

Relationship between Low School Performance and Obesity in Adolescents: An Article Review

Alejandra Lozano Bustillo^{1,*}, Daniela Michell Ocampo Eguigurems¹, Waleska Rosario Betancourth Melendez¹, Kelly Anaïd Montalvan Chirinos^{1,2}

¹Doctor in Medicine and General Surgery, Hospital Escuela Universitario, Tegucigalpa, Honduras

²Regional Hospital of Atlántida, La Ceiba, Honduras

*Corresponding author: alejandra301@gmail.com

Abstract Since 1980, children with obesity between 6 and 11 years of age have doubled, and the percentage of obese adolescents from 12 to 19 years has tripled. It has been found a deterioration of cognitive performance in a growing number of obese adolescents. It has been observed a relationship between birth weight and an adverse academic performance a posteriori. In this review we describe the different relationships between obesity in adolescents and its impact on the academic performance from different articles published between the years 2008 to 2016.

Keywords: *obesity, adolescent, overweight, academic performance, school performance, physical activity*

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1. Introduction

Obesity has become a major public health problem worldwide. The percentage of children and adolescents with overweight or obesity has reached record numbers in most regions around the world. Since 1980, children with obesity between 6 and 11 years old have doubled, and the percentage of obese adolescents from 12 to 19 years has tripled. Childhood obesity has both immediate and long-term severe impacts on health. The prevalence of obesity differs between the racial/ethnic groups and also varies according to age, sex, family environment and the educational level of the parents [2].

The overall records show that in the most recent period (2011-2014), 17% of children and adolescents presented obesity and 5.8% extreme obesity. [32]. The global epidemic of obesity and physical inactivity may have detrimental consequences for young individuals in their cognitive function and academic achievement [3,4,5,6,7].

The overweight on early ages predicts a negative academic performance in adolescence and also a decrease in the level of schooling of the adults and the economic income in the future [5].

Different studies agree that food and nutrition, among other factors, are determinant in the biological development of humans; but over time, it has been demonstrated that also are determinant in the psychological and social development of these [12].

Data of a smaller volume hippocampal, increase in the brain, the spinal fluid and reductions of integrity in the microstructure of the main routes of white substance have been observed in obese adolescents primarily those who

go on to develop more complex situations as the metabolic syndrome [4].

A comprehensive review of different relationships between obesity in adolescents and its impact on the academic performance from articles published in the last few years.

2. Methodology

The bibliographic search was extracted from the databases: MEDLINE (PubMed), Cochrane, Scielo and Google Scholar published between the years from 2008 to 2016 in English and Spanish languages. The period of time of collecting data was approximately 2 month. A broad search was conducted using the keywords: academic achievement, adolescent, overweight and obesity, to determine the domains evaluated in current studies. The different subjects of the articles had an average age of 12.2 years. Inclusion criteria were as follows: English and Spanish language, all races, ethnicities, and genders (a) subjects were in the age range of 6 – 20 year, or the mean age was in this range; (b) a measure of overall academic achievement; and (c) variables were tested for their association with obesity, academic achievement, and life habits. The exclusion criteria were articles published before the year 2008, languages other than English or Spanish, documents non original as case reports, comments, editorials or textbooks.

3. Adolescent Obesity: A Growing Problem

More than 60% of children who are overweight before puberty shall be overweight in early adulthood. Childhood

obesity is strongly associated with risk factors for cardiovascular diseases, type 2 diabetes, orthopedic problems, mental disorders, poor performance in school and low self-esteem [22]. In Latin America according to estimates the total number of adolescents overweight or obese is 16.5 to 22.1 million [29] and in the United States has increased in adolescents 12 to 19 years of age of 10.5 per cent between 1988-1994 and 20.6% between 2013-2014.

According to the Center of Disease and Control (CDC) between the years 2011-2012, 8.4 per cent of children between 2 to 5 years had obesity in comparison with 17.7 per cent of 6 to 11 years and 20.5% of 12 to 19 years. Childhood obesity is also more common among certain racial and ethnic groups. In 2011-2012, the prevalence among children and adolescents was greater among Hispanics (22.4%) and non-Hispanic blacks (20.2%) than among non-Hispanic whites (14.1 per cent) [31] and is lower in Asian youth non-Hispanics (8.6%) than in the younger white non-Hispanics and Black non-Hispanics [31].

