

# School Grades and Standardized Test Scores of Children with and Without Obesity in South-East Mexico

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Received 2016 January 25; Revised 2016 June 23; Accepted 2016 June 28.

## Abstract

**Background:** Obesity has negative impact on health and socialization. Previous studies found that children with obesity have lower grades, but it is unclear: a) if specific subject might affect their grade point averages, b) if the results of standardized tests and school grades are the same for children with and without obesity in a community where pediatric obesity is highly prevalent.

**Objectives:** The current study aimed to compare school grades and standardized test scores of children with and without obesity in a probabilistic sample of primary school children from Southern Mexico, where overweight/obesity is highly prevalent.

**Methods:** The study measured a probabilistic sample of 2971 children going to public primary schools in Merida, Mexico, transformed the anthropometric data into body mass index (BMI) z-scores according the world health organization (WHO) reference values and categorized children according to their BMI status, and the scores they obtained in national standardized tests (n = 2791). The study analyzed the association between children with/without obesity and their academic performance in terms of school grades and standardized tests using mean comparison T-tests and multinomial logistic regression models using Stata 12.

**Results:** Differences were observed between obese and non-obese children in overall grade point averages; however, no differences were observed on national standardized academic test scores. In analyzing specific academic subject areas, no differences were observed in grades for math, literature, social sciences, life sciences and art. The only significant difference observed was in the grade for physical education with obese students earning lower grades than their non-obese counterparts.

**Conclusions:** There were no significant differences between the children with obesity and those without obesity in standardized tests. Students without obesity had significantly higher grade point average than their peers with obesity (8.4 and 8.5, respectively;  $P < 0.000$ ).

**Keywords:** Pediatric Obesity, Schools, Mexico, Standardized Grade Score

## 1. Background

Obesity is a public health problem affecting children worldwide; obesity has short- and long-term consequences and affects children's health profile, increases the risk of metabolic and cardiovascular diseases and chronic inflammation. Obesity also has negative effects on socialization and psycho-emotional wellbeing (1). Stigma, bias and discrimination associated with overweight and obesity might affect individuals in several dimensions (2).

Literature suggests that being overweight or obese might affect academic achievements in children and adolescents; as a consequence, obesity might be a disadvantage for children in life, when competing for entry to university or even for getting better jobs. Identifying the determinants of impaired academic achievement in children

with obesity could be helpful to reduce disparities that could affect their quality of life (3).

Existing evidence suggests consistent findings to the detriment of school performance among children with overweight or obesity (4). A research from the US mentioned how higher body mass index (BMI) values are independently associated with lower general mental ability among children from a large sample (5); while others suggest that lack of physical activity and obesity may mediate the association between childhood motor function and adolescents' academic achievement (6). On the other hand, some authors discuss the possibility that teachers' misperceptions or negative attitudes toward heavier students influence negatively on their grade point averages (7, 8).

Puhl et al., documented weight related bias and dis-

crimination among teachers and educators. Prejudice might involve a preconception that heavier children are lazy and undisciplined individuals who are less likely to succeed (9-11). Weight related negative attitudes might include discrimination, rejection, negative beliefs, stereotypes and prejudice (10, 11).

Obesity is a health problem affecting adults and children worldwide (12). In Mexico, the prevalence of overweight/obesity among primary school children is 35%. In Merida, the most populated city in South-East Mexico, half of the children aged 6 - 12 going to public primary schools are overweight or obese (13). Merida has experienced an important population growth and similar to many other cities around the globe, industrialization and urbanization seem to be related to overweight and obesity rates and consequently with high rates of obesity-related diseases at all ages. Health statistics and educational indicators are discouraging in Merida, since Yucatan was the Mexican state with the highest rates of failings (grade failing) in elementary education until 2013 (14, 15).

In Merida, as in the rest of Mexico, primary education students are evaluated for each subject periodically (bi-monthly) based on a 0.0 - 10.0 scale. Subjects include math, Spanish literature, social and natural sciences, arts and physical education. Math, sciences or literature are commonly evaluated mainly by projects and written tests; while physical education has some theoretical concepts for each grade, it is commonly evaluated and graded by teachers based on the student's performance in class. For each period, grade reports include the obtained point average at the end of the year, the point average for each subject and the point average for all subjects at all periods. The grade point average obtained by the subject is used to determine if a student passes ( $\geq 6.0$ ) or fails the grade ( $< 6.0$ ). Grades are available on the official web page of the department of public education.

