ABSTRACT

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This study investigated the health-related fitness of Hmong youth (male and female), grades 6-11 in the La Crosse School District using the presently implemented physical fitness test battery. Subjects were 2,674 students, including 202 Hmong. The subjects were split into 2 groups, Hmong (H) and all others (AO), then subsequently divided into 3 age categories: 13 years and under, 14-16 years, and 17 years and over. All subjects performed the following tests: sit ups (SU), mile run (MR), sit and reach (SR), flexed arm hang (FAH) or bench press (BP), and skinfold measures (SF). The results were analyzed by t-tests to determine significant differences between H and AO ($p \leq .05$). Current fitness levels were compared to health-related criteria for each component of fitness. Sit up scores for H females, across all age groups, fell into the suboptimal category and were significantly different from AO females in each age group. Mile run scores for both H and AO fell into the good or marginal fitness category. No significant differences were found between groups for any age classification. Sit and reach scores in all cases (except H females, 14-16 years), H were significantly different from AO and fell into the above optimal category. Flexed arm hang scores H (males and females) 13 years and under were below optimal. Skinfold scores for all subjects (except H males 13 years and under) were within the optimal category for health-related fitness. This research identifies the current health-related fitness levels of students in a Midwestern school district and suggests cultural differences that may influence that fitness status. Recommendations are made for practical application and future research.

HEALTH-RELATED FITNESS

IN

HMONG YOUTH

A THESIS PRESENTED

TO

THE GRADUATE FACULTY

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Candidate: Jennifer Alyce Lamb

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Lisa A. Chase — 10/4/93
Thesis Committee Chairperson Signature — Date

[signature] — 10/4/93
Thesis Committee Member Signature — Date

[signature] — 10/4/93
Thesis Committee Member Signature — Date

[signature] — 10/4/93
Thesis Committee Member Signature — Date

This thesis is approved by the College of Health, Physical Education, and Recreation.

[signature] — 1-21-94
Associate Dean, College of Health, Physical Education, and Recreation — Date

[signature] — 8 Feb 94
Dean of UW-L Graduate Studies — Date

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DEDICATION

This thesis is dedicated to my two best friends...

Dad and Mom.

Thanks

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CHAPTER I

INTRODUCTION

Concern for youth fitness in the United States can be traced to the 1860's and the earliest physical education programs (Pate, 1983). These programs were instituted to promote health through vigorous activity, the focus being improvement of muscular strength and flexibility. Strength was believed to be the pathway to fitness and consequently fitness tests focused on the measurement of muscular strength.

Between 1900-1940 a health-related approach to fitness became secondary to the development of motor performance and game/sport skills. The motor performance philosophy became preeminent. To address this focus, motor development and sports programs were initiated in schools. Motor development encompassed components which contributed to an individual's overall movement ability (i.e., speed, agility, power, muscular strength and cardiorespiratory endurance). The previous muscular strength tests were replaced with multi-test batteries that evaluated "athletic achievement."

Youth fitness may have achieved its highest public profile in the early 1950's (Pate, 1983). Kraus and Hirschland (1954), in a landmark study, tested the muscular

fitness levels of 4264 American and 2870 European students, (ages 6-16) from comparable urban and suburban communities, to determine whether or not students had sufficient strength and flexibility to meet daily demands. It was concluded that youth in the United States were less physically fit than their European counterparts (57.9% failure by American students, 8.7% failure by European students) and that insufficient exercise caused a dropping of muscular fitness below the minimum necessary for daily living (Kraus and Hirschland, 1954). In reaction to this study, President Eisenhower, one of Kraus's patients, created the President's Council on Physical Fitness. The primary function of this program was to promote the enhancement of physical fitness among school-aged children. According to Phillips (1955), the Kraus-Weber Test Battery was a minimal test of fitness, incapable of measuring all important components of youth fitness. It was for this reason, as well as President Eisenhower's actions, that a special committee of the AAHPER (American Alliance for Health, Physical Education, and Recreation) research council developed a seven item national youth fitness test battery. This test was designed to comprehensively evaluate fitness of American youths (Corbin and Pangrazi, 1992). The AAHPER Youth Fitness Test, introduced in 1958, evaluated motor fitness using tests which measured speed, agility, power, cardiorespiratory endurance, and muscular strength/endurance.

The motor performance philosophy continued to dominate youth fitness programs through the 1960s. This trend was encouraged by the rapid expansion of school athletic programs during the 1950s and 1960s. In 1965, the Presidential Fitness Award based on the AAHPER Youth Fitness Test was instituted. The award recognized high levels of motor performance measuring speed, power, agility, cardiorespiratory endurance, and muscular strength.

By the mid 1970's, dissatisfaction with the motor performance emphasis had developed. The message being sent to students was if you want to be fit you must be fast, agile and powerful (Pate, 1983). Failure to pass these tests contributed to a decline in students' self-esteem as well as participation in activity. This discontent ultimately led to the changing of the youth fitness philosophy from an emphasis on motor performance to one of health-related fitness. In 1980, AAHPERD (Dance was added to the title in 1979) published a health-related physical fitness manual which made a distinction between health-related fitness objectives and motor performance objectives (Mc Swegin, Pemberton, Petray, & Going, 1989). The new test was introduced in response to the belief by many that fitness tests must measure those variables which are likely to be related to health problems encountered in western culture (Corbin, 1987). That same year the U.S. Department

of Health and Human Services endorsed the implementation of health-related fitness programs for children (Pate, 1983).

Health-related physical fitness is defined as the ability to perform strenuous physical activity with vigor and without excessive fatigue as well as the demonstration of physical activity traits and capacities that are consistent with minimal risk of developing hypokinetic diseases. Motor performance, on the other hand, measures the ability to perform physical activity traits which contribute to overall movement ability (Pate, 1983).

Two widely used health related physical fitness test batteries for youth are Physical Best, which measures cardiorespiratory fitness (mile run), body composition (skin fold measurements), muscular strength/endurance (sit-ups and pull-ups) and flexibility (sit and reach) (McSwegin et al., 1989) and Fitnessgram (Institute for Aerobic Research, 1987). Fitnessgram uses the same tests as Physical Best with the addition of the flexed arm hang to measure muscular strength.

Statement of the Problem

Coronary heart disease was long thought to be a disease of the aging adult; however, many of the risk factors of heart disease begin in childhood. Therefore it is important to test and monitor health-related fitness in youths as well as adults (Baranowski, 1992). Obesity in children causes increased risk of hypertension, respiratory

diseases, diabetes, and several orthopedic conditions (Gortmaker, S., Dietz, W., Sobol, A., Wehler, C., 1987).

