	-
27	Percentage body fat (Newman, 1989)	-	.15 #	-.23 !	.10 #	-	-	-	-	-	-	-	-	-
28	Percentage body fat (Goran et al., 1996)	-	-	-	-	-	-	.09 *	-	-	-	.09 *	-	-
29	Best time 1.6 km walk/ run	-	-	.09*	-	.09*	-	-.09*	-	-.10#	-	-	-	.12#
30	Year of measurement	.27!	-	-	-	.17$	-	-	-	-	-	-	-	-

* p<0.10, # p<0.05, $ p<0.001, ! p<0.0001

Table 6 (Continued): Spearman Rank Correlation Matrix: KSDPP, 1994-1997

		14	15	16	17	18	19	20	21	22	23	24	25	26
1	Physical activity frequency													
2	Age													
3	Gender													
4	School													
5	Family size													
6	Birth order													
7	Parents are physically active													
8	Parents encourage their children to be active													
9	Parents tell their children to be active													
10	Parents offer to exercise with their children													
11	Self-efficacy walk/bike instead of getting a ride													
12	Self-efficacy play outside instead of watch t.v.													
13	Participation in school teams													
14	Enrolled in lessons	1.00												
15	Involvement in summer sports	.11 #	1.00											
16	Television habits during the week	-	-	1.00										
17	Television viewing on Saturday morning	-.09 *	-	.37 !	1.00									
18	Television viewing on Saturday afternoon	-	-	.25 !	.30 !	1.00								
19	Television score (0-a lot, 9- none)	-	-	.65 !	.70 !	.56 !	1.00							
20	Video game playing habits	-	-.15 $	.22 !	.17 !	.17 !	.22 !	1.00						
21	BMI >/ 85th percentile *	-	-	.09 *	.10 #	-	.08 *	-	1.00					
22	BMI & subscapular skinfolds >/ 85th percentile*	-	-	-	.11 #	.09 *	-	-	.86 !	1.00				
23	BMI & triceps skinfolds >/ 85th percentile *	-	-	-	.10 *	-	-	-	.78 !	.81 !	1.00			
24	Sum of skinfolds >/ 85th percentile *	-	-	-	.12 #	-	-	-	.80 !	.88 !	.84 !	1.00		
25	Waist to hip ratio	-	-.08 *	-	-	-	-	-	.33 !	.35 !	.28 !	.32 !	1.00	
26	Subscapular to triceps skinfolds ratio	-	-	-	.12 #	-	-	-	.45 !	.50 !	.31 !	.44 !	.30 !	1.00
27	Percentage body fat (Newman et al., 1989)	-	-	-	-	-	-	-	-.70 !	-.65 !	-.63 !	-.65 !	-.36 !	-.38 !
28	Percentage body fat (Goran et al., 1996)	-	-	-	-	-	-	-	.72 !	.78 !	.78 !	.79 !	.27 !	.46 !
29	Best time 1.6 km walk/ run	-	.11 #	.12 #	-	-	.11 #	-	.34 !	.31 !	.32 !	.30 !	.12 #	.24 !
30	Year of measurement	-	.12 #	.21 !	.11 #	.09 *	.18 $	-	-	-	-	-	-.14 $	.18 $

* p<0.10, # p<0.05, $ p<0.001, ! p<0.0001

Table 6 (Continued): Spearman Rank Correlation Matrix: KSDPP, 1994-1997

		27	28	29	30
1	Physical activity frequency				
2	Age				
3	Gender				
4	School				
5	Family size				
6	Birth order				
7	Parents are physically active				
8	Parents encourage their children to be active				
9	Parents tell their children to be active				
10	Parents offer to exercise with their children				
11	Self-efficacy walk/bike instead of getting a ride				
12	Self-efficacy play outside instead of watch t.v.				
13	Participation in school teams				
14	Enrolled in lessons				
15	Involvement in summer sports				
16	Television habits during the week				
17	Television viewing on Saturday morning				
18	Television viewing on Saturday afternoon				
19	Television score (0-a lot, 9- none)				
20	Video game playing habits				
21	BMI >/ 85^{th} percentile *				
22	BMI & subscapular skinfolds >/ 85^{th} percentile*				
23	BMI & triceps skinfolds >/ 85^{th} percentile *				
24	Sum of skinfolds >/ 85^{th} percentile *				
25	Waist to hip ratio				
26	Subscapular to triceps skinfolds ratio				
27	Percentage body fat (Newman, 1989)	1.00			
28	Percentage body fat (Goran et al., 1996)	.64 !	1.00		
29	Best time 1.6 km walk/ run	.33 !	.34!	1.00	
30	Year of measurement	-	-	.22 !	1.00

* p<0.10, # p<0.05, $ p<0.001, ! p<0.0001

3.2 Univariate analyses

The univariate analysis presented in Table 7 consists of *s x r* tables where 'r' is the response variable, physical activity, and 's' is the strata for the potential correlates. Seven points of interest are as follows. First, 29.8, 33.4, and 36.8 percent of the children were classified as 'inactive', 'active', and 'very active', respectively. Second, the differing activity levels of boys and girls seem to have been largely accounted for by the larger proportion of boys who were 'very active' (44 versus 29.5 percent). Similarly, there was a larger proportion of girls who were classified as 'inactive' (33.1 versus 26.4 percent). Third, activity levels of children seem to be proportional to the activity levels of their parents. The relationship between the remaining parental support variables was not so clear. Fourth, increased self-efficacy corresponded to increased physical activity for both items. Fifth, a larger proportion of children who had participated in more than 1 summer activity were classified as 'very active'. Sixth, a higher proportion of children who watch a lot of television during the week were classified as 'inactive' and a higher proportion of children who watch little or no television during the week were 'very active'. Finally, there were higher proportions of children who were classified as overweight in the 'active' and 'very active' categories and higher proportions classified as not overweight in the 'inactive' category.

Table 7:

Proportion of Mohawk elementary school children who are 'inactive', 'active', and 'very active', by potential correlate and gender, KSDPP, 1994-1997

		Boys				Girls			
Variable	**Category**	**All (N)**	**Inactive (%)**	**Active (%)**	**Very Active (%)**	**All (N)**	**Inactive (%)**	**Active (%)**	**Very Active (%)**
Year of measurement	1994	**95**	37.9	31.6	30.5	**106**	39.6	42.5	17.9
	1996	**98**	15.3	27.6	57.1	**84**	25.0	31.0	44.0
Age	9	**59**	20.3	25.4	54.2	**65**	24.6	36.4	39.0
	10	**67**	26.9	29.9	43.3	**66**	44.6	28.8	39.0
	11	**67**	31.3	32.8	35.8	**59**	30.8	34.9	22.0
School	1	**59**	15.3	35.6	49.2	**64**	26.6	37.5	35.9
	2	**80**	31.3	26.3	42.5	**75**	36.0	41.3	22.7
	3	**54**	31.5	27.8	40.7	**51**	37.3	31.4	31.4

Table 7		Boys				Girls			
Variable	**Category**	**All (N)**	**Inactive (%)**	**Active (%)**	**Very Active (%)**	**All (N)**	**Inactive (%)**	**Active (%)**	**Very Active (%)**
Family size	1 or 2 children	**64**	34.4	26.6	39.1	**51**	35.3	37.3	27.5
	3 or 4	**107**	23.4	29.9	46.7	**95**	34.7	36.8	28.4
	5 or more	**22**	18.2	36.4	45.5	**44**	27.3	38.6	39.1
Birth order	Later born	**121**	24.8	29.8	45.5	**132**	34.9	37.9	27.3
	First born	**72**	29.2	29.2	41.7	**58**	29.3	36.2	34.5
Parents are physically active	Never/rarely	**37**	35.1	27.0	37.8	**33**	54.6	27.3	18.2
	Sometimes	**92**	25.0	30.4	44.6	**99**	34.3	37.4	28.3
	Often	**64**	23.4	29.7	46.9	**58**	19.0	43.1	37.9
Parents encourage physical activity	Never/ rarely	**46**	34.8	30.4	34.8	**29**	31.0	27.6	41.4
	Sometimes	**41**	31.7	36.6	31.7	**51**	52.9	35.3	11.8
	Often	**106**	20.8	26.4	52.8	**10**	24.6	40.9	34.6
Parents tell children to be active	Never/ rarely	**28**	39.3	32.1	28.6	**32**	37.5	28.1	34.4
	Sometimes	**67**	26.9	26.9	46.3	**78**	35.9	42.3	21.8
	Often	**98**	22.5	30.6	46.9	**80**	28.8	36.3	35.0
Parents offer to exercise with their children	Never	**43**	27.9	39.5	32.6	**40**	42.5	32.5	25.0
	Rarely	**38**	15.8	42.1	42.1	**25**	40.0	28.0	32.0
	Sometimes	**67**	29.9	23.9	46.3	**76**	35.5	40.8	23.6
	Often	**45**	28.9	17.8	53.3	**49**	18.4	40.8	40.8
Self-efficacy to walk/bike instead of get a ride	No/ Maybe	**65**	35.4	32.3	32.3	**49**	44.9	34.7	20.4
	I know I can	**128**	21.9	28.1	50.0	**141**	29.0	38.3	32.6
Self-efficacy to play outside instead of watch TV	No/ Maybe	**84**	27.4	34.5	38.1	**32**	40.4	40.4	19.2
	I know I can	**109**	25.7	25.7	48.6	**138**	30.4	36.2	33.3
Involved in school team sports	No	**69**	30.4	33.3	36.2	**93**	36.6	37.6	25.8
	Yes	**124**	24.2	27.4	48.4	**97**	29.9	37.1	33.0
Enrolled in lessons	No	**155**	30.0	30.3	38.7	**124**	33.9	35.5	30.7
	Yes	**38**	7.9	26.3	65.8	**66**	31.8	40.9	27.3
Participates in summer sports	No	**29**	41.4	41.4	17.2	**63**	39.7	41.3	19.1
	Yes	**164**	23.8	27.4	48.8	**127**	29.9	35.4	34.7
TV during on week days	More than 6/ day	**56**	28.6	35.7	35.7	**49**	28.6	38.8	32.7
	5 programs/ day	**44**	25.0	18.2	56.8	**54**	51.9	29.6	18.5
	2-3 programs/ day	**60**	28.3	36.7	35.0	**65**	26.2	43.1	30.8
	0-1 programs/ day	**33**	21.1	21.1	57.6	**22**	18.2	36.4	45.5
TV on Saturday mornings	All morning	**57**	31.6	33.3	35.1	**38**	31.6	34.2	34.2
	Most of	**31**	12.9	35.5	51.6	**46**	43.5	34.8	21.7
	Part of	**87**	28.7	27.6	43.7	**85**	29.4	40.0	30.6
	Don't watch TV	**18**	22.2	16.7	61.1	**21**	28.6	38.1	33.3