Another indicator of student's academic performance is the national assessment of academic achievement in schools (ENLACE) test, applied nationally at primary level to evaluate the performance of students from third to sixth grades annually from 2006 to 2013. ENLACE was developed to evaluate the performance in mathematics and reading, plus the cognitive achievement in a different specific subject each year (e.g., history or geography). ENLACE is comprised of 110 multiple-choice questions; 99% of the students who take the test obtain scores from 200 to 800 points. For every application date, the test is also applied to control groups for calibration (16).

Quality of ENLACE relies on measures such as: a) teachers do not apply test to their own students, instead teachers are sent to a different school to apply the test to another class; b) community agent and parents serve as observers

and c) students are encouraged to attend the day of the exam (17). Yucatan is under the national average scores of ENLACE in math (27th place among 32 states) and literature (20th place among 32) (18); ENLACE is an objective evaluation of students' academic performance that only pertains to the evaluated areas.

On the other hand, school grades reflect intellectual and cognitive abilities, and also the physical education performance, but the evaluation is done by teachers who take into account not only test results but also behavior, participation, projects, attendance and could potentially be mediated by the teachers own interests or attitudes towards his/her students, attendance and participation (19).

Childhood obesity has a widely described negative impact over children's health profiles and also affects socialization and is related to lower grades at schools. But it remains unclear if specific subjects affect the grade point average; for example, if the lower or equivalent proficiency of children with or without obesity is consistent in results of standardized tests and school grades in a community where overweight/obesity and failing rate are significantly frequent.

## 2. Objectives

The current study aimed to identify if children with and without obesity going to public primary schools obtained equivalent grades in 2012 - 2013 academic year, and analyze if the results in national standardized tests of literature comprehension and math applied in 2013 differed significantly between the children with and without obesity.

## 3. Methods

### 3.1. Participants

The present study was part of a cross-sectional, school-based study conducted to obtain the prevalence of overweight/obesity in a probabilistic sample of children aged 6 - 12 going to public primary schools of Merida, Yucatan state, Mexico (15). During the study data were collected from school grades database and ENLACE test scores of students in the 2012 - 2013 academic year. Participants were enrolled from sixteen randomly selected schools. Students attended one of the sixteen primary schools located in Merida, Mexico that were randomly selected for this study.

From April to December 2012 anthropometric measures were collected from a probabilistic sample of 2791 children aged 6 - 12 attending public primary schools of Merida, Mexico. Parents and students were informed about the aim and implications of the study; legal tutors

signed the informed consent and all students provided verbal assent.

### 3.2. Anthropometrics

The weight was measured with the students' lightweight clothes using a digital scale to the nearest 100 grams and height was also measured with a portable stadiometer to the nearest millimeter according to the Lohman manual of anthropometrics (20). The BMI and height status were analyzed based on the world health organization (WHO) reference values for people aged 5 - 19 (21).

To precisely calculate the weight status of participants, the exact date of birth for BMI z-score calculations was used; date of birth was confirmed by the unique population registry code or else as personal ID code number (CURP in Mexico) that parents provided after signing the consent forms.

Children with BMI status z-score below -1 were considered as underweight; with z-scores  $> -1$ ,  $< +1$  as healthy weighted; those with z-scores between  $\geq +1$  and  $< +2$  as overweight; between  $\geq +2$  and  $< +2.5$  as obese and over 2.5 z-score as morbidly obese. When using BMI status as a dichotomous variable, children with z-scores  $\geq +2$  were considered obese, and below +2 as non-obese.

### 3.3. ENLACE Point Scores

Math, literature, social science scores and the point average were obtained from the test applied in 2013 by entering the student's CURP information and school code at <http://www.enlace.sep.gob.mx/> from October to December 2013.

### 3.4. School Grades

The 2012 - 2013 academic year data on grade point average and average point obtained in math, language, social sciences and life sciences were corroborated with student grade reports. Data were retained verbatim as in the school records and the ENLACE test scores, not calculated.

### 3.5. Data Analysis

First the mean of grade point averages obtained by students with and without obesity were compared using T-test. Then the differences between school grades and GPA and ENLACE mean values for boys and girls were analyzed, grade specific scores did not differ by grade when compared to the gender specific average, but school grades differed in GPA significantly, where girls had significantly higher GPA scores compared with those of boys (T-test with a T-value = 8.1992).

Then a logistic regression analysis was run associating BMI percentile and the GPA; then the differences were analyzed by subject, using a multinomial, logistic regression with healthy weight as the reference value, after adjusting by gender.