4. Obesity: Individual, Family and Social Factors

Obesity is defined as a body mass index (BMI) greater than or equal to the 95th percentile for children and adolescents of the same age and sex. This is the more parameter used to measure the patterns of growth in children and adolescents [24].

The obesity is related to physical and psychosocial consequences both for the teenager who suffers it as to his family and the society. Obese children and teens are more likely to develop psychological and social problems such as discrimination and poor self-esteem. [1,2] In addition to a reduced intelligent quotient (IQ) [4] the low concepts that are presented in the overweight or obese adolescents could be the causal factors of a low academic achievement, school absenteeism and low participation in sporting activities [34].

The obesity is a prognostic factor for the demotivation in the adolescent. The obese adolescents have a lower personal interest, motivational conflicts and a reduced degree in the implementation of goals compared with adolescents with a suitable weight [12].

According to some studies, students with overweight are five times more likely to have a higher number of detentions, a greater percentage of absences and more days of delay in school compared with those students with adequate weight [34].

A study conducted in the United States with middle-school students in five cities (Atlanta, Chicago, Denver, Fort Lee (New Jersey) and Los Angeles) concluded that students with overweight and obesity obtain significantly lower grades than their peers with healthy weight [20].

The great British study in adolescents, the ALSPAC, investigated the association of obesity in adolescents and later academic achievement, which suggests that the obesity in adolescents has a negative impact on the academic performance mainly in the students of women [5].

The educational level of the parents or caregivers (a higher educational level increased risk of obesity), the presence of overweight and obesity in the family and the

low level of physical activity of the parents have been identified as risk factors for the development of obesity in adolescence [13,26]. The prevalence of obesity among children, whose head of adult family term the university was approximately half that those who do not complete the secondary [31].

The family economic status is associated significantly with overweight or obesity according to the Health Behavior in School-aged Children (HBSC) Survey which concluded that those families with a lower income were more likely to be overweight or obesity [33].

The promotion and advertising of unhealthy food and beverages has been recognized as one of the major contributors and risk factors for childhood obesity. [28]

5. The Obesity and Impaired Cognitive Development

In children and adolescents, a great amount of body fat can lead to many diseases and other alterations of health [24].

Although adolescence is associated with the increase of the ability of abstract thinking and a unit for the independence, also is characterized by the assumption of risks and emotional reactivity. Some factors that affect the operation neurobehavioral during this stage of development can have a significant effect on the neurological outcome [16].

It has been found a deterioration of cognitive performance in a growing number of obese adolescents [4,30]. From birth it has been observed a relationship between birth weight and an adverse academic performance a posteriori [9]. Studies have been conducted in which high levels of leptin in newborns with intrauterine growth restriction by associating this to insulin resistance and development of obesity in adolescence, all this together with factors such as maternal obesity and gestational diabetes [17].

Adolescents with metabolic syndrome show a tendency toward a general decline in the intelligence, these shows significantly lower performance in areas such as calculation, spelling, attention and a lower mental flexibility [4].

A poor motor activity in the early school years can contribute to establishing the child in a trajectory of negative development. A study conducted in Finland with 8,061 children investigated if the motor function in childhood predicts the late academic achievement through physical activity, the exercise and obesity. The physical activity was associated with an average better, and obesity was associated with a lower average in adolescence [3].

Another important disorder is the deficit of attention that has been found as a factor that has a direct impact on academic achievement. There are data that claim that the deficit of attention in childhood predicts prospectively the development of obesity in adolescence and that could be associated with a poor physical activity [11,16].

6. Life Styles and Academic Achievement

The exercise is strongly and significantly associated with academic performance. Cardiovascular exercise has a

dose-response relationship with the independent academic performance [10]. Physical activity can be beneficial for both the behavior problems and obesity [11,30]. There are data where those teenagers athletes present a better academic performance and have a better attitude to the study and better planning of free time [5,14,19].

Adolescents who practice a sport tend to sleep less during the day than teenagers who do not practice any [14]. The practice of sports that involves a significant time commitment (up to 20 hours a week for example), does not harm the academic performance at these ages [14]. According to recommendations of the CDC children and adolescents must perform 60 minutes or more of daily physical activity [27].