The United States is often labeled the melting pot of the world due to its cultural diversity, yet there is very little fitness data available on U.S. children of different cultural backgrounds. One of the many cultures unrepresented in current fitness data is the Hmong population.

In 1975, the Hmong, originally from Laos, fled Southeast Asia and emigrated to the United States after becoming primary targets for annihilation by Communist forces. This was the same year that U.S. military forces withdrew from Southeast Asia. Today, approximately 90,000 Hmong have resettled in the United States (Kreiger, 1992). The demographics of the Hmong population in La Crosse County alone are significant. As of 1993, 2,737 Hmong, approximately 70% of which are under the age of 18, reside in the area (D. Tucker, personal communication, March, 1993). La Crosse has the third highest Hmong population in the United States. At the present time there is no data available on Hmong youth fitness.

Statement of the Purpose

The purpose of this study was to determine the health-related fitness (muscular strength, muscular endurance, flexibility, body composition, and cardiovascular endurance) levels of 202 Hmong youth (male and female), grades 6-11, in

the La Crosse School District using the presently implemented test battery.

Assumptions

This study had the following assumptions:

1. The students are of Hmong descent.
2. The student's comprehension of the English language is adequate to understand the instructions given to them.
3. The students gave their best effort on all tests.
4. The La Crosse Public School Physical Fitness Test battery is valid and accurate.
5. All the battery administrators were competent in administering the test.

Limitations

This study has the following limitations:

1. The subject selection was limited to Hmong students grades 6-11 in La Crosse, Wisconsin.
2. The results of this study will be specific to the Hmong population.

Delimitations

This study has the following delimitation:

1. The La Crosse Public School Physical Fitness Test, which is part of the Physical Education curriculum, was used rather than any other physical fitness battery test.

Definition of Terms

The following terms were used in this study:

Health-related fitness - the ability to perform strenuous physical activity with vigor and without excessive fatigue as well as the demonstration of physical activity traits and capacities that are consistent with minimal risk of developing hypokinetic diseases (Pate, 1983).

Hmong - minority hill tribe from the country of Laos (Tucker, 1991).

Motor performance - the ability to perform physical activity traits which contribute to overall movement ability. Motor performance is often referred to as "athletic fitness" (Pate, 1983).

La Crosse Public Schools Physical Fitness Test - a health-related physical fitness test which evaluates muscular strength, muscular endurance, flexibility, body composition, and cardiovascular endurance.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Youth fitness has become increasingly important in the United States. The emergence of coronary heart disease (CHD) as the number one cause of death has created a large interest in the fitness level of youth. Approximately 50% of all adult deaths annually are caused by CHD. Among the major risk factors that are alterable in children are hypercholesterolemia, obesity, and sedentary lifestyle (Cohen, McMillian & Samuelson, 1991).

The purpose of this study was to determine the health-related fitness levels of 202 Hmong youth, grades 6-11, in the La Crosse School District using the La Crosse Public Schools Physical Fitness Test battery. The following review of literature will focus on youth fitness testing, the components of current health-related youth fitness tests, and the fitness level of America's children, specifically Hmong children.

Youth Fitness Testing

The catalyst in the emphasis on measurement of youth fitness was the 1954 study by Kraus and Hirschland. This study concluded that U.S. youth were less physically fit than their European counterparts. In 1958, the American

Alliance for Health, Physical Education and Recreation (AAHPER) developed a youth fitness test. The designers of this test equated youth fitness with speed, power, agility, cardiovascular endurance, and muscular strength/endurance (Pate, 1983). Motor performance levels were the measure of youth fitness until the late 1970's; physical educators became dissatisfied with the performance emphasis and its promotion of athletic ability.

In 1980, the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) published the Health-Related Fitness Manual as a first step to incorporate current research findings in its operational definition of physical fitness. Using these findings, a health-related fitness test was created [see Table 1] (Pate, 1983). Promotion of the concept of health-related fitness was meant to compliment the motor skill objectives of Physical Education programs (McSwegin et al, 1989). Also in 1980, the U.S. Department of Health and Human Services endorsed the implementation of health-related fitness programs for children (Pate, 1983).

Two widely used health-related fitness test batteries are Physical Best (AAHPERD, 1988) and Fitnessgram (Institute for Aerobics Research, 1987). The only difference between the two is that Fitnessgram offers an alternative to pull-ups, the flexed arm hang.

Table 1. Comparison of 1958 and 1980 youth fitness tests

Test item	Fitness components
AAHPER (1958) Youth fitness test	
Pull-ups/modified pull-ups	Muscular strength
Sit-ups	Muscular endurance
Shuttle run	Agility, speed
Standing broad jump	Power
50-yd dash	Speed
Softball throw	Skill
600-yd run/walk	Cardiovascular endurance, speed
AAHPERD (1980) Health-related fitness test	
Mile run or 9-minute run	Cardiovascular fitness
Sum of triceps and subscapular skinfolds	Body composition
Sit-ups	Muscular endurance
Sit and reach	Flexibility

Components of Youth Fitness

There are five components of health-related youth fitness that are addressed in the literature. These are the variables tested in the La Crosse Public School test battery.

Cardiovascular Endurance

Coronary heart disease (CHD) is the greatest single cause of death in the United States. Cardiovascular

endurance and the aerobic exercise that develops it have been linked to reduced risk of CHD (Pate, 1983).

In their 1989 report, Updyke and Willett showed approximately a 10% decline in aerobic fitness of children as measured by distance runs (3/4 mile for 10-11 year old and 1 mile for children 12 and older). Both boys and girls showed a decline over the ten-year study.

There is strong evidence that the onset and rapid development of CHD can begin during youth, leading to an irreversible condition. It is, therefore, important to encourage young people to adopt lifestyles that increase their energy base through improved aerobic endurance and, in turn, decrease their risk of developing CHD (McSwegin et al, 1989).

Body Composition

Recent estimates indicate that 15% to 25% of U.S. school children are obese. Childhood obesity is a major public health problem. Diseases once associated with overweight adults (e.g., diabetes, hypertension and hyperlipidemia) are now being found in obese children (Going, 1988).

Skinfolds are a practical index of body composition. They provide a more accurate estimate of body fatness than simple weight and height or the various ratios of these two measurements (Ross, Pate, Lohman & Christenson, 1987).

