goal framework as a useful substitution for the classic dichotomous goal framework. Hence, this new model may hold promise for understanding leisure-time exercise motivation.

1.2 THE RELATIONSHIP BETWEEN ACADEMIC ACHIEVEMENT AND PHYSICAL FITNESS

Abstract

Over the past 50 years research has typically demonstrated either no, or a weak relationship between academic performance and physical performance. Nevertheless, the fact that any positive relationship has been found has lead to the "healthy children learn better" concept currently being promoted in schools, and used as a rationale to justify physical education programs. The conclusions of previous studies have been based on the statistical significance of the results, and have not incorporated the practical significance. The authors investigated the relationship between academic performance, as measured by scores on the Iowa Tests of Basic Skills, and physical fitness, as measured by performance on the President's Challenge. Subjects were 5847 Seattle School District students in grades three, five, six and eight. The correlation between mean physical and academic percentile scores was 0.19, $p < .05$. While statistically significant, this correlation indicated that only 3.6% of the variance in academic performance could be explained by physical fitness. The low level indicated that the relationship between academic performance and physical fitness is of little practical importance. Accordingly, physical education programs should not be advocated as a means to promote academic achievement in students.

It has been suggested that the benefits gained from, or performance in, physical education are related to academic achievement (Almond & McGeorge, 1998; Black, 1995). Some have advocated that not necessarily physical education, but physical activity and fitness are related to cognitive performance and achievement (Dustman, Emmerson, & Shearer, 1994; Etnier et al., 1997). Thus, the concept that "healthy children learn better" is being promoted in schools and elsewhere (Symons, Cinelli, James, & Groff, 1997).

Investigations into the relationship between academic achievement and physical fitness have produced mixed results. Weber (1953) correlated fitness, using the Iowa Physical Proficiency Profile (including sit-ups, pull-ups, running), to entrance exam scores and grade point averages for 246 male college students. Fitness level had a significant positive relationship with grade point average ($r = .41$), but did not relate to performance scores on entrance exams. Hart and Shay (1964) examined mathematics and verbal SAT scores and the Physical Fitness

Index in 60 college women. When the relationships between verbal scores and mathematics scores and fitness index were examined, the r values were .068 and .146, respectively, although neither was significant at the .05 level. A battery of fitness tests (e.g., flexed arm hang, curl-ups, and step test) were administered to 827 female freshmen and subjects were placed in one of three categories of fitness: high, fair or poor (Arnett, 1968). Arnett (1968) found significant differences in grade point average between the groups, with participants with higher fitness levels having higher GPAs.

Studies on school-aged children, using a variety of academic and fitness measures, have also resulted in inconsistent findings. Clarke and Jarman (1961), examining 217 boys (aged 9, 12 and 15), found that there was a consistent, and for some fitness measures, a significant tendency for the students in the high fitness group to have higher means on both standard achievement tests and grade point average.

More recent studies have used standardized achievement and fitness tests as measures. A study involving 1,767 students in second, fourth and sixth grades examined the relationship between performance on the Georgia Criterion Referenced Test for Reading, Mathematics and Career Education and performance on a variety of physical fitness tests from the Minnesota Performance Test, the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) Health Related Physical Fitness Tests, and the Texas Physical Fitness-Motor Ability Test (Harris & Jones, 1982). For the boys and girls, multiple regression analysis demonstrated a low, but significant, relationship between reading and mathematics ability and the combination of eight motor performance measures examined, five of which were fitness measures.

Winn (1993) studied 302 fourth and fifth grade children and examined the relationship between scores on the California Test of Basic Skills (reading, mathematics) and performance on the AAHPERD President's Challenge. Using national norms, total fitness and total academic achievement scores were determined. The overall correlation between the total scores was .213. When each test item was correlated with scores in each of reading, mathematics and language, the correlations ranged from .043 to .462, although none of the correlations were significant at the .05 level.

An examination of 7,961 youngsters from 7 to 15 years of age in Australia was conducted by Dwyer, Sallis, Blizzard Lazarus and Dean (2001). School ratings of scholastic ability were compared with performance on a variety of fitness measures including sit-ups, push-ups, and a 1.6 kilometer run. Across the age groups, there were significant, but weak, correlations (ranging from. 1 to .27)

between fitness (cardiorespiratory endurance, muscular force and power) and academic performance.

Most recently, the California Department of Education (2002; 2005) reported the results of two studies that examined the relationship between scores on achievement tests and the Fitnessgram. In the first study, performance on the Stanford Achievement Tests and scores on the Fitnessgram for 884,715 students in grades 5, 7, and 9 were investigated. A composite score, ranging from zero to six, was created for physical fitness, in which a student obtained one point for each of the six test items for which the student was determined to be in the "healthy zone." In each of the three grades, higher levels of fitness were related to higher academic achievement. The relationship was stronger for math achievement and fitness, especially at higher fitness levels. This study has yet to be published. As a result, no statistical measures are available. Nevertheless, the results were cited by professional sources, such as the National Association for Sport and Physical Education (no date) and the PE Central web site (no date) as evidence that there is a direct relationship between physical fitness levels and academic achievement.

In the latter study (California Department of Education, 2005), performance on the California Standards Tests and the Fitnessgram for 1,036,386 students in grades 5, 7 and 9 were compared. Again in this study, students were awarded a composite score, representing the number of fitness test battery items in which they were in the "healthy zone." Results were similar to the 2002 study, with higher fitness scores associated with higher scores in English-language arts and mathematics ($p < .05$). In this study (California Department of Education, 2005), however, only means were reported; thus, no standard deviations were given for the groups compared, nor were effect size measures made to quantify the practical significance of the differences observed between groups.

In summary, research examining the relationship between academic achievement and physical fitness has produced mixed results. Of these, one study has been published only as a press release in which no statistical analysis was reported and a second study had incomplete statistical information to effectively interpret the results (California Department of Education, 2002; 2005). In the remaining investigations the interpretation of the results focused on whether a statistically significant finding was observed. A number of statistical researchers, however, have emphasized that the correct interpretation of research results requires that not only the statistical significance of the data be considered, but also the practical significance of the findings (e.g., Speed, 1998; Sterne & Smith, 2001; Thomas, Salazar & Landers, 1991; Vincent, 1999). This is particularly important in studies such as the present one, and the ones discussed above, which typically involve very large sample sizes of hundreds to hundreds

of thousands of subjects. Due to the effect of sample size on the calculation of statistical significance, with large sample sizes it is possible to calculate statistical significance on a result that has no practical significance (Vincent, 1999).

As evidenced by the history of investigations, the importance of understanding the relationship between physical fitness and academic performance in children and youth is relevant, and increased by recent evidence from studies conducted on animals and elderly humans that increased physical activity results in improved cognitive function (Colcombe et al., 2004; McAuley, Kramer, & Colcombe, 2004; Rhodes et al., 2003). The purpose of this study was to investigate the relationship between school academic performance and physical fitness, using the Iowa Tests of Basic Skills and the President's Challenge. Further, a unique contribution of the current study to the existing literature is that the meaningfulness of the results is discussed. Thus, data are not simply interpreted based on the statistical significance found.