The consumption of alcohol and smoking are other factors that are associated with a lower academic performance. According to a study carried out in the Netherlands (E-MOVO) that monitors the state of health and lifestyles of adolescents with obesity or overweight, concluded that high alcohol consumption was associated with a low level of education [35].

The number of hours of sleep is important for a suitable academic performance. The highest percentage of sleep apnea syndrome in obese population is large and obese adolescents with this syndrome reported significantly increased symptoms of depression, a high percentage of abnormal neurological behaviors as in their executive functions, care, fatigue and behavior [16].

Moreover overweight adolescents tend to eat fewer vegetables daily and are more likely to watch more hours of television a day [25]. A diet consisting of frequent intakes of fruits, vegetables and milk, eat 3 times a day, without skipping meals, especially the breakfast are related with the good academic performance [23,35]. However, eating a variety of processed foods such as sodas, instant foods, fast food and candies are correlated with a low school performance [23].

7. Conclusion

The number of obese adolescents has increased significantly in the last two decades, associating to perinatal factors ranging from maternal history of gestational diabetes maternal obesity and intrauterine growth restriction in addition to inadequate food and sedentary, taking psychological and physical impact as in the neurodevelopment, partnering with a lower academic achievement with limitations in the calculation, spelling

and decline of IQ, lower self-esteem and reverberate in the long-term development of adolescents as adults.

Of the 36 articles reviewed eleven of them communicate specifically the relationship between obesity and academic performance which 90% are related to low academic performance in this population and only one in which it was found a good performance in this adolescents (Figure 1).

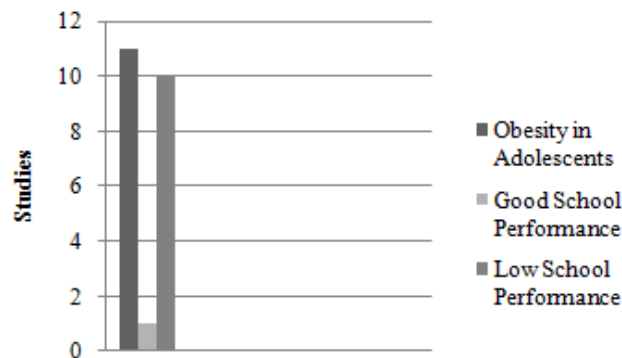


Figure 1. Relationship between Low School Performance and Obesity in Adolescents

12 articles about physical activity and academic performance found in the 91 per cent of the articles a suitable academic performance in teenagers that perform exercise (Figure 2).

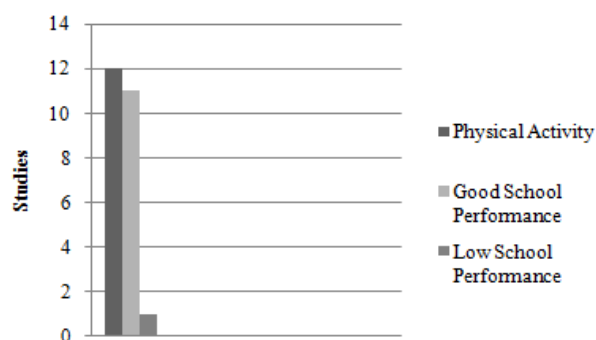


Figure 2. Relationship between Low School Performance and Physical activity

A proper food and practicing a sport or perform some physical activity for at least 60 minutes a day improve the quality of life of adolescents including the academic performance. Table 1 summarizes the original studies included in the revision that associated overweight, obesity, physical activity, school performance and other related factors in adolescents.

