

# Theoretical Literature Review on Lack of Cardiorespiratory Fitness and Its Effects on Children

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**Abstract**—The purpose of this theoretical literature review is to study the relevant academic literature on lack of cardiorespiratory fitness and its effects on children. The total of thirty eight relevant documents were identified and considered for this review which nineteen of those were original research articles published in peer reviewed journals. The other nineteen articles were statistical documents. This literature review is structured to examine 5 effects in deficiency of cardiorespiratory fitness in school aged children (A) Relative Age Effect (RAE), (B) Obesity, (C) Inadequate fitness level (D) Unhealthy life style, and (E) Academics. The categories provide a theoretical framework for future studies where results are driven from the literature review.

The study discusses that regular physical fitness assists children and adolescents to develop healthy physical activity behaviors which can be sustained throughout adult life. Conclusion suggests that advocacy for increasing physical activity and decreasing sedentary behaviors at school and home are necessary.

**Keywords**—Cardiorespiratory, endurance, physical activity, physical fitness.

## I. INTRODUCTION

CARDIORESPIRATORY fitness refers to capacity of the circulatory and respiratory systems which supply oxygen to skeletal muscles throughout continued physical activity. Exercise improves the respiratory system by increasing the amount of oxygen that is inhaled and distributed to body tissue [1]. The American College of Sports Medicine recommends aerobic exercise 3–5 times per week for 20–60 minutes per session, at an intensity that maintains the heart rate between 60–90% of the maximum heart rate [2].

Cardiorespiratory endurance is a health-related component of physical fitness that relates to the ability of the circulatory and respiratory systems to supply fuel during sustained physical activity and to eliminate fatigue products after supplying fuel. Cardiorespiratory endurance is often used interchangeably with aerobic or cardiorespiratory fitness [3].

Several biological mechanisms suggest [4] that cardiorespiratory fitness improves insulin sensitivity, blood lipid profile, body composition, inflammation, and blood pressured. Based on the evidence, physical and health educators should encourage students to improve cardiorespiratory fitness. It is a health-related component of physical fitness defined as the ability of the circulatory, respiratory, and muscular systems to supply oxygen during sustained physical activity [5]. However it is a relatively low-cost and useful health indicator [6].

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As a short term effect, anytime the adequate level of cardiorespiratory fitness decreases, weight status increases. A few of long term effects are obesity, heart disease, high blood pressure, stress and ethical issues such as: lack of respect, cooperation and development of relationships. It is confirmed [7] that poor lifestyle behaviors, including suboptimal diet, physical inactivity, and tobacco use are leading causes of preventable diseases globally.

## II. LITERATURE REVIEW

This literature review examines the 5 effects in deficiency of cardiorespiratory fitness in school aged children. The presented effects in peer reviewed research and statistical articles which exist in this study are (A) Relative Age Effect (RAE), (B) Obesity, (C) Inadequate fitness level, (D) Unhealthy life style, and (E) academics.

### A. Relative Age Effect (RAE)

In a recent study [8] results imply that Relative Age Effect (RAE)s are likely to be of relatively minor concern when people are graded or ranked but can produce substantial inequities and misclassifications when people with extremely high or extremely low ability levels undergo selection. In order to examine the children's physical fitness, it is necessary to investigate the relationship between children's physical fitness level and children's health. In a limited survey of Norwegian children aged 5 to 12, it is indicated that with increasing age, total score of physical fitness is improved [9]. This study measures the physical fitness in a larger magnitude of age group which makes the test result higher for older children.

The percentage of youth in the United States who had adequate levels of cardiorespiratory fitness is presented in a recent national data. This data indicates that the percentage of youth aged 12–15 who had adequate levels of cardiorespiratory fitness decreased from 52.4% in 1999–2000 to 42.2% in 2012 [10]. No significant differences were found in the percentage of youth having adequate levels of cardiorespiratory fitness by race and Hispanic origin, or by family income-to-poverty ratio [11].