Obesity in America's youth is out of control. In one study of children aged 6 to 11 years, the prevalence of

obesity (tricep skinfolds at the 85th percentile) and superobesity (tricep skinfolds at the 95% percentile) increased 54% and 94% respectively from 1963-1980 (Raithel, 1988).

The National Children and Youth Fitness Study (NCYFS I) provided evidence of increased skinfolds in 10 to 18 year old from the 1960's to 1980's (Pate, Ross, Dotson & Gilbert, 1985). A comparison between skinfold data on the National Health Examination Survey (NHES) Cycle 2 (1965) and the second National Health and Nutrition Survey (NHANES), conducted from 1976-1980, indicated a 54% increase in obesity among children 6-11 years old and 98% increase in the superobesity. The NHES Cycle 3 (1966-1970) skinfold data compared to the NHANES data indicated a 39% increase in obesity among children 12-17 years of age and a 64% increase in superobesity (Gortmaker, Dietz, Sobol & Wehler, 1987).

Flexibility

Concern over lack of flexibility in lower back and future risk of back problems was first suggested with the results of the Kraus-Weber tests (Kraus and Hirschland, 1954). Lack of flexibility in the low back/hamstring musculature has been identified as precursors to low back pain (Pate, 1983). Most Americans will encounter back problems at some time during their lives. About 80% of lower back disorders are due to weak or tense muscles (McSwegin et al, 1989).

Muscular Endurance

Low back problems are also associated with weak abdominal muscles. When the abdominal muscles are so weak that they contribute to misalignment of the spine, the strain on the lower back muscles is increased. Improving the strength and endurance of the abdominal muscles can decrease the incidence and severity of back pain (Corbin & Pangrazi, 1989).

Muscular Strength

Upper body strength and endurance are important for performing many daily tasks requiring lifting, carrying, pulling, or pushing objects (Corbin & Pangrazi, 1992). Prevention of injuries may be improved through increases in muscular strength (Rowland, 1992).

Fitness Level of U.S. Children

The fitness level of U.S. children has become a hot topic of debate over the last 10 years. However, it is a debate without an immediate answer. There is not enough evidence to support claims that fitness has declined over the years (Raithel, 1988). There are few health-related fitness variables that have been studied. It is difficult to arrive at such a conclusion with any degree of confidence.

In a study of U.S. children and youth fitness (Corbin & Pangrazi, 1992) it was determined that little, if any, evidence exists that indicates that children are less fit

than they were in previous decades. However, one of the definitive conclusions that can be drawn from studies to date is that children are fatter today than children in decades past (Giel, 1988). The National Children and Youth Fitness Study (NCYFS I) provided evidence of increased skinfolds in 10-18 year old from the 1960's to the 1980's (Pate, Ross, Dotson & Gilbert, 1985). More recently, skinfold data were collected from a nationally representative sample of six to nine year old in NCYFS II. According to NCYFS II, there has been a systematic increase in skinfold thickness among six to nine year old boys and girls (Ross et al., 1987).

The emergence of coronary heart disease (CHD) as the number one killer in the U.S. has forced many individuals to take a good look at personal fitness and the fitness of their children. La Crosse has a significant Hmong youth population; 70% of which are under the age of 18 (D. Tucker, personal communication, March, 1993). However, there is no data presently available on Hmong youth fitness. There is strong evidence that the onset and rapid development of CHD can begin during youth (McSwegin et al., 1989). In an attempt to educate children and parents alike on the risk factors of CHD and how to prevent the onset of disease, fitness testing and educational health-related fitness programs continue to grow throughout the country.

Summary

Youth fitness philosophy in the U.S. has only recently switched from motor performance to health-related emphasis. This switch has resulted in a new set of fitness criteria tests which limit motor performance skills, such as the softball throw; the reason being that they do not contribute to overall health. Two widely used health-related fitness battery tests are Physical Best and Fitnessgram.

Presently, there is no conclusive data on the changes in U.S. youth fitness over the years. One conclusion that can be made from studies is that children are fatter today than children previously studied. The increasing emergence of CHD risk factors in children has alarmed the medical and educational community. Many researchers are now taking a much closer look at the benefits of physical fitness in youth. Complicating this picture is the fact that there are no data available on Hmong youth fitness.

CHAPTER III

METHODS AND PROCEDURES

Introduction

This study was designed to evaluate the health-related fitness level of Hmong students using the La Crosse Public Schools Physical Fitness Test battery which includes measures of muscular strength, muscular endurance, flexibility, body composition, and cardiovascular endurance.

The methods and procedures used in this study have been divided into the following sections: subject selection, testing procedures and apparatus, test protocol, and statistical analysis.

Subject Selection

Hmong children (202 male and female) grades 6-11 in the La Crosse School District participated in this study. All subjects were enrolled in Physical Education classes in the La Crosse School District.

Testing Procedures and Apparatus

A pilot study was completed to insure clarity and organization of the research protocol to be used in this study. The actual fitness testing was performed within a fitness circuit that contained the following stations: flexed arm hang, sit-ups, sit and reach, skinfold measures and the one mile run/walk.

Upon arriving at the test site subjects were weighed to the nearest quarter of a pound and measured to the nearest quarter of an inch using a Toledo Health-O-Meter scale. After all variables were recorded each subject was assigned to a circuit station for testing. When subjects had completed testing at one station they rotated to the next until their data sheet was complete.

The following apparati were used throughout the testing procedure to fully complete the La Crosse Public Schools Physical Fitness Test battery.

Pull Up Bar

A three foot steel bar attached to the wall was used as the flexed arm hang station.

Sit and Reach Box

A box which consisted of a 23 inch ruler with a metal slide was used to measure flexibility of the hamstrings.

Skinfold Calipers

A Lange skinfold caliper (Cambridge Scientific Industries, Inc., Cambridge, MD) was used to measure skinfold thickness.

Stop Watch

An Accusplit 625XCL stop watch was used to monitor the time for the one mile run/walk as well as the flexed arm hang.

Running Track

An eight lane, 440 yard outdoor track was used as the test site for the one mile run/walk.

Test Protocol

The La Crosse Public Schools Physical Fitness Test was used as the testing protocol. This battery was used because it challenged the subjects to perform exercises that were specific to promoting good health and the prevention of cardiovascular disease, rather than the acquisition of sports skills.

Flexed Arm Hang (Muscular Strength)

The flexed arm hang test measures upper body strength. The subject should raise the body to a position where the chin is above the bar with the elbows bent and the palms facing away from the body. The goal is to keep the chin above the bar as long as possible. The timing began as soon as subject was in position. Each subject's score was recorded as the total number of seconds (Corbin & Pangrazi, 1989).