Table 1. Summary of original studies included that associated overweight, obesity, physical activity, school performance in adolescents

Article	Age	Mesure Used	Considerations	Findings
Pan L. et al (2013)	12-17 years	National Health Interview Survey Parent Report BMI	School attendance illness or injury	Overweight and obese adolescents had more sick days than adolescents of normal weight
Marko T. Kantomaa et al (2013)	8 and 16 years	Unstandardized (B) and standardized (β) coefficients	Physical activity Academic achievement Motor Function	Physical activity and obesity may mediate the association between childhood motor function and adolescents' academic achievement
Yau PL et al (2012).	14–20 years	Wechsler Abbreviated Scale of Intelligence, Wide Range Achievement Test, Wide Range Assessment of Memory and Learning, Attention Concentration Index, Imaging Magnetic Resonance	Metabolic Syndrome Cognitive Performance	Lower cognitive performance and reductions in brain structural integrity among adolescents with Metabolic Syndrome

Article	Age	Mesure Used	Considerations	Findings
JN Booth, et al (2014)	11, 13 and 16 years	BMI Compulsory national achievement tests	Weight status Academic attainment	Girls obese at 11 years had lower academic attainment at 11, 13 and 16 years compared with those with healthy weight.
Kronholm E et al (2015)	11-18 years	Finnish School Health Promotion Study Behavior in School-Aged Children study	Sleep problems Tiredness School performance	Insomnia symptoms and tiredness were associated with lower school performance and they were more prevalent among girls compared to boys.
M Kark et al. (2014)	10-15 years	BMI Waist Circumference Questionnaires.	BMI Adiposity School Performance	School performance is one alleyway to social inequalities in obesity in school children.
B. Forrest Christopher et al. (2013)	9-13 years	child self-reported health, state achievement test scores, child-reported school engagement	Health (well-being, functioning, symptoms, and chronic conditions). School outcomes	Both the transition into middle school and puberty had negative impacts on school outcomes. Chronic health conditions that affected children's functional status are linked with poorer academic achievement.
Esteban-Cornejo, et al. (2015)	10.4 ± 3.4 years	BMI, waist circumference, percentage of body fat, schools records.	body composition, birth weight, academic performance	Neonatal and current body composition, both independently and combined, may influence academic performance in youth
Van Dusen DP et al. (2011)	Students of grades 3-11	test records, TAKS™, FITNESSGRAM®	physical fitness, academic performance	Fitness was intensely related to academic performance. Cardiovascular fitness exhibited a dose-response association with academic performance independent of other socio-demographic and fitness variables
Khalife N et al. (2014)	7-8 years/ 16 years	Postal Questionnaires, teachers reports	BMI (IOTF), attention-deficit/hyperactivity disorder symptoms, childhood conduct disorder symptoms	Inattention-hyperactivity symptoms at 8 years were associated with indices of obesity at 16 years
Aguilar Cordero M.J. et al (2012)	10-14 years	Test of motivations in adolescents (SMAT), Group of children with normoweight and group of overweight children	BMI, Motivation	The subjects that are overweight and obesity present a lower level of motivation, a circumstance which is manifested by a greater tendency to the frustrations and the greatest difficulty in achieving its goals.
Roldán González E. Et al (2013)	8-12 years	Sociodemographic survey, questionnaire INTA, 6-minute walk test, Borg scale as amended, battery Da Fonseca.	BMI, physical activity	No significant correlation was found in BMI with other variables such as the level of physical activity, academic performance.
Article	Age	Mesure Used	Considerations	Findings
Capdevila Seder A. et al (2015)	14 -18 years	Questionnaire of habits and study techniques (CHTE), questionnaire on physical practice and use of free time(PFYTL).		The sportsmen obtained better qualifications than non-athletes. The academic performance is related in a negative way with leisure, sedentarism and positively with the study habits.
Camaño Navarrete F. et al (2015)	11-16 years	BMI, percentage of fat mass, waistline, reason waist height and physical performance through battery test		High levels of over weight and obesity in the sample associating this condition with a decrease of the cardiorespiratory capacity loss of muscle functionality and increased cardiometabolic risk.
Xanthopoulos MS et al. (2015)	12–16 years	Behavior Rating Inventory of Executive Function (BRIEF), Conners Abbreviated Symptom Questionnaire and the Attention Problems subscale of the CBCL, Epworth Sleepiness Scale (ESS), Center for Epidemiologic Studies Depression Scale (CES-D), Child Behavior Checklist (CBCL), adolescent and parent reports of behaviors	Neurobehavioral Assessments, Anthropometrics (Weigh/ Height), sleep apnea syndrome (OSAS)	Obese adolescents with OSAS show impaired executive and behavioral function compared to obese and lean controls, and are more likely to score in the clinically abnormal range on measures of neurobehavioral functioning.
Marialena Kyriakakou et al (2008)	20 appropriate for gestational age, 20 asymmetric intrauterine growth restriction (IUGR), full-term fetuses, neonates on day 1 (d1) and day 4 (d4) of life postnatally.	Radioimmunoassay (RIA) Kits	Serum leptin, adiponectin and cortisol levels	The increased umbilical cord leptin levels compared with d1 in IUGR fetuses might be directly and/or indirectly related to the subsequent development of insulin resistance in these neonates