The Center for Disease Control and Prevention [12] reported that participation in physical activity declines as people aged. The same Center found that 77% of children ages 9–13 years reported participating in free-time physical activity during the previous 7 days. In a nationally survey study of a statistically significant the decrease of physical activity in high school when only 29% of high school students

had participated in at least 60 minutes per day of physical activity on each of the 7 days before the survey is evident [13]

### *B. Obesity*

In a study [14] researchers followed children for 3 years to perceive the effects of a 3-year after-school physical activity program, without restriction of dietary energy intake, on percent body fat, cardiorespiratory fitness, and cardiometabolic markers in children. The intervention consisted of 80 minutes of age-appropriate moderate-to-vigorous physical activity each school day. At the end, it was determined that an after-school physical activity program was effective in reducing adiposity and improving cardiorespiratory fitness, especially in the children who attended the sessions at least 3 days a week. Nevertheless, the favorable effects on body fat and cardiorespiratory fitness were lost over the summer. The conclusion was released that, it is critical to incorporate strategies that attract and retain the children to receive an adequate dose of physical activity year round.

Cardiorespiratory fitness is an independent predictor of health outcomes in children and is associated with functional limitations in walking/running capacity in obese youth as indicated [15]. Therefore, obese children are typically less physically active than their healthy-weight peers and are often assumed to be unfit.

There are numerous researches looking at academic achievement and physical activity. However, a study [16] in Finland investigated whether childhood motor function predicts later academic achievement via physical activity, fitness, and obesity. The study sample included 8,061 which contained data about parent reported motor function at age 8 and self-reported physical activity, predicted cardiorespiratory fitness, obesity, and academic achievement (grades) at age 16.

Motor function in childhood may represent an important factor driving the effects of obesity and physical inactivity on academic underachievement. This study suggests that the global epidemic of obesity and physical inactivity may have damaging implications for young people's cognitive function and academic achievement.

There is a constant debate in regards to relationship between disability and healthy life style in childhood and adolescence. Physical education program contributes to a healthier physical condition for both children with or without disabilities. Since a high proportion of disabled children and adolescents are overweight or obese, a study [17] pointed to the effective strategies for preventing and managing excess weight which need to be developed. A United States study [18] indicated that regular physical activity in childhood and adolescence improve strength and endurance, helps build healthy bones and muscles, helps control weight, reduces anxiety and stress, increases self-esteem, and may improve blood pressure and cholesterol levels. The probability that a child will struggle with weight appears to increase with the severity of the child's condition, as it is reported [19] that over 36 percent of American kids ages 10 to 17 with special needs are overweight or obese compared to about 30 percent

of other children. A report [20] signified that roughly 14 to 19 percent of U.S. children have a chronic physical, developmental, behavioral or emotional condition.

### *C. Inadequate Fitness Level*

Child development is a wide field, surrounding by physical as well as intellectual and emotional growth, yet physical growth can be easily observed and measured. According to a study [21] physically, children grow taller and more muscular and refine their ability at controlling their bodies' large and small muscle movements. Their physical advances allow them to become increasingly adept at sports, physical games, crafts and hobbies that require hand/eye coordination, during middle childhood, children's bones broaden and lengthen dramatically. Therefore in general, children will grow taller each year and more muscle weights are added throughout this period.

As children obtain height and increase muscle mass, cardiorespiratory fitness is expected to amplify, however in some cases this is not observed. One reason could be due to habitual inactivity as children are aging. In a separate study [22] parental rules regarding screen time and participation in physical activity among children and adolescents were examined. It was concluded that chances in which children would exceed recommended screen-time limits were positively associated with age and black race/ethnicity and negatively associated with income level.

Adaptation to a sedentary life style increases, as children become older. The televisions watching including games are the most common measure of sedentary behavior and body composition is its outcome. Qualitative analysis of many related studies [23] revealed a dose-response relation between increased sedentary behavior and unfavourable health outcomes. Watching TV for more than 2 hours per day was associated with unfavourable body composition, decreased fitness, lowered scores for self-esteem and pro-social behaviour and decreased academic achievement.