Sit Ups (Muscular Endurance)

The sit up test measures endurance of the abdominal muscles. Each subject will lie on a mat with knees bent and feet flat on the floor, heels approximately 15 inches from buttocks. The arms are crossed and placed on the chest, with the hands on opposite shoulders. The next student waiting to be tested will hold the subject's feet in place.

A full sit up is counted when elbows touch the thighs. Rocking back and forth by lifting the pelvis region off the mat is not allowed. On the instructor's signal, the subject begins the test and continues doing sit ups for sixty seconds. Each subject's score was recorded as the total number completed (Corbin & Pangrazi, 1989).

Sit and Reach (Flexibility)

The sit and reach test measured flexibility in the back of the legs (hamstrings), hips, and lower back. The subject sat at the sit and reach box with legs straight and feet shoulder width apart. The hands were placed one on top of the other. The subject reached forward with both hands pushing the sliding ruler along the measuring scale and held the farthest position for at least one second. Bouncing forward was not allowed. Scores were not recorded unless held at the reach position. Subjects were given two practice attempts. Upon completion of the practice, three attempts were made and scores recorded (Corbin & Pangrazi, 1989).

Skinfold Measures (Body Composition)

Skinfold measures are used to calculate percent fat. Skinfold measures were taken from two sites, the tricep and the calf. The right tricep skinfold was taken first. The instructor measured from the acromion process to the olecranon process and marked the center position of the tricep. Skinfolds were firmly grasped slightly above the

mark and lifted away from the muscle. A Lange skinfold caliper (Cambridge, MD) was used to read the skinfold to the nearest millimeter. Three measurements were taken and scores recorded. The middle score was recorded if the scores were different on each try (Corbin & Pangrazi, 1989).

When measuring the calf skinfold subjects placed the right foot at a ninety degree angle. The measurement spot was marked on the inside and largest part of the calf. Skinfold was grasped firmly above the mark and lifted away from the muscle. Skinfolds were read to the nearest millimeter and recorded. The middle score was recorded if the scores were different on each try (Corbin & Pangrazi, 1989).

One Mile Run/Walk (Cardiovascular Endurance)

The one mile run/walk test measures maximal functional capacity and endurance of the cardiovascular system. All subjects ran/walked one mile. One instructor monitored the time while another counted laps. The test consisted of running four laps on the outside track. The subjects were encouraged to run the entire time, but could walk if necessary. Each subject's score was recorded as a total running/walking time (Corbin & Pangrazi, 1989).

Statistical Analysis

Descriptive statistics were completed on all health-related fitness components. T-tests were also run to determine significant differences ($p \leq .05$) between Hmong

and all other (AO) subjects for the health-related components of fitness. All other subjects is defined as all subjects other than those of Hmong descent. Current fitness levels were then evaluated by health-related criteria for each component of health-related fitness. These components were: muscular strength, muscular endurance, flexibility, body composition, and cardiovascular endurance.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

This study was designed to evaluate the health-related fitness level of Hmong students in a Midwestern school district. The La Crosse Public Schools Physical Fitness Test battery, which includes measures of muscular strength, muscular endurance, flexibility, body composition, and cardiovascular endurance was used. The following schools participated: Central High School, Longfellow Middle School, Lincoln Middle School, Logan Middle School, and Logan High School. The subjects involved in this study were 2,674 students (male and female), 202 of which were Hmong. Due to the fitness level changes which occur naturally with age (Pangrazi & Corbin, 1990), the subjects were split into three age groups: 13 years and under, 14-16 years, and 17 years and over.

The results were analyzed using simple data description and independent t-tests. The ($p \leq .05$) level was used to determine significant differences between Hmong and AO subjects for the health-related components of fitness.

The subject characteristics and a discussion of the fitness variables are presented in this chapter. Tricep and calf skinfolds, sum of skinfolds, abdominal curl ups,

mile run, sit and reach, and flexed arm hang are the variables which were analyzed and compared in this study.

Subject Characteristics

The physical characteristics of all the subjects are presented in Table 2. All students enrolled in Physical Education classes (grades 6-11) in the La Crosse School District participated in this study. Anonymity of all subjects was protected by testing all Physical Education students and assigning each an identification number.

Table 2. Means and standard deviations of physical characteristics of all subjects (N = 2,674)

Variable	13 years and under n = 1,061	14-16 years n = 1,264	17 years and over n = 349
Age			
Everyone	12.42 (.61)	14.96 (.82)	17.30 (.75)
Male	12.43 (.59)	15.02 (.80)	17.30 (.70)
Female	12.40 (.64)	14.92 (.84)	17.29 (.79)
Height(in)			
Everyone	59.98 (4.32)	65.41 (5.08)	66.43 (4.28)
Male	58.71 (4.99)	68.18 (5.29)	68.61 (3.71)
Female	60.60 (3.80)	63.63 (4.05)	64.29 (3.68)
Weight(lbs)			
Everyone	103.68(23.54)	131.22(27.24)	138.21(28.58)
Male	101.76(21.02)	139.95(28.61)	149.94(29.30)
Female	104.62(24.66)	125.42(24.66)	126.41(22.38)
BMI(kg/m^2)			
Everyone	20.28 (4.05)	22.66(34.05)	22.18 (3.51)
Male	20.99 (4.34)	23.91(54.32)	22.64 (3.62)
Female	19.94 (3.85)	21.85 (4.62)	21.72 (3.35)

Note. () = Standard Deviation

Body Mass Index (BMI) is the ratio of body weight (measured in kilograms) to the square of standing height (measured in meters). The established health fitness standard for BMI for males 13 years and under is 15-23 kg/m^2, 14-16 years is 16-24 kg/m^2, and 17 years and over is 18-26 kg/m^2. The established health fitness range for BMI for females 13 years and under is 15-23 kg/m^2, 14-16 years is 17-24 kg/m^2, and 17 years and over is 18-26 kg/m^2 (McSwegin et al, 1989). All subjects were within the optimal health fitness range for BMI.

The physical characteristics of all the Hmong subjects are presented in Table 3. A comparison of the physical characteristics of all Hmong subjects (Table 3) to that of "all other" (AO is defined as all subjects other than those of Hmong descent) subjects (Table 4) clearly shows that the Hmong subjects are both shorter and lighter.