Table 7		Boys				Girls			
Variable	**Category**	All (N)	Inactive (%)	Active (%)	Very Active (%)	All (N)	Inactive (%)	Active (%)	Very Active (%)
TV on Saturday afternoons	All afternoon	**23**	30.4	30.4	39.1	**14**	21.4	35.7	42.9
	Most of	**26**	7.7	42.3	50.0	**27**	55.6	25.9	18.5
	Part of	**85**	31.8	25.9	42.4	**89**	33.7	39.3	27.0
	Don't watch TV	**59**	25.4	28.8	45.8	**60**	25.0	40.0	35.0
Play video games	Every day	**50**	30.0	26.0	44.0	**16**	43.8	18.8	37.5
	Several times/week	**44**	25.0	29.6	45.5	**28**	28.6	42.9	28.6
	Rarely play	**83**	22.9	33.7	43.4	**96**	32.3	38.5	29.2
	Never play	**16**	37.5	18.8	43.8	**50**	34.0	38.0	28.0
TV score	0-3 (excess TV)	**56**	32.1	28.6	39.3	**54**	38.9	33.3	27.8
	4-7 (moderate TV)	**125**	25.6	31.2	43.2	**117**	34.2	40.2	25.6
	8-9 (little/ no TV)	**12**	8.3	16.7	75.0	**19**	10.5	31.6	57.9
BMI >/85th %	Yes	**59**	23.7	35.6	40.7	**67**	29.9	37.3	32.8
	No	**134**	27.6	26.9	45.5	**123**	35.0	37.4	27.6
BMI & Subscapular >/85th %	Yes	**51**	19.6	35.3	45.1	**51**	25.5	35.3	39.2
	No	**142**	28.9	27.5	43.7	**139**	36.0	38.1	25.9
BMI & Triceps >/85th %	Yes	**41**	22.0	29.3	48.8	**47**	23.4	36.2	40.4
	No	**152**	27.6	29.6	42.8	**143**	36.4	37.8	25.9
Sum of Skinfolds >/85th %	Yes	**55**	20.0	36.4	43.6	**54**	25.9	35.2	38.9
	No	**138**	29.0	26.8	44.2	**136**	36.0	38.2	25.7
Waist to hip ratio	4th quartile (larger)	**50**	22.0	34.0	44.0	**45**	31.1	25.6	33.3
	1st - 3rd (smaller)	**143**	28.0	28.0	44.0	**145**	33.8	37.9	28.3
Subscapular to Triceps skinfold ratio	4th quartile (larger)	**39**	30.8	35.9	33.3	**57**	33.3	35.1	31.6
	1st -3rd (smaller)	**154**	25.3	27.9	46.8	**133**	33.1	38.4	28.6
Percentage body fat (Goran et al., 1996)	4th quartile (heavier)	**38**	18.4	39.5	42.1	**57**	28.1	29.8	42.1
	1st-3rd (lighter)	**155**	28.4	27.1	44.5	**133**	35.3	40.6	24.1
Percentage body fat (Newman et al., 1989	4th quartile (heavier)	**35**	25.7	37.1	37.1	**61**	29.5	51.2	39.3
	2nd-3rd	**94**	26.6	26.6	46.8	**99**	33.3	39.4	27.3
	1st quartile (lighter)	**64**	25.6	30.0	43.8	**30**	40.0	43.3	16.7
Best time 1.6 kilometer run/walk test	Do not meet	**64**	28.1	37.5	34.4	**80**	32.5	41.3	26.3
	Meet standard	**129**	25.6	25.6	48.8	**110**	33.6	34.6	31.8

*** NHANES II reference**

Note: rows within the gender may not sum to 100.0 due to rounding

3.3 Univariate and bivariate analyses

There are three tables that present the unadjusted odds ratios and 95 percent confidence intervals for each correlate in non-stratified and gender stratified forms. Tables 8 and 9 were computed using dichotomous forms of the dependent variable, and Table 10 was computed using the trichotomous form of the dependent variable. These tables were computed this way to serve as a reference for exploring the appropriateness of the proportional odds assumption during ordinal regression analysis, as well as providing assurances that the multivariate analysis should be stratified by gender.

Seven points of interest in Table 8, which compares the 'very active' and 'active' children with the 'inactive' children, were noted. First, the odds that boys were 'very active' or 'active' compared to the odds that girls were this active (the odds ratio) was 1.6. Second, the unadjusted odds ratios of children whose parents were physically active 'often' compared to children whose parents were only 'sometimes' active was 1.9. This association became insignificant for boys in the gender stratified unadjusted odds ratios, but increased to 3.1 for girls. Third, the unadjusted odds ratio of being 'very active' or 'active' for children whose parents 'often' encouraged activity compared to those whose parents only 'sometimes' encouraged activity was 2.8. Similarly, the unadjusted odds ratio for being 'very active' or 'active' for children who were 'rarely or never' encouraged compared to those who were 'sometimes' encouraged was 0.6. These associations also became insignificant for boys in the stratified odd ratios, but remained significant for girls. Fourth, the unadjusted odds ratios for being 'very active' or 'active' for children who had high self-efficacy to 'walk or bike instead of get a ride' compared to those who had lower self-efficacy was approximately 2.0. Fifth, the unadjusted odds ratios for being 'very active' or 'active' for children who were enrolled in lessons compared with those who were not enrolled was 3.5. For boys, this unadjusted odds ratio is likely inflated because of the low frequencies of their taking lessons. Involvement in summer sports showed significant odds ratios for both non-stratified and stratified forms. Sixth, the unadjusted odds ratios for being 'very active' or 'active' for children who watch little or no television (television score variable) compared with children who watched a lot of television was 2.7, but this stratum had relatively few counts. The unadjusted odds ratios for being 'very active' or 'active' for boys who watched moderate amounts of television compared to those who watched a lot of television was 1.9; this association was not significant for girls. Seventh, the unadjusted odds ratios associated with the adiposity measures indicate that the odds of being 'very active' or 'active' were higher for heavier children than for lighter children. Though these unadjusted odds ratios indicate that the heavier children are more likely to be more active, the associated confidence intervals were very large. Finally, the unadjusted odds ratios of being 'very active' or 'active' for children who were measured in 1996 compared to those who were measured in 1994 was 2.7, indicating that a secular increase in physical activity frequency took place between 1994 and 1996. Note that there were no significant associations between the school of enrollment and being 'very active' or 'active'.

Table 8:

Unadjusted odds ratios and 95 percent confidence intervals for potential correlates of physical activity among Mohawk children who are 'very active or active' (1) versus those who are 'inactive' (0), KSDPP, 1994-1997.

		Univariate	Bivariate	
Variable		All OR [95% CI]	Boys OR [95% CI]	Girls OR [95% CI]
Year of measurement				
	1996 versus 1994	2.7 [1.7, 4.2]	3.4 [1.8, 6.5]	2.1 [1.2, 3.9]
Gender				
	Boys versus Girls	1.6 [1.0, 2.4]	-	-
Age				
	10 versus 9	0.6 [0.4, 1.1]	0.5 [0.2, 1.2]	0.7 [0.4, 1.4]
	11 versus 9	0.6 [0.4, 1.1]	0.5 [0.2, 1.2]	0.7 [0.3, 1.4]
School				
	2 versus 1	0.7 [0.4, 1.1]	0.5 [0.2, 1.1]	0.8 [0.4, 1.5]
	3 versus 1	0.8 [0.5, 1.4]	0.6 [0.3, 1.3]	1.1 [0.5, 2.3]
	3 versus 2	1.2 [0.7, 2.1]	1.1 [0.5, 2.2]	1.4 [0.7, 2.9]
Family size				
	1 or 2 children versus 3 or 4 children	1.5 [0.9, 2.4]	1.7 [0.9, 3.3]	1.3 [0.7, 2.7]
	1 or 2 children versus 5 or more children	1.6 [0.8, 3.0]	2.2 [0.7, 6.7]	1.6 [0.7, 3.6]
	3 or 4 children versus 5 or more children	1.1 [0.6, 1.9]	1.3 [0.4, 3.7]	1.2 [0.6, 2.4]
Birth order				
	Later born versus first born	1.0 [0.6, 1.5]	0.9 [0.5, 1.7]	1.0 [0.5, 1.8]

Table 8	All OR [95% CI]	Boys OR [95% CI]	Girls OR [95% CI]
Parents are physically active			
Rarely	1.4 [0.8, 2.5]	1.6 [0.7, 3.5]	1.4 [0.7, 3.2]
Sometimes	Reference	Reference	Reference
Often	1.9 [1.2, 3.2]	1.1 [0.6, 2.3]	3.1 [1.5, 6.4]
Parents encourage children to be active			
Never/ Rarely	0.6 [0.3, 1.0]	1.0 [0.4, 2.5]	0.3 [0.1, 0.8]
Sometimes	Reference	Reference	Reference
Often	2.8 [1.7, 4.6]	1.9 [0.9, 4.0]	3.8 [1.9, 7.7]
Parents tell children to be active			
Never/ Rarely	1.3 [0.7, 2.4]	2.3 [0.9, 5.7]	0.8 [0.4, 1.9]
Sometimes	Reference	Reference	Reference
Often	1.3 [0.8, 2.1]	1.2 [0.6, 2.3]	1.4 [0.7, 2.6]
Parents offer to exercise with children			
Never	1.7 [0.9, 3.3]	1.8 [0.7, 4.7]	1.5 [0.5, 4.0]
Rarely	Reference	Reference	Reference
Sometimes	0.7 [0.4, 1.3]	0.5 [0.2, 1.4]	1.0 [0.4, 2.5]
Often	1.1 [0.5, 2.2]	0.5 [0.2, 1.4]	2.5 [0.9, 6.7]
Self-efficacy to walk/bike //catch a ride			
I know I can versus I cannot/Maybe I can	1.9 [1.2, 3.0]	1.9 [1.0, 3.6]	2.2 [1.1, 4.2]
Self-efficacy to play outside //watch T.V.			
I know I can versus I cannot/Maybe I can	1.2 [0.8, 1.9]	1.1 [0.6, 2.1]	1.7 [0.9, 3.2]
Belong to sports team at school			
Yes versus No	1.6 [1.1, 2.4]	1.7 [0.9, 3.1]	1.4 [0.8, 2.5]
Take lessons			
Yes versus No	1.3 [0.8, 2.1]	3.5 [1.3, 9.6]	0.9 [0.5, 1.7]
Summer sports teams			
No activities	Reference	Reference	Reference
One activity	2.1 [1.2, 3.4]	2.5 [1.1, 5.9]	1.8 [0.9, 3.4]
Two or more activities	4.1 [2.3, 7.6]	5.5 [2.2, 14.0]	2.8 [1.1, 6.7]
Television during the week			
More than 6 programs per day	Reference	Reference	Reference
4-5 programs per day	0.8 [0.4, 1.4]	1.6 [0.7, 3.8]	0.5 [0.2, 1.0]
2-3 programs per day	1.2 [0.7, 2.1]	1.3 [0.6, 2.8]	1.1 [0.5, 2.5]
1 program per day/ doesn't watch T.V.	1.6 [0.8, 3.2]	2.2 [0.8, 6.0]	1.0 [0.4, 2.9]
Television on Saturday morning			
All of the morning	Reference	Reference	Reference
Most of the morning	1.2 [0.7, 2.3]	3.5 [1.2, 10.5]^	0.7 [0.3, 1.7]
Part of the morning	1.4 [0.8, 2.3]	1.6 [0.8, 3.3]	1.2 [0.6, 2.6]
Don't watch television	1.6 [0.7, 3.5]	1.8 [0.6, 5.6]	1.5 [0.5, 4.4]