## 4. Results

Anthropometric data and school grades of 3243 students from sixteen schools were obtained; an average of 202 (ranging from 86 to 251 students per school).

### 4.1. Anthropometrics

Mean BMI percentile observed in the sample was 73.06. Table 1 describes the distribution of the sample by BMI status, where 26.8% of participants were obese or morbidly obese.

The proportion of obese boys was significantly higher than that of the girls, while the proportion of overweight was higher among girls when compared to that of boys ( $P = 0.000$ ).

### 4.2. School Records

The scores obtained in the core school subjects (literature, mathematics, social sciences and life sciences) were analyzed. There were no significant differences between the mean grades of the subject and the point averages (first to sixth), but girls obtained higher GPA than boys ( $P < 0.001$ ).

### 4.3. ANLACE Score Points

Data were collected from ENLACE score points of 2721 students from grades 3<sup>rd</sup> to 6<sup>th</sup> and no significant difference was found between total ENLACE score points between the participants attending third, fourth, fifth or sixth grades. The average score of girls was significantly ( $P = 0.02$ ) higher than that of boys in literature (575 compared with 563) and social sciences (524 compared with 517), but not on the total ENLACE score.

### 4.4. Association Between School Grades, ENLACE Point Scores and BMI Status

Using the healthy weight category as reference values, underweight, overweight, obesity and morbid obesity categories obtained lower school grades only in physical education. The low weight category had also significantly higher scores in life sciences, while life sciences ENLACE scores did not differ regarding BMI status.

**Table 1.** Mean Grade Scores of the Subject with and Without Obesity<sup>a</sup>

Subject	Obesity		P Value
	Yes, Mean ± SD	No, Mean ± SD	
<b>Grades</b>			
Grade point average	8.49 ± 0.86	8.42 ± 0.81	0.000
Mathematics	7.77 ± 1.23	7.81 ± 1.16	0.157
Literature	7.95 ± 1.25	8.00 ± 1.15	0.167
Social sciences	8.12 ± 1.20	8.15 ± 1.14	0.124
Life sciences	8.04 ± 1.22	8.01 ± 1.18	0.058
Arts	9.49 ± 0.75	9.47 ± 0.78	0.077
Physical education	9.58 ± 0.59	9.13 ± 0.79	0.000
<b><sup>b</sup>ENLACE Point Score</b>			
Literature	570 ± 113	568 ± 112	0.367
Mathematics	570 ± 123	567 ± 122	0.165
Sciences	522 ± 99	519 ± 100	0.375
Total	1662 ± 306	1653 ± 308	0.450

<sup>a</sup>Mean difference is significant at  $P < 0.05$  level, (two tailed) using Bonferroni correction.

<sup>b</sup>Enlace, the national assessment of academic achievement in schools.

**Table 2.** Mean Grade Point Average Scores Based on Gender and School Grade<sup>a</sup>

Grade	Female				Male			
	Mean GPA	SD	Mean <sup>b</sup> ENLACE	SD	Mean GPA	SD	Mean ENLACE	SD
First	8.74	0.81	-	-	8.50	0.99	-	-
Second	8.58	0.92	-	-	8.32	0.94	-	-
Third	8.57	0.89	572.7	82.1	8.18	0.95	553.9	94.0
Fourth	8.47	0.88	541.6	98.3	8.29	0.89	526.5	97.6
Fifth	8.50	0.81	556.5	101.6	8.25	0.92	559.8	102.4
Sixth	8.69	0.79	577.3	96.6	8.43	0.91	559.7	103.7
Total	8.55	0.86	557.3	98.8	8.29	0.94	552.2	103.2

<sup>a</sup>Mean scores were significantly different at  $P < 0.05$  level.

<sup>b</sup>ENLACE, the national assessment of academic achievement in schools.

## 5. Discussion

Students with and without obesity in the sample did not differ in point scores obtained in ENLACE test or grades in subjects such as mathematics, literature or sciences, but the students with obesity had significantly lower grades in physical education. To the authors' best knowledge, previous studies did not report physical education grades; therefore, it is possible that physical education grades had an impact on lower the grade point average of students with obesity participating in other studies.

Datar et al., found no significant association between being overweight and scores in math and reading in boys,

but girls with overweight from kindergarten to the third year had lower scores in math and reading tests (22). Kaestner and Grossman conducted a study comparing math and reading test scores of children with and without obesity aged 5 - 12, finding no significant difference, which is congruent to the current study findings (23).