Table 3. Means and standard deviations of physical characteristics of all Hmong subjects (N = 202)

Variable	13 years and under n = 35 M n = 37 F	14-16 years n = 33 M n = 38 F	17 years and over n = 32 M n = 27 F
Age			
All	12.33 (.60)	14.93 (.83)	18.17 (1.38)
Male	12.40 (.60)	15.03 (.92)	18.09 (1.23)
Female	12.27 (.61)	14.84 (.75)	18.26 (1.56)
Height(in)			
All	56.84 (3.74)	60.69 (4.40)	61.52 (4.27)
Male	57.28 (5.37)	63.15 (5.31)	63.28 (3.82)
Female	56.65 (2.88)	59.49 (3.36)	59.36 (3.84)
Weight(lbs)			
All	95.56(22.63)	108.24(16.99)	116.14(14.90)
Male	98.43(20.89)	114.47(20.17)	123.55(14.64)
Female	94.31(23.56)	104.94(14.28)	107.79(10.15)
BMI(kg/m^2)			
All	20.64 (3.67)	20.50 (2.72)	22.05 (2.69)
Male	21.10 (3.36)	19.85 (3.12)	22.20 (2.12)
Female	20.44 (3.82)	20.79 (2.51)	21.87 (3.32)

Note. () = Standard Deviation

Table 4. Means and standard deviations of physical characteristics of AO subjects (N = 2,472)

Variable	13 years and under n = 513 M n = 476 F	14-16 years n = 566 M n = 627 F	17 years and over n = 144 M n = 146 F
Age			
	12.42 (.61)	14.97 (.82)	17.12 (.33)
Male	12.43 (.58)	15.02 (.80)	17.12 (.33)
Female	12.42 (.64)	14.92 (.84)	17.12 (.32)
Height(in)			
	60.23 (4.27)	65.70 (4.98)	67.20 (3.74)
Male	58.82 (4.97)	68.44 (5.16)	69.55 (2.80)
Female	60.94 (3.68)	63.91 (3.94)	64.96 (3.11)
Weight(lbs)			
	104.32(23.51)	132.59(27.13)	142.57(28.63)
Male	102.01(21.07)	141.25(28.38)	155.50(28.60)
Female	105.48(24.51)	126.68(24.65)	129.85(22.34)
BMI(kg/m^2)			
	20.25 (4.08)	22.79(35.07)	22.19 (3.62)
Male	20.98 (4.41)	24.11(55.61)	22.72 (3.83)
Female	19.89 (3.86)	21.93 (4.73)	21.69 (3.37)

Note. () = Standard Deviation

As stated earlier, due to the fitness level changes that naturally occur with age, the subjects were split into three groups. Therefore, the results are split into three separate discussions. First the 13 years and under group, followed by subjects 14-16 years, and lastly subjects 17 years and over.

Results 13 Years and Under

Means and standard deviations for health-related fitness tests are presented in Table 5.

Table 5. All subjects 13 years and under fitness test means and standard deviations

Variable		All others n = 513 Males n = 476 Females	Hmong n = 35 Males n = 37 Females	t	p
Triceps(mm)					
	M	14.07 (6.45)	14.26 (5.28)	.16	.88
	F	15.71 (5.54)	16.95 (5.90)	1.16	.25
Calf(mm)					
	M	15.36 (6.88)	15.32 (6.69)	.03	.97
	F	16.72 (6.21)	16.74 (4.43)	.02	.99
Sum of skinfolds					
	M	29.41(12.82)	29.58(11.58)	.07	.56
	F	32.42(11.27)	33.69 (9.85)	.59	.14
Sit ups					
	M	39.71(10.44)	36.84(13.04)	1.48	.14
	F	34.37(10.18)	27.36 (9.72)	3.99	.00*
Mile run (minutes)					
	M	8.88 (2.19)	9.34 (1.88)	1.20	.23
	F	9.89 (2.09)	10.11 (1.53)	.62	.54
Sit and reach(cm)					
	M	23.33 (8.59)	27.94 (8.48)	3.03	.00*
	F	26.79 (8.46)	31.31 (6.91)	3.12	.00*
Flexed arm hang(sec.)					
	M	14.18(12.65)	11.09(11.98)	1.39	.16
	F	11.13(10.92)	6.15 (8.23)	3.25	.00*

Note. () = Standard Deviation
* = Significant Difference p > .05
Mile times converted to minutes to allow for statistical analysis

Sum of Skinfolds

Skinfold measures are used to calculate percent fat. The Physical Best (AAHPERD) skinfold measures were taken. The two sites used, the tricep and calf, were added together. The sum of skinfolds was then compared to the established health fitness standard (McSwegin et al, 1989). The optimal fat content for boys is defined as 10-20% (12-25mm) and for girls is 15-27% (16-36mm). These optimal ranges account for age differences and preferences for activity, and are associated with little or no health risk due to diseases related to body fatness (McSwegin et al, 1989).

No significant differences were found in the sum of skinfolds between the H and AO subjects, both male and female. In addition, all female subjects were within the optimal range. However, all male subjects were slightly over the optimal range.

Sit Ups

The sit up test measures endurance of the abdominal muscles. Subjects completed as many sit ups as possible in 60 seconds (Corbin & Pangrazi, 1989).

The health fitness standard defined as optimal for males 13 years and under is 38-40 sit ups (McSwegin et al, 1989). The Hmong male sit up score was below the optimal fitness standard. AO male sit up score was within the

optimal fitness standard. However, no significant ($p \leq .05$) difference was found between the two.

The health fitness standard defined as optimal for females 13 years and under is 33 sit ups (McSwegin et al, 1989). The Hmong female sit up score was below the optimal fitness standard as well as significantly less ($p \leq .05$) than that of AO females. AO female sit up score was above the optimal fitness standard.

Mile Run

The one mile run measures maximal functional capacity and endurance of the cardiovascular system. The health fitness categories for males 13 years and under for the one mile run are as follows: 7.52-9.00 minutes - good fitness, 9.02-9.93 - marginal fitness, and over 10.00 - low fitness (Corbin and Lindsey, 1993). The Hmong male one mile run time fell into the marginal fitness category. AO male one mile run time fell into the good fitness category. However, no significant differences were found between the male subjects.

The health fitness categories for females 13 years and under for the one mile run are as follows: 7.52-9.00 minutes - good fitness, 11.02-12.48 - marginal fitness, and over 12.5 - low fitness (Corbin and Lindsey, 1993). All female (Hmong and AO) one mile run times were within the marginal fitness category. No significant difference was found between the two subject groups.

Sit and Reach

The sit and reach test measures flexibility in the back of the legs (hamstrings), hips, and lower back. The health fitness standard defined as optimal is 25 cm for all students (approximately 2 cm past the toes)(McSwegin et al,1989). The students who fall below the 25 cm standard are at an increased risk of developing low back/hamstring disorders (McSwegin et al, 1989).