### *D. Unhealthy Lifestyle*

The foundation for healthy lifestyle behaviors begin in childhood [24]. In a different study [25] unhealthy lifestyle behavior, has been identified as a problem among students. It is confirmed [26] that poor lifestyle behaviors, including suboptimal diet, physical inactivity, and tobacco use are leading causes of preventable diseases globally. An additional reason presented here is attitude of students toward physical activity. Students who report positive attitudes toward experiences with physical activity are likely to continue those activities into adulthood, whereas students reporting negative attitudes and experiences are more likely to disengage in physical activities [27].

Attitude toward physical fitness as a function of age or grade level tend to decline as age and grade level increase. In an American government studies (28) it is reported that participation in physical activity declines as young people age. A research study found a statistically significant decrease of physical activity in high school when only twenty nine

percent of high school students had participated in at least 60 minutes per day of physical activity on each of the 7 days before the survey. The same study refers to fourteen percent of high school students who had not participated in 60 or more minutes of any kind of physical activity on any day during the 7 days before the survey. In a nationally representative survey study of student's attitude toward physical education [29] it was found that 77% of children aged 9–13 years reported participating in free-time physical activity during the previous 7 days.

Unhealthy lifestyle is a worldwide problem reported by different countries indicating the same conclusion. The inactivity crisis is especially important in the pediatric population as recent data from the Canadian Health Measures Survey [30] suggested that only 7% of children and youth aged 6-19 years participate in at least 60 minutes of moderate to vigorous intensity physical activity per day. This report meets very closely with the current physical activity guidelines from Canada [31], the U.S. [32], the U.K [33], Australia [34] and the World Health Organization (WHO) [35].

#### E. Academics

Cardiorespiratory fitness has been associated with cognition; however, the magnitude of this association remains unknown. Various elements of physical fitness in children have shown a declining trend during the past few decades. In all research except one which was selected for this study, higher cardiorespiratory fitness had an association with improved academic performance.

Generally, research on academic and cardiorespiratory fitness, is concerned with relationship between motor skills and cognitive functioning. In a study [36] forty 9-10 year old children were selected to be investigated on influence of cardiorespiratory fitness on arithmetic cognition measured by a standardized mathematics achievement test. The study concluded that the benefits of cardiorespiratory fitness extend to arithmetic cognition, which has important implications for the educational environment and the context of learning.

The results of a cross-sectional review [37] concluded that high levels of cardiorespiratory fitness and motor skills may be beneficial for cognitive development and academic performance but the evidence relies mainly on cross-sectional studies. The purpose of this particular review was to provide an overview of the relationship of cardiorespiratory fitness and motor skills with cognitive functions and academic performance in children up to 13 years of age. The report suggested that children with higher cardiorespiratory fitness have more efficient cognitive processing in compare to children with lower cardiorespiratory fitness.

By examining the association between objectively measured of physical activity and academic performance in a relatively large sample of children and adolescents, [38] a study added an opposing view to the debate. This 3-year longitudinal study designed to assess the impact of physical activity and sedentary behaviours on health indicators. The analysis was conducted with 1778 children and adolescents

aged 6–18 years. The study concluded that physical activity may influence academic performance during both childhood and adolescence nevertheless this association was negative and very weak. The suggestion is that longitudinal and intervention studies are necessary to further our understanding.

### III. METHODS

Electronic peer reviewed articles on Google, Google Scholar and Roadrunner Search were identified through scholarly papers by using all combinations of the search terms. Total of 38 related research studies were collected. All selected articles were written after the year 2000. No literature review was found on direct 'Theoretical literature review on lack of cardiorespiratory fitness and its effects on children.' Following the identification of data base, reference list was scanned and articles were recognized. To identify essential study characteristics, independent evaluation of each study for appropriate research design was categorized.

Google was also used to determine several statistical results. The quality of study was assessed by the control of selection, detection, and attrition biases.