Table 8	All OR [95% CI]	Boys OR [95% CI]	Girls OR [95% CI]
Television of Saturday afternoon			
All of the afternoon	Reference	Reference	Reference
Most of the afternoon	1.1 [0.5, 2.6]	5.9 [1.4, 25.4]&	0.3 [0.1, 1.1]
Part of the afternoon	1.1 [0.5, 2.3]	1.6 [0.6, 4.0]	0.6 [0.2, 2.2]
Don't watch television	1.1 [0.5, 2.4]	1.8 [0.6, 4.7]	0.6 [0.2, 2.1]
Television score			
0-3 (a lot of T.V.)	Reference	Reference	Reference
4-7 (moderate amounts of T.V.)	1.5 [1.0, 2.4]	1.9 [1.0, 3.6]	1.2 [0.6, 2.4]
8-10 (little or no T.V.)	2.7 [1.1, 6.7]$	3.5 [0.7, 17.4]$	2.4 [0.8, 7.6]$
Video game playing habits			
Play every day	Reference	Reference	Reference
Play several times a week	1.4 [0.7, 2.8]	1.6 [0.7, 3.9]	1.2 [0.3, 4.2]
Rarely play	1.3 [0.7, 2.4]	1.7 [0.8, 3.6]	1.2 [0.4, 3.6]
Never play	0.8 [0.4, 1.7]	1.0 [0.3, 3.3]	0.9 [0.3, 2.8]
BMI >/ 85th percentile *			
No versus Yes	0.8 [0.5, 1.2]	0.7 [0.4, 1.4]	0.8 [0.4, 1.5]
BMI & Subscapular >/85th percentile *			
No versus Yes	0.6 [0.4, 1.0]	0.5 [0.3, 1.1]	0.6 [0.3, 1.3]
BMI & Triceps >/ 85th percentile *			
No versus Yes	0.6 [0.4, 1.0]	0.6 [0.3, 1.3]	0.6 [0.3, 1.2]
Sum of skinfolds >/ 85th percentile *			
Yes versus No	0.6 [0.4, 1.0]	0.6 [0.3, 1.3]	0.6 [0.3, 1.2]
Waist to hip ratio			
1st to 3rd versus 4th quartile (smaller versus larger ratio)	0.8 [0.5, 1.3]	0.7 [0.3, 1.4]	0.9 [0.5, 1.9]
Subscapular to triceps skinfold ratio			
1st to 3rd versus 4th quartile (smaller versus larger ratio)	1.2 [0.7, 1.9]	1.4 [0.7, 2.9]	1.0 [0.5, 1.8]
Percentage body fat (Newman, 1989)			
4th quartile (heavier)	Reference	Reference	Reference
2nd and 3rd quartile	0.9 [0.5, 1.4]	0.9 [0.4, 2.2]	0.7 [0.4, 1.4]
1st quartile (lighter)	0.7 [0.4, 1.3]	0.8 [0.3, 2.0]	0.5 [0.2, 1.1]
Percentage body fat (Goran et al., 1996)			
1st to 3rd versus 4th quartile (lighter versus heavier)	0.7 [0.5, 1.2]	0.7 [0.3, 1.5]	0.7 [0.4, 1.3]
Best time 1.6 km walk/run test **			
Meet standard versus do not meet standard	1.1 [0.7, 1.7]	1.3 [0.7, 2.5]	0.8 [0.5, 1.5]

* NHANES II reference data
** FITNESSGRAM (1987)
^ inflated due to cell 'TV most of the morning' x 'inactive' with 5 counts
& inflated due to cell 'TV most of the afternoon' x 'inactive' with 3 counts
$ inflated due to cell 'little or no TV' x 'inactive' with less than 7 counts

Six points of interest in Table 9, which compares the unadjusted odds of children being 'very active' with the odds of being 'active' and 'inactive' for each variable, were noted. First, the unadjusted odds ratios for being 'very active' for children who were measured in 1996 compared to those measured in 1996 was 3.0. Second, the unadjusted odds ratios for being 'very active' for children in grade six compared to those in grade four was 0.5. This association remained significant with boys but lost significance with girls. The increased range in the 95 percent confidence interval for girls suggests that the proportion of them classified as 'very active' was not sufficient for this relationship to reach statistical significance. Third, the unadjusted odds ratios for being 'very active' for children whose parents were 'often' physically active compared to those whose parents were only 'sometimes' physically active was 1.6. After stratification, this association was no longer significant, as was the case for other parental variables. Fourth, the unadjusted odds ratios of being 'very active' for children who had high self-efficacy to 'walk or bike instead of get a ride' compared with those who had less self-efficacy was 1.6. Fifth, the unadjusted odds ratios for being 'very active' for children who belonged to a sports team or took lessons compared with those who did not were 1.5 and 1.8, respectively. Small sample sizes rendered the odds ratios of participating in summer activities difficult to interpret. Finally, as before, the unadjusted odds ratios associated with the adiposity measures indicate that heavier girls are more likely to be 'very active' than lighter girls.

Table 9:

Unadjusted odds ratios and 95 percent confidence intervals for potential correlates of physical activity among Mohawk children who are 'very active' (1) versus those who are 'active' or 'inactive' (0), KSDPP, 1994-1997.

		Univariate	Bivariate	
Variable		All OR [95% CI]	Boys OR [95% CI]	Girls OR [95% CI]
Year of measurement				
	1996 versus 1994	3.0 [1.9, 4.8]	2.6 [1.4, 4.8]	3.5 [1.6, 7.5]
Gender				
	Boys versus Girls	2.3 [1.4, 3.6]	-	-

Table 9	All OR [95% CI]	Boys OR [95% CI]	Girls OR [95% CI]
Age			
10 versus 9	1.0 [0.6, 1.8]	0.8 [0.4, 1.5]	1.5 [0.7, 3.4]
11 versus 9	0.5 [0.3, 0.9]	0.4 [0.2, 0.9]	0.5 [0.2, 1.5]
School			
2 versus 1	0.7 [0.4, 1.1]	0.7 [0.3, 1.3]	0.6 [0.3, 1.3]
3 versus 1	0.8 [0.4, 1.4]	0.7 [0.3, 1.8]	0.7 [0.4, 1.6]
3 versus 2	1.2 [0.7, 2.1]	1.1 [0.5, 2.3]	1.3 [0.5, 3.2]
Family size			
1 or 2 children versus 3 or 4 children	1.1 [0.7, 1.8]	1.1 [0.6, 2.1]	1.2 [0.5, 2.8]
1 or 2 children versus 5 or more children	1.1 [0.6, 2.2]	1.3 [0.5, 3.6]	1.4 [0.5, 3.8]
3 or 4 children versus 5 or more children	1.0 [0.5, 1.9]	1.2 [0.5, 3.1]	1.2 [0.5, 2.8]
Birth order			
Later born versus first born	1.1 [0.7, 1.7]	0.7 [0.4, 1.4]	1.7 [0.8, 3.5]
Parents are physically active			
Rarely	1.4 [0.7, 2.7]	1.5 [0.7, 3.4]	1.6 [0.5, 5.1]
Sometimes	Reference	Reference	Reference
Often	1.6 [1.0, 2.6]	1.3 [0.7, 2.5]	2.0 [0.9, 4.3]
Parents encourage children to be active			
Never/ Rarely	0.3 [0.2, 0.7]	0.6 [0.2, 1.6]	0.1 [0.0, 0.6]
Sometimes	Reference	Reference	Reference
Often	3.7 [1.9, 7.5]	2.6 [1.2, 6.1]	8.2 [1.9, 35.9]^
Parents tell children to be active			
Never/ Rarely	1.3 [0.6, 2.6]	2.3 [0.8, 6.5]	0.7 [0.2, 1.8]
Sometimes	Reference	Reference	Reference
Often	1.4 [0.9, 2.3]	1.1 [0.6, 2.1]	1.7 [0.8, 3.8]
Parents offer to exercise with children			
Never	1.7 [0.8, 3.6]	1.5 [0.6, 3.9]	1.8 [0.4, 7.8]
Rarely	Reference	Reference	Reference
Sometimes	1.0 [0.5, 1.9]	1.1 [0.5, 2.6]	1.1 [0.3, 3.8]
Often	1.9 [1.0, 3.8]	1.8 [0.8, 4.5]	2.8 [0.8, 9.5]
Self-efficacy to walk/bike //catch a ride			
I know I can versus I cannot/Maybe I can	1.6 [1.0, 2.7]	1.6 [0.9, 3.0]	1.6 [0.8, 5.4]
Self-efficacy to play outside //watch T.V.			
I know I can versus I cannot/Maybe I can	1.0 [0.6, 1.5]	1.0 [0.5, 1.7]	1.5 [0.7, 3.6]
Belong to sports team at school			
Yes versus No	1.5 [1.0, 2.4]	1.7 [0.9, 3.1]	1.1 [0.5, 2.2]
Take lessons			
Yes versus No	1.8 [1.3, 3.0]	3.5 [1.7, 7.4]	1.5 [0.7, 3.1]

Table 9	All OR [95% CI]	Boys OR [95% CI]	Girls OR [95% CI]
Summer sports teams			
One activity versus no activities	3.2 [1.5, 6.8]*	2.6 [0.8, 8.3]	3.2 [1.1, 9.1]*
Two or more activities versus no activities	8.4 [3.9, 18.4] *	6.9 [2.2, 21.9]*	6.9 [2.2, 21.5]*
Two activities versus one activity	2.7 [1.6, 4.4]	2.7 [1.4, 5.0]	2.1 [0.9, 5.0]
Television during the week			
More than 6 programs per day	Reference	Reference	Reference
4-5 programs per day	0.7 [0.4, 1.4]	1.3 [0.6, 3.1]	0.3 [0.1, 1.0]$
2-3 programs per day	0.7 [0.4, 1.3]	0.7 [0.3, 1.6]	0.8 [0.3, 1.9]
1 program per day/ doesn't watch T.V.	2.0 [1.0, 3.9]	2.1 [0.9, 5.0]	1.8 [0.6, 5.2]
Television on Saturday morning			
All of the morning	Reference	Reference	Reference
Most of the morning	1.0 [0.5, 2.5]	1.4 [0.5, 3.4]	0.9 [0.3, 2.9]
Part of the morning	1.2 [0.7, 2.1]	1.3 [0.6, 2.6]	1.4 [0.5, 3.6]
Don't watch television	1.1 [0.5, 2.5]	1.7 [0.6, 5.1]	0.7 [0.2, 3.2]
Television of Saturday afternoon			
All of the afternoon	Reference	Reference	Reference
Most of the afternoon	0.7 [0.3, 1.7]	1.6 [0.5, 5.1]	0.2 [0.1, 1.0]$
Part of the afternoon	0.6 [0.3, 1.2]	1.0 [0.4, 2.6]	0.3 [0.1, 0.9]$
Don't watch television	0.7 [0.3, 1.4]	1.0 [0.4, 2.8]	0.4 [0.1, 1.3]
Television score			
0-3 (a lot of T.V.)	Reference	Reference	Reference
4-7 (moderate amounts of T.V.)	0.8 [0.5, 1.4]	0.8 [0.4, 1.6]	0.8 [0.3, 1.7]
8-10 (little or no T.V.)	2.3 [1.0, 5.2]	2.3 [0.7, 8.3]	2.8 [0.9, 8.8]
Video game playing habits			
Play every day	Reference	Reference	Reference
Play several times a week	0.8 [0.4, 1.6]	1.0 [0.5, 2.4]	0.5 [0.1, 2.0]
Rarely play	0.6 [0.3, 1.1]	0.8 [0.4, 1.6]	0.5 [0.2, 1.8]
Never play	0.4 [0.2, 0.9]	0.5 [0.1, 1.8]	0.5 [0.1, 1.7]
BMI >/ 85th percentile @			
No versus Yes	0.9 [0.5, 1.4]	1.2 [0.6, 2.2]	0.5 [0.3, 1.1]
BMI & Subscapular >/85th percentile @			
No versus Yes	0.6 [0.4, 1.0]	0.9 [0.5, 1.8]	0.4 [0.2, 0.8]
BMI & Triceps >/ 85th percentile @			
No versus Yes	0.6 [0.4, 1.0]	0.9 [0.4, 1.8]	0.4 [0.2, 0.8]
Sum of skinfolds >/ 85th percentile @			
No versus Yes	0.6 [0.4, 1.0]	1.0 [0.5, 1.9]	0.4 [0.2, 0.7]
Waist to hip ratio			
1st to 3rd versus 4th quartile (smaller versus larger ratio)	0.7 [0.4, 1.1]	0.7 [0.4, 1.4]	0.6 [0.3, 1.3]