According to Florin et al., when students are perceived to be obese, they are more prone to have lower academic achievement, regardless of real weight status. Perceived obesity (perceived by teachers) might explain the results of previous studies reporting a lower academic performance among children with obesity; if so, prejudices about obe-

**Table 3.** Specific Subject Grades for Healthy Weighted Students Compared with Underweight, Overweight, Obese and Morbidly Obese Students<sup>a</sup>

	Beta Exponent	Std. Error	P Value	Beta Exponent	
				Lower Bound	Upper Bound
<b>Physical education</b>	0.791	0.064	0.000	0.697	0.897
<b>Mathematics</b>	1.073	0.138	0.612	0.819	1.405
<b>Literature</b>	0.815	0.140	0.142	0.620	1.071
<b>Social sciences</b>	0.839	0.132	0.182	0.648	1.086
<b>Life sciences</b>	1.367	0.119	0.009	1.082	1.727
<b>Healthy weight</b>	Reference Beta Exponent 1.00				
<b>Overweight</b>					
Physical education	0.901	0.035	0.003	0.842	0.964
Mathematics	1.072	0.073	0.345	0.928	1.238
Literature	0.911	0.075	0.215	0.787	1.055
Social Sciences	0.947	0.071	0.443	0.825	1.088
Life sciences	1.134	0.066	0.055	0.997	1.289
<b>Obesity</b>					
Physical education	0.895	0.036	0.002	0.834	0.960
Mathematics	0.954	0.076	0.536	0.821	1.108
Literature	1.016	0.078	0.842	0.872	1.183
Social sciences	1.022	0.073	0.769	0.885	1.179
Life sciences	1.049	0.068	0.487	0.917	1.199
<b>Morbid obesity</b>					
Physical education	0.830	0.060	0.002	0.738	0.934
Mathematics	1.109	0.129	0.420	0.862	1.428
Literature	0.915	0.131	0.497	0.707	1.183
Social sciences	0.946	0.124	0.654	0.742	1.206
Life sciences	1.005	0.115	0.966	0.802	1.259

<sup>a</sup>Underweight, overweight, obesity and morbid obesity categories are compared to healthy weight category, with Beta exponent = 1.00; pseudo R square = 0.0547; results adjusted by gender.

sity might affect not only grades of the students but the academic and professional future of the individuals with obesity in a dramatic way (24).

Evidence suggests that physical education teachers might be holding negative beliefs toward heavier students, by displaying higher levels of implicit anti-fat bias than other health professionals since their first year of training and it tends to be reinforced with each year of training (25). Physical education teachers might hold negative weight-related attitudes and beliefs manifested by stereotypes, rejection and prejudice towards individuals who are perceived as obese and meanwhile they might also expect more from students perceived to be fit (26).

Students who self-identify themselves as fat might do not like to perform certain activities during physical education sessions, not involving themselves in the way they are expected (27). Obesity is associated with several immediate health problems, including orthopedic conditions (28), there might even be some students with obesity that physically cannot perform as expected during physical education sessions, and it could be misinterpreted by teachers as a lack of interest (29).

There is evidence suggesting that physical activity sessions at school have a positive impact on students' academic performance in reading and mathematics, and children with obesity should not be deprived from such bene-

fit (30).

In Mexico, report cards are typically provided by the class teacher directly to a parent or tutor with a brief verbal report of the students' achievements, limitations and opportunities to improve in the classroom. Physical education teachers in the local context do not often have the opportunity to interview with parents; neither do they provide a qualitative report of a child's performance. It would be very positive if physical education teachers provided a verbal feedback to the parents and included a qualitative, positive evaluation to orient students to improve their performance when it is the case.

Further studies could explain if these lower grades in physical education affect overall grades of students elsewhere, as childhood obesity is a global health problem and inequities affecting the students with obesity might be present elsewhere. It is necessary to consider interventions to make teachers aware of how to be more inclusive during physical education in the studied community.

### 5.1. Conclusions

No significant differences were found in scores obtained in the national standardized tests between the children with and without obesity regarding mathematics or sciences. Students with obesity had lower grade point average; the average was calculated by including grades in sciences, mathematics, literature, arts and physical education. Significantly lower grades of children with obesity were identified in physical education, but not in sciences, literature or mathematics. Social, cultural or psychological aspects might affect the grades of students with obesity in physical education.

### Footnote

**Funding/Support:** The current study was financially supported by the national council of science and technology (CONACyT) Mexico City, Mexico, under the code number: 259717.