The average Hmong male sit and reach score was above the optimal fitness standard as well as significantly higher than that of AO males. AO male sit and reach score was below the optimal fitness standard.

The Hmong female sit and reach score was above the optimal fitness standard of 25 cm and also significantly higher than that of AO females. However, AO females sit and reach score was above the optimal fitness standard.

Flexed Arm Hang

The flexed arm hang test measures upper body strength. The optimal health fitness range for males 13 years and under is 12-17 seconds (Institute or Aerobic Research, 1993). The Hmong male flexed arm hang score was below the optimal range. AO males flexed arm hang score was well within the optimal range. However, no significant differences were found between the two subject groups.

The optimal health fitness range for females 13 years and under flexed arm hang is 8-12 seconds (Institute of

Aerobic Research, 1993). The Hmong female score was below the optimal range as well as significantly lower than AO females flexed arm hang score. AO females flexed arm hang score was well within the optimal range.

Results 14-16 Years

Means and standard deviations for health-related fitness tests are presented in Table 6.

Sum of Skinfolds

The optimal range for sum of skinfolds in males 14-16 years is 12-25mm. This range is associated with little or no health risk due to diseases related to body fatness (McSwegin et al, 1989). The sum of skinfolds for both male subject groups were within the optimal range. However the Hmong male sum of skinfolds was significantly lower than that of AO males 14-16 years.

The optimal range for sum of skinfolds in females 14-16 years is 16-36mm. This range is also associated with little health risk as it is related to body fatness (McSwegin et al, 1989). No significant differences were found between the sum of skinfolds for Hmong females and AO females. In addition, all female subjects were within the optimal range.

Sit Ups

The optimal health fitness range for males 14-16 years is 40-44 sit ups (McSwegin et al, 1989). In addition to being within the optimal fitness range, the Hmong male sit

Table 6. All subjects 14-16 years fitness test means and standard deviations

Variable		All others n = 563 Males n = 624 Females	Hmong n = 33 Males n = 38 Female	t	p
Triceps(mm)					
	M	11.05 (5.98)	8.30 (2.49)	4.99	.00*
	F	15.39 (6.42)	15.61 (4.00)	.29	.77
Calf(mm)					
	M	12.21 (6.44)	8.92 (3.02)	5.04	.00*
	F	15.61 (6.85)	15.65 (3.66)	.05	.96
Sum of skinfolds					
	M	23.21(11.81)	17.22 (4.77)	5.62	.00*
	F	31.00(12.57)	31.26 (6.62)	.20	.84
Sit ups					
	M	47.47(11.81)	44.42 (8.32)	1.98	.05*
	F	41.26(11.12)	33.13(11.23)	4.31	.00*
Mile run (minutes)					
	M	8.02 (1.84)	7.57 (1.23)	1.89	.07
	F	9.72 (2.29)	10.26 (1.96)	1.37	.17
Sit and reach(cm)					
	M	26.94 (9.18)	35.34 (7.53)	4.99	.00*
	F	33.43 (9.71)	33.00 (7.32)	.35	.73
Flexed arm hang(sec)					
	M	18.99(12.86)	28.45(18.45)	2.28	.02*
	F	10.99(10.98)	8.35(11.06)	1.04	.30
Bench(lbs)					
	M	130.55(30.94)	111.92(23.50)	2.12	.04*
	F	64.06(17.49)	51.54 (6.89)	2.56	.01*
Repetitions					
	M	3.67 (4.10)	4.00 (3.67)	.28	.78
	F	6.88 (6.15)	8.00 (6.24)	.64	.52

Notes. () = Standard Deviation
* = Significant Difference p > .05
Mile times converted to minutes to allow for statistical analysis

up score was also significantly lower than that of AO males. AO males sit up score was above the optimal range given for males 14-16 years of age.

The optimal health fitness standard for females 14-16 years is 35 sit ups (McSwegin et al, 1989). The Hmong female sit up score was below the optimal standard as well as significantly lower than that of AO females. AO females sit up score was above the optimal fitness standard for females 14-16 years.

Mile Run

The health fitness categories for males 14-16 years for the mile run are: 7.02-8.00 minutes - good fitness, 8.02-9.48 - marginal fitness, and over 9.5 - low fitness (Corbin and Lindsey, 1993). The Hmong male one mile run time fell within the good fitness category. Whereas, AO males one mile run time fell into the marginal fitness category. However, no significant difference was found between the male subjects.

The health fitness categories for females 14-16 years for the one mile run are: 9.27-10.5 minutes - good fitness, 10.5-11.98 - marginal fitness, and over 12.0 - low fitness (Corbin and Lindsey, 1993). The Hmong female one mile time fell within the good fitness category as did AO females. No significant difference was found between the female subjects.

Sit and Reach

The health fitness standard defined as optimal is 25 cm for all students (approximately 2 cm past the toes)(McSwegin et al, 1989). The Hmong male sit and reach score was well above the optimal standard as well as significantly longer than that of AO males 14-16 years. The sit and reach score of AO males was also above the optimal standard.

The sit and reach scores for all female subjects were well above the optimal standard of 25 cm. No significant differences were found between the female subjects.

Flexed Arm Hang

The optimal health fitness range for males 14-16 years is 15-20 seconds (Institute of Aerobic Research, 1993). Hmong male flexed arm hang score was above the optimal health fitness range as well as significantly higher than that of AO males 14-16 years. However, AO males flexed arm hang score was within the optimal health fitness range.

The optimal health fitness range for females 14-16 years is 8-12 seconds (Institute of Aerobic Research, 1993). The flexed arm hang scores for all female subjects were within the optimal fitness range. No significant differences were found between the female subjects.

Bench Press

The bench press test measures upper body strength/endurance by the maximum number of repetitions completed. Females lifted 50% of their body weight and

males lifted 100% of their body weight (Physical Fitness Manual, 1992). This test was used for grades nine through eleven. Although national optimal standards are not available for comparison, a statistical analysis was run.

The H males lifted significantly less weight than AO males. This difference is due to the fact that H males weigh less than AO males (Tables 3 and 4). There was no significant difference between the amount of repetitions completed by the subjects.

The H females also lifted significantly less weight than AO females. This is also due to the difference in body weight between the female subjects (Tables 3 and 4). No significant difference was found between the number of repetitions completed by the subjects.

Results 17 Years and Over

Means and standard deviations for health-related fitness tests are presented in Table 7.