Table 9	All OR [95% CI]	Boys OR [95% CI]	Girls OR [95% CI]
Subscapular to triceps skinfold ratio			
1st to 3rd versus 4th quartile (smaller versus larger ratio)	1.0 [0.6, 1.7]	1.4 [0.6, 2.9]	0.6 [0.3, 1.2]
Percentage body fat (Newman, 1989)			
4th versus 2nd & 3rd quartiles (heavier versus medium weight)	0.9 [0.5, 1.5]	1.9 [0.8, 4.3]	0.4 [0.2, 0.8]#
4th versus 1st quartiles (heavier versus lighter weight)	0.6 [0.3, 1.2]	1.1 [0.5, 2.8]	0.0 [0.0, 0.5]#
2nd & 3rd versus 1st quartiles (medium versus lighter weight)	0.7 [0.4, 1.3]	0.6 [0.3, 1.2]	0.2 [0.0, 1.4]#
Percentage body fat (Goran et al., 1996)			
1st to 3rd versus 4th quartile (lighter versus heavier)	0.6 [0.4, 1.0]	1.1 [0.5, 2.4]	0.3 [0.1, 0.5]
Best time 1.6 km walk/run test**			
Met standard versus did not meet standard	1.4 [0.9, 2.2]	1.6 [0.8, 2.9]	1.0 [0.3, 2.1]

@ NHANES II reference data
** FITNESSGRAM (1987)
^ frequency for girls being 'very active'
* frequency counts low in cell 'no activities during the summer' x 'very active' resulting in inflated OR
# frequency count low in cell 'females' x 'very active' x '1st quartile percentage body fat' resulting in inflated OR
$ cells with counts less than 6 resulting in inflated OR

Table 10 presents the unadjusted cumulative odds ratios and 95 percent confidence intervals for each variable. For the non-stratified form, nine significant cumulative odds ratios were determined. Of these, only two variables remained significant after gender stratification, supporting a gender stratified multivariate analysis. Specifically, being involved in summer activities and having measurements taken in 1996 rather than 1994 were significant cumulative odds ratios for both boys and girls. For boys, age and being enrolled in lessons were variables with significant unadjusted cumulative odds ratios after gender stratification. For girls, parents being physically active, parents encouraging their children to be active, self-efficacy to walk/bike instead of getting a ride, being involved in summer sports, and the television score were variables with significant unadjusted cumulative odds ratios after gender stratification.

Table 10:

Unadjusted cumulative odds ratios and 95 percent confidence intervals for potential correlates of physical activity among Mohawk children: ordinal values 'very active' (3), 'active' (2) and 'inactive' (1), KSDPP, 1994-1997.

	Univariate	**Bivariate**	
Variable	All (n=383) OR [95% CI]	Boys (n=193) OR [95% CI]	Girls (n=190) OR [95% CI]
Year of measurement	**1.7 [1.4, 2.1]**	**1.7 [1.2, 2.2]**	**1.7 [1.3, 2.2]**
Gender	**2.1 [1.3, 3.4]**	-	-
Age	**0.7 [0.6, 0.9]**	**0.6 [0.4, 0.9]**	0.9 [0.6, 1.3]
School	0.9 [0.7, 1.2]	0.9 [0.6, 1.3]	1.0 [0.7, 1.6]
Family size	**1.4 [1.0, 1.9]**	1.5 [0.9, 2.5]	1.3 [0.8, 2.1]
Birth order	0.9 [0.6, 1.4]	0.9 [0.5, 1.6]	1.0 [0.5, 2.1]
Parents are physically active	**1.5 [1.1, 2.1]**	1.2 [0.8, 1.8]	**2.2 [1.4, 3.5]**
Parents encourage children to be active	1.3 [0.9, 1.3]	1.1 [0.7, 1.6]	**1.6 [1.0, 2.5]**
Parents tell children to be active	1.0 [0.8, 1.4]	1.2 [0.8, 1.9]	0.9 [0.6, 1.4]
Parents offer to exercise with children	1.1 [0.9, 1.3]	1.0 [0.8, 1.3]	1.2 [0.9, 1.6]
Self-efficacy to walk/bike //catch a ride	**1.8 [1.1, 3.0]**	1.6 [0.8, 3.1]	**2.9 [1.3, 6.5]**
Self-efficacy to play outside //watch T.V.	1.1 [0.7, 1.7]	0.8 [0.4, 1.6]	1.7 [0.8, 3.4]
Belong to sports team at school	1.1 [0.7, 1.8]	1.2 [0.6, 2.4]	1.3 [0.7, 2.4]
Take lessons	1.4 [0.9, 2.3]	**3.0 [1.3, 6.7]**	1.0 [0.5, 1.9]
Summer sports teams	**1.1 [1.0, 1.1]**	**1.1 [1.0, 1.1]**	**1.1 [1.0, 1.1]**
Television during the week.	1.0 [0.8, 1.3]	1.0 [0.7, 1.4]	0.9 [0.6, 1.4]
Television on Saturday morning	0.9 [0.7, 1.2]	1.0 [0.7, 1.5]	0.9 [0.6, 1.3]
Television of Saturday afternoon	0.8 [0.6, 1.0]	0.8 [0.6, 1.2]	0.8 [0.5, 1.1]
Television score	**2.1 [1.0, 4.1]**	1.8 [0.7, 4.7]	**2.5 [1.0. 6.7]**
Video game playing habits	**0.8 [0.7, 1.0]**	0.9 [0.7, 1.2]	0.9 [0.6, 1.2]
BMI >/ 85th percentile @	2.1 [0.8, 5.4]	1.9 [0.4, 9.3]	3.2 [0.9, 12.0]
BMI & Subscapular >/85th percentile @	0.5 [0.2, 1.7]	0.4 [0.1, 3.0]	0.4 [0.1, 3.1]
BMI & Triceps >/ 85th percentile @	0.6 [0.2, 1.5]	0.7 [0.1, 3.0]	0.6 [0.1, 2.7]
Sum of skinfolds >/ 85th percentile @	1.6 [0.5, 4.9]	1.9 [0.5, 7.1]	1.6 [0.1, 20.6]
Waist to hip ratio	1.2 [0.7, 2.1]	0.8 [0.4, 1.9]	1.4 [0.7, 3.1]
Subscapular to triceps skinfold ratio	1.2 [0.7, 2.1]	1.2 [0.5, 2.9]	1.4 [0.6, 3.1]
Percentage body fat (Newman, 1989)	0.5 [0.4, 0.8]	0.7 [0.3, 1.3]	0.4 [0.2, 0.7]
Percentage body fat (Goran et al., 1996)	0.8 [0.3, 2.0]	1.0 [0.3, 3.8]	0.8 [0.2, 3.1]

Best time 1.6 km walk/run test $	1.3 [0.8, 2.0]	1.1 [0.6, 2.2]	1.5 [0.7, 3.0]

@ NHANES II reference data
$ ** FITNESSGRAM (1987)

3.4 Multivariate analysis

The multivariate analysis is presented in 3 sets of tables, in which Tables 11 and 12 present the results of the logistic regression procedures and Table 13 presents the results of the ordinal regression procedure. By doing separate logistic regression procedures in which 'very active' children are contrasted with 'active' and 'inactive' children, and 'very active' and 'active' children are contrasted with 'inactive children', it can be demonstrated that the correlates may not be the same for different levels of physical activity. Such differences may not be evident in the ordinal regression procedure that follows the proportional odds assumption.

The variables were coded so that the odds ratios would be positive. Five highlights of the three sets of tables are noted. First, the adjusted odds ratios found using both logistic regression procedures for children measured in 1996 compared to those measured in 1994 were consistently between 1.5 and 2.2 for non-stratified and gender stratified models. These associations remained significant after gender stratification and in ordinal regression analysis. Second, the odds ratios of being 'very active' for boys compared to the girls was 2.9; the odds ratios of being 'very active' or 'active' for boys compared to girls was not significant. Using ordinal regression, the cumulative odds ratios for boys being more active compared to girls being more active was 1.7. These results show that boys and girls do not differ in their frequency of physical activity in the 'inactive' and 'active' ranges, but boys are more active in the 'very active' range. This is in line with the comments of Table 3 suggesting that there are more opportunities for boys to participate in organized sports in these communities. Third, the odds ratio of being 'very active' in older boys compared to younger boys was 0.6. Using ordinal regression, the cumulative odds ratios for being more active for older boys compared to younger boys was 0.7. Fourth, several of the adiposity indicators showed that children who were not overweight were less likely to be active than children who were overweight. Finally, the p-value of the score test for the proportional odds assumption was only 0.38 in the non-stratified ordinal regression model, but changed to 0.90 for boys and 0.18 for girls in the stratified models. Even though the proportional odds assumption was met for both analyses, the assumption was better met when the boys were analyzed alone. Therefore, the boys' data was best analyzed using ordinal regression. On the other hand, the low p-value of 0.18 for girls suggested that ordinal regression was not the best form of analysis for the girls' data. Given the large confidence intervals associated with a low proportion of girls classified as 'very active', logistic regression in which the 'very active' and 'active' girls were contrasted with the 'inactive' girls was the best way to analyze the girls' data.

The significant physical activity correlates for boys were year of measurement, younger age, enrollment in school #1, enrollment in lessons, and involvement in summer sports (Table 13h). The significant correlates for being physically active for girls were year of measurement and parents being physically active. Parents offering to exercise with their children, involvement in summer sports, and higher percentage body fat were correlates for girls' activity that approached significance only after rounding (Table 12f).

3.4.1. Assessment of interaction and confounding

Interaction is the condition where the relationship of interest is different at different levels of the extraneous variables. First order interaction terms were derived from combinations of all potential correlates, and terms that included age, year of measurement, and overweight were found. Though there were interaction terms with significant odds ratios, when these terms were placed into a model with their component variables, the confidence intervals for the latter were large, suggesting that the interaction was not meaningful. For instance, the odds ratio and confidence interval for the interaction term, 'age x year of measurement' was 0.76[0.60,0.97], but for the components 'age' and 'year of measurement', they were 999[20-999] and 26.1[2.4,283], within the same model, respectively. Interestingly, parents telling their sons to be active and parents encouraging their daughters to be active interacted significantly in a negative direction with overweight. While it would seem that being verbally supportive is associated with higher activity levels, this does not seem to be the case for these overweight children. These verbal support x overweight interaction terms were no longer significant when they were adjusted by other variables.