Article	Age	Mesure Used	Considerations	Findings
Fisher et al (2011)	6.2 years	Physical education (PE) session, Cambridge Neuropsychological Test Battery (CANTAB), Attention Network Test (ANT), Cognitive Assessment System (CAS), Connor's Parent Rating Scale (CPRS:S).	physical education intervention, cognitive function	Practical and age-appropriate cognitive and behavioral outcome measures for future RCT, and identified that schools are willing to increase PE time.
Capdevila Seder A. et al (2015)	14 -18 years	Questionnaire of habits and study techniques (CHTE), questionnaire on physical practice and use of free time(PFYTL).		The sportsmen obtained better qualifications than non-athletes. The academic performance is related in a negative way with leisure, sedentarism and positively with the study habits.
C MacCann et al (2013)	12-15 years/18-25 years	Vocabulary test scores and SES indices. Computerized test battery, parents test protocol.	Student measures (Study 1): Mathematics, Vocabulary. Parent measures: Household income, level of education. Combined: Student grades, Student BMI, Students' conscientiousness, Students' life satisfaction scale. Study 2: Positive and negative feelings, HEXACO-PI-R, Socioeconomic status, Population density, High-stakes test scores, Student grades, BMI.	Overweight and obese students are not getting the same grades as their healthy-weight equals, despite no clear differences in either mathematics or vocabulary scores.
Rodríguez Escobar G. et al. (2015)	5-16 years	Measures of weight and height were recorded cups of absence.		It was found a significant relationship between a greater number of general absenteeism and sick with the delay of growth and on weight in schoolchildren.
So Young Kim et al (2016)	12-18 years	Korea Youth Risk Behavior Web-based Survey	Dietary habits, physical activity, obesity, region of residence, subjective assessment of health, stress level, economic level, and parental education level.	Eat 3 times per day without skipping meals, particularly breakfast, and frequent intakes of fresh fruits, vegetables, and milk were related to good school performance.
Stroebele N et al (2013)	Fifth-grade students	School-administered health survey	Academic performance, eating behavior, physical activity, sleep patterns	More positive health behaviors generally were associated with better academic performance
Ickovics et al. (2014)	9-13 years	Connecticut Mastery Test (CMT) and Connecticut Academic Performance Test (CAPT), BMI, US Department of Agriculture (USDA) 2010 dietary guidelines, WHO Health Behaviour in School-Aged Children survey.	Health Index, Academic Achievement.	Students with extra health assets were more likely to be at goal for standardized tests (reading/writing/mathematics), and students with the most health assets were 2.2 times more likely to achieve goal compared with students with the fewest health assets
Noriteru Morita et al. (2016)	12-13 years	BMI, total grade points, total score on eight fitness tests	Academic achievement, BMI, mother's educational background, household income, cram school utilization, time spent on video games/mobile phones.	Physical fitness in boys and obesity status in girls could be important factors not only for health status but also for academic achievement, independent of socioeconomic and behavioral backgrounds
Stuart M. Shore et al (2008)	6th and 7th grade students	Grade point averages (GPAs), degree of reading power (DRP), Year-end totals for the number of days absent, School Population Fitness Survey, BMI.	Academic achievement, Attendance and discipline, Physical fitness and athletic team participation	Overweight students achieved lower grades than their nonoverweight peers. Overweight students, also demonstrated significantly more detentions, worsened school attendance, more tardiness to school, and less participation on school athletic teams.
Croezen S et al. (2009)	13-16 años	Electronic monitoring and health education (E-MOVO	BMI, Physical activity, s breakfast intake, alcohol consumption.	Skipping breakfast, alcohol consumption and physical inactivity were associated with overweight in second and fourth grade adolescents. The associations were strongest for younger adolescents

Statement of Competing Interests

We declare that we have no competing interests.

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