### References

1. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. *Int J Obes (Lond)*. 2011;**35**(7):891-8. doi: [10.1038/ijo.2010.222](https://doi.org/10.1038/ijo.2010.222). [PubMed: [20975725](https://pubmed.ncbi.nlm.nih.gov/20975725/)].
2. Puhl RM, King KM. Weight discrimination and bullying. *Best Pract Res Clin Endocrinol Metab*. 2013;**27**(2):117-27. doi: [10.1016/j.beem.2012.12.002](https://doi.org/10.1016/j.beem.2012.12.002). [PubMed: [23731874](https://pubmed.ncbi.nlm.nih.gov/23731874/)].
3. Burkhalter TM, Hillman CH. A narrative review of physical activity, nutrition, and obesity to cognition and scholastic performance across the human lifespan. *Adv Nutr*. 2011;**2**(2):2015-6S. doi: [10.3945/an.111.000331](https://doi.org/10.3945/an.111.000331). [PubMed: [22332052](https://pubmed.ncbi.nlm.nih.gov/22332052/)].
4. Taras H, Potts-Datema W. Obesity and student performance at school. *J Sch Health*. 2005;**75**(8):291-5. doi: [10.1111/j.1746-1561.2005.00040.x](https://doi.org/10.1111/j.1746-1561.2005.00040.x). [PubMed: [16179079](https://pubmed.ncbi.nlm.nih.gov/16179079/)].
5. Li Y, Dai Q, Jackson JC, Zhang J. Overweight is associated with decreased cognitive functioning among school-age children and adolescents. *Obesity (Silver Spring)*. 2008;**16**(8):1809-15. doi: [10.1038/oby.2008.296](https://doi.org/10.1038/oby.2008.296). [PubMed: [18551126](https://pubmed.ncbi.nlm.nih.gov/18551126/)].
6. Kantomaa MT, Stamatakis E, Kankaanpaa A, Kaakinen M, Rodriguez A, Taanila A, et al. Physical activity and obesity mediate the association between childhood motor function and adolescents' academic achievement. *Proc Natl Acad Sci U S A*. 2013;**110**(5):1917-22. doi: [10.1073/pnas.1214574110](https://doi.org/10.1073/pnas.1214574110). [PubMed: [23277558](https://pubmed.ncbi.nlm.nih.gov/23277558/)].
7. MacCann C, Roberts RD. Just as smart but not as successful: obese students obtain lower school grades but equivalent test scores to nonobese students. *Int J Obes (Lond)*. 2013;**37**(1):40-6. doi: [10.1038/ijo.2012.47](https://doi.org/10.1038/ijo.2012.47). [PubMed: [22531092](https://pubmed.ncbi.nlm.nih.gov/22531092/)].
8. Kenney EL, Gortmaker SL, Davison KK, Bryn Austin S. The academic penalty for gaining weight: a longitudinal, change-in-change analysis of BMI and perceived academic ability in middle school students. *Int J Obes (Lond)*. 2015;**39**(9):1408-13. doi: [10.1038/ijo.2015.88](https://doi.org/10.1038/ijo.2015.88). [PubMed: [25982793](https://pubmed.ncbi.nlm.nih.gov/25982793/)].
9. Puhl R, Brownell KD. Bias, discrimination, and obesity. *Obes Res*. 2001;**9**(12):788-805. doi: [10.1038/oby.2001.108](https://doi.org/10.1038/oby.2001.108). [PubMed: [11743063](https://pubmed.ncbi.nlm.nih.gov/11743063/)].
10. Puhl RM, Moss-Racusin CA, Schwartz MB, Brownell KD. Weight stigmatization and bias reduction: perspectives of overweight and obese adults. *Health Educ Res*. 2008;**23**(2):347-58. doi: [10.1093/her/cym052](https://doi.org/10.1093/her/cym052). [PubMed: [17884836](https://pubmed.ncbi.nlm.nih.gov/17884836/)].
11. Schwartz MB, Puhl R. Childhood obesity: a societal problem to solve. *Obes Rev*. 2003;**4**(1):57-71. [PubMed: [12608527](https://pubmed.ncbi.nlm.nih.gov/12608527/)].
12. Wright L. Childhood obesity. *J Pediatr Biochem*. 2013;**3**(1):5-12.
13. Mendez N. Aspects of family and school environment related to eating habits and physical activity are associated with overweight among schoolchildren in Merida Yucatan [in Spanish]. Yucatan: Autonomous University of Yucatan; 2013.
14. Cruz M. Cultural diagnosis on the social, economic and local environments for the design or interventions in the prevention and eradication of violence in the South Region: The Case of the metropolitan area of Merida [in Spanish]. In: Federal G, editor. Interior Ministry. Yucatan: Mexico DF; 2009.
15. Mendez N, Barrera-Perez TL, Palma-Solis M, Zavala-Castro J, Dickinson F, Azcorra H, et al. Ethnicity and Income Impact on Bmi and Stature of School Children Living in Urban Southern Mexico. *J Biosoc Sci*. 2016;**48**(2):143-57. doi: [10.1017/S0021932015000127](https://doi.org/10.1017/S0021932015000127). [PubMed: [26041567](https://pubmed.ncbi.nlm.nih.gov/26041567/)].
16. Secretary of Public Education . National Assessment of Academic Achievement in Schools (ENLACE). Planning and Evaluation Unit of Educational Policy [in Spanish]. Lisbon: Tecnico; 2012.
17. Agüero JM, Beleche T. Test-Mex: Estimating the effects of school year length on student performance in Mexico. *J Dev Econ*. 2013;**103**:353-61.
18. Secretary of Public Education . Basic Link Results Management Evaluation and Educational Outreach [in Spanish]. Mexico: Educational Evaluation Institute of the State of Mexico; 2012.
19. Riegle-Crumb C, Humphries M. Exploring Bias in Math Teachers' Perceptions of Students' Ability by Gender and Race/Ethnicity. *GenD Soc*. 2012;**26**(2) doi: [10.1177/0891243211434614](https://doi.org/10.1177/0891243211434614). [PubMed: [24187437](https://pubmed.ncbi.nlm.nih.gov/24187437/)].
20. Lohman TJ, Roache AF, Martorell R. Anthropometric standardization reference manual. Chicago: Human Kinetics; 1991.
21. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ*. 2007;**85**(9):660-7. [PubMed: [18026621](https://pubmed.ncbi.nlm.nih.gov/18026621/)].
22. Datar A, Sturm R, Magnabosco JL. Childhood overweight and academic performance: national study of kindergartners and first-graders. *Obes Res*. 2004;**12**(1):58-68. doi: [10.1038/oby.2004.9](https://doi.org/10.1038/oby.2004.9). [PubMed: [14742843](https://pubmed.ncbi.nlm.nih.gov/14742843/)].