Confounding, in which meaningfully different interpretations of the relationship of interest occur when an extraneous variable is introduced into the model, was assessed by individually adding each variable not retained to the final model and comparing the odds ratios before and after this adjustment. Gender, a confounding variable, was controlled for by doing a gender stratified analysis. No significant changes were made in either the magnitude of the odds ratios or the width of the confidence intervals, indicating that no confounding by the other variables occurred.

3.4.2 Assessment of missing values assumption

Missing values were placed into the category in which children would be least likely to be active. To evaluate this procedure, the multivariate analyses concerning the final models were redone in which the observational units with missing values were deleted. After deleting the missing values, there were 354 observational units available for analyses (177 boys and 177 girls). The resulting models had the same significant variables, similar odds ratios and confidence intervals, and comparable goodness of fit statistics. These results confirmed that the coding of missing values was appropriate.

Table 10:
Adjusted odds ratios and 95 percent confidence intervals for correlates of physical activity in Mohawk elementary school children, KSDPP, 1994-1997 [dichotomous responses 'very active' versus 'active/ inactive']

a) All Children (n = 383)

Correlates	Odds ratio [95 percent confidence interval]	Global null: Beta = 0 –2 Log L statistic (Intercept only, intercept and covariates)	Score test for Proportional odds assumption	Breslow and Day Goodness of Fit Residual Chi-square statistic
Year of measurement (1996)	1.8 [1.4, 2.4]			
Gender (male)	2.9 [1.6, 5.1]	455.630 – 355.830 = 99.800	Not applicable	17.0720
Older age	0.7 [0.5, 1.0]	9 degrees of freedom		21 degrees of freedom
Parents offer to exercise with children	1.6 [1.2, 2.0]	p = 0.0001		p = 0.7067
Lessons	2.0 [1.1, 3.6]			
Involved in summer sports	1.1 [1.1, 1.1]			
Lower % body fat (Newman, 1989)	0.5 [0.3, 0.8]			
Enrolled in school #1	*1.7 [1.0, 3.1]			
Watch little t.v. on Saturday afternoon	*0.8 [0.6, 1.0]			

* rounded up to 1.0

b) Boys (n = 193)

Correlates	Odds ratio [95 percent confidence interval]	Global null: Beta = 0 –2 Log L statistic (Intercept only, intercept and covariates)	Score test for proportional odds assumption	Breslow and Day Goodness of Fit Residual Chi-square statistic
Year (1996)	1.6 [1.1, 2.2]			
Older age	0.6 [0.4, 1.0]	252.812 – 208.940 = 43.872	Not applicable	15.9862
Lessons	2.7 [1.2, 6.0]	6 degrees of freedom		23 degrees of freedom
Involved in summer sports	1.1 [1.0, 1.2]	p = 0.0001		p = 0.8559
Enrolled in school #1	@1.8 [0.9, 3.8]			
Parents offer to exercise with children	*1.3 [1.0, 1.8]			

*rounded up to 1.0
@ not significant at alpha of 0.05

c) Girls (n = 190)

Correlates	Odds ratio [95 percent confidence interval]	Global null: Beta = 0 −2 Log L statistic (Intercept only, intercept and covariates)	Score test for proportional odds assumption	Breslow and Day Goodness of Fit Residual Chi-square statistic
Year of measurement (1996)	2.2 [1.4, 3.5]			
Parents are physically active	@1.7 [0.9, 3.1]	190.153 – 152.169 = 37.984	Not applicable	13.1421
Parents offer to exercise with children	1.8 [1.2, 2.9]	5 degrees of freedom		18 degrees of freedom
Involved in summer sports	1.1 [1.0, 1.2]	p = 0.0001		p = 0.7831
Lower subscapular to triceps skinfold ratio	@0.5 [0.2, 1.1]			

@ not significant at an alpha of 0.005

Table 11:
Adjusted odds ratios and 95 percent confidence intervals for correlates of physical activity in Mohawk elementary school children, KSDPP, 1994-1997 [dichotomous responses 'very active/ active' versus 'inactive']

d) All Children (n = 383)

Correlates	Odds ratio [95 percent confidence interval]	Global null: Beta = 0 −2 Log L statistic (Intercept only, intercept and covariates)	Score test for proportional odds assumption	Breslow and Day Goodness of Fit Residual Chi-square statistic
Year of measurement (1996)	1.8 [1.4, 2.3]			
Enrolled in school #2	0.6 [0.3, 0.9]	499.497 – 430.782 = 68.715	Not applicable	18.2048
Parents are physically active	1.6 [1.1, 2.3]	8 degrees of freedom		22 degrees of freedom
Parents encourage physical activity	1.4 [1.1, 1.9]	p = 0.0001		p = 0.6938
Self-efficacy walk/bike // get a ride	1.8 [1.1, 2.0]			
Involved in summer sports	1.1 [1.0, 1.1]			
Both BMI and subscapular < 85^{th} % ^	0.5 [0.3, 0.9]			
Lower waist to hip ratio	*1.9 [1.0, 3.5]			

* rounded up to 1.0
^ NHANES II reference

e) Boys (n = 193)

Correlates	Odds ratio [95 percent confidence interval]	Global null: Beta = 0 −2 Log L statistic (Intercept only, intercept and covariates)	Score test for proportional odds assumption	Breslow and Day Goodness of Fit Residual Chi-square statistic
Year of measurement (1996)	1.8 [1.3, 2.6]			
Enrolled in school #1	2.2 [1.0, 4.8]	237.628 – 203.953 = 33.675	Not applicable	21.0574
Enrolled in lessons	2.9 [1.0, 8.3]	4 degrees of freedom		25 degrees of freedom
Involved in summer sports	1.1 [1.0, 1.1]	p = 0.0001		p = 0.6894

f) Girls (n = 190)

Correlates	Odds ratio [95 percent confidence interval]	Global null: Beta = 0 –2 Log L statistic (Intercept only, intercept and covariates)	Score test for Proportional odds assumption	Breslow and Day Goodness of Fit Residual Chi-square statistic
Year of measurement (1996)	1.5 [1.1, 2.1]			
Parents are physically active	2.0 [1.2, 3.3]	257.279 – 224.177 = 33.102	Not applicable	19.2688
Parents offer to exercise with children	*1.3 [1.0, 1.8]	6 degrees of freedom		23 degrees of freedom
Self-efficacy to walk/bike // catch a ride	@1.9 [0.9, 3.9]	p = 0.0001		p = 0.6855
Involved in summer sports	*1.0 [1.0, 1.1]			
Lower % body fat (Newman equation)	*0.6 [0.4, 1.0]			

* reached significance due to rounding

@ not significant at an alpha 0.05

Table 12:
Adjusted odds ratios and 95 percent confidence intervals for correlates of physical activity in Mohawk elementary school children, KSDPP, 1994-1997 [ordinal response 'very active', 'active', and 'inactive']

g) All Children (n = 383)

Correlates	Odds ratio [95 percent confidence interval]	Global null: Beta = 0 −2 Log L statistic (Intercept only, intercept and covariates)	Score test for proportional odds assumption	Breslow and Day Goodness of Fit Residual Chi-square statistic
Year of measurement (1996)	1.7 [1.4, 2.1]			
Gender (male)	1.7 [1.1, 2.7]	836.858 – 730.949 = 105.908	9.6531	22.1951
Older age	0.7 [0.6, 0.9]	9 degrees of freedom	9 degrees of freedom	21 degrees of freedom
Parents are physically active	1.6 [1.2, 2.1]	p = 0.0001	p = 0.3793	p = 0.3883
Parents encourage physical activity	1.3 [1.0, 1.7]			
Self-efficacy to walk/bike // catch a ride	1.8 [1.1, 2.8]			
Summer sports involvement	1.1 [1.0, 1.1]			
Watch little t.v. on Saturday afternoon	0.8 [0.7, 1.0]			
Lower percentage body fat (Newman, 1989)	0.7 [0.5, 0.9]			

h) Boys (n = 193)

Correlates	Odds ratio [95 percent confidence interval]	Global null: Beta = 0 −2 Log L statistic (Intercept only, intercept and covariates)	Score test for proportional odds assumption	Breslow and Day Goodness of Fit Residual Chi-square statistic
Year of measurement (1996)	1.7 [1.3, 2.2]			
Older age	0.7 [0.5, 0.9]	423.123 – 370.779 = 52.344	1.6338	18.8151
Enrolled in school # 1	2.0 [1.1, 3.6]	5 degrees of freedom	5 degrees of freedom	24 degrees of freedom
Lessons	2.8 [1.3, 5.9]	p = 0.0001	p = 0.8971	p = 0.7618
Summer sports involvement	1.1 [1.0, 1.1]			

i) Girls (n = 190)

Correlates	**Odds ratio [95 percent confidence interval]**	**Global null: Beta = 0 −2 Log L statistic (Intercept only, intercept and covariates)**	**Score test for proportional odds assumption**	**Breslow and Day Goodness of Fit Residual Chi-square statistic**
Year of measurement (1996)	1.8 [1.3, 2.4]			
Parents are physically active	2.0 [1.3, 3.1]	400.764 – 342.812 = 57.953	10.1297	17.4467
Parents encourage physical activity	*1.4 [1.0, 2.2]	7 degrees of freedom	7 degrees of freedom	22 degrees of freedom
Parents offer to exercise with children	*1.3 [1.0, 1.8]	p = 0.0001	p = 0.1813	p = 0.7382
Self-efficacy to walk/ bike // catch a ride	*1.8 [0.9, 3.6]			
Summer sports involvement	1.1 [1.0, 1.1]			
Lower percentage body fat (Newman, 1989)	0.5 [0.3, 0.8]			

* reached significance due to rounding

Discussion

The objective of this study was to determine the frequency of physical activity and correlates of physical activity in Mohawk elementary school children. The frequency and correlates of physical activity, limitations of this study, a brief discussion of variables not assessed in this study, and the conclusion of this study are presented in this section.

4.1 Frequency of physical activity

This study found that 29.8 percent of children did less than 2 activities per day, 33.4 percent of children did between 2 and 4 activities per day, and 36.8 percent of children did 4 or more activities per day. The Healthy People 2000 objective is that by this year at least 30 percent of people aged 6 years and older will be participating in recommended levels of activity and no more than 15 percent will be inactive (46). If children who did less than 2 activities per day can be classified as 'inactive', roughly 30 percent of the children in this study were inactive. However, if doing less than 1 activity per day constitutes physical inactivity, then 13.5 percent (11.4 percent for boys and 14.7 percent for girls) of the children in this study were inactive. Since the Surgeon General's Report of Physical Activity and Health (1996) defines inactivity as performing no light, moderate, or vigorous activity during the week preceding the survey (46), a conservative definition of inactivity for this study is less than 1 activity per day.

These results indicate that both objectives for activity and inactivity have been reached in this population. Despite this, children constitute the most physically active segment of a population, and physical activity levels generally decrease with age, therefore it is unlikely that these objectives will continue to be met in older age groups. Since shifting the distribution of health-related characteristics within a population may result in predictable changes in the prevalence of related disease (191), then augmenting the frequency of physical activity in all children, inactive and active, will reduce the risk for the development of obesity and diabetes in this age group.