Sum of Skinfolds

The optimal range for sum of skinfolds in males 17 years and over is 12-25mm (McSwegin et al, 1989). The sum of skinfolds for both groups of male subjects were within the optimal range and no significant difference was found.

The optimal range for sum of skinfolds in females 17 years and over is 16-36mm (McSwegin et al, 1989). The sum of skinfolds for both groups of female subjects were within the optimal range and no significant difference was found.

Table 7. All subjects 17 years and over fitness test means and standard deviations

Variable	All others n = 143 Males n = 146 Female	Hmong n = 32 Males n = 27 Females	t	p
Triceps(mm)				
M	9.55 (4.51)	9.07 (3.35)	.52	.60
F	12.74 (5.59)	11.96 (4.11)	.65	.51
Calf(mm)				
M	9.61 (5.03)	8.96 (3.99)	.63	.53
F	13.04 (5.15)	12.33 (5.11)	.62	.54
Sum of skinfolds				
M	19.17 (8.97)	18.04 (7.03)	.61	.54
F	25.70 (9.82)	24.29 (8.61)	.65	.51
Sit ups				
M	52.01(11.76)	46.09(12.28)	2.55	.01*
F	41.17(11.36)	34.28 (8.95)	2.87	.00*
Mile run (minutes)				
M	7.76 (1.77)	8.13 (1.42)	1.08	.28
F	10.50 (2.26)	10.16 (1.98)	.70	.49
Sit and reach(cm)				
M	33.59 (7.12)	37.89 (5.71)	3.19	.00*
F	37.76 (7.34)	35.36 (8.96)	1.46	.15
Bench(lbs)				
M	151.73(29.71)	123.85(27.41)	3.86	.00*
F	66.04(19.27)	50.00 (1.39)	2.97	.00*
Repetitions				
M	3.66 (4.10)	4.00 (3.67)	.28	.78
F	5.90 (4.97)	4.61 (2.87)	1.32	.20

Notes. () = Standard Deviation
* = Significant Difference p > .05
Mile times converted to minutes to allow for statistical analysis

Sit Ups

The optimal health fitness standard for males 17 years and over is 44 sit ups (McSwegin et al, 1989). In addition to being within the optimal range, the H male sit up score was also significantly lower than that of AO males 17 years and under. AO males sit up score was above the optimal standard.

The optimal health fitness standard for females 17 years and over is 35 sit ups (McSwegin et al., 1989). The H female sit up score was below the optimal standard as well as significantly lower than that of AO females 17 years and under. AO females sit up score was above the optimal standard.

Mile Run

The health fitness categories for males 17 years and over for the mile run are: 6.57-8.00 minutes - good fitness, 8.02-8.98 - marginal fitness, and over 9.00 - low fitness (Corbin and Lindsey, 1993). The Hmong male one mile run score fell within the marginal fitness category. Whereas, AO males one mile run score fell within the good fitness category. However, no significant difference was found between the male subjects.

The health fitness categories for females 17 years and over for the mile run are: 9.26-10.50 minutes - good fitness, 10.52-11.98 minutes - marginal fitness, and over 12.00 - low fitness (Corbin and Lindsey, 1993). The mile

run score for both female subjects was within the good fitness category and no significant difference was found.

Sit and Reach

The optimal health fitness standard for all students for the sit and reach test is 25 cm (McSwegin et al., 1989). The H male sit and reach score was well over the optimal standard as well as significantly higher than that of AO males 17 years and over. AO males sit and reach score was also over the optimal standard.

The sit and reach score for all female subjects was over the optimal standard of 25 cm. No significant difference was found between the female subjects.

Bench Press

The bench press test measures upper body strength/endurance by the maximum number of repetitions completed. Females lifted 50% of their body weight and males lifted 100% of their body weight (Physical Fitness Manual, 1992). Although national optimal standards are not available for comparison, a statistical analysis was run.

The H males and females both lifted significantly less weight than that of their counterparts. This difference is due to the fact that H males and females have less total body weight than AO males and females (Tables 3 and 4). No significant differences were found between the total number of repetitions completed by males or females.

Summary

The results of this study show significant differences ($p \leq .05$) between H subjects and AO subjects within the three age divisions. They are as follows.

13 Years and Under

Both the H male and female abdominal curl up scores were below the optimal standard. The H female curl up score was also significantly lower than that of AO females. AO males sit and reach score was below the optimal standard as well as significantly lower than that of the H male. Although both female sit and reach scores were within the optimal standard, the H female score was significantly higher than that of AO females. Both the Hmong male and female flexed arm hang scores were below the optimal range. The H female score was also significantly lower than that of AO females.

14-16 Years

The H female abdominal curl up score was below the optimal standard as well as significantly lower than that of AO females. Although all male subjects sit and reach scores were within the optimal standard, the H male sit and reach score was significantly higher than that of AO males.

17 Years and Over

The H female abdominal curl up score was below the optimal standard as well as significantly lower than that of AO females. Once again, although all male subjects sit and reach scores were within the optimal standard, the H male

sit and reach score was significantly higher than that of AO males. A visual representation of this summary can be found in Appendix A.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

"Children by nature gravitate toward healthy activities and habits. At the most fundamental levels, they genuinely want to have strong and sound bodies and minds. Yet in many cases the forces of unwise nutrition, sedentary living and lack of knowledge among parents have contrived to deprive children of the benefits they desire so deeply" (Cooper, 1991). One cannot overlook the roles of home and community on a child's exercise habits (McGinnis, 1987). It is for this reason, as well as those stated in previous chapters that schools and physical educators must continually promote youth fitness throughout the classroom and the community.

The majority of health-related fitness scores for the La Crosse Public School Physical Fitness test were within the optimal range prescribed by two widely used fitness batteries: Physical Best (AAHPERD) and Fitnessgram (Institute of Aerobic Research). A concluding discussion of health-related fitness variables which were found to be significantly different ($p \leq .05$) between Hmong and AO subjects and recommendations to address the suboptimal areas of health-related fitness in youth, especially the Hmong, are presented in this chapter.

Muscular Endurance

The sit up score for H females across all three age groups was below the optimal standard (McSwegin et al., 1989) and significantly ($p \leq .05$) lower than the score of AO females. This lack of muscular endurance may have a direct relationship to the fact that Hmong females are not encouraged to participate in strenuous and/or extracurricular activity. According to Lo (personal communication, September 21, 1993), females in the Hmong culture are encouraged to concentrate their time and energies on activities such as sewing, child care, and household chores.