23. Kaestner R, Grossman M. Effects of weight on children's educational achievement. *Econ Educ Rev.* 2009;**28**(6):651-61.
24. Florin TA, Shults J, Stettler N. Perception of overweight is associated with poor academic performance in US adolescents. *J Sch Health.* 2011;**81**(11):663-70. doi: [10.1111/j.1746-1561.2011.00642.x](https://doi.org/10.1111/j.1746-1561.2011.00642.x). [PubMed: [21972986](https://pubmed.ncbi.nlm.nih.gov/21972986/)].
25. O'Brien KS, Hunter JA, Banks M. Implicit anti-fat bias in physical educators: physical attributes, ideology and socialization. *Int J Obes (Lond).* 2007;**31**(2):308-14. doi: [10.1038/sj.ijo.0803398](https://doi.org/10.1038/sj.ijo.0803398). [PubMed: [16733526](https://pubmed.ncbi.nlm.nih.gov/16733526/)].
26. Greenleaf C, Weiller K. Perceptions of youth obesity among physical educators. *Soc Psycho Educ.* 2005;**8**(4):407-23.
27. Sykes HJ. *Queer bodies: Sexualities, genders, & fatness in physical education.* 36. Switzerland: Peter Lang; 2011.
28. Must A, Strauss RS. Risks and consequences of childhood and adolescent obesity. *Int J Obes Relat Metab Disord.* 1999;**23** Suppl 2:S2-11. [PubMed: [10340798](https://pubmed.ncbi.nlm.nih.gov/10340798/)].
29. Griggs G. Physical education: Primary matters, secondary importance. *Education.* 2007;**35**(1):59-69.
30. Mullender-Wijnsma MJ, Hartman E, de Greeff JW, Bosker RJ, Doolaard S, Visscher C. Improving academic performance of school-age children by physical activity in the classroom: 1-year program evaluation. *J Sch Health.* 2015;**85**(6):365-71. doi: [10.1111/josh.12259](https://doi.org/10.1111/josh.12259). [PubMed: [25877433](https://pubmed.ncbi.nlm.nih.gov/25877433/)].