4.2 Correlates of physical activity

The most consistent correlate of physical activity was year of measurement. Children who were measured in 1996 were 1.5 to 2.0 times as likely to be more active than children who were measured in 1994. Since it has been previously shown that the increase in average physical activity cannot be attributable to the intervention (180), the significance of this correlate is either due to a secular increase in physical activity in the Mohawk population, and/or that the taking of the anthropometric, questionnaire, and cardiovascular fitness tests constituted an intervention in itself. Year of measurement was also the only correlate that was simultaneously correlated with physical activity (Tables 12f and 13h).

In this study older boys were 0.7 times more likely to report the highest category of physical activity as younger boys. This relationship disappeared in the logistic regression tables when 'very active' and 'active' boys were contrasted with 'inactive' boys, meaning that age better distinguished between the 'very active' and less active boys than the 'active' and 'inactive' boys. Similarly, boys were 1.7 times more likely to report higher frequencies of physical activity than girls, and this relationship disappeared in the logistic regression tables when the children who were active were contrasted with the 'inactive' children. From this, being an older boy, or being male were better correlates for being 'very active' than they were for lower levels.

Interestingly, being enrolled in school #1 and school #2 approached or were significant for several logistic and ordinal regression tables. Specifically, boys enrolled in school #1 were 2 times more likely to be more active than boys enrolled in school #2. This relationship was not found for girls. If the school of enrollment as a correlate of physical activity was merely a reflection of the policies and activities of the school, then this effect might have shown with girls too. Schools constitute an environment that is external to the family. The fact that significant correlates for boys were enrollment in school #1, enrollment in lessons, and involvement in summer sports may suggest that boys were influenced by community influences more so than family influences.

Along these lines, girls whose parents are physically active were 2 times more likely to be active than children whose parents were not as active. The item, "Parents offering to exercise with their children", was also a correlate which approached significance in girls. Given that there were no other significant correlates besides year of measurement, these results support the contention that the frequency of girls' physical activity is influenced the most by family factors. For instance, Stucky-Ropp and

DiLorenzo (1993) found that the physical activity levels of 5th and 6th grade girls (n=121) were significantly influenced by parental levels of physical activity. On the other hand, the physical activity levels of boys (n=121) in this same study were significantly influenced by the physical activities and support of both their parents *and* friends (96). Similarly, in a study of 9th and 11th grade students, Zakarian et al. (1994) found that significant correlates of vigorous activity for girls included family support while correlates for boys included friend's support (99). Gottleib and Chen (1985) cite that teachers have been found to be more important in influencing the activities of boys and family influences have been more important for girls (56). Furthermore, these authors contend that because exercise and sport have been sex-typed as masculine and boys have more salient models and reinforcement for exercise, parental modeling may be especially important for girls (56). It seems that boys may have a larger supportive network for physical activity outside of the family than girls.

The parental influences in this study were categorized as modeling, enacted support, and verbal support. Though the enacted support item, 'parents offering to exercise with their children' approached significance for girls, neither of the two items assessing verbal support (parents encouraging or telling their children to be active) were near significance. Sallis et al. (1992) propose that more concrete forms of parental support rather than verbal prompts are needed to influence physical activity (129). On the other hand, parents encouraging activities and telling their children to be active had significant unadjusted odds ratios when these items were assessed as interaction terms with measures of body composition. That is, the relationship between verbal forms of support and levels of activity was not the same for different levels of overweight. Perhaps overweight children might be less active with increasing amounts of parental encouragement because they feel that they are being nagged to be active.

In this study, the indicators for physical fitness and television viewing habits were not found to be significant correlates of physical activity frequency. The simple correlation between physical activity and physical fitness in most studies are moderate at best (58). In this study, the simple correlation between physical fitness and physical activity was not significant at an alpha of 0.10, thus it is not surprising that physical fitness did not emerge as a significant correlate. Sallis et al. (1992) explain that physical fitness might not be an important influence on physical activity levels because aerobic power per kilogram of body weight remains stable throughout childhood while levels of physical activity decrease (58).

With regards to television viewing habits, this study found that 25.6 percent of the children watched 4 to 5 programs, and 27.4 percent watched more than 6 programs per day. Since we cannot be sure whether 1 program is ½ an hour or a full hour, the units were converted to 'hours of television per day' using a standard 45 minutes per program. Accordingly, this study found that roughly ¼ of these children watched an excess of 4 hours of television per day. Andersen et al. (1998) report that 26% of US children watch 4 or more hours of television per day (114), which is comparable to our estimate. However, despite the fact that watching television reduces the opportunity for children to be active (58), viewing habits did not emerge as significant correlates of frequency of physical activity in this study. A simple graph where numbers of television programs watched was plotted against physical activity showed that children who watched between 2 and 3 programs per day were the most active. A positive relationship between television viewing habits and physical activity was also found by Myers et al., (1996). These authors suggest that children who are active may remember their activities, including their sedentary ones, better than less active children (75).

The KSDPP items measuring self-efficacy were derivations of items from a previous study. Two of the four items had to be excluded from this study because they did not have enough variability and did not meet sufficient face validity. The remaining self-efficacy items did not emerge as significant correlates of physical activity frequency. In their study of 5th and 6th grade students, Stucky-Ropp et al. (1993) state that shortcomings in their assessment and children perceiving that being involved in activities is not a difficult task contributed to the inability of self-efficacy to emerge as a significant predictor (96). Bandura (1996) cites that a limited scope of self-efficacy assessment, faulty assessments of self-efficacy and the related behavior, discontextualized global measures of self-efficacy, and long temporal disparities between the assessment of self-efficacy and action are among some of the reasons for the generally poor ability for this construct to explain and predict behavior (152).

In sum, more predictors were identified in boys than girls, suggesting that there are other factors that influence physical activity relevant to girls who were not assessed in this study. Despite this, the correlates of boys were interpreted as being more community-oriented while the correlates for girls were more family-oriented. These results suggest that girls need more support from their families to be involved in physical activities (89).

4.3 Limitations of the study

Potential limitations of this study can be understood in terms of internal and external validity. Internal validity, which is the validity of the conclusions as they pertain to the actual subjects in the study, is a necessary prerequisite of external validity, which is the validity of the conclusions as they pertain to people outside of the study population.

4.3.1 Internal Validity

Three general types of biases, which can compromise the internal validity of study results, are selection bias, information bias, and confounding

1) Selection bias: KSDPP sought to arrive at a comprehensive sample of Mohawk elementary school children from Kahnawake and Tyendinaga. Though participation was high, with rates consistently over 85 percent, it is possible that the responders were different from the non-responders. A subjective evaluation in 1994 of the obesity levels of the students who did not fill out the questionnaire by nurses with KSDPP found that the respondents were not more or less overweight than the non-respondents (Serge Desrosiers, KSDPP, personal communication). There is no other information available about the non-responders to further assess selection bias.

2) Information/ measurement bias: the sample size and measurement of the dependent and independent variables were potential sources of measurement bias.

a) sample size: there were 1066 crude observational units in the KSDPP data set (1994 to 1996). Since students in grades 4 through 6 filled out the KSDPP questionnaires on their own while younger students filled them out with the help of their parents, and since the physical activity assessment was derived from this questionnaire, the observations of students from 1st to 3rd grade were excluded to control for the potential measurement bias that would have otherwise occurred. This procedure effectively halved the sample size available for analyses. To augment the sample size, the data was used in its cross-sectional rather than longitudinal form, and data from the 3 community schools were collapsed. A similar procedure was done in the Child and Adolescent Trial for Cardiovascular Health (CATCH) (1991-1994) where the data of two separate intervention groups were pooled when no significant differences were observed between the two groups (67).

The sample size resulting from these procedures was 383, in which 190 were girls and 193 were boys. With approximately 30 potential correlates and an alpha of 0.05, this study had a power of 0.80 to detect medium sized effects of the correlates on frequency of physical activity in a gender stratified analysis (179). Despite this, there were still problems associated with the small sample size, which were manifested as 95 percent intervals with an unusually large range, correlates that were close to but did not reach significance, and ordinal regression models that did not adequately support the proportional odds assumption. These problems were mostly encountered in the stratified analyses for girls. That is, the proportion of girls who were 'very active' (29.5 percent) was small compared to boys (44.1 percent), which resulted in low counts in the many of the cells associated with the 'very active' activity category.

The limitation associated with using the cross-sectional rather than the longitudinal form of the data was that the temporal relationship between physical activity and the explanatory variables could not be examined. The study design, for instance could not discern whether children who are involved in school sports teams are involved because they are generally active, or if children are physically active because they are involved in school sports teams.

b) physical activity assessment: this study aligned its dependent variable, frequency of physical activity, with the recommendation by Simons-Morton et al. (1990) that children should participate in at least two 10-minute bouts of moderate to vigorous activity per day (78). The physical activity checklist used by KSDPP asked children to mark activities that were 15 minutes or longer in the past week. Two checks on a given day, roughly equal to 30 minutes of physical activity, was the conservative estimate used to indicate whether the child had participated in recommended levels of activity for that day. However, the KSDPP checklist yielded a frequency score that does not include an indicator of intensity, therefore we could not be sure if the children were getting adequate levels of 'moderate to vigorous' physical activity, as recommended.

Sallis et al. (1993) explains that activities of the Weekly Activity Checklist can be weighted by standard metabolic equivalent values to give an indicator of the relative intensity of the total activity during the week (181). Though weighted activity scores would enable children to be classified according to whether or not they attained recommended amounts of 'moderate to vigorous' activity, this study restricted its analysis of the checklist to frequency counts to control for the bias of classifying boys as being more intensely active. Briefly, Table 3 shows that for those activities of the KSDPP checklist in which boys and girls differentially participate, the metabolic equivalents associated with the boys' activities seem to be higher than those of girls' activities. A more comprehensive list of activities in which the activities of boys and girls have comparable intensities would enable children to be classified according to the intensity of their activities without such bias.

Misclassification also could have occurred with regards to the assumption that an unfilled cell on the physical activity checklist corresponded to the child not having done the activity in question on that particular day. However, if some children had the tendency to not read the questions and/or not complete the questions, then the resultant blank in the cell would correspond to a missing value rather than not having done the activity. This assumption served to misclassify some students as inactive, and resulted in the correlates of inactive and more active children being more similar, which would reduce the effects of interest in this study.

Recall bias, another potential source of measurement bias, occurred in the assessment of the frequency of past week activities. That is, participation in more organized forms of activity are more likely to be recalled than participation in spontaneous forms of activity. The third column of Table 3 illustrates that some activities are participated in more by one gender than the other. Of the activities in which participation by boys and girls differ, the activities of boys are more organized than girls i.e. lacrosse, football, hockey, and boxing versus tag, hop scotch, and skipping rope. From this, boys are likely to be classified as more active when using this checklist.