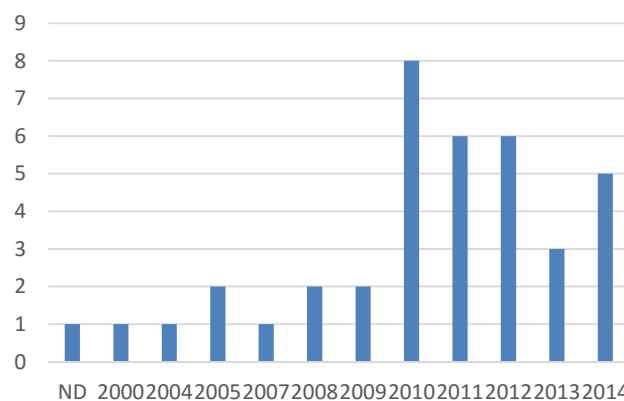


Fig. 1 Dates of articles

Fig. 1 indicates the dates which articles were written for the purpose of this study. The year 2010 had the most amounts of related studies.

### IV. RESULTS

The results are driven from the literature Review which are divided into 5 sections, (A) Relative Age Effect (RAE), (B) Obesity, (C) Inadequate fitness (D) Unhealthy life style, and (E) Academics.

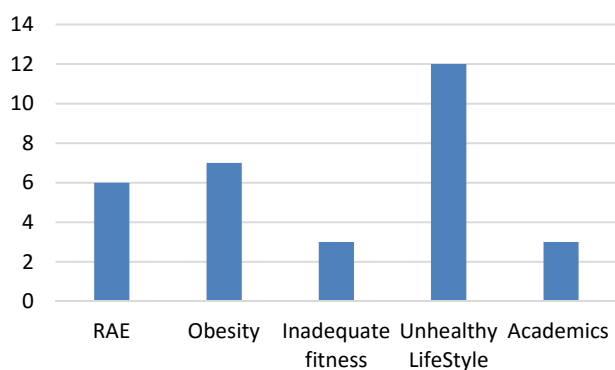


Fig. 2 Results

Fig. 2 indicates that out of 38 presented researched articles for this study Unhealthy Lifestyle had the most amount of studies and Obesity came second followed by RAE. The lowest research was presented in Inadequate Fitness and Academics.

Out of 38 articles, total of 7 articles were contributed to the introduction section with 2 research studies specified on race and poverty as researchers found no significant differences in the percentage of youth having adequate levels of cardiorespiratory fitness based on family income or race. Furthermore, only one article presented that cardiorespiratory fitness is a low cost activity. The remainder of studies focused on scientific definition of cardiorespiratory fitness. In addition, 6 articles addressed the Relative Age Effect (RAE). These set of articles suggested that as children develop, more muscle mass and longer, broaden bones are produced which expected to generate higher results when cardiorespiratory fitness is conducted. However a national survey study illustrated significant decrease of physical activity in high school children which is direct results in inadequate fitness level. Contribution of 7 articles expressed on how obesity will occur if cardiorespiratory fitness is not present. Children also suffer from inadequate fitness level, where 3 selected papers voiced on lacked of movement. Children's unhealthy life style were indicated in 12 articles poor diet, physical inactivity, and tobacco use spoke on how lack of cardiorespiratory fitness results in harmful lifestyle. In the area of academics 3 articles were selected where revealed that the cardiorespiratory fitness and motor skills have been associated with cognition. Nevertheless one study showed that the gap is not in large numbers and in order to accuse failure in academics on lack of cardiorespiratory fitness, there must be further research

#### V.CONCLUSION

It is suggested that advocacy for increasing physical activity and decreasing sedentary behavior must continue at school and home. Schools aggressively need to fulfill the recommended physical education curriculum and physical education should be recognized as an academic subject and part of core curriculum subject. Programs such as Play60 or Let's move need be introduced and continued at home and schools. It is recommended that parents and caregiver

encourage approaches to daily physical activities and decrease inactivity pattern.

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