Flexibility

The sit and reach scores for all subjects, with the exception of AO males 13 years and under, were within the optimal standard (McSwegin et al., 1989). The H male sit and reach scores (from all age groups), in addition to being well above the optimal standard, were also significantly higher than that of AO subjects (male and female). This greater flexibility may be a result of the games in which Hmong students participate (K. Lo, personal communication, September 21, 1993). Kato is a popular game played by Hmong males. This game is similar to volleyball, however, hands are used only for balance. A typical pass may include an individual jumping in the air or standing on his hands to kick the ball. Extreme ranges of motion are necessary to

successfully play Kato. Another game, which is popular with female Hmongs is Chinese jumprope (jumping the rubberband). Approximately 100 rubberbands are tied together to create the jumprope. The rope starts at near waist level and elevates with every successful jump. A successful jump is achieved by pulling the rope down with one foot and then jumping over. It is not uncommon for the rope to reach eye level and above. Lower body flexibility, which is measured by the sit and reach test, is necessary to successfully participate in each game.

Muscular Strength

The flexed arm hang scores for Hmongs (male and female) 13 years and under is below the optimal range (McSwegin et al., 1989). The Hmong female score is significantly lower than that of their counterparts. As stated previously (K. Lo, personal communication, September 21, 1993), Hmong females are not encouraged to participate in strenuous activity, resulting in restricted strength gains. Although Hmong males are more physically active than the females, they also are discouraged, to some extent, from becoming involved in extracurricular activities, many of which contribute to strength. In the Hmong culture, males and females are asked to take on adult-like responsibilities during the early teenage years resulting in less time for extracurricular activities (K. Lo, personal communications, September 21, 1993). Those individuals who spend a large

amount of time away from the home and involved in extracurricular activities are often seen as lazy and unwilling to take responsibility (K. Lo, personal communication, September 21, 1993).

Another possible reason why Hmongs are not as involved in sports and other extracurricular fitness related activities is the cost which is involved to participate. Many activities have equipment or facility fees which are prohibitive for poorer families. The poverty rate in 1990 for Asian children living in neighborhoods dominated by Cambodian, Hmong or Laotian Asians approached and/or exceeded 50% (Wisconsin Organization for Asian Americans, 1992).

Body Composition

The sum of skinfold scores for all subjects, with the exception of males (H and AO) 13 years and under, were within the optimal range. In the Hmong culture, a chubby baby is viewed as a healthy baby and this perception of body composition continues into the adult years (K. Lo, personal communication, September 21, 1993). This may account for the less than optimal skinfold score among Hmong males 13 years and under.

Most children are offered TV and video games as after school options, rather than exercise and sports. The typical six to eleven year old watches nearly 20 hours of television weekly (Cooper, 1991). This lack of activity

along with poor eating habits (Cooper, 1991) may contribute to the less than optimal body composition of AO male subjects.

Cardiovascular Endurance

The mile run scores for all subjects fell into one of two categories, good fitness or marginal fitness. No scores were within the low fitness category and no significant differences were found between scores. However, the fact that scores in each age group were within the marginal category is an area of concern.
As stated in an earlier chapter, cardiovascular endurance and the aerobic exercise that develops it have been linked to reduced risk of coronary artery disease (Pate, 1983).

The findings of this study support previous research done by Corbin and Pangrazi (1990). As with the majority of United States youth, students in the La Crosse School District meet most criterion-referenced standards such as those found in Physical Best (McSwegin et al., 1989) and Fitnessgram (Institute of Aerobic Research, 1993).

Recommendations

The information that follows are recommendations to address the suboptimal areas of health-related fitness in youth, especially Hmong youth, and point to areas for future research:

1. The implementation of programs designed to educate the Hmong community on the benefits of physical

activity for all men and women, young and old in the hopes of preventing future health problems.

2. An investigation of Hmong dietary habits, to determine whether or not there is a correlation between their diet and optimal body composition.
3. The incorporation or enhancement of Physical Education lessons that aide in developing the fitness components which, according to this study, all subjects (Hmong and AO) scored less than optimal. These lessons should specifically target muscular strength and endurance.
4. Physical Education lessons which incorporate multicultural activities such as the Hmong games. This could promote cultural exchange as well as high levels of flexibility.
5. The continual gathering of fitness data on American children of different cultural backgrounds and using that data to improve fitness education within all cultures.

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APPENDIX A

HMONG SCORES IN HEALTH-RELATED FITNESS CATEGORIES AND SIGNIFICANT DIFFERENCES BETWEEN H AND AO

Table 8. Hmong scores in health-related fitness categories and significant differences between H and AO

Test	Male	Female	Difference between H and AO
SF	ABOVE OPTIMAL	OPTIMAL	M - NON SIGNIFICANT F - NON SIGNIFICANT
SU	BELOW OPTIMAL	BELOW OPTIMAL	M - NON SIGNIFICANT F - SIGNIFICANT
MR	MARGINAL FITNESS	MARGINAL FITNESS	M - NON SIGNIFICANT F - NON SIGNIFICANT
SR	ABOVE OPTIMAL	ABOVE OPTIMAL	M - SIGNIFICANT F - SIGNIFICANT
FAH	BELOW OPTIMAL	BELOW OPTIMAL	M - NON SIGNIFICANT F - SIGNIFICANT
SF	OPTIMAL	OPTIMAL	M - SIGNIFICANT F - NON SIGNIFICANT
SU	OPTIMAL	BELOW OPTIMAL	M - SIGNIFICANT F - SIGNIFICANT
MR	GOOD FITNESS	GOOD FITNESS	M - NON SIGNIFICANT F - NON SIGNIFICANT
SR	ABOVE OPTIMAL	ABOVE OPTIMAL	M - SIGNIFICANT F - NON SIGNIFICANT
FAH	ABOVE OPTIMAL	OPTIMAL	M - SIGNIFICANT F - NON SIGNIFICANT
SF	OPTIMAL	OPTIMAL	M - NON SIGNIFICANT F - NON SIGNIFICANT
SU	OPTIMAL	BELOW OPTIMAL	M - SIGNIFICANT F - SIGNIFICANT
MR	MARGINAL FITNESS	GOOD FITNESS	M - NON SIGNIFICANT F - NON SIGNIFICANT
SR	ABOVE OPTIMAL	ABOVE OPTIMAL	M - [illegible] SIGNIFICANT F - NON SIGNIFICANT

Note. Table represents all age categories, 13 years and under (top), 14-16 years (middle), and 17 years and over (bottom)