Another potential source of information bias occurred with the misclassification of the children's physical activity levels based on their activity frequency scores. Children whose scores were at or near the cutoff points, i.e. 14 and 28 bouts of activity to differentiate 'inactive', 'active', and 'very active' children, could have been placed into an invalid activity category. The resultant misclassification made the activity categories more similar, which served to underestimate the effects under study. Aside, though changing the dependent random variable from a continuous to a trichotomous form reduced its variance, this procedure bypassed the problems associated with a large skew in the distribution of the scores in their continuous form

c) assessment of potential correlates: translating psychosocial concepts into tangib!e forms like questionnaires is a resource-intense endeavor requiring the enlistment of researchers well versed in the relevant theory. Time and budgetary constraints have forced moderate-sized physical activity behavior studies to opt for tools that have not been formally validated to assess constructs of interest. Since the psychometric properties of the items used to assess parental support, self-efficacy, involvement in community sports, and television viewing and video game playing habits in this study were never formally assessed, the use of non-validated tools were a source of measurement bias. To compensate, each item was assessed individually and summary scores were not used in the final analyses of this study. This procedure increased the number of potential correlates entered into the multivariate analyses, which reduced the power of the study to detect significant correlates within the given sample size.

Social desirability bias, a final source of information bias, occurs when the responses of individuals in a questionnaire are influenced by what they think the investigator or other people would expect to learn from their response (175). The association that overweight children were more likely to be active than children who were not overweight suggests that either this association is true, that the overweight children inflated their physical activity frequencies by checking off too many cells, or that the children who were not overweight checked off too few cells. In their report of physical activity and fatness among children in the NHANES III survey, Andersen et al. (1998) report that boys who were the most vigorously active had the highest BMIs, and boys who were only vigorously active 3 times or fewer per week had the lowest (114). Though these authors did not elaborate, this finding might simply be due to the boys having a higher proportion of lean muscle tissue.

3) Confounding: since 20% of children are expected to experience the onset of puberty by age 11 (67), since girls develop into adolescence at an earlier age than boys, and since adolescence is marked by both physiological and psychosocial change, gender was expected to confound the relationship between physical activity and several of the potential correlates. As an indicator of maturity was not included in the KSDPP design, comparing the results of the stratified and non-stratified analyses controlled the confounding effects of gender. The gender stratified analysis revealed that boys and girls are differentially influenced by community- and family-related variables.

4.3.2 External validity

Since the purpose of this study was to assess correlates of physical activity in Aboriginal children, the significant correlates are not directly applicable to the general population. To facilitate univariate comparisons with the general population, indicators of overweight and physical fitness were age- and sex-standardized using cutoff values derived from NHANES II (192) and the FITNESSGRAM (1987)(184,185), respectively. Furthermore, the cutoff values for physical activity were aligned with published physical activity recommendations for children. Comparing these results with those of the general population suggest that the Mohawk children of this study are not very different from other children.

The result in which year of measurement was found to be a significant correlate of physical activity poses a potential limitation to the external validity of the results. That is, repeated measures using the same instrument might have resulted in students learning about the instrument and answering questions differently in subsequent assessments. This might have affected the relationship between physical activity and other variables. Such an effect would not be seen in students who are being measured for the first time. Since there were only two measurement sessions, two years apart, the effect of repeated measures on the relationship of interest and the external validity of the results is likely to be minimal.

Insofar as external validity with other Aboriginal populations is concerned, other physical and social environmental factors must be considered. For instance, communities that experience a colder climate, greater isolation, fewer physical activity resources, and greater access to television might find differing influences on children's physical activity. In their study of the geographical distribution of diabetes among Natives in Canada, Young et al. (1990) found that the distribution is determined by both genetic and environmental factors. These authors found that communities situated in south-eastern Canada that are proximal to large urban centers and whose inhabitants are of Iroquoian and Algonquin speaking linguistic groups have the highest diabetes prevalence rates (193). Since Kahnawake conforms to all these specifications, the external validity of these results may be extended to Native communities that have similar attributes.

4.4 Correlates not assessed

Since the objective of KSDPP was not to assess correlates of physical activity in elementary school children, several potentially interesting variables were either not assessed or sufficiently detailed to allow for a more comprehensive analysis of correlates. Of the physical activity determinants listed in the Background section of this dissertation and suggested in Social Cognitive Theory, the influence of community-prevalent values on the socializing of children into sports and activity is an important consideration.

For instance, the salient 'masculinity' of Kahnawake and its effects on the children's physical activities can be alluded to by a brief accounting of community organized activities and events. First, there are numerous organized physical activities in which children can participate. Lacrosse, hockey, wrestling, tae kwon do, boxing, golf, softball, figure skating, paddling, swimming, and school sports are the most popular organized activities in the Kahnawake; most of them are traditionally masculine sports. Though there are girls participating in sports like lacrosse, hockey, wrestling, and tae kwon do, they largely do not continue with these sporting endeavors into adolescence. Thus, in adolescence, there are fewer activities available for girls than there are for boys. Second, the emphatic community support for lacrosse, wrestling, boxing, 'Tough Guy' competitions, and 'Gladiator' fundraising events, most of which are participated in only by males, may reinforce the value that sport and physical activity is a more masculine endeavor.

Garcia et al. (1995) cite that an "absence of a highly athletic self-schema, low self-esteem, low perceived health status, and a behavioral history of minimal exercise, taken together, may make girls more vulnerable than boys to the scarcity of exercise role models and the lower level of social support for exercise" (89). From this, community roles models, pervasive community attitudes towards sport and physical activity, personal attitudes towards being active, and perceived norms and desire to conform to perceived norms are some psychosocial variables that might be considered in further assessing correlates of physical activity in Aboriginal communities such as Kahnawake.

4.5 Conclusion

The frequency of physical activity and the correlates of physical activity were identified among children in grades 4 through 6 in the Kahnawake and Tyendinaga Mohawk communities. These results suggest that these children are as physically fit and active as other children, but are more overweight. Boys are also more active than girls are. The year that the children were measured was the most significant correlate independent of the intervention, suggesting that the act of being measured was an intervention in itself. Significant correlates for boys were younger age, enrollment in a particular school, enrollment in lessons, and involvement in summer sports. Parents' being physically active was the only significant correlate for girls while parents offering to exercise with their daughters approached significance. Fewer correlates identified in girls suggested that there were other relevant variables not assessed in this study. In sum, boys seemed to be more influenced by community-oriented variables while girls were more influenced by family-oriented variables. These results emphasize that community-prevalent values affecting the physical activities of children, especially girls, should be explored.

Appendix I:

Kahnawake Schools Diabetes Prevention Project

1996 In-Class Student Questionnaire (Grades 4- 6)

Kahnawake Schools Diabetes Prevention Project

1996

In-Class Student Questionnaire (Grades 4 - 6)

- **This questionnaire is about eating and exercise.**
- **Do not write in the gray shaded area.**
- **Fill out the identification section on this page.**
- **For confidentiality reasons, this front page will be detached when a project I.D. number will be assigned.**

Identification Section

School: ❑ Karonhianónha ❑ Kateri ❑ Quinte Mohawk

Student Name: ______________________________

Date of Birth: ______ / ______ / ______

Class: ______________________

STUDENT QUESTIONNAIRE (GRADES 4-6)

Project I.D. Number: |______|______|______|______|______|______|

Date of Birth: (month / day / year) ______ / ______ / ______

Date received: (month / day / year) ______ / ______ / ______

School: ❑ Karonhianónha ❑ Kateri ❑ Quinte Mohawk

File Number: 3 **Project's year:** 3

There are no right or wrong answers to the questions.
Just indicate whatever is true for you.

Please give the following information by placing a check (✓) beside the answer that is true for you.

Do not write on this page

Do not write here

|3| 1
|3| 2
|_|_|_| 3-5
|_|_|_| 6-8
|_|_| 9-10
|_|_| 11-12
|_|_| 13-14
|_|_| 15-16
|_|_| 17-18
|_|_| 19-20
|_| 21
|9| 22

Do not write here

Please give the following information by placing a check (✓) beside the answer that is true for you.

1.1a You are in grade: |_| 23

❑ 4 ❑ 5 ❑ 6

1.1b You are a: |_| 24

❑ Girl
❑ Boy

1.2a How many brothers and sisters do you have? |_| 25

❑ None
❑ 1 ❑ 2 ❑ 3
❑ 4 ❑ 5 ❑ 6 ➡ Other (specify): ________

1.2b Indicate your birth order (for example, first born, second born, third born, etc.) |_| 26

❑ 1 ❑ 2 ❑ 3
❑ 4 ❑ 5 ❑ 6 ➡ Other (specify): ________

TELEVISION VIEWING AND VIDEO GAMES

1.3 On school days, you usually watch: |_| 27

❑ 6 or more TV programs a day
❑ 4 or 5 TV programs a day
❑ 2 or 3 TV programs a day
❑ 1 TV program a day
❑ I don't watch TV on school days

1.4 Usually, you play video games like Nintendo, Sega or Gameboy: |_| 28

❑ Every day
❑ Several times a week
❑ Rarely
❑ I never play video games

1.5a On Saturday mornings, you usually watch television or video cassettes: |_| 29

❑ All morning
❑ most of the morning
❑ Part of the morning
❑ I don't watch TV or video cassettes on Saturday mornings

Do not write here

1.5b On Saturday afternoons, you usually watch television or video cassettes: |_| 30

- ❑ All afternoon
- ❑ Most of the afternoon
- ❑ Part of the afternoon
- ❑ I don't watch TV or video cassettes on Saturday afternoons

PHYSICAL ACTIVITY

Check the response (✓)

1.6 Does one of your parents or guardians do physical activity or play sports: |_| 31

- ❑ Rarely or never
- ❑ Sometimes
- ❑ Often

1.7 Does one of your parents or guardians tell you to be physically active or to play sports: |_| 32

- ❑ Rarely or never
- ❑ Sometimes
- ❑ Often

1.8a Since the beginning of the school year, have you joined a sports team? |_| 33

- ❑ Yes ➡ Which one(s)? ____________________ |_||_| 34-35
- ❑ No

1.8b Last summer, did you belong to a:

	Yes	No	
Baseball team	❑	❑	|_| 36
Lacrosse team	❑	❑	|_| 37
Swimming team	❑	❑	|_| 38
Paddling club	❑	❑	|_| 39
Golf Team	❑	❑	|_| 40
Soccer Team	❑	❑	|_| 41
Gymnastic Club	❑	❑	|_| 42
Other sports team	➡ ____________________		|_| 43
			|_||_| 44-45

Do not write here

1.9 **Since the beginning of the school year, did you take any lessons like swimming, dance, ballet, gymnastics, tae kwon do or judo?** |_| 46

❑ No

❑ Yes ➨ How many hours a week did you practice this activity?

_____________ hours. |_|_| |_|_| 47-48

Mark a check (✓) to show which days you did this activity

1.10a **Think about activities you did last week from Monday to Sunday. For each day you participated in a gym class at school, mark a check (✓) to show which days you did it.** |_| 49

Activity	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Gym class at school							

1.10b **Read the activity in the table and think about the activities you did last week from Monday to Sunday. Mark a check (✓) to show which days you did this activity for 15 minutes at a time or more outside of school hours.** |_| 50

Activity	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Walk							

Do not write here

1.10c **Read each activity in the table and think about the activities you did <u>last week</u> from Monday to Sunday. Mark a check (✓) to show which days you did any of these activities for 15 minutes at a time or more <u>outside of school hours</u>.**

Activity	Monday	Tuesday	Wednes-day	Thursday	Friday	Satur-day	Sunday	Do not write here
Do not put a check (✓) if you did this activity at school during gym class								
Bicycling								|_| 51
Swimming								|_| 51
Jogging								|_| 53
Golfing								|_| 54
Roller skating / blading								|_| 55

1.10d **Read each activity in the table and think about the activities you did <u>last week</u> from Monday to Sunday. Mark a check (✓) to show which days you did these activities for 15 minutes at a time or more <u>outside of school hours</u>.**

Activity	Monday	Tuesday	Wednes-day	Thursday	Friday	Satur-day	Sunday	Do not write here
Do not put a check (✓) if you did this activity at school during gym class								
Skipping rope								|_| 56
Lacrosse								|_| 57
Skateboarding								|_| 58
Baseball / Softball								|_| 59
Ball games								|_| 60
Soccer								|_| 61

Do not write here

1.10e Read each activity in the table and think about the activities you did last week from Monday to Sunday. Mark a check (✓) to show which days you did this activity for 15 minutes at a time or more outside of school hours.

Activity	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Do not write here
Do not put a check (✓) if you did this activity at school during gym class								
Skating								|_| 62
Basketball								|_| 63
Football/Touch football								|_| 64
Jazz ballet								|_| 65
Aerobic Dance								|_| 66
Social Dance								|_| 67
Activity	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	
Running games (Tag)								|_| 68
Play outside/in the street								|_| 69
Boxing / Wrestling								|_| 70
Judo / Karate								|_| 71
Hockey / Ball Hockey								|_| 72
Hopscotch								|_| 73
Bowling								|_| 74
Gymnastic								|_| 75

Do not write here

PART 2

Please give the following information by placing a check (✓) beside the answer that is true for you.

Mark only one check (✓) for each of the food items listed below.

WHAT HAVE YOU BEEN EATING?

2.1a During the past week, how often did you eat the following foods?

Food Item	How often? Did not eat it	Once	2 to 3 times	4 to 5 times	Everyday	Do not write here
Milk (including in cereal)						|_| 76
Cheese						|_| 77
Yogurt						|_| 78
Ice Cream						|_| 79
Vegetables (raw or cooked)						|_| 80
Vegetable juice (V-8, tomato juice, etc.)						|_| 81
Green salad or lettuce						|_| 82
Fruit (orange, apple, banana, grapes, etc.)						|_| 83
Fruit juice						|_| 84
Brown Bread						|_| 85
White Bread						|_| 86
Rice						|_| 87
Potatoes						|_| 88
Bagel						|_| 89

Do not write here

Please give the following information by placing a check (✓) beside the answer that is true for you.

Mark only one check (✓) for each of the food items listed below.

2.1b During the past week, how often did you eat the following foods?

Food Item	Did not eat it	Once	2 to 3 times	4 to 5 times	Everyday	Do not write here
Cookies						|_| 90
Donuts, cake, or pastries						|_| 91
Crackers						|_| 92
Croissant or sweetrolls						|_| 93
High fiber cereals (Oatmeal, bran)						|_| 94
Sweetened cereals (Sugar Crisps, Fruit Loops)						|_| 95
Grain cereals (Corn Flakes, Cheerios)						|_| 96
Pancakes						|_| 97
French toast or waffles						|_| 98
Sodas or Soft drinks (Coke, Pepsi, Diet-Pepsi)						|_| 99
Candy or chocolate bars						|_| 100
Salad dressing or mayonnaise						|_| 101
Gravy						|_| 102
Peanut butter						|_| 103
Jam or syrup						|_| 104
Cornbread						|_| 105
Muffin						|_| 106
Tortillas						|_| 107

Do not write here

Please give the following information by placing a check (✓) beside the answer that is true for you.

Mark only one check (✓) for each of the food items listed below.

2.1c During the <u>past week</u>, how often did you eat the following foods?

Food Item	How often? Did not eat it	Once	2 to 3 times	4 or more times	Do not write here
Baked beans or chili beans					|_| 108
Spaghetti, macaroni, or other pasta					|_| 109
Eggs					|_| 110
Pork (including chops or roast)					|_| 111
Pizza					|_| 112
Hot dogs or Pogo					|_| 113
Hamburgers					|_| 114
Bacon or sausages					|_| 115
Cold cuts (salami, bologna, ham, pepperoni)					|_| 116
Hamburger steak (including meatballs)					|_| 117
Chicken or turkey					|_| 118
Fish					|_| 119
Fried fish					|_| 120
Steak or roast beef					|_| 121
French fries or poutine					|_| 122
Fried chicken (like Kentucky)					|_| 123
Meat pie					|_| 124
Dumplings					|_| 125
Potato chips					|_| 126

Do not write here

PART 3

Please give the one best answer for you.
If you don't know, choose "I don't know".

Check one response (✓)

EATING HABITS, EXERCISE & FAMILY SUPPORT

3.1 Are activities like running, walking, biking or playing sports good for your health? |_| 127

- ❑ Yes
- ❑ No
- ❑ I don't know

3.2 When you play or exercise, do you think that it is better for your health if you breath harder and your heart beats faster? |_| 128

- ❑ Yes
- ❑ No
- ❑ I don't know

3.3 Which of these exercises makes your heart beat fastest? |_| 129

- ❑ Walking
- ❑ Running
- ❑ Golfing
- ❑ I don't know

3.4 How many times a week should you exercise? |_| 130

- ❑ At least three times a week
- ❑ Twice a week
- ❑ Once a week
- ❑ I don't know

3.5 Do eating habits (food choices) affect your health? |_| 131

- ❑ Yes
- ❑ No
- ❑ I don't know

Do not write here

3.6 A healthy snack is: |_| 132

- ☐ A donut
- ☐ Fresh fruit
- ☐ Potato chips
- ☐ I don't know

3.7 A healthy lunch is: |_| 133

- ☐ Bologna sandwich, milk, chips, cookies
- ☐ Hamburger, french fries, pickles, milk
- ☐ Vegetable soup, egg sandwich, fruit, milk
- ☐ I don't know

3.8 Is brown bread (like whole wheat, rye) better for your health than white bread? |_| 134

- ☐ Yes
- ☐ No
- ☐ I don't know

Below is a list of things people might do or say to someone who is trying to exercise regularly or eat healthy food.

During the past six months, how often someone in your family (parents, grandparents, brothers, sisters) did the following?

For each question, please mark (✓) only one answer.
Give one answer to every question.

During the past six months,

my family (or members of my household) has:

3.9 Encouraged me to eat "healthy food"? |_| 135

- ☐ Never
- ☐ Rarely
- ☐ A few times
- ☐ Often

3.10 Reminded me not to eat junk food? |_| 136

- ☐ Never
- ☐ Rarely
- ☐ A few times
- ☐ Often

Do not write here

For each question, please mark (✓) only one answer .
Give one answer to every question.

<u>During the past six months,</u>

my family (or members of my household) has:

3.11 Complimented me on changing my eating habits (or told me something positive about the way I eat like "Keep up", "We are proud of you"). |_| 137

- ❑ Never
- ❑ Rarely
- ❑ A few times
- ❑ Often

3.12 Exercised with me. |_| 138

- ❑ Never
- ❑ Rarely
- ❑ A few times
- ❑ Often

3.13 Offered to exercise with me. |_| 139

- ❑ Never
- ❑ Rarely
- ❑ A few times
- ❑ Often

3.14 Encouraged me to exercise ("Are you going to play outside?"). |_| 140

- ❑ Never
- ❑ Rarely
- ❑ A few times
- ❑ Often

Do not write here

HOW DO YOU FEEL ABOUT...

Please rate how sure you are that you can do each of these activities. Please only one check (✓) for each activity.

3.15 How sure are you that you could really try to do each of the following activities regularly, beginning tomorrow, for at least the next six months.

Activity	I know I cannot	Maybe I can	I know I can	
Eat fruits instead of cookies or candies for dessert or snack				|_| 141
Eat carrots or celery instead of chips for snacks.				|_| 142
Eat plain popcorn instead of chips.				|_| 143
Eat bread with little or no butter or margarine on it.				|_| 144
Eat whole grain cereals instead of refined cereals.				|_| 145
Eat baked potatoes instead of french fries.				|_| 146
Drink low fat or skim milk instead of whole milk.				|_| 147
Walking or biking instead of getting a ride in a car.				|_| 148
Play outside after school.				|_| 149
Play outside on weekends.				|_| 150
Play outside instead of watching TV or playing video games.				|_| 151

Do not write here.

NUTRITION, DIABETES AND LIFESTYLE

5.1 To be in good health, is it important to eat foods from the four food groups and to be physically active everyday? |_| 152

- ❑ Yes
- ❑ No
- ❑ I don't know

5.2 Which of these foods <u>does not</u> belong to any of the four food groups? |_| 153

- ❑ Soda
- ❑ Corn
- ❑ Bread

5.3 A balanced meal has at least one food from each of the four food groups? |_| 154

- ❑ Yes
- ❑ No
- ❑ I don't know

5.4 Diabetes is the name of a disease which affects many Native people? |_| 155

- ❑ Yes
- ❑ No
- ❑ I don't know

5.5 What is the best way to try to prevent diabetes? |_| 156

- ❑ Watching T.V.
- ❑ Riding your bike
- ❑ I don't know

5.6 Do you think that diabetes is a major problem in Kahnawake? |_| 157

- ❑ No
- ❑ Yes
- ❑ I don't know

Do not write here

5.7 **Reading package labels can heou to find out more about the nutrients in a food?** |_| 158

- ❑ No
- ❑ Yes
- ❑ I don't know

Do you have any comments about this questionnaire or about the Kahnawake Schools Diabetes Prevention Project? |_| 159

____

____

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Do you have any suggestions for activities or projects that can be organized in the school or in the community to encourage people to become more physically active or to eat more healthy food? |_| 160

____

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____

Your contribution is very much appreciated.
Thank you for your help.

Appendix II: NHANES II 85th percentiles (192)

a) Body mass index (weight/height2)

Age	Girls' Value	Boys' Value
5	16.9	16.8
6	17.2	17.1
7	17.6	17.7
8	18.8	18.1
9	19.9	19.4
10	20.5	20.0
11	21.7	21.7
12	22.7	22.1

b) Subscapular skinfolds measurement (mm)

Age	Girls' Value	Boys' Value
5	8.0	6.0
6	7.0	5.5
7	8.0	6.0
8	11.5	7.5
9	14.0	10.5
10	16.0	11.0
11	16.0	15.0
12	15.5	14.0

c) Triceps skinfolds measurement (mm)

Age	Girls' Value	Boys' Value
5	14.0	12.0
6	13.5	12.0
7	15.0	13.0
8	17.0	13.0
9	19.5	16.5
10	20.0	18.0
11	21.5	20.0
12	20.5	20.0

d) Sum of skinfolds measurement (mm)

Age	Girls' Value	Boys' Value
5	21.0	18.0
6	22.0	19.0
7	24.0	20.5
8	28.5	21.0
9	30.5	27.0
10	34.5	28.0
11	37.0	36.4
12	36.3	34.0

Appendix III: FITNESSGRAM values (minutes) (184)

Age	Girls' Value	Boys' Value
5	17	16
6	16	15
7	15	14
8	14	14
9	13	12
10 +	12	11

Correlates of Physical Activity Frequency in

Mohawk Elementary School Children

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